Standard Specifications
for
Roads and Bridges

October 1971

State of Louisiana
Department of Highways

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PART I

GENERAL PROVISIONS

Section 101

Definitions and Terms

Wherever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

101.01 ABBREVIATIONS. Wherever the following abbreviations are used in these specifications or on the plans, they are to be construed the same as the respective expressions represented:

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHO	American Association of State Highway Officials
AGC	Associated General Contractors of America
AIA	American Institute of Architects
ANS	American National Standards
ARA	American Railway Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
AWPA	American Wood-Preservers Association
AWWA	American Water Works Association
AWS	American Welding Society
FHWA-DOT	Federal Highway Administration, Department of Transportation
CRCP	Continuously Reinforced Concrete Pavement
FSS	Federal Specifications and Standards, General Services Administration
IPCEA	Insulated Power Cable Engineers Association

LDH	Louisiana Department of Highways
NEMA	National Electric Manufacturers Association
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council

101.02 ACCESS CONNECTION. Any roadway facility by means of which vehicles can enter or leave an arterial highway. Included are intersections at grade, private driveways, and ramps or separate lanes connecting with cross streets or frontage roads.

101.03 ADVERTISEMENT. The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

101.04 ARTERIAL HIGHWAY. A general term denoting a highway primarily for through traffic, usually on a continuous route.

101.05 AUXILIARY LANE. The portion of the roadway adjoining the traveled way for parking, speed-change or for other purposes supplementary to through traffic movement.

101.06 AWARD. The acceptance by the Department of a bid.

101.07 BIDDER. An individual, firm or corporation submitting a bid for the advertised work.

101.08 BRIDGE. A structure, including supports, erected over a depression or an obstruction, as water, highway or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between under-copings of abutments or extreme ends of openings for multiple boxes.

Length: The length of a bridge structure is the overall length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor, but in no case less than the total clear opening of the structure.

Roadway width: The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timbers or in the case of multiple height of curbs, between the bottoms of the lower risers.

101.09 CALENDAR DAY. Every day shown on the calendar.

101.10 CHANGE ORDER. A written order issued by the engineer to the contractor covering changes in the plans or quantities or both within the scope of the contract and establishing the basis of payment and time adjustments for the work affected by the changes.

101.11 CONTRACT. The written agreement between the Department and the contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor and materials and the basis of payment.

The contract includes the invitation for bids, proposal, contract form and contract bond, specifications, supplemental specifications, special provisions, general and detailed plans, and notice to proceed, also any change orders and agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.

101.12 CONTRACT BOND. The approved form of security, executed by the contractor and his surety or sureties, guaranteeing complete execution of the contract and all supplemental agreements pertaining thereto and the payment of all legal debts pertaining to the construction of the project.

101.13 CONTRACT ITEM (Pay Item). A specifically described unit of work for which a price is provided in the contract.

101.14 CONTRACT TIME. The number of working days or calendar days allowed for completion of the contract, including authorized time extensions.

In case a calendar date of completion is shown in the proposal, in lieu of the number of working or calendar days, such work contemplated shall be completed by that date.

101.15 CONTRACTOR. The individual, firm or corporation contracting with the highway department for performance of prescribed work.

101.16 CONTROLLED ACCESS HIGHWAY. Any highway, to or from which access is denied or controlled, in whole or in part, from or to abutting land or intersecting

streets, roads, highways, alleys or other public or private ways.

101.17 CONTROL OF ACCESS. The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is fully or partially controlled by public authority.

Full Control: Full control of access means that the authority to control access is exercised to give preference to through traffic by providing access connections with selected public roads only and by prohibiting crossings at grade or direct private driveway connections.

Partial Control: Partial control of access means that the authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings at grade and some private driveway connections.

101.18 CULVERT. A structure which provides an opening used primarily for the passage of water.

101.19 DEPARTMENT. The Department of Highways of the State of Louisiana, constituted under the laws of the State for the administration of highway work.

101.20 DIRECTOR. Director of Louisiana Department of Highways.

101.21 DIVIDED HIGHWAY. A highway with separated roadways for traffic in opposite directions.

101.22 ENGINEER. The chief engineer of the Department, acting directly or through his duly authorized representatives, who is responsible for engineering supervision of the construction. When the term "Chief Engineer" is used, it shall mean the chief engineer in person.

101.23 EQUIPMENT. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.

101.24 EXPRESSWAY. A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections.

101.25 EXTRA WORK. An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

101.26 FLUME. A structure used primarily for the passage of irrigation water.

101.27 FREEWAY. An expressway with full control of access.

101.28 GRADE SEPARATION. A crossing of two highways, or a highway and a railroad, at different levels.

101.29 HIGHWAY, STREET OR ROAD. A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way. Recommended usage in urban areas—highway or street; in rural areas—highway or road.

101.30 INSPECTOR. The engineer's authorized representative assigned to make detailed inspections of contract performance.

101.31 INTERCHANGE. A grade-separated intersection with one or more turning roadways for travel between intersecting legs.

101.32 INVITATION FOR BIDS. The advertisement for proposals for all work or materials on which bids are required. Such advertisement will indicate with reasonable accuracy the quantity and location of the work to be done or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

101.33 LABORATORY. The testing laboratory of the Department or any other approved testing laboratory which may be designated by the engineer.

101.34 LOCAL STREET OR LOCAL ROAD. A street or road primarily for access to residence, business or other abutting property.

101.35 MAJOR STREET OR MAJOR ROAD. An arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

101.36 MATERIALS. Any substances specified for use in the construction of the project and its appurtenances.

101.37 MEDIAN. The portion of a divided highway separating the traveled ways for traffic in opposite directions.

101.38 NOTICE TO PROCEED. Written notice to the

contractor to proceed with the contract work, including the date of beginning of contract time.

101.39 PARISH. The parish in which the work herein specified is to be done.

101.40 PAVEMENT STRUCTURE. The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

101.41 PLAN CHANGE AND/OR SPECIAL AGREEMENT. A change order concerning the performance of work or furnishing of materials involving extra work. Such extra work may be performed at agreed prices or on a force account basis as provided elsewhere in these specifications.

101.42 PLANS. The approved plans, profiles, typical cross sections, general cross sections, working drawings and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions and details of the work to be done.

101.43 PROFILE GRADE. The trace of a vertical plane intersecting the top surface of the proposed wearing surface or other designated course usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

101.44 PROJECT. The specific section of the highway together with all appurtenances and construction to be performed thereon under the contract.

101.45 PROJECT ENGINEER. An engineer assigned to one or more specified construction projects to represent the Department through the Chief Engineer.

101.46 PROJECT NUMBER. A number used for convenience to describe and delineate certain construction within definite geographical limits.

101.47 PROPOSAL. The offer of a bidder, on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

101.48 PROPOSAL FORM. The approved form on which the Department requires bids to be prepared and submitted for the work.

101.49 PROPOSAL GUARANTY. Security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

101.50 QUESTIONNAIRE. The specified forms on which the contractor shall furnish required information as to his ability to perform and finance the work.

101.51 RIGHT-OF-WAY. A general term denoting land, property or interest therein, usually in a strip, acquired for or devoted to a highway.

101.52 ROADBED. The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder.

101.53 ROADSIDE. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

101.54 ROADSIDE DEVELOPMENT. Those items necessary to the complete highway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

101.55 ROADWAY. In general that portion of a highway, including shoulders, provided for vehicular use. A divided highway has two or more roadways. In construction specifications, a roadway is that portion of a highway within the limits of construction.

101.56 SERVICE ROAD OR FRONTAGE ROAD. A local street or road auxiliary to and located on the side of the roadway for service to abutting property and adjacent areas and for control of access.

101.57 SHOULDER. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

101.58 SIDEWALK. That portion of the roadway primarily constructed for the use of pedestrians.

101.59 SPECIAL PROVISIONS. Additions and revisions to the standard and supplemental specifications covering conditions peculiar to an individual project.

101.60 SPECIFICATIONS. A general term applied to

all directions, provisions and requirements pertaining to performance of the work.

101.61 STATE. The State of Louisiana, acting through its authorized representative.

101.62 STRUCTURES. Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work and not otherwise classed herein.

101.63 SUBBASE. The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

101.64 SUBCONTRACTOR. An individual, firm or corporation to whom the contractor sublets part of the contract.

101.65 SUBGRADE. The top surface of a roadbed upon which the pavement structure and shoulders are constructed.

101.66 SUBSTRUCTURE. All of that part of the structure below the bearings of simple and continuous spans, skewbacks or arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

101.67 SUPERINTENDENT. The contractor's authorized representative in responsible charge of the work.

101.68 SUPERSTRUCTURE. The entire structure except the substructure.

101.69 SUPPLEMENTAL AGREEMENT. A written agreement made and entered into by and between the contractor and the Department covering work not otherwise provided for, revisions in or amendments to the terms of the contract or conditions specifically prescribed in the specifications as requiring supplemental agreements. Such supplemental agreement becomes a part of the contract when approved and properly executed.

101.70 SUPPLEMENTAL SPECIFICATIONS. Additions and revisions to the standard specifications that are adopted subsequent to issuance of the printed book.

101.71 SURETY. The corporation, partnership or individual, other than the contractor, executing a bond furnished by the contractor.

101.72 TITLES (Or Headings). The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

101.73 THROUGH AND LOCAL TRAFFIC.

(a) Through traffic is that traffic which has neither its origin nor its destination within the limits of the project.

(b) Local traffic is that traffic which has either its origin or its destination within the limits of the project.

101.74 THROUGH STREET OR THROUGH HIGHWAY. Every highway or portion thereof on which vehicular traffic is given preferential right-of-way, and at the entrances to which vehicular traffic from intersecting highways or streets is required by law to yield right-of-way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

101.75 TRAFFIC LANE. The portion of traveled way for the movement of a single lane of vehicles.

101.76 TRAVELED WAY. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

101.77 WORK. Work shall mean the furnishing of all labor, materials, equipment and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all duties and obligations imposed by the contract.

101.78 WORKING DAY. A working day is a calendar day, other than exceptions stated in this subsection, on which weather and working conditions not under control of the contractor will permit operations to proceed for at least five continuous hours of the day with the normal working force engaged in performing the controlling item or items of work which normally would be in progress at that time.

No working days will be charged for the days listed below, except as specified by the succeeding paragraph:

1. Saturdays
2. Sundays
3. State Recognized Holidays
   a. January 1, New Year's Day
   b. Good Friday
   c. July 4, Independence Day

d. August 30, Huey P. Long's Birthday
e. First Monday in September, Labor Day
f. Veteran's Day
g. Fourth Thursday in November, Thanksgiving Day
h. December 24, Christmas Eve
i. December 25, Christmas Day
j. General Election Day for Members of Congress every two (2) years.
k. Governor's Inauguration Day
l. Monday following January 1, July 4, and December 25, when any such date falls on Sunday.
m. Any other special holidays that may be proclaimed by the Governor or fixed by the Legislature.

4. Days on which delays, attributable solely to the Department of Highways or other governmental agencies, prevent contractor from proceeding with the controlling item(s) of work in effect at time of delay.
5. Days on which delays are attributable to the direct effect of strikes, riots or civil commotions.

In the event the contractor performs work which requires engineering supervision or inspection on a state recognized holiday, a working day will be charged regardless of the size of the working force or the number of hours worked. Any state recognized holiday that falls on a Saturday or Sunday will be charged as a working day in the event work is performed as provided in the preceding sentence. Any work done in connection with the continuing of curing, loading of test piles, watering of sod, etc., as is required by the specifications, is excluded from the work defined by this paragraph and a working day will not be charged if this is the only work performed.

The controlling item(s) of work will be determined after careful consideration of the contractor's approved progress schedule and will be the operation(s) of construction that normally would be in progress at that time, as essential to the orderly completion of the work within the time allowed. If it becomes necessary, the progress schedule may be revised upon request of either party, but before a revision requested by the contractor shall apply, it must be approved by the engineer.

101.79 WORKING DRAWINGS. Stress sheets, shop drawings, erection plans, falsework plans, framework plans,

cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans or similar data which the contractor is required to submit to the engineer for approval.

101.80 WORK ORDER. A written order, signed by the engineer, of a contractual status requiring performance by the contractor without negotiation of any sort.

101.81 In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be done, if, as, or, when or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected or condemned," it shall be understood as if the expression were followed by the words "by the engineer" or "to the engineer."

Section 102

Bidding Requirements and Conditions

102.01 PREQUALIFICATION OF BIDDERS. Prior to submitting a bid, the bidder may be required to file an experience questionnaire and a confidential financial statement which shall be certified by a certified public accountant. The statement will include a complete report of the bidder's financial resources and liabilities, equipment, past record and personnel.

Bidders intending consistently to submit proposals shall prequalify at least once a year. However prequalification may be changed during that period upon the submission of additional favorable reports or upon unsatisfactory performance.

102.02 CONTENTS OF PROPOSAL FORMS. Upon request, the Department will furnish the prospective bidder with a proposal form. This form will state the location and description of the contemplated construction and will show the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished and will have a schedule of items for which unit bid prices are invited. The proposal form will state the time in which the work must be completed, the amount of the proposal guaranty, and the date, time and place of the opening of proposals. The form will also include any special provisions or requirements which vary from or are not contained in the standard specifications.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted.

The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

The prospective bidder will be required to pay the Department the sum stated in the notice to contractors for each set of plans.

102.03 ISSUANCE OF PROPOSALS. The Department

reserves the right to disqualify or refuse to issue a proposal if a bidder is in default for any of the following reasons:

(a) Lack of competency and adequate machinery, plant and other equipment as revealed by the financial statement and experience questionnaires required under Subsection 102.01.

(b) Uncompleted work which, in the judgment of the Department, might hinder or prevent the prompt completion of additional work if awarded.

(c) Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of issuance of proposals.

(d) Failure to comply with any qualification regulations of the Department.

(e) Default under previous contracts.

102.04 INTERPRETATION OF QUANTITIES IN BID SCHEDULE. The quantities appearing in the bid schedule are approximate only and are prepared for the comparison of bids. Payment to the contractor will be made only for the actual quantities of work performed and accepted or for the materials furnished in accordance with the contract. The scheduled quantities of work to be done and materials to be furnished may each be increased, decreased or omitted as hereinafter provided.

102.05 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OR WORK. The Department will prepare full, complete and accurate plans and specifications giving such directions as will enable any competent contractor to carry them out. The bidder is expected to examine carefully the site of the proposed work, the proposal, plans, specifications, supplemental specifications, special provisions and contract forms before submitting a proposal. The submission of a bid shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the plans, specifications, supplemental specifications, special provisions and contract.

Any pre-bid test and boring data in connection with subsurface conditions which have been compiled by the De-

partment and furnished the contractor at his request shall not be considered as fully representative of actual subsurface conditions existing throughout the area tested nor shall they in any way be binding upon the Department; it being understood that said data will be furnished the contractor for his convenience only and the contractor shall be solely responsible for conducting his own boring explorations which he may deem necessary in preparing his bid.

No claim shall be made against the Department for any additional compensation incurred as a result of unforeseen subsurface conditions arising during the progress of the work and which might be in variance with the Department's pre-bid boring data.

102.06 PREPARATION OF PROPOSAL. The bidder shall submit his proposal upon the forms furnished by the Department. The bidder shall specify a unit price in words and figures for each pay item or alternate pay item for which a quantity is given and shall also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose. All the words and figures shall be in ink or typed. In case of a discrepancy between the prices written in words and those written in figures, the prices written in words shall govern.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation or by an agent of the contractor legally qualified and acceptable to the state. If the proposal is made by an individual, his name and post office address must be shown; by a partnership, the name and post office address of each partnership member must be shown; as a joint venture, the name and post office address of each member or officer of the firm represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate officials must be shown.

102.07 IRREGULAR PROPOSALS. Proposals will be considered irregular and may be rejected for the following reasons:

(a) If the proposal is on a form other than that furnished by the Department or if the form is altered or any part thereof is detached.

(b) If there are unauthorized additions, conditional or alternate bids or irregularities of any kind which tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.

(c) If the bidder adds any provisions reserving the right to accept or reject an award or to enter into a contract pursuant to an award.

(d) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

102.08 PROPOSAL GUARANTY. No proposal will be considered unless accompanied by a guaranty of the character and in an amount not less than the amount indicated in the proposal form.

102.09 DELIVERY OF PROPOSALS. Each proposal should be submitted in a special envelope furnished by the Department. The blank spaces on the envelope shall be filled in correctly to clearly indicate its content. When an envelope other than the special one furnished by the Department is used, it shall be the same general size and shape and be similarly marked to clearly indicate its contents. When sent by mail, the sealed proposal shall be addressed to the Department at the address and in care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and at the place specified in the notice to contractors. Proposals received after the time for opening of bids will be returned to the bidder unopened.

102.10 WITHDRAWAL OR REVISION OF PROPOSALS. A bidder may withdraw or revise a proposal after it has been deposited with the Department provided the request for such withdrawal or revision is received by the Department, in person or in writing or by telegram, before the time set for opening proposals.

102.11 COMBINATION OR CONDITIONAL PROPOSALS. If the Department so elects, proposals may be issued for projects in combination or on separate units of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department. No combination bids other than those specifically set up in the proposals by the Department will be considered. Separate contracts will be

written for each individual project included in the combination.

Conditional proposals will be considered when so stated in the special provisions.

102.12 PUBLIC OPENING OF PROPOSALS. Proposals will be opened and read publicly at the time and place indicated in the notice to contractors. Bidders, their authorized agents and other interested parties are invited to be present.

102.13 DISQUALIFICATION OF BIDDERS. Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal or proposals:

(a) More than one proposal for the same work from an individual, firm or corporation under the same or different name.

(b) Evidence of collusion among bidders. Participants in such collusion will receive no recognition as bidders for any future work of the Department until any such participant shall have been reinstated as a qualified bidder.

102.14 MATERIAL GUARANTY. The successful bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials to be used in the construction of the work together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

Section 103

Award and Execution of Contract

103.01 CONSIDERATION OF PROPOSALS. After the proposals are opened and read, they will be compared on the basis of the summation of the projects of the approximate quantities shown in the bid schedule by the unit bid prices. The results of such comparisons will be immediately available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals if, in the judgment of the awarding authority, the best interests of the Department will be promoted thereby.

103.02 AWARD OF CONTRACT. The award of contract, if it be awarded, will be made within 30 calendar days after the opening of proposals to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified by letter mailed to the address shown on his proposal that his bid has been accepted and that he has been awarded the contract.

103.03 CANCELLATION OF AWARD. The department reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the Department.

103.04 RETURN OF PROPOSAL GUARANTY. All proposal guaranties, except those of the two lowest bidders, will be returned immediately following the opening and checking of the proposals. The retained proposal guaranty of the unsuccessful of the two lowest bidders will be returned within 10 days following the award of contract and that of the successful bidder will be returned after a satisfactory bond has been furnished and the contract has been executed.

103.05 REQUIREMENT OF CONTRACT BOND. At the time of the execution of the contract, the successful bidder shall furnish a surety bond or bonds in a sum equal

to the full amount of the contract. The form of the bonds and the security shall be acceptable to the Department.

103.06 EXECUTION AND APPROVAL OF CONTRACT. The contract shall be signed by the successful bidder and returned, together with the contract bond, within 15 days after the contract has been mailed to the bidder. If the contract is not executed by the Department within 15 days following receipt from the bidder of the signed contract and bond, the bidder shall have the right to withdraw his bid without penalty. No contract shall be considered as effective until it has been fully executed by all of the parties thereto.

103.07 FAILURE TO EXECUTE CONTRACT. Failure to execute the contract and file acceptable bond within 15 days after the contract has been mailed to the bidder shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the Department, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder or the work may be readvertised and constructed under contract, as the Department may decide.

Section 104

Scope of Work

104.01 INTENT OF CONTRACT. The intent of the contract is to provide for the construction and completion in every detail of the work described. The contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, specifications and terms of the contract.

When an item in the proposal and contract contains a choice to be made by the contractor as to the type material to be furnished, the contractor, before the work is initiated, shall indicate his choice in accordance with the specifications for that particular item. Such notification shall be submitted to the engineer in writing, and thereafter no further choice will be permitted.

104.02 ALTERATION OF PLANS OR CHARACTER OF WORK. The Department reserves the right to make, at any time during the progress of the work, such increases or decreases in quantities and such alterations in the details of construction, including alterations in the grade or alinement of the road or structure or both, as may be found to be necessary or desirable. Such increases or decreases and alterations shall not invalidate the contract nor release the surety and the contractor agrees to accept the work as altered, the same as if it has been a part of the original contract.

Under no circumstances shall alterations of plans or of the nature of the work involve work beyond the termini of the proposed construction except as may be necessary to satisfactorily complete the project.

Unless such alterations and increases or decreases materially change the character of the work to be performed or the cost thereof, the altered work shall be paid for at the same unit prices as other parts of the work. If, however, the character of the work or the unit costs thereof are materially changed, an allowance shall be made on such basis as may have been agreed to in advance of the performance of the work, or in case no such basis has been previously

agreed upon, then an allowance shall be made, either for or against the contractor, in such amount as the engineer may determine to be fair and equitable.

No claim shall be made by the contractor for any loss of anticipated profits because of any such alteration or by reason of any variation between the approximate quantities and the quantities of work as done.

Payment for work occasioned by changes or alterations will be made in accordance with the provisions set forth under Subsection 109.03. If the altered or added work is of sufficient magnitude as to require additional time in which to complete the project, such time adjustment may be made in accordance with the provisions of Subsection 108.06.

If the quantities of work, or increases or decreases in the cost therefor, due to alteration of plans or character of work as defined above, result in an increase or decrease of more than 25 percent of the total amount of the original contract, a supplemental agreement to the contract may be executed between the Department and the contractor and when a supplemental agreement is executed, the consent of the contractor's surety to such supplement shall be obtained.

104.03 EXTRA WORK. The contractor shall perform unforeseen work for which there is no price included in the contract whenever it is deemed necessary or desirable in order to complete fully the work as contemplated. Such work shall be performed in accordance with the specifications and as directed, and will be paid for as provided under Subsection 109.04.

104.04 MAINTENANCE OF TRAFFIC. Reasonable provisions for local traffic throughout the length of the project and the life of the contract must be made by the contractor, at his own expense, during construction.

When required on the plans or in the special provisions, the contractor may also be required to provide for through traffic, at his own expense, over the entire project or any designated portion thereof.

If the engineer directs special maintenance for the benefit of the traveling public, then the contractor will be paid therefor at unit prices in the contract or as provided in Subsection 104.03. The engineer will be the sole judge of work to be classed as special maintenance.

104.05 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK. The contractor, with the written approval of the Chief Engineer, may use on the project such stone, gravel, sand or other material determined acceptable by the engineer as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding contract unit price and for the pay item for which the excavated material is used. The contractor shall replace at his own expense with other acceptable material all of that portion of the excavation material so removed and used which was needed for use in the embankments, backfills, approaches or otherwise. No charge for the materials so used will be made against the contractor. The contractor shall not excavate nor remove any material from within the highway location which is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the engineer. In the event authorization is obtained, excavation beyond the minimum slope and grade lines will not be paid for.

Unless otherwise provided, the material from any existing old structure may be used temporarily by the contractor in the erection of the new structure. Such material shall not be cut or otherwise damaged except with the approval of the engineer.

104.06 FINAL CLEANING UP. Before final acceptance, the highway right-of-way, borrow pits and all ground occupied by the contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures, haul roads and equipment; and all parts of the work, including private property adjacent to the right-of-way which has been damaged or rendered unsightly during the prosecution of the work, shall be left in a condition acceptable to the engineer, and if required, the right-of-way shall be mowed; all at no cost to the Department.

Section 105

Control of Work

105.01 AUTHORITY OF THE ENGINEER. The engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the contractor.

The engineer will have the authority to suspend the work wholly or in part due to the failure of the contractor to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessay due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

All orders to suspend the work will be in writing and will include the specific reasons for the suspension. The order to resume work will also be in writing.

105.02 PLANS AND WORKING DRAWINGS. Plans will show details of all structures, lines, grades, typical cross sections of the roadway, location and design of all structures and a summary of items appearing on the proposal. Only general features will be shown for steel bridges. The contractor shall keep one set of plans available on the work at all times.

The plans will be supplemented by such working drawings as are necessary to adequately control the work. Working drawings for structures shall be furnished by the contractor and shall consist of such detailed plans as may be required to adequately control the work and are not included in the plans furnished by the Department. They shall include stress sheets, shop drawings, erection plans, false work plans, cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans or similar

data required of the contractor. All working drawings must be approved by the engineer and such approval shall not operate to relieve the contractor of any of his responsibility under the contract for the successful completion of the work.

The type and size of drawings furnished shall be as described in Subsection 801.03.

The contract price shall include the cost of furnishing all supplementary working drawings.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS. All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the engineer finds the materials or the finished product in which the materials are used or the work performed are not in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the contactor.

105.04 COORDINATION OF PLANS, SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS AND SPECIAL PROVISIONS. These specifications, the supplemental specifications, the plans, special provisions and all supplementary documents are essential parts of the contract and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; plans will govern over standard specifications or supplemental specifications; supplemental specifications will govern over standard specifications; special provisions will govern over standard specifications, supplemental specifications and plans.

Neither the contractor nor the Department shall take advantage of any apparent error or omission in the plans or specifications. In the event the contractor discovers such an error or omission, he shall immediately notify the engineer. The engineer will then make such corrections and interpre-

tations as may be deemed necessary for fulfilling the intent of the plans and specifications.

105.05 COOPERATION BY CONTRACTOR. The contractor will be supplied with a minimum of two sets of approved plans and contract assemblies including special provisions, one set of which the contractor shall keep available on the work at all times.

The contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the engineer, his inspectors and other contractors in every way possible.

The contractor shall have on the work at all times, as his agent, a competent superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of work being performed, who shall receive instructions from the engineer or his authorized representatives. The superintendent shall have full authority to execute orders or directions of the engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Such superintendence shall be furnished regardless of the amount of work sublet.

The contractor shall certify to the engineer, by written notice, the name(s) of the person(s) authorized to sign for him in all matters pertaining to the changing of plans, force account or extra work, contract time charges and other fiscal documents. No work will commence on the project until the contractor has complied with this requirement. Such written notice shall also be furnished at any time the person(s) so designated is removed and replaced on the project.

105.06 COOPERATION WITH UTILITIES. The Department will notify all utility companies, all pipe line owners or other parties affected and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines and other appurtenances within or adjacent to the limits of construction made as soon as possible.

Upon award of the contract, utility companies affected will be advised by the Department of the name and address of the contractor, the approximate date work will begin and other pertinent information.

Unless otherwise specifically provided, and regardless of

whether the utility is shown on the plans or otherwise referred to in these specifications or in the special provisions, any adjustment or relocation of water lines, gas lines, wire lines, service connections, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the right-of-way are to be done by the owners at no expense to the contractor. In case the utility is located on supports outside the limits of the right-of-way, but overhangs same, this shall be considered as occupancy of the right-of-way.

Where a utility is adjacent to, but occupies no portion of the Department's right-of-way, and the utility will not have the Department's required clearance when the work is completed, it shall be the Department's responsibility to arrange for necessary relocation to the required clearance only, at no expense to the contractor. If the required clearance will exist when the work is completed, the contractor will, at his own expense, make arrangements with the owner for any relocation or adjustment he considers necessary or convenient to his operations. In such cases, upon completion of the work and prior to final acceptance, the final location of the utility must be acceptable to the Department. Nothing in these requirements shall be interpreted directly or by implication, to mean that the Department waives any of its rights to control the entrance onto, or location on, its right-of-way, of any utility or appurtenance.

It is understood and agreed that the contractor has considered in his bid all the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenances or the operation of moving them.

In general, the contract will indicate any utility items which are to be relocated, adjusted or constructed by the contractor. The special provisions will indicate the means of adjudication, if any, in case of failure by the utility owner to comply with their responsibility in relocating or adjusting their facilities.

In the event the engineer determines that the contractor is experiencing significant delays in the controlling item(s) of work because of the delays by others in removing, re-

locating or adjusting utility appurtenances, contract time credits will be considered for such delays.

105.07 COOPERATION BETWEEN CONTRACTORS. The Department reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. Contractors working on the same project shall cooperate with each other as directed.

Each contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay or loss experienced by him because of the presence and operations of other contractors working within the limits of the same project.

The contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

105.08 CONSTRUCTION STAKES, LINES AND GRADES. The engineer will set construction stakes necessary to establish the lines, slopes and continuous profile grade for roadway work and will provide the contractor with all construction layout lines, control measurements and stakes, along with construction grades, necessary for the prosecution of the work contracted for under these specifications in accordance with the related project plans and special provisions for culvert work, bridge work, protective or accessory structures with all necessary appurtenances.

These layout lines, control measurements and stakes, along with construction grades, shall constitute the field control by and in accordance with which the contractor shall establish such other necessary auxiliary controls as he may desire in performing the work contracted for under these specifications, plans and special provisions.

The contractor shall be held responsible for the preservation of all stakes and marks established by the engineer and, if any of the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the contractor, the cost of replacing same will be charged to the contractor and will be deducted from the payments for the work.

The Department shall be responsible for the accuracy of all lines, measurements, stakes, elevations and grades or other engineering layout and control work done by its authorized representatives, unless otherwise stipulated elsewhere in these specifications or in the special provisions.

105.09 AUTHORITY AND DUTIES OF PROJECT ENGINEER. As the direct representative of the engineer, the project engineer has immediate charge of the Department's engineering details of each construction project. He is responsible to the Department for the administration and satisfactory completion of the contract. The project engineer shall have the authority to reject defective material and to suspend any work that is being improperly performed. In no case will he perform any duties for or act as the representative of the contractor.

105.10 DUTIES OF THE INSPECTOR. Inspectors employed by the Department will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of these specifications. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the contractor.

105.11 INSPECTION OF WORK. All materials and each part or detail of the work shall be subject to inspection by the engineer. The engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the contractor as is required to make a complete and detailed inspection.

If the engineer requests it, the contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the contractor shall restore said portions of the work to the standard required by the specifications.

Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed, will be at the contractor's expense.

Any work done or materials used without supervision or inspection by an authorized Department representative may be ordered removed and replaced at the contractor's expense.

When any unit of government or political subdivision or any railroad corporation is to pay a portion of the cost of the work covered by this contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision or any railroad corporation a party to this contract and shall in no way interfere with the rights of either party hereunder.

105.12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. All work which does not conform to the requirements of the contract will be considered as unacceptable work.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the engineer. Work done contrary to the instructions of the engineer, work done beyond the lines shown on the plans, or as given, except as herein specified, or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the contractor's expense.

Upon failure on the part of the contractor to comply forthwith with any order of the engineer, made under the provisions of this subsection, the engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed

and to deduct the costs from any monies due or to become due the contractor.

105.13 LOAD RESTRICTIONS. The contractor and his subcontractors and suppliers shall comply with all legal load restrictions in the hauling of materials or equipment on public roads beyond the limits of the project, and on completed bridge structures, bases and pavements within the limits of the project. A special permit will not relieve the contractor of liability for damage which may result from the moving of equipment.

The operation of equipment on the project of such weight or so loaded as to cause damage or overstress to structures or the roadway or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. The contractor shall be responsible for all damage done by his hauling equipment.

105.14 MAINTENANCE DURING CONSTRUCTION. The contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway or structures are kept in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the contractor shall maintain the previous course or subgrade during all construction operations.

When bridges are constructed over streams, the stream banks shall be kept in their natural state as much as possible. The contractor shall not unduly strip existing protective vegetation in the vicinity of the stream banks and shall so conduct his operations as not to damage the banks with his equipment. No bank up or downstream shall be excavated except as provided for and as shown on the plans. No work roads shall be constructed upstream where it is necessary to cut the stream or river banks except by approval of the engineer. Banks cut for work roads shall be located downstream and replaced by the contractor to their original shape and density. Unnecessary stripping of vegetational growth along banks in the construction area is not permitted.

Except as provided elsewhere in these specifications, all cost of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various pay items and the contractor will not be paid an additional amount for such work.

105.15 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE. If at any time, the contractor fails to comply with the provisions of Subsection 105.14 the engineer will immediately notify the contractor, in writing, of such non-compliance. If the contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the engineer may immediately proceed to maintain the project, and the entire cost of this maintenance will be deducted from monies due, or to become due, the contractor on his contract.

In the event the unsatisfactory maintenance results in a condition that is hazardous to life, health and property of the public, or to the integrity of the work, the engineer may declare an emergency situation and may immediately proceed to effect the repairs necessary, and will charge the entire cost to the contractor.

105.16 ACCEPTANCE.

(a) Partial Acceptance: If at any time during the prosecution of the project, the contractor satisfactorily completes a unit or portion of the project, such as a structure, an interchange or a section of road or pavement that can be used advantageously for traffic, he may request the engineer to make final inspection of that unit. If the engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the contract he may accept that unit as being completed and the contractor will be relieved of further responsibility for that unit.

In no event will a partial acceptance of a project be made until that portion being accepted has been completed in its entirety, including all safety devices, signs and striping. In the event a partial acceptance is made, the terms of the acceptance, including the responsibilities of all parties and any allowance of additional contract time, shall be set forth in a change order, mutually agreed to by the engineer and the contractor, with the concurrence of any unit of government or political sub-

division or any corporation having monetary interest in the work. Such partial acceptance shall in no way void or alter any terms of the contract, except as set forth in the change order.

(b) Final Acceptance: Upon due notice from the contractor of presumptive completion of the entire project, the engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the engineer will make the final acceptance and notify the contractor in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the engineer will give the contractor the necessary instructions for correction of same, and the contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the engineer will make the final acceptance and notify the contractor in writing of this acceptance as of the date of final inspection.

105.17 CLAIMS FOR ADJUSTMENT AND DISPUTES. If, in any case, the contractor deems that additional compensation is due him for work or material not clearly covered in the contract or not ordered by the engineer as extra work, as defined herein, the contractor shall notify the engineer in writing of his intention to make claim for such additional compensation before he begins the work on which he bases the claim. If such notification is not given and the engineer is not afforded proper facilities by the contractor for keeping strict account of actual cost as required, then the contractor hereby agrees to waive any claim for such additional compensation. Such notice by the contractor and the fact that the engineer has kept account of the cost as aforesaid shall not in any way be construed as proving or substantiating the validity of the claim. If the claim, after consideration by the engineer, is found to be just, it will be paid for as extra work or as provided herein for force account work. Nothing in this subsection shall be construed as establishing any claim contrary to the terms of Subsection 104.02.

Section 106

Control of Materials

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the contractor shall notify the engineer of his proposed sources of materials prior to delivery. At the option of the engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the contractor shall furnish materials from other sources or make necessary changes to provide acceptable materials.

106.02 LOCAL MATERIAL SOURCES.

(a) Designated Sources: Possible sources of local materials may be designated on the plans and described in the special provisions. The quality of material in such deposits will be acceptable in general, but the contractor shall determine for himself the amount of equipment and work required to produce a material meeting the specifications. It shall be understood that it is not feasible to ascertain from samples the limits for an entire deposit and that variations shall be considered as usual and are to be expected. The engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable prior to incorporation in the work.

The Department may acquire and make available to the contractor the right to take materials from the sources designated on the plans and described under special provisions, together with the right to use such property as may be specified, for plant site, stockpiles and hauling roads.

(b) Contractor Furnished Sources: If the contractor desires to use material from sources other than those designated, he shall acquire the necessary rights to take materials from the sources and shall pay all costs related

thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the contractor. The use of material from other than designated sources will not be permitted until representative samples taken by the engineer have been approved and written authority is issued for the use thereof.

When material deposits are not designated in the special provisions, the contractor shall provide sources of material acceptable to the engineer.

When sources of material or material deposits are provided by the contractor, the Department may assume the cost of processing samples to determine the suitability of the material.

Sites from which material has been removed shall, upon completion of the work, be left in a neat and presentable condition.

Unless otherwise authorized by the engineer in writing, borrow pits, gravel pits and quarry sites shall be located not less than 300 feet from the highway right-of-way.

106.03 SAMPLES, TESTS, CITED SPECIFICATIONS. All materials will be inspected, tested and accepted by the engineer before incorporation in the work. Any work in which untested and unaccepted materials are used, without approval or written permission of the engineer, shall be performed at the contractor's risk and may be considered as unacceptable and unauthorized and will not be paid for. Unless otherwise designated, samples and tests will be run in accordance with the most recent cited standard method of the Department's Sampling Manual and the Testing Procedures Manual; if not contained therein, by the AASHO methods. If a procedure is not available in AASHO, then the ASTM procedure will be used. Sampling and testing procedures not contained as above shall be as determined by the engineer. All procedures will be the most recent cited which are current on the date of the advertisement for bids. Unless otherwise designated, all testing will be made by and at the expense of the Department. Samples will be taken by a qualified representative of the Department. All materials being used are subject to inspection, test or rejection at any time prior to incorporation into the

work. Copies of all test reports will be furnished to the contractor's representative at his request.

106.04 PLANT INSPECTION. The engineer may undertake the inspection of materials at the source.

In the event plant inspection is undertaken the following conditions shall be met:

(a) The engineer shall have the cooperation and assistance of the contractor and the producer with whom he has contracted for materials.

(b) The engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

(c) If required by the engineer, the contractor shall arrange for an approved building for the use of the inspector, such building to be located conveniently near the plant, independent of any building used by the material producer and conforming to the requirements of Subsection 106.05.

(d) Adequate safety measures are to be provided and maintained.

It is understood that the Department reserves the right to retest all materials, prior to incorporation into the work, which have been tested and accepted at the source of supply after the same have been delivered and to reject all materials which, when retested, do not meet the requirements of these specifications or those established for the specific project.

106.05 FIELD LABORATORY. The contractor shall provide one or more suitable shelters or field laboratories as required in accordance with Section 722 to house and use the equipment essential to the Department's inspectors to carry on the required tests.

106.06 STORAGE OF MATERIALS. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage purposes and for the placing of the contractor's plant and equipment, but any additional space required therefor must be provided by the

contractor at his expense. Private property shall not be used for storage purposes without written permission of the owner and lessee and, if requested by the engineer, copies of such written permission shall be furnished him. All storage sites shall be restored to their original condition or to the satisfaction of the owner or lessee by the contractor at his expense. This shall not apply to the stripping and storing of topsoil or to other materials salvaged from the work.

106.07 HANDLING MATERIALS. All materials shall be handled in such manner as to preserve their quality and fitness for the work. The materials shall be transported from the storage site to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there be no inconsistencies in the quantities of materials intended for incorporation in the work as loaded and the quantities as actually received at the place of operations.

106.08 UNACCEPTABLE MATERIALS. All materials not conforming to the requirements of the specifications at the time they are used shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

106.09 DEPARTMENT-FURNISHED MATERIAL. The contractor shall furnish all materials required to complete the work except those specified to be furnished by the Department.

Material furnished by the Department will be delivered or made available to the contractor at the points specified in the special provisions.

The cost of handling and placing all materials after they are delivered to the contractor shall be considered as included in the contract price for the item in connection with which they are used.

The contractor will be held responsible for all material delivered to him and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such delivery, and for any demurrage charges.

106.10 ADJUSTMENT FOR CHANGES IN COMMON CARRIER RATES. It is understood and agreed that the accepted proposal for this project is based on common carrier rates on file with the Interstate Commerce Commission or with a corresponding intrastate commission or body and in effect on the date of opening of bids. Payments to the contractor will be adjusted to compensate for increases and decreases in cost due to changes in common carrier rates becoming effective after the date of opening of bids and before the date stipulated for completion of the work, as adjusted because of authorized extensions of time. The adjustment shall be limited to an amount determined as follows:

The adjustment shall be the product of the increase or decrease in the said common carrier rates multiplied by the net quantity of material shipped at the new rates to the work and incorporated therein, all as shown by receipted common carrier bills.

In the event that the freight cost by common carrier to the jobsite is included in the quotation by the supplier to the contractor, then in addition to the receipted freight bills, the supplier shall furnish on each of his invoices a breakdown showing the freight rate, quantity of material and total freight cost, and the contractor shall be required to furnish the supplier's written quotation made prior to the date of letting of the contract and shall further furnish a notarized statement to the effect that he has in fact paid the increased freight rate.

This provision is in no way intended to apply to any other than shipments by common carrier.

Section 107

Legal Relations and Responsibility to Public

107.01 LAWS TO BE OBSERVED. The contractor shall keep fully informed of all Federal, State and local laws, ordinances, and regulations and all orders and decrees of bodies of tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, bylaws, ordinances, regulations, orders and decrees; and shall protect and indemnify the state and its representatives against any claim or liability arising from or based on the violation of any such law, bylaw, ordinance, regulation, order or decree, whether by himself or his employees.

107.02 PERMITS, LICENSES AND TAXES. Except as otherwise provided, the contractor shall procure all permits and licenses, pay all charges, fees, and taxes and give all notices necessary and incidental to the due and lawful prosecution of the work.

107.03 PATENTED DEVICES, MATERIALS AND PROCESSES. If the contractor employs any design, device, material or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The contractor and the surety shall indemnify and save harmless the state, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright and shall indemnify the state for any costs, expenses and damages which it may be obliged to pay by reason of any infringement at any time during the prosecution or after the completion of the work.

107.04 RESTORATION OF SURFACES OPENED BY PERMIT. The right to construct or reconstruct any utility service in the highway or street or to grant permits for same, at any time, is hereby expressly reserved by the Department for the proper authorities of the municipality in

which the work is done and the contractor shall not be entitled to any damages either for the digging up of the street or for any delay occasioned thereby.

Any individual, firm or corporation wishing to make an opening in the highway must secure a permit from the Department. The contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. The contractor shall, when ordered by the engineer, make in an acceptable manner all necessary repairs due to such openings and such necessary work will be paid for as extra work, or as provided in these specifications, and will be subject to the same conditions as original work performed.

107.05 FEDERAL AID PROVISIONS. When the United States Government pays all or any portion of the cost of a project, the Federal laws and the rules and regulations made pursuant to such laws must be observed by the contractor, and the work shall be subject to the inspection of the appropriate Federal agency.

Such inspection shall in no sense make the Federal Government a party to this contract and will in no way interfere with the rights of either party hereunder.

On all Federal Aid projects the contractor will be required to complete Federal Aid Form PR-47, entitled, "Statement of Materials and Labor used by Contractors on Highway Construction Involving Federal Funds," prior to the time final inspection is requested for the project. In no case will the final estimate be paid until this form has been submitted to the Federal Highway Administration and accepted by them.

107.06 SANITARY PROVISIONS. The contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the state and local Boards of Health or of other bodies or tribunals having jurisdiction.

The disposal of sewage into streams or on the surface of the ground is prohibited unless sewage has been properly treated.

107.07 PUBLIC CONVENIENCE AND SAFETY. The

contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic.

When the road under construction is to be kept open for the use of the traveling public, special attention shall be paid to keeping both the subgrade and newly laid surfacing reasonably free from dust and in such condition that the public can travel the road in safety. The safety and convenience of the general public and the residents along the highway and the protection of persons and property shall be a primary responsibility of the contractor.

In the event the contractor elects to work at night, adequate artificial lighting, signs, flagmen or other traffic controls shall be provided to protect the workmen, the work and, if applicable, the traveling public. When such work affects traffic safety, the contractor shall submit to the engineer for his approval a plan of special lighting, signing, flagmen or other traffic controls. If the approved plan proves inadequate after work begins, the contractor shall make such changes as the engineer requires. In the event the engineer finds that the night work is so hazardous as to preclude the beginning of, or to require the discontinuing of such work, the contractor shall immediately cease all such operations. All costs of providing or making changes in the special lighting, signs, flagmen or other traffic controls shall be the responsibility of the contractor.

107.08 RAILWAY-HIGHWAY PROVISIONS. If the plans require that materials be hauled across the tracks of any railway, the Department will make arrangements with the railway for any new crossings required or for the use of any existing crossings. If the contractor elects to use crossings other than those shown on the plans, he shall make his own arrangements for the use of such crossings.

All work to be performed by the contractor in construction on the railroad right-of-way shall be performed at such times and in such manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the railway company. The contractor shall use all care and precaution in order to avoid accidents, damage, or unnecessary delay or interference with the railway company's trains or other property.

107.09 BRIDGES OVER NAVIGABLE WATERS. All work on navigable waters shall be so conducted that free

navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by whatever agency officially issues such permits.

The Department will obtain a permit for construction from the appropriate agencies for the construction of the highway structure over navigable waters and such permit will be available for inspection in the office of the Department's Bridge Design Engineer. The contractor is further directed to the applicable requirements of Subsection 801.04.

107.10 BARRICADES AND WARNING SIGNS. The contractor shall provide, erect and maintain all necessary barricades, suitable lights, danger signals, signs and other traffic control devices and shall take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to control and to direct traffic.

The contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the plans furnished.

All barricades, warning signs, lights, temporary signals and other protective devices must conform with the Louisiana Manual on Uniform Traffic Control Devices except that battery operated flashing warning lights that meet the requirements of Subsection 915.16 will be permitted at locations approved by the engineer.

Unless a pay item for "Signs and Barricades" is provided in the contract, all materials furnished and work performed as provided by this subsection shall be considered as subsidiary and the costs thereof shall be included in the various bid items of the contract.

107.11 USE OF EXPLOSIVES. When the use of explosives is deemed necessary for the prosecution of the work, and when approved, the contractor shall exercise the utmost care not to endanger life or property, including new work. Their use shall be in strict compliance with all laws

and ordinances. The contractor shall be responsible for any and all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner, in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the engineer and in general not closer than 1,000 feet from the road or from any building or camping area or place of human occupancy.

The contractor shall notify in writing each public utility company having facilities in proximity to the site of the work of his intention to use explosives and such notice shall be given sufficiently in advance to enable the companies to take such steps as they deem necessary to protect their property from injury.

107.12 PRESERVATION AND RESTORATION OF PROPERTY, LANDSCAPE AND SURVEY MONUMENTS. The contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance and damage all land monuments, property line markers and/or horizontal and vertical control monuments such as those established by the United States Coast and Geodetic Survey, Louisiana Geodetic Survey, Corps of Engineers, United States Geological Survey, etc.

Before removing and resetting any of the above listed type monuments, the contractor shall give sufficient advance notice in writing to the appropriate agency responsible for the particular monument as well as to the project engineer of his intention to perform the work in order that the proper authority of such agency may have a representative present if he so desires. Under no conditions should the contractor disturb or move any such monument without the approval of the project engineer.

The project engineer shall designate the location and the precise manner in which these monuments are to be reset.

The contractor shall be responsible for all damage or injury to property of any character during the prosecution of the work resulting from any act, omission, neglect or misconduct in his manner or method of executing the work, or at any time due to defective work or materials.

When or where any direct or indirect damage or injury

is done to public or private property by or on account of any act, omission, neglect or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the contractor, he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done by repairing, rebuilding or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner.

107.13 FOREST PROTECTION. In carrying out work within or adjacent to State or National Forests, the contractor shall comply with all regulations of the State Fire Marshal, Conservation Commission, Forestry Department or other authority having jurisdiction governing the protection of forests and the carrying out of work within forests, and shall observe all sanitary laws and regulations with respect to the performance of work in forest areas. He shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks and other structures in accordance with the requirements of the forest supervisor.

The contractor shall take all reasonable precaution to prevent and suppress forest fires and shall require his employees and subcontractors, both independently and at the request of forest officials, to do all reasonably within their power to prevent and suppress and to assist in preventing and suppressing forest fires and to make every possible effort to notify a forest official at the earliest possible moment of the location and extent of any fire seen by them.

107.14 WATER POLLUTION. The contractor shall schedule and conduct his operations to minimize erosion of soils and to prevent silting and muddying of streams, rivers, irrigation systems and impoundments (lakes, reservoirs, etc.). Construction of drainage facilities and performance of other contract work which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with earthwork operations or as soon thereafter as practicable. The area of bare soil exposed at any one time by construction operations shall be kept to a minimum.

Prior to suspension of construction operations for appreciable lengths of time, the contractor shall shape the earthwork in a manner that will permit storm runoff with a

minimum of erosion. Temporary erosion and sediment control measures such as berms, dikes, slope drains or sedimentation basins deemed necessary by the engineer shall be provided and maintained until permanent drainage facilities and erosion control features are completed and operative.

The contractor shall also conform to the following practices and controls:

(a) When borrow material is obtained from other than commercially operated sources, erosion of the borrow site shall be so controlled both during and after completion of the work that erosion will be minimized and sediment will not enter streams or other bodies of water. Waste or disposal areas and construction roads shall be located and constructed in a manner that will keep sediment from entering streams.

(b) Frequent fording of live streams will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by the engineer, mechanized equipment shall not be operated in live streams.

(c) When work areas or gravel pits are located in or adjacent to live streams, such areas shall be separated from the main stream by a dike or other barrier to keep sediment from entering a flowing stream. Care shall be taken during the construction and removal of such barriers to minimize the muddying of a stream.

(d) All waterways shall be cleared as soon as practicable of falsework, piling, debris or other obstructions placed during construction operations and not a part of the finished work.

(e) Water from aggregate washing or other operations containing sediment shall be treated by filtration, a settling basin or other means sufficient to reduce the sediment content to not more than that of the stream into which it is discharged.

(f) Pollutants such as fuels, lubricants, bitumens, raw sewage and other harmful materials shall not be discharged into or near rivers, streams and impoundments or into natural or manmade channels leading thereto.

Wash water or waste from concrete mixing operations will not be allowed to enter live streams.

(g) All applicable regulations of fish and wildlife agencies and statutes relating to the prevention and abatement of pollution shall be complied with in the performance of the contract.

All costs pertaining to the requirements contained herein will not be paid for directly but will be considered as a subsidiary obligation of the contractor under the various contract items of work.

107.15 RESPONSIBILITY FOR DAMAGE CLAIMS. The contractor shall indemnify and save harmless the Department, its officers and employees from all suits, actions or claims of any character brought because of any injuries or damage received or sustained by any person, persons or property on account of the operations of the said contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect or misconduct of said contractor; or because of any claims or amounts recovered from any infringements of patent, trademark or copyright; or from any claims for amount arising or recovered under the "Workmen's Compensation Act" or any other law, ordinance, order or decree; and so much of the money due the said contractor under and by virtue of his contract as may be considered necessary by the Department for such purpose, may be retained for the use of the state; or, in case no money is due, his surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department; except that money due the contractor will not be withheld when the contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

107.16 OPENING SECTIONS OF PROJECT TO TRAFFIC. Opening of sections of the work to traffic prior to completion of the entire contract may be desirable from a traffic service standpoint or may be necessary due to conditions inherent in the work or by changes in the contractor's work schedule and may be required due to conditions or

events unforeseen at the time of the contract. Such openings as may be necessary due to any of the foregoing conditions shall be made when so ordered by the engineer. Under no condition shall such openings constitute acceptance of the work or a part thereof or a waiver of any provisions of the contract.

Special provisions shall state, insofar as possible, which sections shall be opened prior to completion of the contract. On any section opened by order of the engineer, whether covered in the special provisions or not, the contractor shall not be required to assume any expense entailed in maintaining the road for traffic. Such expense shall be borne by the Department or compensated for in a manner provided hereinafter in Subsection 109.04. On such portions of the project which are ordered by the engineer to be opened for traffic, in the case of unforeseen necessity which is not the fault of the contractor, compensation for additional expense, if any, to the contractor and allowance of additional time, if any, for completion of any other items of work on the portions of the project ordered by the engineer to be opened in the event of such unforeseen necessity, shall be as set forth in a change order mutually agreed on by the engineer and the contractor as set forth hereinafter.

If the contractor is dilatory in completing shoulders, drainage structures or other features of the work the engineer may so notify him in writing and establish therein a reasonable period of time in which the work should be completed. If the contractor is dilatory or fails to make a reasonable effort toward completion in this period of time, the engineer may then order all or a portion of the project opened to traffic. On such sections which are so ordered to be opened, the contractor shall conduct the remainder of his construction operations so as to cause the least obstruction to traffic and shall not receive any added compensation due to the added cost of the work by reason of opening such section to traffic.

On any section opened to traffic under any of the above conditions, whether stated in the special provisions or opened by necessity of contractor's operations or unforeseen necessity, any damage to the highway not attributable to traffic which might occur on such section (except slides) shall be repaired by the contractor at his expense. The re-

moval of slides shall be done by the contractor on a basis agreed to prior to the removal of such slides.

107.17 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until final written acceptance of the project by the engineer, the contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The contractor shall rebuild, repair, restore and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the contractor, including but not restricted to acts of God, of the public enemy or of governmental authorities.

In case of suspension of work from any cause whatever, the contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project, provided for normal drainage and to erect any necessary temporary structures, signs or other facilities at his expense. During such period of suspension of work, the contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings and soddings furnished under his contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

107.18 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES. At points where the contractor's operations are adjacent to properties of railway, telegraph, telephone and power companies or are adjacent to other property, damage to which might result in considerable expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made.

The contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and that duplication of rearrangement work may be reduced to a minimum and

that services rendered by those parties will not be unnecessarily interrupted.

In the event of interruption to water or utility services as a result of accidental breakage or as a result of being exposed or unsupported, the contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. If water service is interrupted, repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

107.19 FURNISHING RIGHT-OF-WAY. The Department will be responsible for the securing of all necessary rights-of-way in advance of construction. Any exceptions will be indicated in the contract.

107.20 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Director, Chief Engineer or their authorized representatives, either personally or as officials of the state, it being understood that in all such matters they act solely as agents and representatives of the state.

107.21 NO WAIVER OF LEGAL RIGHTS. Upon completion of the work, the Department will expeditiously make final inspection and notify the contractor of acceptance. Such final acceptance, however, shall not preclude or estop the Department from correcting any measurement, estimate or certificate made before or after completion of the work, nor shall the Department be precluded or estopped from recovering from the contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Department of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The contractor, without prejudice to the terms of the contract, shall be liable to the Department for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

107.22 THIRD PARTY LIABILITY. It is specifically agreed between the parties executing this contract that it is not intended by any of the provisions of any part of the contract to create the public nor any member thereof a third party beneficiary hereunder, nor to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract. The duties, obligations and responsibilities of the parties to this contract with respect to third parties shall remain as imposed by law.

Section 108

Prosecution and Progress

108.01 SUBLETTING OF CONTRACT. The contractor shall not sublet, sell, transfer, assign or otherwise dispose of the contract or contracts or any portion thereof, or of his right, title or interest therein, without written consent of the engineer. In case such consent is given, the contractor will be permitted to sublet a portion thereof but shall perform with his own organization, work amounting to not less than 50 percent of the total contract cost, except that any items designated in the contract as "specialty items" may be performed by subcontract and the cost of any such specialty items so performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the contractor with his own organization. No subcontracts or transfer of contract shall in any case release the contractor of his liability under the contract and bonds.

108.02 NOTICE TO PROCEED. The "Notice to Proceed" will stipulate the date on which it is expected that the contractor will begin the construction, which date shall be the beginning of the contract time charges. Commencement of work by the contractor prior to the date stipulated in the notice may be deemed and taken as a waiver on his part of this notice and contract time will be charged beginning on the date of commencement of work.

108.03 PROSECUTION AND PROGRESS. The contractor shall furnish the engineer with a "Progress Schedule" for his approval. The progress schedule will be used as the basis for establishing major construction operations and as a check on the progress of the work. The contractor shall provide sufficient materials, equipment and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal. Should the prosecution of the work for any reason be discontinued, the contractor shall notify the engineer in writing at least 24 hours in advance of resuming operations.

108.04 LIMITATION OF OPERATIONS. The contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. He shall not open up work to the prejudice or detriment of work already started, and the engineer may require the contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

108.05 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT. The contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the contractor or by any subcontractor who, in the opinion of the engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the engineer, be removed forthwith by the contractor or subcontractor employing such person and shall not be employed again in any portion of the work without the approval of the engineer.

Should the contractor fail to remove such person or persons as required above or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property or other highways will result from its use.

When the methods and equipment to be used by the contractor in accomplishing the construction are not prescribed in the contract, the contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the engineer will accomplish the contract work in conformity with the requirements of the contract.

When the contract specifies that the construction be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the engineer. If the contractor desires to use a method or type of equipment other than those specified in the contract, he may request authority from the engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the contractor will be fully responsible for producing construction work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the engineer determines that the work produced does not meet contract requirements, the contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The contractor shall remove the deficient work and replace it with work of specified quality or take such other corrective action as the engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

108.06 DETERMINATION AND EXTENSION OF CONTRACT TIME. The number of days allowed for the completion of the work included in the contract will be stated in the proposal and contract, and will be known as the "Contract Time."

When the contract time is on a working day basis the engineer will furnish the contractor a monthly statement showing the number of days charged to the contract for the preceding month and the number of days specified for completion of the contract. The contractor will be allowed 10 days in which to file a written protest setting forth in what respect said monthly statement is incorrect, otherwise the

statement shall be deemed to have been accepted by the contractor as correct.

When the contract time is on a calendar day basis, it shall consist of the number of calendar days stated in the contract beginning with the effective date of the engineer's order to commence work, including all Saturdays, Sundays, holidays and non-work days. All calendar days elapsing between the effective dates of any written orders by the engineer to suspend work and to resume work for suspensions not the fault of the contractor shall be excluded.

When the contract completion time is a fixed calendar date, it shall be the date on which all work on the project shall be substantially completed.

The number of days for performance allowed in the contract as awarded is based on the original quantities as defined in Subsection 102.04 and includes the time necessary to procure material, equipment and an adequate labor force to complete the work properly. If satisfactory fulfillment of the contract requires performance of work in greater quantities than those set forth in the proposal, the contract time allowed for performance shall be increased on a basis commensurate with the amount and difficulty of the added work.

If the contractor finds it impossible, for reasons beyond his control, to complete the work within the contract time as specified or as extended in accordance with the provisions of this subsection, he may at any time prior to the expiration of the contract time as extended, make a written request to the engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the engineer finds that the work was delayed because of conditions beyond the control and without the fault of the contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

When final acceptance has been duly made by the engineer as prescribed in Subsection 105.16, the daily time charge will cease.

108.07 FAILURE TO COMPLETE ON TIME. For each

calendar day or work day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the work provided for in the contract, the sum specified below will be deducted from any money due the contractor not as a penalty but as liquidated damages; provided however, that due account shall be taken of any adjustment of the contract time for completion of the work granted under the provisions of Subsection 108.06.

Permitting the contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Department of any of its rights under the contract.

The Department may waive such portions of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the traveling public.

Based on the amount of the original contract, the following charges per contract day will be made for each such day after the expiration of the contract time or extended contract time, as the case may be.

When the contract time is on either the calendar day or fixed calendar date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used.

ORIGINAL CONTRACT AMOUNT		DAILY CHARGE	
From More Than	To and Including	Calendar Day or Fixed Date	Work Day
$ 0	$ 25,000	$ 30.00	$ 42.00
25,000	50,000	50.00	70.00
50,000	100,000	75.00	105.00
100,000	500,000	100.00	140.00
500,000	1,000,000	150.00	210.00
1,000,000	2,000,000	200.00	280.00
2,000,000	----------	300.00	420.00

The amount of liquidated damages, determined as provided above, will be deducted from any money due the contractor under this contract, and the contractor and his surety shall be liable for any liquidated damages in excess of amounts due the contractor.

108.08 DEFAULT AND TERMINATION OF CONTRACT. If the contractor:

(a) Fails to begin the work under the contract within the time specified in the "Notice to Proceed," or

(b) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or

(c) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

(d) Discontinues the prosecution of the work, or

(e) Fails to complete the project within the contract time set forth within the contract or as extended, or

(f) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

(g) Becomes insolvent or is declared bankrupt or commits any act of bankruptcy or insolvency, or

(h) Allows any final judgment to stand against him unsatisfied for a period of 10 days, or

(i) Makes an assignment for the benefit of creditors, or

(j) For any other cause whatsoever, fails to carry on the work in an acceptable manner, the engineer will give notice in writing to the contractor and his surety of such delay, neglect or default.

If the contractor or surety, within a period of 10 days after such notice, shall not proceed in accordance therewith, then the Department will, upon written notification from the engineer to the contractor and surety of the fact of such delay, neglect or default and the contractor's failure to comply with such notice, have full power and authority without violating the contract to take the prosecution of the work out of the hands of the said contractor. The Department may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the engineer will be required for the completion of said contract in acceptable manner.

All costs and charges incurred by the Department, to-

gether with the cost of completing the work under contract, will be deducted from any monies due or which may become due said contractor. If such expense exceeds the sum which would have been payable under the contract, then the contractor and the surety shall be liable and shall pay to the Department the amount of such excess.

108.09 TERMINATION OF CONTRACTOR'S RESPONSIBILITY. The contract will be considered complete when all work has been satisfactorily completed, the final inspection made and the work accepted by the Chief Engineer. The contractor will then be released from further obligation except as set forth in his contract bond, and except as provided in Subsection 107.21.

108.10 TERMINATION OF CONTRACT. If at any time during the progress of the work all of said work or all of the major controlling operations are delayed any single period of time for more than 90 consecutive calendar days by reason of war conditions involving the United States or by reason of orders of the United States Government or its duly authorized agencies or Executive Order with respect to prosecution of war or national defense, the Department may enter into an agreement of postponement with the contractor covering postponement of the performance of part or all the work for a specified period of time or may terminate the contract by notifying the contractor, in writing, of such action. If an agreement of postponement is made, it shall be executed by the contractor and the Department and shall be approved by the surety.

In the event of delay, as hereinbefore provided, the contractor shall be paid 95 percent of value of all work completed or partially completed, as provided in the specifications, in accordance with the terms of the agreement of postponement; or in the event of termination of contract, the contractor shall be paid in full, in accordance with the terms of the contract and particularly of Subsection 109.07, for all work done and completed in accordance therewith; and he shall be paid a reasonable amount or amounts, which shall be fixed or determined by the engineer, for work partially completed; but he shall not be paid for any work not performed. Nothing herein contained shall be in derogation of any rights or remedies vested in or available to the Department by the terms of the contract.

108.10

Accepted materials obtained by the contractor for the work, but not in excess of job requirements, that have been inspected, tested and accepted by the Department and that are not incorporated in the work, shall be purchased from the contractor at actual cost as shown by receipted bills at such points of delivery as may be designated by the Department.

Section 109

Measurement and Payment

109.01 MEASUREMENT OF QUANTITIES. All work completed under the contract will be measured by the engineer according to United States standard measure.

A station when used as a definition or term of measurement will be 100 linear feet.

The engineer shall be the final judge as to the accuracy of any measurements or quantities and the reasonableness of any approximations made in lieu of accurate determinations and his decisions shall be binding upon both parties.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally and no deductions will be made for individual fixtures having an area of 9 square feet or less. Unless otherwise specified, traverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

All items which are measured by the linear foot, such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans.

In computing volumes of excavation, the average end area method or other acceptable methods will be used.

The term gage, when used in connection with the measurement of plates, will mean the U.S. Standard Gage, except that when reference is made to the measurements of galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, the term gage will mean that specified in the referenced AASHO Designations. The thickness of corrugated metal sheets and plates may be specified in inches.

When the term gage refers to the measurement of wire, it will mean the wire gage specified in the AASHO Designation: M 32.

109.01

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois. All materials which are measured or proportioned by weight shall be weighed on accurate, approved scales by competent, qualified personnel at locations designated by the engineer. If material is shipped by rail, the car weight may be accepted provided the actual weight of material only will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the engineer directs, and each truck shall bear a plainly legible identification mark.

Materials specified to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and shall be measured therein at the point of delivery. Vehicles used for this purpose may be of any size or type acceptable to the engineer, provided that the body of the vehicle is of such shape that the actual volume or capacity may be readily and accurately determined. All vehicles shall be loaded to at least a predetermined permanently fixed mark, which defines a known volume or capacity, upon arrival at the point of delivery. No vehicle will be approved unless its capacity, or the volume below the predetermined permanently fixed mark, is in multiples of whole cubic yards; except that when tail-gate spreader-boxes are used to place aggregate materials under Section 505, Bituminous Surface Treatment, the volume of the spreader-box will be added to the whole-cubic-yard volume of the vehicle. No other fractional cubic yard volumes will be allowed.

When requested by the contractor and approved by the engineer in writing, material specified to be measured by the cubic yard may be weighed and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the engineer and shall be agreed to by the contractor before such method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon or by the ton.

Volumes of liquid bituminous materials will be measured at 60°F, or will be converted to the gallonage at 60°F in

accordance with the conversion tables in Subsections 504.08 and 505.11.

Net certified scale weights or weights based on certified volumes in the case of shipments by rail, truck or other transport will be used as a basis of measurement, subject to correction when material has been lost in transit, wasted or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights or volume, subject to correction for loss or foaming, may be used for computing quantities.

Portland Cement will be measured by the barrel. The term barrel will mean 376 pounds of cement.

Timber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by the time in hours of actual working time and necessary traveling time of the equipment within the limits of the project unless special equipment has been ordered by the engineer in connection with force account work in which case travel time and transportation to the project will be measured. If equipment has been ordered held on the job on a standby basis by the engineer, half time rates for the equipment will be paid.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

109.02 SCOPE OF PAYMENT. The contractor shall re-

ceive and accept compensation provided for in the contract as full payment for furnishing all materials and for performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Subsection 107.21.

If the "Basis of Payment" clause in the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the specifications.

109.03 COMPENSATION FOR ALTERED QUANTITIES. When the accepted quantities of work vary from the quantities in the bid schedule, the contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the accepted quantities of work done. No allowance, except as provided in Subsection 104.02, will be made for any increased expense, loss of expected reimbursement or loss of anticipated profits suffered or claimed by the contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursements therefor or from any other cause.

109.04 EXTRA AND FORCE ACCOUNT WORK. Extra work performed in accordance with the requirements and provisions of Subsection 104.03 will be paid for at the unit prices or lump sum stipulated in the order authorizing the work or the Department may require the contractor to do such work on a force account basis, to be compensated in the following manner:

(a) **Labor:** For all labor and working foremen in direct charge of the specific operations, the contractor shall receive the rate of wage (or scale) agreed upon in writing before beginning work for each and every hour that said labor and foremen are actually engaged in such work.

The contractor shall receive the actual costs paid to, or in behalf of, workmen by reason of subsistence and travel

allowances, health and welfare benefits, pension fund benefits or other benefits when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work, but limited to a maximum daily rate for subsistency and travel allowances, which maximum will be agreed upon prior to incurring such charges.

An amount equal to 20 percent of the sum of the above items will also be paid the contractor.

(b) Bond, Insurance and Tax: For property damage, liability, and workmen's compensation insurance premiums, unemployment insurance contributions and social security taxes on the force account work, the contractor shall receive the actual cost thereof, to which 6 percent will be added. The contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance and tax.

(c) Materials: For materials accepted by the engineer and used, the contractor shall receive the actual cost of such materials delivered on the work including transportation charges paid by him (exclusive of machinery rentals as hereinafter set forth), to which cost 15 percent will be added.

(d) Equipment: For any machinery or special equipment (other than small tools) including fuel and lubricants, plus transportation costs, the use of which has been authorized by the engineer, the contractor shall receive the rental rates agreed upon in writing before such work is begun for the actual time such equipment is in operation on the work.

(e) Miscellaneous: No additional allowance will be made for general superintendence, the use of small tools or other costs for which no specific allowance is herein provided.

(f) Compensation: The contractor's representative and the engineer shall compare records of the cost of work done as ordered on a force account basis. Such comparison shall be made daily if required by the engineer. Should any work be performed by a sub-contractor, the project contractor shall be paid the actual and reasonable cost of such sub-contracted work computed as outlined above, plus an additional allowance of 5 percent for materials

cost and for direct labor cost to cover the contractor's profit, superintendents, administration, insurance and overhead.

(g) **Statements:** No payment will be made for work performed on a force account basis until the contractor has furnished the engineer with duplicate itemized statements of the cost of such force account work detailed as follows:

(1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

(2) Designation, dates, daily hours, total hours, rental rate and extension for each unit of machinery and equipment.

(3) Quantities of materials, prices and extensions.

(4) Transportation of materials.

(5) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions and social security tax.

Statements shall be accompanied and supported by invoices for all materials used and for all transportation charges. If materials used on force account work are not specifically purchased for such work but are taken from the contractor's stock, then in lieu of invoices, the contractor shall furnish an itemized list of such materials showing that the quantity claimed was actually used, and that the price and transportation costs claimed represent the actual cost of the contractor. All invoices submitted shall be accompanied by the contractor's notarized statement that payment in full has been made for the materials.

109.05 ELIMINATED ITEMS. Should any items contained in the proposal be found unnecessary for the proper completion of the work, the engineer may, upon written order to the contractor, eliminate such items from the contract and such action shall in no way invalidate the contract. When a contractor is notified of the elimination of items, he will be reimbursed for actual authorized work done and all costs incurred, including mobilization of materials prior to said notification.

109.06 PARTIAL PAYMENTS. So long as the work herein contracted for is prosecuted in accordance with the provisions of the contract, and with such progress as may

be satisfactory to the engineer, the engineer will make or cause to be made, the first progress estimate one calendar month from the date indicated to begin work in the "Notice to Proceed." Each successive progress estimate will be made on this same date of each month thereafter until completion of the contract. Each progress estimate shall be an approximation of the proportionate value of the work performed up to and including the date the estimate is made and shall be based on material in place and labor expended thereon, but no more than 95 percent of the contract price of the work shall be paid in advance of full completion of the contract and its acceptance by the Department.

The amount of said estimate, after deducting 5 percent and all previous payments, shall be due and payable to the contractor.

The monthly estimates will be approximate only and all partial or monthly estimates and payments shall be subject to corrections in the estimate rendered following discovery of any error in any previous estimates.

Should any defective work or material be discovered or should a reasonable doubt arise as to the integrity of any part of the work completed previous to the final acceptance and payment, there will be deducted from the first estimate rendered after the discovery of such defective or questioned work an amount equal in value to the defective or questioned work, and this work will not be included in a subsequent estimate until the defects have been remedied or the causes for doubt removed.

The payment of the monthly estimate shall not in any respect be taken as an admission that the work is done or that its quality is satisfactory nor as a release of the contractor from the responsibility for any portion thereof, but the whole work and all particulars relating thereto shall be subject to revision and adjustment by the engineer at the time of final acceptance and the payment of the final estimate.

109.07 PAYMENT FOR MATERIAL ON HAND. Upon written request, 90 percent of the invoice cost of the appropriate value of approved specification materials delivered by the contractor at the project site or other designated location in the vicinity of such construction will be paid. Payment will not exceed the total estimated quantity re-

quired to complete the project. The agreed value will not exceed the appropriate portion of the contract item or items in which such materials are to be incorporated. Payment for stockpiled materials shall be limited to bulky materials that are durable in nature and represent a significant portion of the project cost, such as aggregates, bridge timber, structural steel, reinforcing steel, etc. Perishable articles and small warehouse items will not be included.

The contractor will furnish the engineer a certified inventory of the quantity of each stockpiled item and its invoiced cost when advanced payment is requested.

Within thirty days after payment by the state, the contractor shall submit a copy of an invoice statement for each item for which payment has been made. In the event certification of payment is not presented within the thirty-day period, the advanced payment will be deducted from the next progress payment. All such invoices submitted shall be accompanied by the contractor's notarized statement that payment in full has been made for the materials.

Title, ownership and incidentals thereto of materials for which advancements have been made by the Department shall not vest in the Department until such materials are actually incorporated in the work and the work accepted by the Department and the making of advancements therefor by the Department shall not release the contractor from the responsibility for any portion thereof. The contractor shall save the Department harmless in the event of loss or damage of materials for which advancements have been made, regardless of cause of loss or damage.

109.08 ACCEPTANCE AND FINAL PAYMENT. Upon the completion and acceptance of the work, the Chief Engineer shall execute a certificate that the whole work provided for in this contract has been completed and accepted under the terms and conditions of the contract and said certificate of acceptance shall be recorded in the office of the Recorder of Mortgages of the parish in which the work has been done, and the entire balance found to be due the said contractor, including all retained percentages (all prior certificates or estimates upon which payments have been made being approximate only and subject to correction in the final payment) shall be paid to the contractor after the Department has satisfied itself that the quantities shown on

the final estimate are correct; provided, however, that before the payment of said final estimate shall be made, the contractor shall submit to the Department a certificate from the Recorder of Mortgages of the parish in which the said work has been done to the effect that there are no claims or liens recorded against the said contract. The date of said certificate shall be not prior to the expiration of 45 days after the certificate of acceptance was recorded by the Department in the Mortgage office.

Prior to payment of the final estimate, all releases or waivers on buildings, wells, utilities and railroads must be furnished as well as any maintenance bonds, certificates from Health Department, tracings, brochures or other items required by the contract.

It is expressly stipulated and understood that payment of the final estimate shall not operate to release the contractor or his sureties from liability for any fraud in construction, or in obtaining progress payments, or in payment for materials, labor or other supplies or services incidental to the work, or for any and all claims for damages, loss or injury sustained by any person or persons whomsoever, through the fault, negligence or conduct of the said contractor or any of his employees.

PART II

EARTHWORK

Section 201

Clearing and Grubbing

201.01 DESCRIPTION. This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the right-of-way and easement areas, except such objects as are designated to remain or are to be removed in accordance with other sections of these specifications. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

201.02 CLEARING. This work shall consist of cutting, removing, burning and clearing up of timber, logs, brush, stumps and debris from within the entire construction area and to a point in fills 10 feet beyond the toes of foreslopes and in cuts 10 feet beyond the tops of backslopes when width of right-of-way permits; also from such areas required for offtake ditches, channel changes and borrow pits furnished by the Department. Also, where fencing is required, it shall include an area 10 feet wide adjacent to and inside the right-of-way line. In addition, it shall include clearing of fruit trees, shrubbery and flowers within the above limits which are not removed by their owners, except shrubbery which is to be removed and transplanted by the contractor in connection with other bid items.

201.03 SELECTIVE CLEARING. This work shall consist of selectively clearing areas within the limits of the right-of-way, which are not included under "Clearing" in the foregoing paragraphs, of all non-valuable trees, shrubs, vines, logs, brush, stumps, snags and debris, for the purpose of leaving valuable vegetation to remain. Items to remain shall be selected and designated by the project engineer.

201.04 GRUBBING. This work shall consist of the excavation and removal of all stumps, roots, submerged logs, snags, corduroy and other perishable and objectionable materials from all areas to be cleared or selectively cleared as provided above.

CONSTRUCTION REQUIREMENTS

201.05 GENERAL. The engineer will establish right-of

way lines and construction lines and shall designate trees, shrubs, plants and other items to remain. The contractor shall preserve all items designated to remain. Trees shall be felled and removed in such manner as to avoid injury to other items marked to remain. In case of injuries to bark, trunks, limbs or roots of vegetation marked to remain, the contractor shall repair such damage without additional compensation, by corrective pruning, bark tracing, wood painting and other acceptable horticultural and tree surgery practices. Trees falling outside the right-of-way limits shall be removed.

201.06 CLEARING AND GRUBBING. Surface objects and all trees, stumps, roots and other protruding obstructions not designated to remain shall be cleared and/or grubbed including mowing as required except undisturbed stumps, roots and nonperishable solid objects which will be a minimum of 2 feet below subgrade or slope of embankments. When authorized, the contractor may leave stumps and nonperishable solid objects provided they do not extend more than 6 inches above the ground line or low water level.

Grubbing with explosives will not be permitted in swampy areas or adjacent to high pressure oil and gas lines without special permission.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled and compacted to the approximate density of the surrounding natural ground all in accordance with the applicable requirements of Section 203 and as directed.

If perishable material is burned, it shall be burned under the constant care of competent watchmen at such times and in such a manner that anything designated to remain on the right-of-way, the surrounding forest cover or other adjacent property will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

Materials and debris which cannot be burned and perishable materials which are not burned shall be removed from the right-of-way and disposed of at locations off the project outside the limits of view from the property owner on whose property the materials and debris are placed. The contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and

the cost involved shall be included in the unit price bid. Copies of all agreements with property owners shall be furnished the engineer.

All merchantable timber in the clearing area which has not been removed from the right-of-way prior to the beginning of construction shall become the property of the contractor unless otherwise provided.

Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

201.07 SELECTIVE CLEARING. Areas indicated on the plans, or as much thereof as the engineer may direct, shall be cleared of all trees and vegetation except those selected to remain and also of all stumps, rubbish and other perishable or objectionable matter. The contractor shall notify the engineer at least 2 weeks in advance of the work to be done. The engineer shall select and mark or otherwise designate to remain all trees and other standing vegetation which are considered valuable. Selective clearing may be performed by hand or machine methods or a combination of both.

In order to facilitate the removal of trees, vegetation, etc., the following procedures shall apply:

(a) Except in instances as listed below in (b), spacing between trees to remain shall be approximately 50 feet. No attempt should be made to "line up" any trees. This is applicable to thick woods growth in order to give the contractor working space for equipment. The engineer should consider the kinds of trees to be marked as to their present spread or ultimate spread of tops in order to leave sufficient space.

(b) In exceptional instances where groups of trees or native shrubs are to be left standing, such groups may be left with closer spacing than stated in (a). Such closer spacing will be applicable to such trees and shrubs as pines, magnolias, and flowering trees—dogwood, redbud, holly (American and Yaupon), hawthorn and others which form upright growths or shrub effects.

Any trees found to be dead or dying in any areas that

have been selectively cleared, before project is accepted, shall be removed by the contractor at his own expense.

In all other respects clearing in areas designated herein or on the plans to be selectively cleared shall be performed in accordance with the requirements under Subsection 201.06.

201.08 METHOD OF MEASUREMENT. Measurement will be by one or more of the following methods:

(a) Area Basis: The work to be paid for will be the number of acres and fractions thereof acceptably cleared, grubbed, selectively cleared or cleared and grubbed within the limits shown on the plans or staked for clearing and grubbing by the engineer. Areas not shown on the plans or not staked for clearing and grubbing will not be measured for payment.

(b) Lump Sum Basis: When the bid schedule contains a clearing and grubbing lump sum item no measurement of area will be made.

201.09 BASIS OF PAYMENT. The accepted quantities of clearing, grubbing, selective clearing, and clearing and grubbing will be paid for at the contract unit prices as follows:

(a) Area Basis: The quantities determined will be paid for at the contract unit price bid per acre respectively for each of the particular pay items listed that appear in the bid schedule.

(b) Lump Sum Basis: When the bid schedule contains a lump sum item, the lump sum price so bid will be paid and shall be full compensation for all required clearing and grubbing.

(c) Exclusions: When the bid schedule does not contain an estimated quantity or a lump sum item for clearing and grubbing, the work will not be paid for directly, but will be considered as a subsidiary obligation of the contractor under other contract items.

Payment will be made under:

Item No.	Pay Item	Pay Unit
201(1)	Clearing	Acre, Lump Sum
201(2)	Grubbing	Acre, Lump Sum
201(3)	Selective Clearing	Acre, Lump Sum
201(4)	Clearing and Grubbing	Acre, Lump Sum
201(5)	Selective Clearing and Grubbing	Acre, Lump Sum

Section 202

Removal of Structures and Obstructions

202.01 DESCRIPTION. This work shall consist of the removal and satisfactory disposal of all buildings, fences, structures, old pavement, abandoned pipe lines and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items in the contract as directed. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes and pits. When the proposal does not include pay items for removal of structures and obstructions, as set out in this section, cost of such work shall be included in prices bid on other construction items.

202.02 CONSTRUCTION REQUIREMENTS. The contractor shall remove and dispose of all buildings and foundations, fences and other obstructions, any portions of which are on the right-of-way, except utilities and those for which other provisions have been made for removal. All designated salvageable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported and shall be stacked at specified storage areas by the contractor within the project limits or hauled to a designated maintenance storage yard and stacked. All materials designated not to be salvaged may be destroyed or disposed of off the project outside the limits of view with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished the engineer. Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and, if within the limits of construction, shall be compacted to the approximate density of the surrounding ground.

202.03 REMOVAL OF BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES. Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Unless otherwise directed the substructures of existing

structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down to one foot below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Steel bridges and wood bridges as specified shall be carefully dismantled without unnecessary damage. This dismantling shall include the stripping of all hardware and the removal of all nails. Steel members shall be match marked before dismantling unless otherwise indicated. All salvaged material shall be stored or removed as specified in Subsection 202.02.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

Unless waived in writing, all concrete removed which is of suitable size for riprap and not needed for such use on the project shall be stockpiled on the project as directed for use by the Department. When waived the removed concrete shall be disposed of by the contractor off the project as specified in Subsection 202.02.

202.04 REMOVAL OF PIPE. Unless otherwise provided all pipe shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe. Pipes to be relaid shall be removed and stored when necessary so that there will be no loss or damage before relaying. The contractor will be required to replace sections lost from storage or damaged by negligence or by use of improper methods. Pipes not to be relaid and considered usable shall be salvaged, cleaned of soils or other materials, stored or removed and stacked as specified in Subsection 202.02.

202.05 REMOVAL OF PAVEMENT, SIDEWALKS, CURBS, ETC. All concrete pavement, base course, sidewalks, curbs, gutters, etc., designated for removal, shall be:

(a) Broken into pieces and used for riprap on the project, or

(b) broken into sizes suitable for riprap and stockpiled at designated locations on the project for use by the Department, or

(c) otherwise disposed of as directed.

When specified, ballast, gravel, bituminous material or other surfacing or pavement materials shall be removed and stockpiled as required in Subsection 202.02 otherwise such materials shall be disposed of as directed.

There will be no separate payment for excavating for removal of structures and obstructions or for backfilling and compacting the remaining cavity.

202.06 METHOD OF MEASUREMENT. When the contract stipulates that payment will be made for removal of structures and obstructions on a lump sum basis, the pay item will include all structures and obstructions within the right-of-way in accordance with the provisions as set out in this section. Where the proposal stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the contract.

Unless otherwise specified the cost of removing pipe culverts will be included in cost of other items. When specifically provided as a pay item the length of pipe removed will be measured in linear feet, computed by multiplying the number of commercial lengths removed by the nominal laying length or by measuring in place prior to removal if practicable.

Hauling salvaged material will be measured by the lump.

202.07 BASIS OF PAYMENT. The accepted quantities of removal of structures and obstructions will be paid for at the contract lump sum price bid, which price shall be full compensation for removing and disposing of the obstructions in accordance with the contract.

Specific obstruction items, including pipe removal, stipulated for removal or disposal under unit price pay items will be paid for at the contract unit price bid per unit specified in the proposal, which price shall be full compensation for removal and disposal of such items, excavation and subsequent backfill incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as provided herein.

When an item for hauling salvaged material is provided, the hauling of such material to the designated maintenance

storage yard will be paid for at the contract lump sum price bid.

Payment will be made under:

Item No.	Pay Item	Pay Unit
202(1)	Removal of Structures and Obstructions	Lump Sum
202(2)	Removal of_____	Each, Linear Feet, Square Yard
202(3)	Hauling Salvaged Material	Lump Sum

Section 203

Excavation and Embankment

203.01 DESCRIPTION. This work shall consist of excavating, removing and satisfactorily placing or disposing of all materials encountered within the limits of the work, except structural excavation and such other work as may be covered by other pay items. It shall include excavation for the roadway, ditches, channel changes and all operations necessary for the construction of the roadway in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the engineer. Excavation will be classified as "Unclassified Excavation," "Drainage Excavation," "Muck Excavation," "Special Borrow" "Embankments" or "Hydraulic Embankments."

The plans may include data regarding the boring and classification of existing roadway materials. The Department does not guarantee the accuracy of such information shown on the plans and bidders should make, at their own expense, such additional investigations as they consider necessary. No additional payment will be made for any increased costs due to the inaccuracy of soil boring data shown on the plans.

203.02 UNCLASSIFIED EXCAVATION. Unclassified excavation shall consist of all excavation within the highway right-of-way not otherwise classified and paid for.

203.03 DRAINAGE EXCAVATION. Drainage excavation includes all excavation made for the primary purpose of facilitating drainage beyond the limits of the roadway section except for wing ditches at cuts. Drainage excavation also includes inlet and outlet ditches to structures or roadway; changes in or deepening of channels of streams, berm ditches, ditches parallel to or adjacent to the roadway, beyond the limits of the roadway section; and material excavated from areas under bridges.

203.04 MUCK EXCAVATION. Muck excavation shall consist of the removal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for

foundation material. Muck shall include materials which will decay or produce unsatisfactory subsidence in the embankment and may be made up of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment. The engineer shall determine the material to be classified as muck and wasted and the material that is satisfactory for use in the embankment in accordance with the specifications.

The method of determination of muck elevation, both before and after mucking operation, shall follow the procedure as set forth in LDH Designation: TR 426.

203.05 BORROW. Borrow excavation shall include all excavation obtained from borrow pits furnished by the Department as shown on plans or designated by the engineer. Borrow excavation material shall be tested and classified by the Laboratory before being placed in embankments and be subject to the restrictions for materials hereinafter contained, shall be soil identification classes LDH Designation: TR 423 A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-3, A-4, A-5, A-6, A-7-5 and/or A-7-6 except that material in the A-5, A-6, A-7-5 and A-7-6 classes considered unsatisfactory by the engineer will not be accepted. Should a material of the A-1-b class (Coarse sand or gravelly sand) or A-3 class (Sand) be used, the contractor will be required to use on slopes a plastic material of the A-4, A-6, A-7-5 and/or A-7-6 classification, with a minimum Plasticity Index of 10, at the discretion of the engineer.

No charge will be made against the contractor for material secured from pits furnished by the Department, but the contractor shall construct and maintain, at his own expense, any necessary haul roads from the pits to the highway. The Department will secure all necessary easements along the approved routes of haul roads without cost to the contractor.

203.06 SPECIAL BORROW. Special borrow excavation shall include all acceptable excavation obtained from borrow pits furnished by the contractor. Special borrow excavation material shall be tested and classified by the Laboratory before being placed in the embankment and shall meet the requirements for borrow excavation in Subsection 203.05.

The contractor shall notify the engineer in writing at least 15 calendar days in advance of special borrow opera-

tions so that samples may be taken and soil tests completed prior to beginning the excavation. The contractor will not be permitted to begin the special borrow operations until soil tests have been completed and the materials approved for use.

Securing of exclusive option by any contractor on borrow pit areas and/or materials for the work to be done will be interpreted as a violation of Section 423 of Title 48 of the Louisiana Revised Statutes of 1950 and will be a basis for rejection of bids or such other action the Department may deem advisable.

Clearing, grubbing, stripping of pits and material not used in the embankment will not be measured or paid for. Any overhaul involved in moving material from pits to the embankment will not be measured or paid for. The contractor shall provide and maintain all necessary haul roads from the borrow pits to the work at his own expense.

Borrow pits, except as specified in Subsection 203.12, shall be located a minimum distance of 300 feet from the right-of-way unless otherwise authorized in writing by the engineer. In instances where pits are located closer than 300 feet and are visible from the roadway, they shall be screened in accordance with LDH requirements at no cost to the Department.

203.07 HYDRAULIC EMBANKMENT. Hydraulic embankment shall consist of acceptable material pumped from approved sources and placed in the roadway embankment by hydraulic methods in accordance with Section 203.12.

CONSTRUCTION REQUIREMENTS

203.08 GENERAL. Excavation and embankments for the roadway, intersections and entrances shall be finished to reasonably smooth and uniform surfaces. No material shall be wasted without permission of the engineer. Excavation operations shall be conducted so that material outside of the limits of construction will not be disturbed. Prior to beginning excavation, grading and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 201, Clearing and Grubbing.

Drainage excavation and rough grading shall be performed simultaneously unless otherwise directed. Drainage

excavation shall be disposed of or placed in the embankment as directed. Roots, stumps and other obstructions in sides and bottom of ditches and channel changes shall be cut to conform to required cross section and grade. No excavated material shall be left within 3 feet of the edge of ditch.

If the contractor places more borrow material than is required and thereby causes a waste of excavation or excess embankment, the amount of such waste or excess will be deducted from the borrow volume as measured in the borrow area by computing the excess or waste plus 15 percent. All borrow areas shall be left in such shape as to permit accurate measurements after excavation beyond the dimensions and elevations established, and no material shall be removed prior to the staking out and cross-sectioning of the site. When necessary to remove fencing, the fencing shall be replaced in as good condition as it was originally. The contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

When required or directed, obliteration of old roadways shall include all grading operations necessary to incorporate the old roadway into the new roadway and surroundings in order to provide a pleasing appearance from the new roadway. Roadway obliteration will be paid for as unclassified excavation.

When the contractor's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archeological significance, the operations shall be temporarily discontinued. The engineer will contact archeological authorities to determine the disposition thereof. When directed, the contractor shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the proper authorities. Such excavation will be measured and paid for as extra work, including an appropriate adjustment in contract time.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable or unstable soil, the engineer may require the contractor to remove the unsuitable or unstable materials by undercutting and backfill to the finished graded section with approved material.

Removed materials, when acceptable, shall be used in the work, unless otherwise directed.

The contractor shall conduct his operations in such a manner that the engineer can make the necessary measurements before the backfill is placed. Undercut will be paid for as unclassified excavation.

203.09 EMBANKMENT CONSTRUCTION OTHER THAN HYDRAULIC. Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes inside or outside the right-of-way when required by the plans; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; the placing and compacting of embankment material in holes, pits and other depressions within the roadway area; and the placing and compacting of embankment material for backfilling structures. Only approved materials shall be used in the construction of embankments and backfills.

The contractor shall be responsible for the stability of all embankments made under the contract until final acceptance of the work and shall bear the expense of replacing any portions which have become displaced due to carelessness or negligent work on the part of the contractor, or to damages resulting from natural causes, such as storms, etc., and not attributable, in the opinion of the engineer, to unavoidable movements of the ground upon which the embankment is made.

When required by the plans or special provisions, the top of the embankment in both cut and fill sections shall be constructed of selected materials which shall be interpreted to mean materials of LDH Designation: TR 423 Classes A-1-a, A-1-b, A-3, A-2-4, A-2-6, A-4 or A-6 with a maximum Liquid Limit of 35 and a maximum Plasticity Index of 15 or as modified by the plans or special provisions.

203.10 CONSTRUCTION METHODS FOR EMBANKMENTS OTHER THAN HYDRAULIC. Rocks, broken concrete or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

When embankments are constructed on a hillside, sloping more than 6:1 from the horizontal, the slop of the ground on which the embankment is to be placed shall be plowed or cut into steps before the fill is placed. Where a new road is to be constructed on an existing road, it shall be plowed

or scarified and broken up full width to a depth of not less than 6 inches, regardless of height of new fill and recompacted as directed.

Unless shown otherwise by the plans or special provisions, where an embankment is to be constructed to a height of 3 feet or less, heavy sod and objectionable vegetable matter shall be removed from the surface upon which the embankment is to be placed and the cleared surface shall be completely broken up by plowing, scarifying or stepping to a depth of approximately 6 inches. This area shall be recompacted to the approximate density of surrounding ground. When height of fill is greater than 3 feet, sod not required to be removed shall be thoroughly disked and recompacted to the approximate density of surrounding ground before construction of embankment.

If embankment material is to be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of or excessive pressure against the structure. Unless otherwise indicated, the fill adjacent to the end bent of a bridge shall not be placed higher than the top of the substructure until the superstructure is in place. When the embankment is to be deposited on both sides of a concrete wall or similar type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure. Backfilling of structures to natural ground shall be performed as outlined in Subsection 203.14.

All excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments, when permitted, may be placed on the side slopes of the nearest fill or berm in a satisfactory manner and shall be placed so as to maintain a distinct shoulder line by keeping all such waste material the specified distance below the finished shoulder. In case it is impossible to dispose of all such material in the manner described, the remainder shall become the property of the contractor and shall be satisfactorily disposed of beyond the limits of the right-of-way.

Roadway embankment of earth material shall be placed in layers or lifts approximately parallel to the finished grade line not exceeding approximately 9 inches thick (loose

measurement). Each lift shall be placed for the full width of the embankment and compacted as specified before the next layer is placed. Suitable spreading equipment shall be used on each lift to obtain reasonably uniform thickness and section prior to compacting. As the compaction of each layer progresses, necessary spreading and manipulating will be required to assure uniform density. Water shall be added or removed, as necessary, to obtain the required density.

When embankments are constructed through or into lakes, streams, swamps or other unstable areas that do not afford a satisfactory foundation for embankments and the unstable material cannot be economically removed, or the area drained, the requirement for placing material in lifts as outlined above may be waived in these areas and the embankment placed by end dump or other approved methods to an elevation where it is determined that normal construction methods can begin. This elevation shall be determined by the engineer during construction. Material placed below this determined elevation shall be compacted according to the applicable requirements of Subsection 203.14. Embankments placed above this determined elevation shall be constructed in approximately 9-inch lifts as specified in the preceding paragraph.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, without crushing, pulverizing or further breaking down the pieces resulting from excavation method, such material may be placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks. Each layer shall be leveled and smoothed with suitable leveling equipment. The lifts shall not be constructed above an elevation 2 feet below the finished subgrade. Rock fills placed in this manner shall be compacted according to applicable requirements of Subsection 203.14. The remaining embankment shall be constructed of approved material placed in layers not exceeding approximately 9 inches in loose thickness and compacted as specified for embankments.

203.11 HYDRAULIC EMBANKMENTS. Hydraulic embankments shall be constructed of acceptable materials dredged and pumped from approved sources, shaped to rea-

sonably conform to the lines, grades and cross sections indicated on the plans.

Unless otherwise provided, the contractor must procure all necessary permits from the proper authorities to operate in waters under their control. He shall also obtain all necessary permits for passage of discharge pipe over private property.

Dredging and other equipment adequate to assure completion of project shall be furnished and shall be subject to approval.

In the event information is shown on the plans indicating the availability of material suitable for hydraulic embankment, it is understood that the Department does not guarantee the depth, extent and character of the material so indicated. Bidders should make, at their own expense, such additional investigations as they consider necessary. No additional compensation will be allowed should it develop that the material is of a different nature from that indicated.

203.12 CONSTRUCTION METHODS FOR HYDRAULIC EMBANKMENTS. No material shall be obtained from sources closer than 500 feet from the toe of the slope of the embankment shown on plans, unless otherwise specifically permitted. Unsatisfactory material shall be removed from the borrow area before embankment material is removed. All muck and unsuitable material shall be removed from the embankment area to the line, grade and section shown on the plans. Any muck or other unsuitable material entrapped or brought to the top of the embankment shall be removed. Placement of material, in the embankment, shall begin at the centerline and then proceed in either or both directions towards the toes of the slopes and the discharge shall always be along and parallel to the centerline, unless otherwise permitted. Method of discharge shall not cause erosion or damage to property of others. Material shall be deposited in such a manner as to maintain a higher elevation at the center. Retaining levees along highways that may cause damage will not be permitted. Operations shall be conducted in such a manner that will insure the completion of the embankment in reasonable conformity with the cross sections shown on plans except that flatter side slopes will be permitted at no cost to the Department. However, if material is deposited on private property, written permis-

sion from the owners must be secured by the contractor. All necessary precautions shall be taken to prevent filling existing streams and waterways. The contractor assumes all responsibility for compression, subsidence, displacement or slides that may take place in the hydraulic fill and no payment will be made for materials outside the limits of the net pay section. Where discharge pipelines cross the surface of an existing highway, they shall be bridged in a satisfactory manner and traffic shall be properly protected by warning signs and/or signals at all times. Any damage done to existing highway facilities due to the contractor's operations shall be repaired by the contractor at his expense.

203.13 CONSTRUCTION OF EMBANKMENT AND TREATMENT OF CUT AREAS WITH DENSITY CONTROL. Unless otherwise provided, all embankments are to be constructed with density control.

In cut areas, for the full width of roadbed, the top 6-inch layer on which fill or base materials is to be placed shall be thoroughly scarified and the moisture content increased or reduced as necessary. This 6-inch layer shall then be compacted to not less than 95 percent of the maximum density. When required by the plans, the top of the embankment in both cut and fill sections shall be constructed of selected material as described in Subsection 203.09 and compacted to not less than 95 percent of maximum density.

All material in embankments requiring density control shall be placed in layers not to exceed 9 inches uncompacted thickness, and shall be compacted to not less than 95 percent of maximum density. At the option of the contractor, approximately the top 2 inches of intermediate layers may be compacted in conjunction with the next succeeding layer. The material used for building this portion of the embankment shall be dried or moistened to be within reasonable limits of optimum moisture before compaction.

Compaction of embankments may be accomplished by any satisfactory method or methods that will obtain the required density unless a specified method is required by the special provisions or plans.

Dumping and rolling areas shall be kept separate and no lift shall be covered by another until density complying with the requirements of this subsection is secured.

Maximum density shall be determined in accordance with

LDH Designation: TR 418 and the in-place density determined by LDH Designation: TR 401 as described in the Department's Testing Procedures Manual.

203.14 COMPACTION OF EMBANKMENTS NOT CONSTRUCTED WITH DENSITY CONTROL. Except for rock fills, sand fills below the water table and the first layer of fills over unstable areas, embankment materials shall be deposited in layers not exceeding approximately 9 inches uncompacted thickness and compacted in such a manner as to result in a satisfactory embankment. Compacting equipment and methods employed for the entire depth of the embankment shall be sufficient to obtain not less than 90 percent of maximum density in the top layer of such embankment.

Embankments constructed of rock fills, sand fills placed in water and in the first layer of fills constructed through or into lakes, streams, swamps and other soft areas shall be constructed and compacted in such a manner as to permit construction of superimposed layers as specified. These materials shall be placed in accordance with Subsection 203.10 and 203.12.

203.15 SUBGRADE. All materials that will not satisfactorily compact shall be removed and replaced with suitable material and the subgrade, for its entire width, shall be brought to line and grade within reasonable limits and compacted to uniform density. Where the subgrade is of a nonuniform compacted nature or where required, it shall be scarified to a depth of not less than 6 inches for its full width and the material spread and compacted to a uniform density.

All submerged roots, stumps or other perishable matter encountered in the preparation of the subgrade shall be removed to a depth of not less than 2 feet below subgrade.

After the subgrade has been prepared as specified above, it shall be maintained in such condition as to drain. If damaged by hauling or handling materials, the subgrade shall be scarified and recompacted to required density. The subgrade shall be in final condition for receiving the base or surface for a distance of at least 500 feet in advance of placing subsequent courses. Subsequent courses shall not be placed until the subgrade has been approved by the engineer.

203.16 METHOD OF MEASUREMENT.

(a) General: Where the contract does not specifically provide a pay item for embankment, the work of embankment construction will be considered incidental to the various classifications and items of excavation.

Water used will not be measured nor paid for but will be considered incidental to the work.

(b) Excavation: Measurement will be made by one or more of the following methods as designated on the plans or the special provisions. However, if no method is specified, Method (2) shall apply.

(1) Contract Quantity Payment: The quantities of excavation for which payment will be made will be those shown in the contract for the various items, provided the project is constructed essentially to the lines and grades shown on the plans.

When the plans have been altered or when disagreement exists between the contractor and the engineer as to the accuracy of the plan quantities in any balance, or the entire project, either party shall have the right to request and cause the quantities involved to be measured in accordance with measured quantities. When the quantities are measured for payment, the original plan cross sections plotted on the plans shall be used as original field cross sections. Additional original cross sections may be interpolated at points where necessary to more accurately determine the quantities.

(2) Measured Quantities: When payment is specified on a volume basis, all accepted excavation and borrow shall be measured in its original position by cross-sectioning the area excavated, which measurements will include slides in unclassified material not attributable to carelessness of the contractor. Volumes will be computed from the cross-section measurements by the average end area method.

Measurements will be made for unsuitable and/or unstable materials actually excavated and removed to obtain proper compaction in cut sections and in foundations for fill sections.

No measurement will be made of the suitable material temporarily removed and replaced to facilitate com-

paction of the material for the full depth shown on the plans.

When it is impractical to measure material by the cross-section method due to the erratic location of isolated deposits, other accepted methods involving three-dimensional measurements may be used.

(3) Vehicular Measurement: When it is specified that an item of excavation is to be measured by vehicular measurement, the material will be measured by the cubic yard in approved hauling vehicles at the point of delivery in accordance with Subsection 109.01.

(4) Net Section Quantities: When specified on the plans or in the special provisions, excavation will be measured by the cubic yard (net section) and shall be computed by the average end area method. The end area shall be the area bounded by (1) the original ground line as established by the original construction cross sections taken after the clearing and grubbing (if required) is complete and (2) the theoretical pay line established by the plans. No allowance will be made for excavation (including stumps) made outside the limits described above, nor for slides, falls and insecure masses.

(c) Embankment: When payment for embankment is specified as a separate bid item, measurements will be made by one of the following methods as designated on the plans or the special provisions. No measurements will be made for any excavation which is used in an embankment when that embankment is specified as a separate pay item.

(1) Net Section Quantities: When specified, embankment will be measured by the cubic yard (net section) and will be computed by the average end area method. The end area shall be the area bounded by (1) the original ground line as established by the original construction cross sections taken after the clearing and grubbing (if required) is complete and (2) the theoretical pay line established by the embankment cross sections shown in the plans. Embankment placed outside the limits described will not be included in the pay quantity.

(2) Measured Quantities: When specified, embank-

ment will be measured by cross-sectioning the embankment constructed. Volumes will be computed from the cross-section measurements by the average end area method.

203.17 BASIS OF PAYMENT. The accepted quantities of excavation and embankment will be paid for at the contract price per unit of measurement for each of the pay items listed below that is included in the bid schedule.

Payment will be made under:

Item No.	Pay Item	Pay Unit
203(1)	Unclassified Excavation	Cubic Yard
203(2)	Drainage Excavation	Cubic Yard
203(3)	Muck Excavation	Cubic Yard
203(4)	Borrow Excavation	Cubic Yard
203(5)	Special Borrow Excavation	Cubic Yard
203(6)	Embankments	Cubic Yard
203(7)	Hydraulic Embankments	Cubic Yard

If soil materials for use in base and/or shoulder construction are specified to be furnished and paid for under bid items other than the earthwork items, or at no direct payment, and the contractor elects to obtain the materials from the same borrow areas used for special borrow excavation, the net volume of such materials, computed from the dimensions shown on the plans plus a shrinkage factor of 15 percent, will be deducted from the borrow pit measurements.

No measurements will be made for excavation for culverts or culvert headwalls, except as provided below.

Whenever the invert of a pipe or box culvert is lowered or relocated so that additional excavation is necessary over and above that required at the original planned location, the additional excavation involved will be paid for at a rate of 3 times the contract unit price for Unclassified Excavation, or Special Borrow Excavation in event Unclassified Excavation is not an item in the contract. In no event, will such additional excavation be paid for if the volume included for each such structure is 10 cubic yards or less.

In the event the invert elevation is raised or relocated so that a lesser amount of excavation than that required at the originally planned location is required, the Department will deduct from the contractor's estimate the value of the decreased quantity of excavation, at the rate of 3 times the

contract unit price of Unclassified Excavation, or Special Borrow Excavation in event Unclassified Excavation is not an item in the contract. If the volume involved for each such structure is 10 cubic yards or less, such deduction will be waived.

The volume involved in each of the above shall be considered as a rectangular solid with a length equal to the length of the pipe or box culvert laid; a width equal to the (1) nominal diameter of the pipe plus 3 feet, or (2) the outside width of the box culvert plus 3 feet and a depth equal to the average change in flow line elevation.

PART III

BASE COURSES

Section 301

Base Course

301.01 DESCRIPTION. This work shall consist of furnishing and placing a base course on a prepared surface in accordance with these specifications, in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the engineer.

The plans or special provisions will usually indicate which base course types or base course classes the contractor may use.

A base course class is defined as a group of selected base course types that are required to meet the design requirements for a specific pavement structure.

If not specified, the base course shall be composed of any of the types of material listed below (except asphaltic concrete base course or multi-layered base courses) at the option of the contractor.

Unless approved in writing by the engineer or specified on the plans or in the special provisions, the same type material shall be used throughout the project.

Soil Cement
Cement Treated Sand Clay Gravel
Cement Treated Shell and Sand
Lime Treated Sand Clay Gravel
Multi-layered Base Course
Sand Clay Gravel (Grade A)
Shell Base Course
Asphaltic Concrete (Type 5)

Multi-layered base course shall consist of (1) one of the stabilized or treated base courses; asphaltic concrete type 5 base course and (2) sufficient unstabilized material of the same type or when specified, suitable materials in accordance with Subsection 301.02 to provide the total thickness of base course sections shown on the plans.

301.02 MATERIALS. Materials shall conform to the

requirements of Subsections of Part IX, Materials, and these specific material requirements.

Portland Cement	901.01
Water	915.01
Emulsified Asphalt (SS-1)	902.03
Cutback Asphalt (MC-30)	902.04
Sand Clay Gravel	903.04(a)
Shell Base Course	903.04(b)
Lime	915.03

(a) Soil for Soil Cement: Soil for soil cement base course shall consist of suitable materials that will stabilize with Portland cement. Suitable materials shall be interpreted to mean selected soils of the LDH Designation: TR 423 Classification Groups, A-1-a, A-1-b, A-2-4, A-2-6, A-3, A-4 and A-6.

Excluded from these suitable materials, regardless of classification, are soils with liquid limits greater than 35, plasticity indices greater than 15 and organic contents greater than 5 percent. Soils with silt contents above 79 percent may be used if tested and approved prior to use.

The contractor shall obtain the material, which is to be stabilized with cement, from outside the limits of the right-of-way, except as provided in Subsection 104.05.

All soils to be stabilized will be tested by the Laboratory to determine their acceptability and the percent of cement, by volume, as determined by LDH Designation: TR 432. Soils that have been furnished by the contractor and placed in the embankment and which are found not suitable for stabilization shall be removed and replaced at no cost to the Department. If the contractor elects to stockpile the material, or to use a pugmill for mixing, samples of material from the stockpiles will be tested prior to use.

(b) Soils for Multi-layer Base Course: When required, the soil layer for multi-layered base course shall consist of suitable materials. Suitable materials shall be interpreted to mean selected soils of the LDH Designation: TR 423 classification groups A-1-a, A-1-b, A-2-4, A-2-6, A-3, A-4 and A-6 with a maximum liquid limit of 35 and a maximum plasticity index of 15.

(c) Lime Treated Sand Clay Gravel: In the event either

Grade "A" or Grade "B" sand clay gravel is to be lime treated, the maximum allowable liquid limit is waived. The plastic index shall be within a range of 6 to 20.

(d) Portland Cement and Lime: Unless otherwise specified Portland cement may be Type I or Type II. The quantity of these materials used shall be supported by invoices.

(e) Asphaltic Concrete (Type 5-A or 5-B): The material requirements for asphaltic concrete type 5 base course shall be as described in Sections 501 and 502 and in the project specifications.

(f) The materials furnished shall be of such quality that, when properly proportioned and mixed, a satisfactory base will be produced.

301.03 EQUIPMENT. All necessary equipment shall be on the project, in satisfactory working condition, and shall have been approved before construction begins. The necessary equipment used for asphaltic concrete base course construction shall be in accordance with Sections 501 and 502 and in the project specifications.

If a mixing machine is used, it shall be an approved mechanical mixer that will satisfactorily mix the materials and shall be capable of producing a satisfactory product. The machine shall be equipped with a watering device so water can be introduced in the proportion required to perform the moist mixing operation.

When a pugmill is used, it shall be of an approved type capable of effectively mixing all required materials in the approximate proportions designated.

Provisions shall be made by the contractor for furnishing sufficient water at the work site. Water vehicles or other approved sprinkling devices shall be provided.

Spreading equipment shall be of such types as to adequately spread the material.

Rollers or other equipment used to compact the base course may be any approved type or combination of types that will obtain the required density.

CONSTRUCTION REQUIREMENTS

GENERAL NOTE: The asphaltic concrete type 5 base course construction requirements are in accordance with

Sections 501 and 502, the project specifications and the requirements herein.

The soil layer for multi-layered base course shall be constructed in accordance with Section 203 and shall meet the density requirements as stated in Subsection 301.11.

301.04 SUBGRADE. The base course materials shall be placed on a subgrade prepared in accordance with Section 203, or if specifically provided, in accordance with Section 302.

301.05 MIXING.

(a) Soil Cement: Materials meeting these specifications shall be combined with Portland cement and water by travel plant, central plant or other approved methods and shaped and formed on the approved subgrade. Any additional water needed to bring the moisture content of the mixture to within the tolerance specified herein shall be introduced and uniformly mixed throughout the entire mass by approved methods. If prior to spreading the cement the moisture content of the soil is excessive, the soil shall be scarified and pulverized or otherwise manipulated until the moisture content is such that the tolerance specified herein for the mixture can be met.

The percentage of cement shall be determined in accordance with LDH Designation: TR 432 prior to mixing. The method of mixing employed shall be such that the actual amount of cement used and incorporated can be readily determined.

When central plant mixing is used, a reduction of 1 percent in the volume of cement required, if approved by the Laboratory, will be permitted.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with the LDH Designation: TR 418. The percentage of moisture in the mixture, on the basis of dry weight, shall not vary from the specified optimum percentage of moisture by more than ±2 percent at the time of compaction.

A minimum of 70 percent of the pulverized soil, as determined by LDH Designation: TR 431, shall pass the No. 4 sieve after mixing.

(b) Cement Treated Sand Clay Gravel: Materials meeting these specifications shall be combined with Portland

cement and water by travel plant, central plant or other approved methods and shaped and formed on the approved subgrade. Any additional water needed to bring the moisture content of the mixture to within the tolerance specified herein shall be introduced and mixed throughout the entire mass by means of the mixer. If prior to spreading the cement the moisture content of the material is excessive, the material shall be scarified and pulverized or otherwise manipulated until the moisture content is such that the tolerance specified herein for the mixture can be met.

Unless otherwise specified the percentage of cement required shall be 6 percent by volume, and the method of mixing employed shall be such that the actual amount of cement used and incorporated can be readily determined. When central plant mixing is used, a minus variation of ½ percent in the volume of cement required, if approved by the Laboratory will be permitted.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with LDH Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than ±2 percent at the time of compaction.

(c) Cement Treated Shell and Sand: Materials meeting these specifications shall be combined with Portland cement and water by travel plant, central plant or other approved methods and shaped and formed on the approved subgrade. Any additional water needed to bring the moisture content of the mixture to within the tolerance specified herein shall be introduced and mixed throughout the entire mass by means of the mixer. If prior to spreading the cement the moisture content of the material is excessive, the material shall be scarified and pulverized or otherwise manipulated until the moisture content is such that the tolerance specified herein for the mixture can be met.

The percentage of cement required for cement treated shell and sand will be 4 percent by volume unless otherwise specified on the plans or project specifications and the method of mixing employed shall be such that the actual amount of cement used and incorporated can be

readily determined. When central plant mixing is used, a minus variation of ½ percent in the volume of cement required, if approved by the Laboratory will be permitted.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with the LDH Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than ±2 percent at the time of compaction.

(d) Lime Treated Sand Clay Gravel: Materials meeting these specifications shall be combined with hydrated lime and water by travel plant, central plant or other approved methods and shaped and formed on the approved subgrade. Any additional water needed to bring the moisture content of the mixture to within the tolerance specified herein shall be introduced and mixed throughout the entire mass by means of the mixer. If prior to spreading the lime the moisture content of the material is excessive, the material shall be scarified and pulverized or otherwise manipulated until the moisture content is such that the tolerance specified herein for the mixture can be met.

The percentage of lime required will be 10 percent by volume and the method of mixing employed shall be such that the actual amount of lime used and incorporated can be readily determined by the engineer.

The lime may be furnished in bags or bulk and distributed either in powder form or in a slurry in such manner as to assure obtaining the required proportions.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with LDH Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than ±2 percent at the time of compaction.

(e) Sand Clay Gravel (Grade A): The sand clay gravel shall be uniformly mixed. If mixed prior to placement, it shall be mixed in an approved pugmill or on a mixing table. Materials shall be wet during mixing operations, if necessary, for proper blending. Mixing will not be required if the material is a natural mix and uniformly blended, meeting all specification requirements.

Samples for acceptance testing shall be secured after the materials have been thoroughly mixed. Materials failing to meet specifications shall be rejected until the necessary corrective measures are taken to assure compliance.

(f) Shell Base Course: The shell base shall be uniformly mixed. If mixed prior to placement, it shall be mixed in an approved pugmill or on a mixing table. Materials shall be wet during mixing operations, if necessary, for proper blending. Mixing will not be required if the material is a natural mix meeting all specification requirements. The sand and shell shall be tested and approved prior to mixing. Proper proportioning of the approved materials shall be as directed. Materials failing to meet specifications shall be rejected until the necessary corrective measures are taken to assure compliance.

301.06 TRANSPORTING AND PLACING ON SUBGRADE. Transportation and spreading methods shall be such that minimum damage is done to the subgrade. The base course shall be placed in one or more approximately equal layers as necessary and as directed in order to obtain the required compaction. The compacted thickness of each layer shall in no event exceed 9 inches. It shall be the contractor's responsibility to place and spread sufficient material to obtain required width and compacted thickness within the tolerance set forth in Subsection 301.11. Every effort shall be made to prevent subgrade materials from contaminating the base course. Such contamination will require retesting and correction of deficiencies.

Shoulder base course materials shall not be placed, spread or mixed on Portland cement concrete or asphaltic concrete pavements, and shoulder base course construction operations shall be conducted in such manner that pavement surfaces, edges and joints are not damaged.

301.07 COMPACTING AND FINISHING.

(a) Soil Cement: The mixture shall be uniformly compacted immediately upon completion of mixing or after placement.

The number of rollers used shall be sufficient to uniformly compact the base course for the specified width and depth and time.

The surface shall be kept uniformly moist at all times during compaction and final finishing.

A rack or harrow shall be used to loosen surface material during final rolling.

Final blading and finishing shall be accomplished by a cutting operation and all loose material wasted on the shoulders. No filling with loose material shall be allowed.

Should soils containing 65 percent silt or more, classified as silty loams or silts and having plasticity indices of 5 or less, be used for stabilization, compaction shall be by sheepsfoot rolling followed by light (not to exceed 10 tons) pneumatic rolling.

Compaction shall continue until the entire depth of each lift of the stabilized base course has met the requirements of Subsection 301.11 when tested in accordance with LDH Designation: TR 401.

At all places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted to required density using hand tampers, pneumatically operated mechanical tampers, vibrating compactors or other approved devices that will obtain uniform compaction to required density without damage to the adjacent structures.

When the compaction of a base course has been completed, the thickness, width and density shall be checked. Any deviation from the accepted tolerances, as set forth elsewhere herein, shall be corrected at the expense of the contractor.

All compaction shall be completed within 3 hours after initial mixing of cement with base course materials. Final finishing shall be done as directed. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, undulations, laminations, loose material or laitance.

(b) Cement Treated Sand Clay Gravel: The compaction and finishing requirements shall be the same as those specified for soil cement.

(c) Cement Treated Shell: The compaction and finishing requirements for this material shall be the same as those specified for soil cement except that sheepsfoot rollers will be required for primary compaction of the base course.

(d) Lime Treated Sand Clay Gravel: The compaction

and finishing requirements for this material shall be the same as those specified for soil cement above, except that the maximum period for completion of all compaction and finishing operations shall be 72 hours after initial mixing of lime with sand clay gravel. At the completion of the mixing operation, the surface shall be sealed to maintain moisture and section.

(e) Multi-layered Base Course: The compaction and finishing requirements for this material shall be as follows:

(1) The cement stabilized or treated layer shall conform to the requirements specified for soil cement.

(2) The remaining portion of the base course shall meet the requirements specified for untreated sand clay gravel (Grade A), shell base course, or lime treated sand clay gravel, as the case may be, or if the remaining portion is soil, the applicable requirements of Section 203.

(f) Sand Clay Gravel (Grade A): Following the placing, spreading and shaping of the base course material, it shall be brought to the moisture content required for compaction to the required density. Optimum moisture and maximum density shall be determined in the Laboratory in accordance with LDH Designation: TR 418. The density of the material in place on the roadway shall be determined in accordance with LDH Designation: TR 401. Any waves or irregularities that develop under rolling shall be corrected by scarifying and adding or removing material until the surface presents a smooth appearance. Between rollings, the surface shall be machined as necessary. Machining, watering and rolling shall continue until the material is compacted to 100 percent of maximum density for full depth of the base course. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, depressions or loose material.

(g) Shell Base Course: The compaction and finishing requirements for this material shall be the same as those listed for sand clay gravel (Grade A). Sheepsfoot rollers will be required for primary compaction of the base course.

301.08 PROTECTION AND CURING.

(a) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Shell and Sand, Lime Treated Sand Clay

Gravel and Multi-layered Base Course: Upon completion of smooth rolling of the final lift, the base shall be kept protected against rapid drying for a period of 72 hours by applying an asphaltic curing membrane consisting of either emulsified asphalt Grade SS-1 or cutback asphalt MC-30 at the minimum rate of 0.10 gallon per square yard. Any additional applications required shall be placed by the contractor at his expense.

The SS-1 diluted with water or MC-30 diluted with kerosene, as required, shall be applied so as to provide a continuous seal over the base course. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72-hour curing period.

All extraneous material which has collected on the completed base shall be removed before additional application of asphaltic curing membrane. Unless specifically permitted, traffic shall not be allowed on the completed base course during the curing period, except equipment used in construction of Portland cement concrete pavement. When the base course is to be covered by Portland cement concrete pavement, the pavement slab may be constructed at any time following placement of the asphaltic curing membrane and completion of all tests and measurements.

In the event traffic is permitted to use the completed base course subsequent to the 72-hour curing period and prior to the construction of the surface course, the base shall be further protected by such additional applications as the engineer may deem necessary. The base course shall be cleaned and an additional application of asphaltic curing membrane applied (if necessary) before the surface is placed.

Should the original base course material consist of soils containing 65 percent silt or more, classified as silty loams or silts and having plasticity indices of 5 or less, the surfacing shall be constructed upon the base course immediately after the 72-hour curing period.

In any event, if traffic is permitted to use the completed base course prior to the construction of the surface course, any damages thereto caused by traffic shall be properly corrected by the contractor without additional compensation.

(b) Sand Clay Gravel (Grade A) and Shell Base Course: The completed base course will be opened to traffic when required by the special provisions or as directed. Any weak spots that may develop shall be satisfactorily corrected and the base shall be kept free from holes, waves and undulations. The base course shall be kept reasonably true to profile, grade and cross section. The base course shall not be allowed to become dusty with consequent loss of binder. The surface shall be kept moist, as directed, to avoid loosening of surface material. Water used in processing base course materiails shall be included in price bid on Base Course. The base course shall be primed in accordance with Section 504.

301.09 MAINTENANCE. The contractor shall maintain and protect the completed base course against both the public traffic and the traffic caused by his own equipment and employees. In the event there is any evidence of deterioration of the base course, the engineer may require the contractor to construct the surfacing at the conclusion of the curing period. The contractor shall conduct his operations in such a manner as not to impair the existing drainage systems.

301.10 WEATHER LIMITATIONS.

Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Shell and Sand, Lime Treated Sand Clay Gravel and Multi-layered Base Course: Mixing will not be permitted when the base course material or subgrade is frozen. Mixing shall be discontinued when a descending air temperature at the project site in the shade and away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

301.11 REQUIREMENTS AND TOLERANCES FOR ACCEPTANCE. The completed base course shall be checked for determining acceptance as provided herein. The sampling schedule contained herein shall not prevent the project engineer from taking such adidtional tests as may be required for adequate control of the work in progress but such tests shall be independent of the tests taken herein for acceptance.

(a) Density Requirements: Upon completion of compaction operations, the density of the base course shall be

determined in accordance with LDH Designation: TR 401. One density test shall be taken per 500 linear feet per roadway. Upon determining that any density test is below the requirements, 2 additional tests shall be taken within 5 feet of the location of the failing test and the average of the 3 tests shall be used as the value for that test location.

The density requirements as based on LDH Designation: TR 418 shall be as follows:

Base Course Type	LDH Designation	Compaction Min.
Soil Cement	TR 418 (B)	95%
Cement Treated SCG	TR 418 (F)	95%
Cement Treated Shell & Sand	TR 418 (D)	95%
Lime Treated SCG	TR 418 (F)	100%
Multi-layered	See Note	
Sand Clay Gravel (Grade A)	TR 418 (E)	100%
Shell	TR 418 (C)	100%
Soil for Multi-layered	TR 418 (A)	95%
Asphaltic Concrete (Type 5)	See Note	

NOTE: Multi-layered base courses except soils shall meet the density requirements given in the preceding table for the top or the predominant layer. The bottom layer shall be compacted to the satisfaction of the engineer to such a density that the requirements of the top layer can be met. When soil is used as a layer of multi-layered base courses, the compaction requirements shall be as given in the preceding table.

The density requirements for asphaltic concrete (Type 5) base course shall be in accordance with Subsection 502.09. The minimum density shall be shown in Table VI of Subsection 502.09.

(b) Soil Cement, Cement Treated Sand Clay Gravel, Cement Treated Shell and Sand and that Portion of Multi-layered Bases using one of these types: In the event that a test representing 500 linear feet of roadway does not meet the required 95 percent compaction, but is not below 93 percent, then this section is acceptable provided the average of this test, the 2 tests of the 2 preceding sections and the 2 tests of the 2 succeeding sections meet the 95 percent requirement. In computing this average percent compaction of the five sections, any final test

value in excess of 100 percent compaction shall be considered as 100 percent.

In the event that the average percent of compaction does not meet the 95 percent requirement, but is not below 93 percent and no final test value used to compute the average is below 90 percent, then this section may remain in place at a penalty of 25 percent reduction in the contract unit price for the quantity involved.

In the event that the average percent is below 93 percent but not below 90 percent and no final test value used to compute the average is below 90 percent, then this section may remain in place at a penalty of 50 percent reduction in the contract unit price for the quantity involved.

Any section not meeting these tolerances shall be reconstructed in accordance with these specifications at the contractor's expense.

(c) Lime Treated Sand Clay Gravel, Sand Clay Gravel (Grade A), Shell Base and Soil for Multi-layered Base Course: In the event any test value is less than that required in the preceding table, compaction shall continue until the specified density is obtained.

(d) Thickness and Width Requirements: The thickness and width of the completed base course shall be determined in accordance with LDH Designation: TR 602. The thickness of the base course shall not vary in excess of the following tolerances for any individual test.

Plan Thickness	(All Base Courses) Under Thickness	(Stabilized & Treated Base Courses) Over Thickness
6 inches & under	½ inch	1½ inch
Over 6 inches & less than 8 inches	¾ inch	1½ inch
8 inches & over	1 inch	1½ inch

When stabilized or treated material is pugmill mixed, over thickness shall be waived at no additional cost to the Department.

The thickness and surface requirements and tolerances for asphaltic concrete (Type 5) base course shall be in accordance with Subsection 501.18.

Variations from plan width measured along the surface of the base course shall not be in excess of ±6 inches.

For shoulder base construction variations from plan width shall not be in excess of ±3 inches on the outside edge. When stabilized material or lime or cement treated material is pugmill mixed, over widths shall be waived at no additional cost to the Department.

Whenever an individual test is found to exceed the allowable tolerances, 2 additional tests shall be taken within 5 feet of the location of the failing test and the average of the 3 tests shall be used as the value for that location. Areas showing deficiencies beyond the tolerances outlined herein shall be corrected as follows:

(1) Sand Clay Gravel (Grade A) and Shell Base Course—shall be corrected by scarifying, reshaping and recompacting or by scarifying, adding additional materials and recompacting to bring deficient area to plan dimensions at no additional cost to the Department.

(2) Soil Cement, Cement Treated Sand Clay Gravel, Lime Treated Sand Clay Gravel, Cement Treated Shell and sand and Multi-layered Base Course—shall be replaced at no additional cost to the Department. Deficient areas may be replaced with (1) stabilized or treated material meeting these specifications, (2) Asphaltic Concrete meeting LDH specifications, or (3) Portland Cement Concrete (4 bags of cement per cu. yd.) designed by the Laboratory for this purpose.

(e) Average Minimum Thickness (2,000 Ft. Section): The average thickness of the completed base for a 2,000 foot section shall not be less than ½ inch of the thickness shown on the plans. In computing the average thickness of each 2,000 foot section, any thickness in excess of one inch of the thickness shown on the plans shall be considered as one inch.

Sections shown deficiencies beyond the tolerances outlined above shall be penalized, corrected or removed as follows:

Deficiency (less than Plan Thickness)	Disposition (for Pay Purposes)
½ inch to ¾ inch	75% of Contract Unit Price
¾ inch to 1 inch	50% of Contract Unit Price
Over 1 inch	(1) Correct or (2) Remove

(1) Sand Clay Gravel (Grade A) and Shell Base

Course: Deficient areas within a section shall be corrected by adding, scarifying and compacting additional materials as required to bring deficient area to plan thickness at no additional cost to the Department.

(2) Soil Cement, Cement Treated Sand Clay Gravel, Lime Treated Sand Clay Gravel, Cement Treated Shell and sand and Multi-layered Base Course: Deficient areas within a section shall be replaced to full depth of base course at no cost to the Department by replacing with (1) stabilized or treated material meeting these specifications, (2) Asphalt Concrete meeting specifications, or (3) Portland Cement Concrete (4 bags of cement per cu. yd.) designed by the Laboratory for this purpose.

(f) Final Acceptance by Dimensions: Final acceptance will be based on measurements taken in accordance with LDH Designation: TR 602. Required tests shall be taken within 7 days after completion. Subsequent courses shall not be placed until the base course has hardened sufficiently for adequate thickness and width determinations.

Multi-layered Base Course shall meet the following dimensional requirements:

The combined depth and width of the two components shall meet the thickness and width requirements of aggregate base courses (nonstabilized or untreated).

The stabilized or treated portion of this base course shall meet the width and depth requirements specified for stabilized or treated base course including the average minimum thickness requirements.

Any penalty, disposition or correction necessary in multi-layered base course construction shall be applied to the entire depth of the base course for the area found deficient.

301.12 SHOULDER CONSTRUCTION WITH STABILIZED OR TREATED BASE. When specified on the plans, aggregate and soil materials required on the shoulders in conjunction with stabilized or treated base shall be constructed to the depths shown on the plans and shall meet the requirements of Sections 203 and 401. Payment will be made under Section 301, if specified on the plans.

301.13 METHOD OF MEASUREMENT. The base course, completed and accepted, will be measured by the

cubic yard (net section) as indicated on the plans. Measurement will be based on the typical sections shown on the plans and the length will be measured horizontally along the center line of each roadway. Base course for turnouts, ramps and other irregular sections, if required on the plans, will be the calculated volume as constructed and determined by the engineer.

Shoulder base course when shown on the plans to be paid for separately from the main base course, will be measured by the cubic yard (net section) from dimensions shown on the plans. The length for payment, of the completed shoulders, will be the horizontal measurements taken along the edge of the pavement.

301.14 BASIS OF PAYMENT.

(a) The base course other than asphaltic concrete (Type 5) base course, completed and accepted, will be paid for at the contract unit price per cubic yard (net section), adjusted as required under Subsection 301.11.

All materials including Portland cement, lime, water and the furnishing and placing of emulsified asphalt, cutback asphalt or bituminous prime coat as required, shall be included in the payment for this item.

In the event the emulsified asphalt, cutback asphalt or bituminous prime coat does not meet specification requirements, adjustments in price will be made in accordance with the appropriate tables of Section 902.

(b) The asphaltic concrete (Type 5) base course, complete and accepted, will be paid for at the contract unit price per cubic yard (net section), adjusted on a lot basis for Marshall Stability and roadway density in accordance with Subsections 502.04 and 502.09, the thickness deficiency chart of Subsection 301.11 and in accordance with the following.

(1) Adjustment for Stability: The mix shall be accepted on the basis of the average of four, three, two or one Marshall Stability test results, and the payment per unit price shall be made as outlined in Schedule No. 1-A, 1-B, 1-C or 1-D respectively for the lot in accordance with Subsection 502.12.

(2) Adjustment for Roadway Density: For roadway density, the payment per unit price shall be adjusted

as in Schedule No. 2 for the average of five samples in a lot in accordance with Subsection 502.12.

(3) Adjustment for Thickness Deficiency: For thickness deficiency, the payment per unit price shall be adjusted in accordance with Subsection 301.11 on a lot basis.

(4) Final Adjustment in Unit Price Per Lot: The lower percent of contract price shall be used for final adjustment in unit prices for mixes deficient in Marshall Stability, roadway density and thickness.

(5) Asphalt Cement: In addition to the price adjustments for the mix as stated above, if the asphalt cement furnished does not conform to the specifications, then the final test results for asphalt cement will be applied to Schedule 1 of Section 902 for Bituminous Materials for price adjustments, and adjustments in unit price will be made as specified. If test results are such that a penalty would result from more than one test value, only the price adjustment for the greatest reduction will apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
301(1)	Base Course	Cubic Yard

Section 302

Scarifying and Compacting Roadbed

302.01 DESCRIPTION. This work shall consist of scarifying, shaping and compacting an existing roadbed to form a foundation or subbase for the base course material, in accordance with these specifications, and in reasonably close conformity with the lines, grades, depth and cross section shown on the plans or established by the engineer.

302.02 CONSTRUCTION REQUIREMENTS. When new base course material is to be placed on an existing roadbed, the contractor will be required to scarify the existing roadbed, for its full width, to a minimum depth of 6 inches and shape to the approximate section shown on the plans. The scarified and shaped surface shall be machined, watered or dried if necessary, and compacted to a minimum of 95 percent of maximum density as determined by LDH Designations: TR 401 and TR 418.

302.03 CONSTRUCTION LIMITATIONS. The work of scarifying roadbed shall not be performed in excess of one mile in advance of compacting the roadbed.

302.04 METHOD OF MEASUREMENT. Scarifying and compacting roadbed shall be measured horizontally by the mile along the centerline of the roadbed.

302.05 BASIS OF PAYMENT. The accepted quantity of scarifying and compacting roadbed shall be paid for at the contract unit price per mile.

Payment will be made under:

Item No.	Pay Item	Pay Unit
302(1)	Scarifying and Compacting Roadbed	Mile

Section 303

Cement Stabilized Base Course

303.01 DESCRIPTION. This work shall consist of scarifying, pulverizing, blending, shaping and stabilizing existing roadbed material with Portland cement in accordance with these specifications, in reasonably close conformity with the lines, grades, thickness and sections shown on the plans or established by the engineer.

This cement stabilization shall be primarily for existing roadbed materials; however, it shall include all selected materials furnished and placed on the roadbed under other pay items for the purpose of developing the required section in areas designated by the engineer or indicated in the plans or special provisions.

For bid purposes, the estimated rate of Portland cement required for stabilization is 10 percent by volume; however, the actual rate of Portland cement to be used for stabilization will be determined by the Laboratory. In the event the actual rate of cement differs from the estimated rate, the Department will make an adjustment to compensate for this difference, as specified hereinafter under "Basis of Payment."

303.02 MATERIALS. Materials shall conform to the requirements of the following Section or Subsections of Part IX, Materials.

Portland Cement	901
Water	915.01
Emulsified Asphalt (SS-1)	902.03
Cutback Asphalt (MC-30)	902.04

303.03 EQUIPMENT. All necessary equipment to be used in completing this item will have been approved prior to use.

The mixing machine used shall be an approved mechanical mixer that will satisfactorily mix the materials and shall be capable of producing a satisfactory product. The machine shall be equipped with a watering device so that water can be introduced in the proportion required to per-

form the moist mixing operation. Blade mixers or discs will not be permitted.

Provisions shall be made by the contractor for furnishing sufficient water at the work site. Water vehicles or other approved sprinkling devices shall be provided.

Spreading equipment shall be of such weight and type as to adequately spread the material.

Rollers or other equipment used to compact the base may be any approved type or combination of types that will obtain the required density.

CONSTRUCTION REQUIREMENTS

303.04 PREPARATION OF ROADBED. The contractor shall scarify and pulverize the materials to be stabilized for the full width and depth of the cement stabilized base course indicated on the plans or in the special provisions. In the event the existing roadway has a bituminous surfacing, the bituminous surfacing shall be pulverized and blended so as to form an intimate mixture with the materials below the surfacing.

Any of the surfacing materials or base materials used in patching which cannot be pulverized sufficiently to form an intimate mixture with the material below to the satisfaction of the engineer will be removed from the roadway and disposed of as directed by the engineer, all at no cost to the Department.

Samples for testing will be obtained after the materials including special borrow have been thoroughly pulverized and blended. Materials failing to meet specifications shall not be stabilized until the necessary corrective measures have been taken to assure compliance.

After the roadbed has been prepared as specified above, the contractor shall shape the roadbed to the required section and uniformly compact the roadbed material to the satisfaction of the engineer.

303.05 MIXING. After the roadbed material to be stabilized has been prepared to the satisfaction of the engineer, Portland cement shall be uniformly spread and mixed with the material and shaped to the section shown on the plans.

Prior to mixing, the percent of cement to be used for stabilization will be determined by the Laboratory in ac-

cordance with LDH Designation: TR 432 and the method of mixing used shall be such that the actual amount of cement incorporated can be accurately and readily determined.

Water shall be added as needed by means of the mixer and shall be uniformly incorporated in the mixture in the amounts required to attain the optimum moisture content specified for the mixture.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with the LDH Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than ±2 percent at the time of compaction.

303.06 COMPACTING AND FINISHING. The mixture shall be uniformly compacted immediately upon completion of mixing operations. The rate of operation and the number of rollers used shall be sufficient to uniformly compact the base course for the specified width and depth within 3 hours after the initial mixing of cement with base course material.

Compaction shall continue until the entire depth of each lift of the stabilized base has met the requirements set forth in Subsection 303.10 when tested in accordance with LDH Designation: TR 401.

At all places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted to required density using hand tampers, pneumatically operated mechanical tampers, vibrating compactors or any other approved device that will obtain uniform compaction to required density without damage to the adjacent structures.

When the compaction of the base course has been completed, the width and depth shall be checked. Any deviation from the accepted tolerances, as set forth in Subsection 303.10, shall be corrected at the expense of the contractor.

All compaction shall be completed within 3 hours of the first application of cement to the base course material. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, undulations, laminations, loose material or laitance.

303.07 PROTECTION AND CURING. Upon completion of smooth rolling of the final lift, the base shall be kept

protected against rapid drying for a period of 72 hours by applying an asphaltic curing membrane consisting of either emulsified asphalt Grade SS-1 or cutback asphalt MC-30 at the minimum rate of 0.10 gallon per square yard.

Any additional applications required as hereinafter set forth shall be placed by the contractor at his expense.

The SS-1 diluted with water, or MC-30 diluted with kerosene, as required, shall be applied so as to provide a continuous seal over the base. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72 hour curing period. Equipment or traffic shall not be allowed on the completed base during the curing period, unless specifically permitted by the engineer.

In the event traffic is permitted to use the completed base subsequent to the 72 hour curing period and prior to the construction of the surface course, the base shall be further protected by such additional applications of the curing compound as the engineer may deem necessary and as specified above.

In any event, if traffic is permitted to use the completed base prior to the construction of the surface course, any damages thereto caused by traffic shall be properly corrected without additional compensation.

303.08 MAINTENANCE. The contractor shall maintain and protect the completed base course against both the public traffic and the traffic caused by his own employees. The contractor shall conduct his operations so as to not impair the existing drainage. When berms of earth are placed along the shoulders, proper provision shall be made for surface drainage.

303.09 WEATHER LIMITATIONS. Mixing will not be permitted when the base course material or subgrade is frozen. Mixing shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

303.10 REQUIREMENTS AND TOLERANCES FOR ACCEPTANCE. The completed base course will be checked for determining acceptance as provided herein. The sampling

schedule contained herein shall not prevent the engineer from taking such additional tests as may be required for adequate control of the work in progress but such tests shall be independent of the tests as provided herein for acceptance..

(a) Density Requirements: Upon completion of compaction operations, the density of the completed base course will be determined in accordance with LDH Designation: TR 401. A minimum of one density test will be taken per 500 linear feet per roadway. Upon determining that any density test is below the requirements, two additional tests will be taken within 5 feet of the location of the failing test and the average of the three tests will be used as the value for that test location.

The density requirements as based on LDH Designation: TR 418 will be 95 percent of maximum density.

In the event that a test representing 500 linear feet of roadway does not meet the required 95 percent compaction, but is not below 93 percent, then this section is acceptable provided the average of this test, the 2 tests of the 2 preceding sections and the 2 tests of the 2 succeeding sections meet the 95 percent requirement. In computing this average percent compaction, any test value in excess of 100 percent compaction shall be considered as 100 percent.

In the event that the average percent of compaction does not meet the 95 percent requirement, but is not below 93 percent and no test value used to compute the average is below 90 percent, then this section may remain in place at a penalty of 25 percent reduction in the contract unit price for the quantity involved.

In the event that the average percent compaction is below 93 percent, but not below 90 percent and no test value used to compute the average is below 90 percent, then this section may remain in place at a penalty of 50 percent reduction in the contract unit price for the quantity involved.

Any section not meeting these tolerances shall be reconstructed in accordance with these specifications at the contractor's expense.

(b) Thickness and Width Requirements: The thickness

and width of the completed base course shall be determined in accordance with LDH Designation: TR 602.

Individual Tests: The thickness of the base course shall not vary in excess of the following tolerances for any individual test.

Plan Thickness	Under Thickness	Over Thickness
6 inches and under	½ inch	1½ inch
Over 6 inches and less than 8 inches	¾ inch	1½ inch
8 inches and over	1 inch	1½ inch

Variations from plan width measured along the surface of the base course shall not be in excess of ±6 inches.

Whenever an individual test is found to exceed the allowable tolerances, 2 additional tests shall be taken within five feet of the location of the failing test and the average of the 3 tests shall be used as the value for that location.

Areas showing deficiencies beyond the tolerances outlined above shall be replaced or otherwise corrected at no additional cost to the Department by one of the following methods.

(1) Replace with stabilized material meeting these specifications (entire depth).

(2) Replace with asphaltic concrete meeting LDH specifications (entire depth).

(3) Replace with Portland cement concrete (4 bags of cement per cubic yard) designed by the Central Testing Laboratory for this purpose (entire depth).

Final Acceptance for Dimensions: Final acceptance will be based on measurements taken in accordance with LDH Designation: TR 602. Required tests shall be taken within 7 days after completion. Subsequent courses shall not be placed until the base course had hardened sufficiently for adequate thickness and width determinations.

303.11 METHOD OF MEASUREMENT. Cement stabilized base course will be measured by the square yard. The width for measurement will be that shown on the plans. The length will be the actual centerline length measured horizontally along the centerline of each roadway. Base course

for turnouts, ramps and other irregular sections will be the calculated volume as constructed, determined by the engineer.

303.12 BASIS OF PAYMENT. The accepted quantity of cement stabilized base course, measured as provided above, will be paid for at the contract unit price per square yard. This price and payment shall constitute full compensation for roadbed preparation and pulverization; for furnishing all materials, except selected materials, including Portland cement, water and emulsified asphalt or cutback asphalt for curing, as required; and for performance of all other operations required to complete the item. Selected materials will be paid for under other items.

In the event the emulsified asphalt or cutback asphalt does not meet specification requirements, adjustments in price will be made in accordance with the appropriate tables of Section 902.

In the event the actual rate of cement required differs from the estimated rate, the Department will make an adjustment to compensate for this difference at the rate of $4.50 per barrel of cement regardless of whether the actual rate is greater than or less than the estimated rate. If the actual rate is greater than the estimated rate, the Department will pay the contractor $4.50 for each barrel of cement furnished in excess of the number of barrels required at 10 percent; however should the actual rate be less than the estimated rate, the Department will determine the difference between the estimated quantity and the actual quantity used and deduct $4.50 per barrel for the quantity shown by the difference.

Payment will be made under:

Item No.	Pay Item	Pay Unit
303(1)	Cement Stabilized Base Course	Square Yard

PART IV

Surface Courses

Section 401

Aggregate Type Surface Course

401.01 DESCRIPTION. This work shall consist of constructing an aggregate type surface course for roadway, shoulders or ramps on a prepared subgrade in accordance with these specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical sections shown on the plans or established by the engineer.

401.02 TYPES AND MATERIALS. Unless otherwise specified, aggregate type surface course shall, at the option of the contractor, be washed gravel with binder, crushed stone with binder, sand clay gravel (Grade A) or shell surface course. Approximately 60 percent washed gravel or crushed stone shall be mixed with 40 percent binder.

The material shall meet the requirements specified in the following subsection of Part IX, Materials, listed below.

Washed gravel	903.05(a)
Crushed stone	903.05(b)
Binder	903.05(c)
Sand clay gravel	903.05(d)
Shell surface course	903.05(e)

The material furnished shall be of such quality that, when properly proportioned and mixed, a satisfactory surface course will be produced.

CONSTRUCTION REQUIREMENTS

401.03 SUBGRADE. The subgrade shall be prepared as provided in Section 203 and shall be approved before any surfacing material is placed.

401.04 PLACING MATERIAL. The material shall be deposited directly on the subgrade from vehicles used for hauling or from spreading equipment. In shoulder construction, material shall not be deposited on the finished pavement. The contractor shall be responsible for placing the required amount of material to obtain the required typical section. The material shall be spread over the entire subgrade when and as directed and in accordance with required typical sec-

tion. No surface course shall be placed on a muddy or rutted subgrade.

Shoulder surfacing materials shall not be placed, spread or mixed on Portland cement concrete or asphaltic concrete pavements, and shoulder aggregate surfacing operations shall be conducted in such manner that pavement surfaces, edges and joints are not damaged.

401.05 MIXING. When the surface course consists of a combination of different materials, the contractor will be required to thoroughly mix the material by disking, harrowing, blading or other approved methods.

401.06 SHAPING AND COMPACTING. The material shall be shaped by the use of a blade grader or other suitable means while being compacted. Any ruts formed shall be filled by blading as often as necessary to prevent breaking through the surfacing material into the subgrade. Holes, waves and deficiencies in thickness which may develop and are not filled by blading shall be filled by adding more material. Shaping and compacting shall continue until the surface reasonably conforms to the cross sections shown on the plans and until it is free from ruts, waves and undulations.

On roadways and shoulders 5 feet wide or wider, the contractor will be required to compact the surfacing material by means of 12 passes of a sheepsfoot roller of the following size and type or an approved equal: 5,000-pound single drum of 3-foot 4-inch diameter. In the event the contractor wishes to use a roller of another size, the number of passes will be proportionately increased or decreased. Upon the completion of the required number of passes of the sheepsfoot roller, the surface shall be rolled with a pneumatic-tired or steel wheel roller and wet, if necessary, during blading so as to insure a tight uniform surface.

On shoulders less than 5 feet wide and ramps, the contractor will be required to compact the material by means of a sheepsfoot roller, pneumatic-tired roller or by other approved means. During compaction operations the material shall be wet, if necessary and rolling, wetting and blading shall continue until a tight uniform surface is obtained.

When material is measured by the cubic yard net section as computed from dimensions shown on the plans, the completed surfacing shall be checked for determining accept-

ance as provided herein. The sampling schedule contained herein shall not prevent the engineer from taking such additional tests as may be required for adequate control of the work in progress, but such tests shall be independent of the tests taken herein for acceptance.

The thickness and width of the completed surfacing shall be determined in accordance with the applicable requirements of LDH Designation: TR 602. The thickness of the surfacing shall not vary in excess of the following tolerances for any individual test.

Plan Thickness	Roadway	Each Shoulder
6 inches and under	Minus ½"	Minus ½"
Over 6 inches and less than 8 inches	Minus ¾"	Minus ¾"
8 inches and over	Minus 1"	Minus 1"

Variations from roadway plan width, measured along the surface, shall not be more than minus 3 inches on either side of centerline. For shoulders, variations from plan width shall not be more than minus 3 inches on the outside edge of each shoulder.

Whenever an individual test is found to be outside the allowable tolerances, 2 additional tests shall be taken within 5 feet of the location of the failing test and the average of the 3 tests shall be used as the value for that location.

Areas showing deficiencies beyond the tolerances outlined above shall be corrected by scarifying and adding and compacting additional materials as required to bring deficient areas to plan dimensions, at no additional cost to the Department.

401.07 EQUIPMENT. All equipment for the proper construction of the surface course shall be on the project in good working order and shall be approved before construction begins.

401.08 METHOD OF MEASUREMENT. Surface course material, complete in place and accepted, will be measured by the cubic yard as indicated by the contract.

(a) Cubic Yards (Net Section): Where roadway and shoulders will be measured by the cubic yard as computed from the dimensions shown on the plans (net section), the length of the completed roadway will be measured horizontally along the centerline of the roadway,

and the length of completed shoulders will be measured horizontally along the edge of the shoulder adjacent to the travel lane.

(b) Cubic Yards (Vehicular Measurement): Surface course material will be measured by the cubic yard in approved vehicles at the point of delivery in accordance with Subsection 109.01. If the several materials making up the surface course are delivered separately and measured separately, the measured quantities of the several materials will be added and the total thereof shall be reduced by the shrinkage factor as determined by Laboratory in order to determine the pay quantity.

Water required for mixing and operations will be considered as incidental to the surface course.

401.09 BASIS OF PAYMENT. The accepted quantity of aggregate surface course, measured as provided herein, will be paid for at the contract unit price per cubic yard.

Payment will be made under:

Item No.	Pay Item	Pay Unit
401(1)	Aggregate Surface Course (Net Section)	Cubic Yard
401(2)	Aggregate Surface Course (Vehicular Measurement)	Cubic Yard

PART V

BITUMINOUS PAVEMENTS

Section 501

Plant Mix Pavements—General

501.01 DESCRIPTION. These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type regardless of the gradation of aggregate, kind and amount of bituminous material or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the engineer. Work will be accepted on a lot basis as described in Subsection 502.04.

501.02 COMPOSITION AND QUALITY CONTROL OF MIXTURES. The bituminous plant mix shall be composed of a mixture of aggregate, filler, if required, and bituminous material with silicone blended together. The several aggregate fractions shall be sized, graded and combined in such proportions that the resulting mixture meets the physical characteristics of these specifications.

(a) Quality Control of Mixes: The contractor will assume full responsibility for the quality control of the mixes supplied to the Department. He will assume responsibility for the initial determination and all necessary subsequent adjustments in proportioning of materials used to produce the specified job mix and other physical characteristics. The contractor will have available at all times during the plant operation, the testing equipment necessary to perform the required tests and analyses.

The contractor shall be required to have a Certified Asphaltic Concrete Technician present at all times when the plant is in operation. A Certified Asphaltic Concrete Technician is that person who is capable of designing the asphaltic concrete mixes at the plant. He will also be ca-

pable of conducting any test and/or analyses necessary to put the plant into operation and to produce a mixture within the requirements of the specifications. The certification will be awarded by the Department upon satisfactory completion of an examination.

The Department's inspector will also be a Certified Asphaltic Concrete Technician and will not be authorized to assume by act or word the responsibility of testing and analysis of the mix for control purposes, calculations or the setting of dials, gages, scales and meters. Such duties are to be assumed only by the contractor.

In the event the contractor is not in a position to provide a Certified Asphaltic Concrete Technician as specified in the previous paragraphs for quality control of mixes, then the Department shall be so notified in writing prior to operation of the plant. Upon request from the contractor, the Chief Engineer may furnish a Certified Asphaltic Concrete Technician from within the Department's personnel, at a cost of $75.00 per day charge to the contractor. Additionally, the Department may also furnish an asphaltic concrete tester for $50.00 per day upon request. A day will be charged to the contractor whenever the technician reports to the plant to perform his duties in behalf of the contractor regardless of whether the plant runs several hours or not at all. Furnishing of an asphaltic concrete technician by the Department will not relieve the contractor of the responsibility of controlling the mix. The Chief Engineer may also authorize rental of the Department's laboratory testing equipment at a rate of $5.00 per day of possession.

(b) Job Mix Formula: No work shall be started nor any mixture accepted until the contractor has submitted in writing for approval, his job mix formula for the mixture he proposes to furnish. The formula so submitted shall indicate a single definite percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, a single temperature at which the mixture is to be produced and the wet and dry mixing time.

(c) Approval of Job Mix Formula: The contractor will be given 2 days operation at the start of the project in order to make any necessary adjustments or corrections

in the proposed job mix formula and establish his construction procedures and sequences. A day's operation will be considered to be any day on which the plant is in operation for a period greater than 2 hours.

The contractor will be given an additional adjustment period whenever a change in mixture type or course is required by the specifications or plans and a change in the proportions of the various components is required to accomplish this. When the contractor elects to substitute a wearing course mixture for binder course, he will not be allowed the adjustment period when he starts the wearing course operations. However, in cases where the mixture being produced is used for patching or other incidental work, an additional adjustment period will be allowed, even though the mix is not changed.

The material produced and placed during this time shall be paid for at 100 percent of the contract unit price, provided it (1) meets the minimum requirements for 80 percent payment given in Schedules 1 and 2; (2) meets minimum requirements for 100 percent payment given in Schedule 3. If it does not meet this requirement it shall be paid for as provided in the schedules. In the event the job mix formula cannot be established during the adjustment period, then all the material produced after the second day shall be paid for in accordance with Subsection 502.12. Following the initial set up of the asphaltic concrete mix according to the contractor's submitted job mix formula, the plant shall operate at least 30 minutes prior to sampling of the mix by the engineer. Four trucks shall be sampled at random for determination of Marshall Test properties as based on one briquette per sample. Only two of these samples shall be analyzed for bitumen content and extracted gradation.

It is recommended that the average of four Marshall Stabilities, for approval of the job mix formula, conform to the desirable values given in Table I. The Contractor may have the option of submitting the job mix formula that does not meet these values, as long as the average of the four stability results meets the minimum requirements given in Table I. However, the contractor should be fully aware that if the design stability values are below the desirable values he is assuming a greater risk that the

Marshall Stabilities for acceptance obtained throughout the project will fall below the required value for 100 percent of the contract unit price.

Table I

Type of Mix	Marshall Stability @ 140°F, lbs.		
	Desirable Values	Minimum Requirements	Flow 1/100"
Type 1, 2 & 4			
AC-3, BC & WC	1650	1200	15 Max.
AC-5, BC & WC	1500	1100	15 Max.
Type 3			
AC-3 Binder	1850	1400	15 Max.
AC-3 Wearing	2150	1700	15 Max.
Type 5(A) Base	1650	1200	15 Max.
Type 5(B) Base	1200	800	15 Max.
Shoulder	1400	1000	8-18

Dry and wet mixing time shall be such as to give a minimum coating of 95 percent of the coarse aggregate particles when tested in accordance with AASHO Designation: T 195. Other pertinent design properties shall be as specified by the Department's Laboratory. The bitumen content and extracted gradation shall be within the tolerances applied to the job mix formula initially submitted by the contractor.

The engineer may permit the contractor to change the job mix formula provided the changed job mix meets all the physical requirements of the specifications. This change shall be made in writing.

(d) Application of Job Mix Formula and Allowable Tolerances for Control of Mixes: Maintenance of adequate control on the quality of bituminous mixes shall be the responsibility of the contractor. In order to check this control, the contractor shall obtain a minimum of two samples of the mixture from each lot. A lot shall be considered as one day's production of a given mixture. He shall obtain these samples using a stratified random sampling plan. One of the samples shall represent the morning control and the other indicative of the afternoon control. The time at which to obtain these two samples shall be set by the contractor using random number tables in accordance with LDH Sampling Manual.

The contractor shall conduct his operations so as to pro-

duce a mixture conforming to the approved job mix formula except that variations shall be permitted within specified control limits for individual and average of two samples. Results of each lot shall be charted on the Control Charts for Individuals and Averages. The upper and lower control limits for individuals and averages shall be set at the following values from the specified job mix formula.

Table II

U.S. Sieve	Control Limits	
	Individual	Average of 2 Tests
¾ inch and larger	±9	±6
½ inch	±12	±9
⅜ inch	±10	±7
No. 4	±10	±7
No. 10	±9	±6
No. 40	±7	±5
No. 80	±5	±4
No. 200	±3	±2
% Bitumen	±.6	±.4
Temperature of Mix °F*	±25	±25
Percent Crushed	Minimum Value as Specified in Subsection 903.07, Table VII	

*As based on the approved mixing temperature measured after discharge.

When the tendency of the individual test results on the charts indicate that the mix falls outside of the control limits for individuals, then the contractor shall make adjustments to bring the mix into the job mix formula.

Individual materials from more than one source shall not be used alternately nor mixed when used in surface courses without the written consent of the engineer. Where additional sources of materials are approved, a job mix formula shall be established and approved before the new material is used. When unsatisfactory results or other conditions make it necessary, the contractor may be required to establish a new job mix formula.

In the event a change in the job mix formula for the mixture being used is necessary, there will be no additional adjustment period and the mix produced during this period shall be paid for in accordance with Subsection 502.12.

501.03 AGGREGATES. Aggregates shall meet the requirements of Subsection 903.07.

501.04 FILLER. Filler shall meet the requirements of Subsection 903.07.

501.05 BITUMINOUS MATERIALS. The type and grade of bituminous materials will be specified in the plans or special provisions.

A silicone additive shall be dispersed in the asphalt cement by methods and in concentrations that are determined by the engineer. The silicone additive material shall be approved by the Department prior to use.

When Grade AC-3 or Grade AC-5 is specified, the grade may be changed by the engineer whenever applicable from AC-3 to AC-5, or from AC-5 to AC-3, as the case may be, at no change in unit price. When such a change is required, the engineer will give sufficient notice to the contractor to allow the changing of materials in tank. Only AC-3 grade asphalt will be used in Type 3 mixes.

The bituminous material shall meet the applicable requirements of Section 902, Bituminous Materials.

CONSTRUCTION REQUIREMENTS

501.06 WEATHER LIMITATIONS. Bituminous plant mix shall not be applied on a wet surface, except that material in transit at the time the plant operation is discontinued may be laid, subject to the end product meeting specifications. Placing of bituminous plant mix shall be discontinued when the descending air temperature in the shade and away from artificial heat falls below 45°F and shall not be resumed until the ascending air temperature in the shade and away from artificial heat reaches 40°F.

If the work consists of placing material in lift thicknesses 3½ inches or greater, then these temperature limitations shall not apply provided all other requirements of the specifications are met.

501.07 BITUMINOUS MIXING PLANT. The plant may be of either a batch or a continuous mixing type. All plants used by the contractor for the preparation of the bituminous mixture shall conform to all requirements of these specifications.

(a) Batch Plants:

(1) Uniformity: The plant shall be so designed, co-

ordinated and operated as to produce a mixture within the specified tolerances of the job mix formula.

(2) Equipment for Preparation of Asphalt: Asphalt working tanks shall be capable of heating the material, under effective and positive control at all times, to the temperature requirements set forth in the specifications. The heating system shall provide uniform heating of the entire contents of the tanks. Heating shall be accomplished by steam coils, electricity or other approved means so that no flame shall come in contact with the heating tank. The circulating system for bituminous material shall be of adequate size to insure proper and continuous circulation during the entire operating period. All pipe lines and fittings shall be steam-jacketed or otherwise properly insulated to minimize heat loss. Working tank capacity shall be sufficient for satisfactory plant operation. In addition to working tanks, the contractor shall provide adequate storage of asphalt in order that the asphalt may be tested. The contractor shall also provide a calibration chart and a measuring stick for each tank to measure the amount of asphalt cement actually used when deemed necessary.

(3) Cold Aggregate Feeder: The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier to secure a uniform production and a uniform temperature. The feeder or feeders shall be capable of delivering the maximum number of aggregate sizes required in their proper proportion. When more than one cold feed is used, each shall be fed as a separate unit, and the individual controls shall be integrated with a total master control. Mixing on the ground, at the plant site, of the various aggregates will not be permitted at any time.

(4) Drier: The plant shall include one or more driers that will continuously agitate the aggregates during the heating and drying process. The equipment shall be capable of heating and drying all aggregates specified in the necessary quantities to supply the mixing unit continuously at its operating capacity and at a specified temperature and moisture content.

(5) Screens: Plant screens capable of screening all aggregates to the sizes required for proportioning, and having normal capacity in excess of the full capacity of the mixer or the drier, shall be provided. The contractor shall expose the screens for inspection at the request of the engineer.

(6) Bins: The bin sizes shall be adequate for continuous operation of the plant at rated capacity. Bins shall be so arranged to insure separate and adequate storage of appropriate fractions of the aggregate. Adequate dry storage shall be provided for the mineral filler and provisions made for proportioning the filler for each batch of mixture. Each hot bin shall be provided with a overflow pipe or chute (except the mineral filler bin) to prevent contamination of materials. Each size of aggregate, as required, shall be stored in separate bins.

(7) Asphalt Control Unit: An approved means of weighing or metering shall be provided to obtain the required percentage of asphalt in the mix within the tolerances specified. Suitable steam-jacketing or other insulation for maintaining the specified temperature of asphalt in pipe lines, weigh buckets, flow lines or other containers shall be provided. Where the quantity of asphalt is controlled by metering, provisions shall be made whereby the amount of asphalt delivered through the meter may be readily checked by weight when deemed necessary.

(8) Thermometric Equipment: An armored thermometer of adequate range shall be fixed in the asphalt feed line at an approved location near the discharge valve at the mixer unit. The plant shall also be equipped with an approved mercury-actuated thermometer, a recording electric pyrometer or other approved thermometric instrument having an accuracy of $\pm 5°F$ and a sensitivity which will provide an indication of temperature change at the rate of not less than $10°F$ per minute. It shall be so placed at the discharge chute of the drier to register automatically the temperature of the heated aggregate. The engineer shall have the right to test the efficiency of thermometric instruments for better control of asphalt, aggregate and mix tempera-

tures. The immediate repair or replacement of any defective or unsatisfactory instrument by some approved temperature recording apparatus will be required.

(9) Dust Collector: The plant shall be provided with a dust collection system meeting all federal, state and local requirements. All plants shall have mixer covers and such additional housing as may be necessary to insure the proper collection of dust.

(1) Plant Scales: Scales for any weigh box or hopper shall be the springless dial type and shall be of a standard make and design, accurate to ½ percent of the indicated load.

Dial scales shall be springless and of standard make. They shall be designed, constructed and installed in such a manner as to be reasonably free from vibration. They shall also be of such size that the numerals on the dial can be read at a reasonable distance. All dials shall be so located as to be plainly visible to the operator at all times. The end of the pointer shall be set close to the face of the dial and shall be free from excessive parallax. The accumulative weights shall be marked on scales.

Scales for the weighing of asphalt shall conform to the requirements for aggregate scales. Dial scales for weighing the asphalt shall read to the nearest pound. All scales for weighing the asphalt shall have a capacity which will insure accuracy within the tolerances specified elsewhere herein.

Scales shall be tested as often as deemed necessary to insure their accuracy. All weighing equipment shall be substantially constructed and of a design which will permit easy realignment and adjustment. Weighing equipment that easily gets out of adjustment shall be replaced when so ordered. The Department shall provide and have on hand at least ten 50-pound standard weights for frequent testing of all scales or provide other adequate means.

The test weights shall be kept clean and near the scales. The contractor shall provide for each scale a suitable cradle, or platform, for applying the test load so that the load is uniformly distributed. The contrac-

tor shall also provide an approved printer system which will print separately the weights of the aggregate and of the asphalt. The total of the printed weights, delivered to a truck, shall be the verification for issuing haul tickets for each load.

In the event of a breakdown of the printing mechanism, the contractor will be permitted to operate through a maximum period of 48 hours (two consecutive calendar days) from the time of the breakdown. During the breakdown period, the pay quantity will be determined by visual observation of the weighing operation by an authorized representative of the Department.

(11) Weigh Box or Hopper: Equipment shall include a means for accurately weighing each bin size of aggregate in a weigh box or hopper suspended on scales ample in size to hold a full batch without hand raking or running over. The weigh box or hopper shall be supported on a fulcrum; knife edges shall be so constructed that they will not easily be thrown out of alignment. Gates on both bins and hopper shall be so constructed as to prevent leakage when they are closed. Proportioning of aggregates and charging of mixer shall be performed so as to blend the aggregates thoroughly and prevent segregation in the mixer. Automatic plants may proportion and discharge all aggregate sizes simultaneously if provision is made to establish or control individual bin proportions by weight.

(12) Asphalt Measuring Equipment: Asphalt measuring equipment provided on the plant shall be capable of accurately measuring into each batch the required amount of asphalt within the tolerance of ± ½ of one percent of the weight of asphalt.

The asphalt bucket shall be a non-tilting type provided with a loose sheet metal cover. The capacity of the asphalt bucket shall be at least 15 percent in excess of the weight of asphalt required for a one-batch mix. The plant shall have a steam or hot oil jacketed, quick closing, non-dripping, charging valve. The length of the discharge opening or spray bar shall not be less than ¾ of the length of the mixer, and it shall discharge directly into the mixer. The discharge system shall be designed and arranged to deliver the asphalt the full

length of the mixer in a thin, uniform sheet or in multiple streams or sprays.

(13) Mixer Unit: The plant shall include a batch mixer of an approved pugmill containing twin shafts and shall be steam or hot oil jacketed. It shall be capable of producing a uniform mix within the specified tolerances.

During mixing at full capacity, the paddle tips of the mixer shall remain exposed at the top of their periphery. In cases where the pugmill is designed to accommodate more mix than this, then the pugmill will be inspected by the engineer to determine its mixing capacity.

Deviation in size of batches will be permitted to provide for mixing batches 20 percent below the full capacity of the mixer, thus established, provided the quality of the mix is not impaired.

The clearance of the blades from all fixed and moving parts shall not exceed ¾ inch. The paddles shall be set in such a manner to insure a completely uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The mixer shall be so constructed as to prevent leakage of contents until the batch is to be discharged.

(14) Control of Mixing Time: The mixer shall have an approved accurate timing device to prevent the entrance of additional material while the mixing operation is in progress, and the discharge gates shall be locked to insure proper mixing. The device shall also lock the asphalt bucket throughout the dry mixing period. The dry mixing period is the interval of time between the opening of the weigh box gate and the application of asphalt. The wet mixing period is the interval of time between the start of the application of asphalt and the opening of the mixer gate for discharge.

(b) Continuous Mix Plants: It shall be the contractor's responsibility to furnish equipment that will produce a satisfactory paving mix. The plant shall meet the following minimum requirements.

(1) General Requirements: The requirements as set

forth under paragraphs 1 through 6, 8 and 9 for batch plants shall apply for continuous mixing type plants.

(2) Mixer Unit: The plant shall include a continuous mixer of an approved pugmill containing twin shafts capable of producing a uniform mix within the job mix tolerances specified. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mix. The clearance of the blades from all fixed and moving parts shall not exceed ¾ inch. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on the permanent gage.

(3) Asphalt Control Unit: Means shall be provided to obtain the required percentage of asphalt in the mix wherein the tolerances specified either by metering or volumetric measurements. Where the quantity of asphalt is controlled by metering, provisions shall be made whereby the amount of asphalt delivered through the meter may be readily checked by weight. Steam-jacketing or other insulation which will maintain the specified temperature of asphalt in pipe lines, meters, spray bars, flow lines or other containers shall be provided. A continuous recording device will be required on the discharge side of the asphalt pump to the pugmill. This device will record the amount of asphalt introduced into the mix.

(4) Gradation Control Unit: The plant shall include a means for accurately proportioning each bin size of aggregate by volumetric measurement. The unit shall include a feeder mounted under the bins with each bin compartment having an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from it. The orifice shall be rectangular, with one dimension adjustable by positive mechanical adjustment, and provided with a lock. Indicators shall be provided on each gate to show the gate opening in inches. Mineral filler, if specified, shall be proportioned separately from a hopper equipped with an adjustable feed which may be accurately and conveniently calibrated and which shall be interlocked with the aggregate and asphalt feeds. The feeder equip-

ment for the mineral filler shall meet the approval of the engineer.

(5) Weight Calibration of Aggregate Feed: Samples shall be taken and weighed as a means of calibrating gate openings. Material shall be fed out of a bin through the individual orifice and bypassed to an approved test box. The material from each compartment shall be taken separately. The plant shall be equipped to handle conveniently such test samples weighing not less than 200 pounds. An accurate platform scale shall be provided by the contractor to weigh the test samples.

(6) Synchronization of Aggregate and Asphalt Feed: Satisfactory means shall be provided to assure positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning device. This shall be accomplished by interlocking mechanical means or by any positive method approved by the engineer. The aggregate bins shall be provided with signal devices and controls which will warn of low levels and which will automatically stop the flow of all aggregate and asphalt to the mixer when the aggregate in any one bin is so low that the feeder will not operate at set capacity. The asphalt storage system shall be provided with signal devices and controls which will warn of low levels of asphalt and which will automatically stop the entire plant operation when the asphalt storage level is lowered to the point of exposing the feed end of the asphalt suction line.

If mineral filler is specified, the plant shall include separate equipment to accurately proportion the mineral filler sufficiently in advance of the addition of the bitumen to give a proper dry mix time. This equipment shall be of such design as to give a constant flow of the material and shall include a storage bin of sufficient capacity and an adjustable calibrated gate. The filler feed system shall be interlocked with the aggregate control system and feed the material by mechanical means. A gravity type feed will not be permitted.

(7) Control of Mixing Time: The plant shall be equipped with a positive means to govern the time

of mixing. Mixing time shall not be altered unless so ordered by the engineer.

The determination of mixing time shall be by a weight method under the following formula unless otherwise instructed by the engineer:

$$\text{Mixing Time, sec.} = \frac{\text{Pugmill Dead Capacity, lbs.}}{\text{Pugmill Output, lbs. per sec.}}$$

The weights shall be determined for the job from tests made by the engineer.

(8) Discharge Box: The plant shall be equipped with a discharge box of sufficient size to collect the mix as it comes out of the pugmill to prevent segregation.

(9) Truck-platform scales will be furnished by the contractor for the purpose of determining the pay weights of the mix when using a continuous mixing type plant. The scales furnished by the contractor shall be of sufficient length to weigh the entire unit transporting the mix and shall be the product of a reputable manufacturer and of a simple rugged design with the minimum number of adjustments consistent with the accuracy required, all as approved by the engineer. Suitable provisions shall be taken to protect all moving parts and to level the equipment. The scales shall be accurate to ½ of one percent of the loads applied.

The contractor shall have the scales certified by the State Bureau of Weights and Measures prior to their use and in the event there is cause to believe that the scales are performing incorrectly, he shall furnish additional certification.

The scales shall be equipped with an approved automatic printer system which will print the weight of the unit transporting the mix.

The printed weight of the loaded truck less the printed weight of the truck when empty shall be used as a basis for issuing haul tickets for each load.

(c) Storage Silos and Surge Bins: The contractor may use storage silos or surge bins for storing asphaltic concrete mixtures with the approval of the Department and provided it is not detrimental to the mix.

(1) Heated Storage Silos: The bins shall be such that mix drawn from the bin meets the same requirements

as mix loaded directly into the trucks from the pugmill for delivery to the job.

The system shall be capable of conveying the hot mix from the plant to the silo by means of a drag-slat conveyor system or other approved systems. The conveyor may be enclosed and heated to prevent a drop in the mix temperature; however, hot air shall not be blown on the mix. The conveyor shall be of a continuous type designed to prevent spillage and to remove the mix from the plant as fast as it is produced.

a. Heating: The silo shall be insulated and may be heated electrically, or with hot oil or hot air.

The atmosphere within the silo may be air or inert gas. The storage silo heating system shall be capable of maintaining the mix temperature without localized heating (hot spots). If inert gas is used, the inert gas system must be capable of purging the silo with an oxygen free (insert) atmosphere and then sealing the silo to prevent the loss of the inert gas.

b. Maximum Allowable Storage Time: The maximum allowable storage time of the hot mix in the heated storage silo shall be as follows:

	Storage Time-Hours	
	Fine Mix (3/4" max. agg. size)	Coarse Mix (1 1/2" max. agg. size)
1. Silicone treated asphalt, air in bin	36	18
2. Silicone treated asphalt, inert gas	144	72

After the storage silo is in use for some time, the Department may grant the contractor permission to exceed the above storage times, provided test results and other data indicate that the additional storage time is not detrimental to the mix.

(2) Unheated Surge Bins: The bins shall be such that the mix drawn from the bin meets the same requirements as mix loaded directly into the trucks from the pugmill for delivery to the job.

The system shall be capable of conveying the hot mix from the plant to the bin by means of a drag-slat conveyor system or other approved systems. The con-

veyor shall be of a continuous type designed to prevent spillage and to remove the mix from the plant as fast as it is produced. The maximum allowable storage time for unheated surge bins shall be two hours.

(3) General Requirements for Storage Silos and Surge Bins:

a. Transporting the Mix from the Pugmill: The mix may be transported directly from the pugmill to the storage silo or surge bins by means of the conveyor system or it may be trucked from the pugmill to the site of the storage silo or surge bin and then transported into the bin by means of the conveyor system, as long as the mix remains within ±15°F of the pugmill discharge temperature.

b. Unloading: The storage silo or surge bin unloading gates may be clam gates operating under gravity feed, or any other type gate which will not cause segregation or be detrimental to the mix in any way.

(4) Weighing Scales: Truck-platform scales shall be furnished by the contractor and positioned near the discharge gate in order that the total weight of mix discharged into the truck may be recorded. The scales shall be of sufficient length to weigh the entire unit transporting the mix and shall be the product of a reputable manufacturer and of a simple rugged design with the minimum number of adjustments consistent with the accuracy required, all as approved by the engineer. Suitable provision shall be taken to protect all moving parts and to level the equipment. The scales shall be accurate to ½ of one percent of the loads applied.

The contractor shall have the scales certified by the State Bureau of Weights and Measures prior to their use and in the event there is cause to believe that the scales are performing incorrectly, he shall furnish additional certification.

The scales shall be equipped with an approved automatic printer system which will print the weight of the transporting unit both unloaded and loaded. The printed weight of the loaded truck less the printed weight of the truck when empty shall be used as a basis for issuing haul tickets for each load. The printed weights

from the automatic printer system at the batch plant shall be used for vertification only.

501.08 HAULING EQUIPMENT. Vehicles used for the transportation of hot mix asphalt from the plant to the site of the work shall have tight metal bottoms and shall be free from dust, screenings, petroleum oils and volatiles of other mineral spirits which may affect the mix being hauled. The truck beds shall be painted or sprayed at least once a day or as often as required with lime-water, soap solution or other approved materials. After this operation, the truck bed shall be elevated and thoroughly drained; no excess solution shall be permitted.

The trucks used for transporting of the mixture will be of such size that the lay-down machine or the paver being used will be capable of pushing them with ease without affecting the surface smoothness or the edge of the material. Any distortions in the surface finish resulting from improper unloading of the mixture shall be corrected immediately or removed and replaced. During placement of the final or top surface course, and when the mixture is being placed directly on the apron of the spreader, the trucks used for transporting the mixture shall be limited to loads of 15 tons or less.

Trucks shall be provided with covers of canvas or other material of sufficient size and weight to protect the load during adverse weather conditions.

When variations in size, speed and condition of trucks are such as to interfere with orderly operation, the engineer may order suitable substitutions to be made.

501.09 BITUMINOUS PAVERS. Bituminous pavers shall be one of two types: (1) the conventional self-powered spreading and finishing machine, (2) the self-powered spreading and finishing machine with electronic screed and slope control devices used in conjunction with a 30-foot traveling stringline or with an erected stringline as specified by the plans, special provisions or as directed by the engineer.

(a) **Conventional Pavers:** Bituminous pavers shall be capable of laying mixtures within the tolerances specified. A screed or strike-off assembly shall be used, distributing the mixture either over the entire width or over such par-

tial width lanes as may be practicable. The assembly shall be adjustable to give the cross section shape as indicated on the plan typical sections. The screed shall be equipped with a heater.

Pavers shall be equipped with hoppers and distributing screws to place the mix evenly in front of adjustable screed. They shall be equipped with a quick and efficient steering device and shall be capable of traveling both forward and in reverse.

Pavers shall be capable of spreading mixes to required thickness without segregation or tearing.

Unless otherwise specified, when leveling is required by the plans, a blade grader may be used when approval is given by the engineer.

In shoulder construction, modified conventional spreaders or widener spreaders shall be provided.

(b) Bituminous Pavers with Electronic Screed Control: This type paver shall meet the same requirements as described above for conventional pavers and shall be equipped with automatic screed and slope control devices capable of laying the mixture to grade within the tolerances specified, distributing the mixture over the entire width or over such partial width lanes as may be practicable. Pavers shall be equipped with two sensors when specified.

The pavers shall be equipped to work from an erected stringline or a traveling stringline that will accurately reflect, for a 30-foot length, the average grade of the surface on which it is to be operated. Pavers shall also be equipped with a shoe attachment to control the grade of a lane being placed adjacent to a previously placed lane.

If a malfunction occurs in the electronic screed control device during lay-down operations, work may continue for the balance of that day on any course other than the final surface course. Any overrun resulting from placing material without the electronic screed control device shall be borne by the contractor. If a screed control device malfunctions during final surface course paving operations, plant operations shall be discontinued immediately and shall not be resumed until the screed malfunction has

been remedied. Material in transit may be placed, provided all surface and grade tolerances are met.

501.10 ROLLERS. Rolling equipment shall consist of 10 ton three-wheel rollers, 10 ton tandem rollers, high intensity self-propelled pneumatic-tire rollers unless otherwise approved. Approval of other rollers will be at the discretion of the Department. A second tandem roller may be used in lieu of the three-wheel roller.

All rollers shall be capable of reversing without backlash. When necessary, additional rollers of an approved design shall be furnished.

Steel wheel rollers shall be equipped with adjustable scrapers to keep the rollers clean and with efficient means of keeping the wheels wet to prevent the mixture from sticking to the rollers. Rollers shall also be free of flat areas, openings or projections which will mar the surface of the pavement.

High intensity pneumatic-tire rollers shall be self-propelled and shall have 2 axles. The roller shall be capable of applying a range of contact or ground pressure from 50 to 90 psi. Tires will be smooth without any treads. All tires of the same roller shall be of equal size and diaimeter and shall be arranged in such a manner that the gap between the tires of one axle will be covered by the tires of the other. The pneumatic rollers shall be equipped with cocoa mats or suitable scrapers to prevent pickup. Suitable devices will also be provided to keep the mats damp.

When Type 3 or 5 mix is specified, in addition to the requirements given above, the high intensity pneumatic-tire rollers shall be capable of exerting a wheel load of 4,000 pounds.

501.11 INCIDENTAL EQUIPMENT AND HAND TOOLS. Power revolving brooms or power blowers and distributors shall be provided and maintained in a satisfactory working condition.

Tamping irons used to consolidate the edges of the binder and wearing courses shall be of sufficient weight to compact the edges to the same degree as the body of the pavement. Satisfactory mechanical equipment may be used instead of tamping irons.

The asphalt distributor shall be equipped with pneumatic tires of such width and design so that the load produced on the road surface shall not be detrimental to the previous course. The distributor shall be equipped with suitable manifold and appliance so designed as to distribute evenly heated material within the temperature range specified with positive controlled heat and temperature at all times, and shall be equipped with thermometers to indicate the temperature of the material in the tank. The distributor shall be so designed as to maintain a constant and uniform pressure upon the bituminous material as it passes through the nozzles.

Sufficient and proper screens shall be installed between the tank and the nozzles, and the screens shall be cleaned frequently to prevent clogging of the nozzles. The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of bituminous materials being applied per square yard of surface under the operating conditions, and shall have a tachometer, reading speeds in feet per minute. The distributor shall be so designed as to apply bituminous material at the specified rate.

501.12 CONDITIONING OF EXISTING SURFACE. The surface to be covered shall be swept clean and free from all dust and dirt, caked clay and loose foreign material by means of revolving brooms or other approved mechanical sweepers supplemented by hand brooms, as directed.

When the bituminous mixture is to be placed on an existing pavement, the contractor shall, in addition to cleaning the surface as required above, remove excess joint filler from the surface. This does not relieve the contractor from maintaining, at his expense, the existing pavement.

Contact surfaces of curbs, gutters, manholes, longitudinal joints and other structures shall be painted with a thin uniform coating of tack coat before the bituminous mixture is placed against them.

The condition of the base shall be approved prior to the placing of the mixture.

501.13 PREPARATION OF BITUMINOUS MATERIAL. The bituminous material shall be heated to the temperature specified in the job mix in a manner that will avoid local overheating and provide a continuous supply of the bitumi-

nous material to the mixer at a uniform temperature at all times.

501.14 PREPARATION OF AGGREGATES. The aggregates for the mixture shall be dried and heated to the temperature required in the job mix. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot or oil coating on the aggregate.

The aggregate, immediately after heating and drying, shall be screened into 2 or more fractions as specified and conveyed into separate compartments ready for batching and mixing with bituminous material.

501.15 MIXING. The dried aggregates shall be combined in the mixer, in the amount of each fraction of aggregrates required to meet the job mix formula. The bituminous material shall be measured or gaged and introduced into the mixer in the amount specified by the job mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured. Dry and wet mixing time shall be submitted by the contractor on the basis of a single determination and will conform to the minimum requirements given in Subsection 501.02(c).

501.16 JOINTS. The longitudinal joints in one layer shall offset that in the layer immediately below by approximately 3 inches; however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises 2 lanes of width, or at lane lines if the roadway is more than 2 lanes.

Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. Transverse joints in succeeding courses shall be offset at least 2 feet. When directed, a brush coat of bituminous material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

501.17 PAVEMENT SAMPLES. The contractor shall furnish for testing, when required, samples cut from the

completed work. The area of pavement so removed shall be replaced with new mixture and refinished. No additional compensation will be allowed for furnishing test samples and replacing the areas with new pavement.

Samples of the finished roadway will be taken by the contractor in presence of the engineer's representative from areas selected by the engineer. Saws or core drills of an approved type will be required. The size of each sample shall be approximately 4 inches by 4 inches square or 4 inches in diameter.

501.18 REQUIREMENTS AND TOLERANCES FOR ACCEPTANCE.

(a) **Job Control Testing:** The control testing for surface tolerance will be the responsibility of the Department. The control testing will be required only on the binder course or shoulder mixes. The binder course will be defined as the last course to be laid prior to the wearing course.

The allowable variation in surface finish, cross slope and grade of the binder or shoulder mix shall not exceed the applicable values shown in Table III. If the plans and/or special provisions require the use of an automatic screed control device, then the allowable variation shown in Part A of Table III shall apply. If the use of an automatic screed control device is not required then the allowable variation shown in Part B of Table III shall apply.

The finished surface shall be tested by the engineer in both the longitudinal and transverse directions for conformance to the specifications for surface finish. The contractor shall furnish a 10 foot rolling straight edge acceptable to the engineer for testing in the longitudinal direction and a 10 foot static straight edge for testing in the transverse direction.

In the longitudinal direction, one path in each lane will be selected at random in accordance with LDH Sampling Manual. The lot will be divided into five equal sections and 200 feet of each section will be randomly selected and tested with the 10 foot rolling straight edge. The engineer may decide to test the entire lot. If the lot is less than 1,000 linear feet, then the entire lot will be tested.

The variations in the surface when tested for the tolerance shown in Table III shall not show more than 3 percent outside of the tolerance for a given lot. In the event that greater than 3 percent is outside the tolerance then the entire lot will be checked and the deviations corrected. In the transverse direction, random sites will be selected for testing. The variations of the surface from the testing edge contacts with the surface shall not exceed the applicable values shown in Table III. The variation in surface finish allowed by Table III shall apply to a 10 foot length.

(1) Cross Slope: When the plans or typical section require the section to be constructed to a specified cross slope, tests for conformance shall be run at selected locations, using a string line, slope board or other comparable method. The variation of the cross slope shall not exceed the applicable values shown in Table III. The variation in cross slope allowed by Table III shall apply to the width of one lane.

(2) Grade: When the plans require the pavement to be constructed to a grade, tests for conformance shall be run at selected locations, using a string line or other comparable method. Maximum deviation from grade shown on the plans, or as altered by the engineer, shall not exceed the values shown in Table III. If the engineer finds that the pavement as constructed is consistently above or below the proposed finish grade for a reasonably long segment, he may, for the sole purpose of determining conformance to the grade tolerance specified in Table III, use a new grade approximately parallel to and above or below the established grade; in which case, any required transition in grade or vertical curve at each extremity of the segment will be in accordance with the best design requirements. The variation in grade allowed by Table III shall apply to only one longitudinal line such as the center line, outside edge of pavement, etc. The engineer shall designate the longitudinal line to which this variation shall apply.

Table III

Type Mix	Allowable Variation							
	Part A — With Automatic Screed Control — Surface Finish				Part B — Without Automatic Screed Control — Surface Finish			
	Longi-tudinal	Trans-verse	Cross Slope	Grade (1)	Longi-tudinal	Trans-verse	Cross Slope	Grade (1)
BC 1, 2, 4	¼"	¼"	½"	½"	⅜"	⅜"	1"	½"
BC 3	¼"	¼"	⅜"	½"	¼"	¼"	⅜"	½"
Shoulder Mixes	—	—	—	—	3/16"	3/16"	¾"	¾"
Base Course	3/16"	3/16"	¾"	¾"	3/16"	3/16"	¾"	¾"

(1) Applicable only when grade is specified.

The intent of this specification is that 97 percent of all surface tolerance measurements per lot conform to this specification and that no single surface tolerance measurement exceed the specification requirements by more than ½ of the tolerance specified. If less than 97 percent meet these tolerances, all deficient areas shall be corrected.

(3) Correction of Deficient Areas: Any irregularities in the hot mix binder, shoulder course or base course may be corrected by either skin patching, feather-edging, wedge course construction, or full depth patching, where appropriate, and where it can be completed in a satisfactory manner at no additional expense to the Department.

(b) Acceptance Testing: The acceptance testing will be required only on the wearing course. The surface shall be tested by the engineer, with a 10 foot rolling straight edge at stratified randomly selected longitudinal and transverse locations in accordance with LDH Sampling Manual. At the start of each project the rolling straight edge shall be calibrated by the District Laboratory according to LDH Designation: TR 603.

All testing will be made in a longitudinal direction.

A lot shall constitute one day's production of bituminous mix. The lot will be divided into five equal segments.

In each segment a 200 foot section will be randomly se-

lected and tested with the rolling straight edge. The percent non-compliance shall be computed by adding the linear feet of each of the 200 foot sections of the lot that do not conform to the applicable tolerances given in Table IV, dividing that sum by 1000 (or the length of the lot if the lot is less than 1000 feet) and multiplying by 100 to convert to percent. If the lot is less than 1000 linear feet then the entire lot will be tested. The engineer may decide to test the entire lot for surface smoothness.

The surface tolerance for the wearing course shall be as shown in Table IV. When the total depth of mixture constructed consists of a single lift then Part B of Table IV shall apply for acceptance.

Table IV

Type Mix	Part A With Automatic Screed Control Surface Finish Longitudinal	Part B Without Automatic Screed Control Surface Finish Longitudinal
WC 1, 2, 4	1/8″	3/16″
WC 3	1/8″	1/8″

Whenever sections of pavement do not meet the requirements for surface tolerance, an adjustment in the unit price for the lot of the mixture shall be made as outlined in Subsection 502.12.

(c) Tolerances for acceptance of Type 5 base course or shoulder mixes when measured and paid for by cubic yard (net section):

(1) Surface Tolerances: The Type 5 base course when placed directly under Portland cement concrete pavement shall be finished in such manner that the Portland cement concrete pavement shall conform to the acceptance requirements of Section 601.

Type 5 base course other than under Portland cement concrete pavement and shoulder mixes shall conform to the surface tolerances as specified under Table III, and the material shall be placed in such a manner that the surface tolerances of the succeeding layers will be met.

(2) Thickness and Width Tolerances: Thickness and width of completed sections will be determined in accordance with LDH Designation: TR 602, except that acceptance measurements will be made at random locations to represent 1,000-foot sections in lieu of 500-foot sections.

Width of base course shall not vary from plan width in excess of minus 3 inches on each side of the roadway center line. Thickness measurements made at 3 locations in each section shall not vary in excess of the following tolerances for any individual test. Over-thickness will be waived.

Plan Thickness	Under-Thickness
4" and under	¼"
Over 4"	½"

If an individual test for thickness or width exceeds allowable tolerances, 2 additional tests will be made within 5 feet of the location of the failing test, and the average of the 3 tests will be used as the value for that location. Areas showing deficiencies beyond allowable tolerances shall be corrected at the contractor's expense.

501.19 METHOD OF MEASUREMENT. The asphaltic concrete will be measured as prescribed under Subsection 502.11.

501.20 BASIS OF PAYMENT. The accepted quantity of asphaltic concrete used in plant mix bituminous pavement will be paid for as provided in Subsection 502.12.

Section 502

Asphaltic Concrete Pavement

502.01 DESCRIPTION. This work shall consist of a base course, binder course and a wearing course or a combination of these courses, each consisting of a mixture of mineral aggregate and bituminous material with silicone added, applied hot on the prepared base in accordance with these specifications.

The type of mixture furnished shall be as indicated on the plans or if more than one type is indicated, whichever type the contractor elects, but in any event shall be one of the following 5 types:

(a) Type 1 mix shall be composed of the following:

(1) Wearing Course: Crushed gravel, crushed slag, crushed granite or a combination of these materials, sand, mineral filler and bituminous material.

(2) Binder Course: Crushed gravel, crushed stone, crushed granite, crushed slag or a combination of these materials, sand, mineral filler and bituminous material.

(b) Type 2 mix shall be composed of crushed clam shell, crushed reef shell or a combination thereof, sand, mineral filler (when needed) and bituminous material.

(c) Type 3 mix shall be composed of the following:

(1) Wearing Course: Crushed gravel, crushed slag, crushed granite combined with crushed gravel, slag, granite, stone or other approved types of screenings, sand, mineral filler and bituminous material.

(2) Binder Course: Crushed gravel, crushed slag, crushed stone, crushed granite or a combination of these materials, sand, mineral filler and bituminous material.

(d) Type 4 mix shall be composed of expanded clay aggregate, sand, mineral filler and bituminous material.

(e) Type 5 mix—Base Course:

(1) Mix 5A shall be composed of gravel, slag, granite, stone, reef shell, clam shell or expanded clay, sand, mineral filler (when needed) and bituminous material.

(2) Mix 5B shall be composed of gravel, slag, granite, stone, reef shell, clam shell, expanded clay, sand and bituminous material; or pit run sand clay gravel and bituminous material.

The thickness of courses shall be in approximate conformity with the plan typical sections unless otherwise specified. In the event the plans and/or proposal provides for both binder and wearing courses, the contractor will be permitted, at his option, to substitute wearing course material for binder course material at no change in unit price. Should the contractor elect to make such substitution, the mixture will be laid in layers of such thickness that the compaction and surface requirements are met. No substitutions are allowed for Types 3 and 5 mixtures.

The mineral aggregate and bituminous material in the mixtures shall be combined in such proportions that the mixture shall meet the following requirements by weight:

Mix	Bitumen, Percent	Min. Agg. Percent	% Crushed Ret. on #4	% Mineral Filler Minimum*
Type 1:				
WC	3.5 to 7.0	93.0 to 96.5	75 Min.	3
BC	3.0 to 6.0	94.0 to 97.0	60 Min.	2
Type 2:				
WC & BC	4.5 to 7.5	92.5 to 95.5		As Needed
Type 3:				
WC	3.5 to 7.0	93.0 to 96.5	80 Min.	2
BC	3.0 to 6.0	94.0 to 97.0	60 Min.	2
Type 4:				
WC & BC	6.0 to 8.5	91.5 to 94.0		2
Type 5:				
Base Courses				
(A)	3.0 to 8.5	91.5 to 97.0	As Needed	As Needed
(B)	3.0 to 8.5	91.5 to 97.0		

*When hydrated lime is used only ½ as much filler will be required.

502.02 MATERIALS. The materials and their use shall conform to the requirements of Subsections 501.02 through 501.05.

CONSTRUCTION REQUIREMENTS

502.03 GENERAL. The construction requirements shall be as prescribed in Subsections 501.06 through 501.18.

502.04 PHYSICAL PROPERTIES OF MIXTURE. The contractor shall design his mix with the intent that compacted specimens of the mixture shall conform to the properties in Table V when tested in accordance with LDH Designation: TR 305, for an average of four samples taken from each lot after it is placed in the trucks using random sampling procedures. A lot shall be considered as one day's production of bituminous mix. A stratified random sampling plan shall be utilized such that two of the four samples are obtained during the morning and the other two during the afternoon using LDH Sampling Manual. The time at which these acceptance samples are obtained from the trucks shall be set by the engineer using random number tables.

Compaction of mixtures for Marshall Stability and Flow determination shall be conducted by the engineer's personnel at the plant. The testing and final approval of the mixture will be done by the Department personnel.

When the average of four tests is outside of the acceptance limits specified for the average of the four test results for Marshall Stability, an adjustment in the unit price for the lot of the mixture shall be made as further outlined. No adjustment in the unit price will be made for mixture being outside the limits on the individual results except as noted below.

When it is not possible to sample the whole lot (four samples) due to unfavorable circumstances caused by plant breakdown or inclement weather or other causes, then the acceptance limits will be as shown in Table V as based on the number of tests made during the time the plant was in operation. In no event will the number of tests or samples be less than four for eight hours of plant operation and less than two for four hours of operation.

In the event the plant operates for less than four hours and only one sample has been obtained, then the mix will be accepted on the basis of limits for one sample.

When the average of the number of tests representing the period the plant was in operation for the day is outside the acceptance limits for Marshall Stability shown in Table V for the average of the number of samples tested during the day, an adjustment in the unit price for the lot of the mixture represented by the number of samples shall be made as further outlined in Subsection 502.12. No adjustment in the unit price shall be made for mixes being outside the limits on the flow for the average of the lot or the individual test result.

502.05 HANDLING OF AGGREGATES. Coarse and fine aggregates shall be stored at the plant in such a manner that the separate sizes will not become intermixed.

The aggregate screenings shall be stored at the plant in separate stockpiles.

When stockpiling, the material shall be placed in such a manner as to minimize segregation of aggregate sizes.

Blending of aggregates in stock piles or on the ground at the plant site shall not be permitted.

(a) Drying: The aggregate shall be heated and dried to provide a paving mix meeting the requirements of these specifications.

The quantity of the material fed through the drier shall, in all cases, be held to an amount which can be adequately heated and dried. In the event proper drying is not achieved and the quality of the mix is impaired the contractor shall adjust the rate of production of the drier, as required to obtain satisfactory results. The discharge chute of the drier and the discharge end of the asphalt line shall be equipped with pyrometric or thermometric devices, acceptable to the engineer, to assure that proper temperatures are being maintained.

(b) Screening: Aggregates shall be screened into sizes such that they may be recombined into a gradation meeting the requirements of the job mix formula.

(c) Hot Aggregate Storage: Hot screened aggregate shall be stored in bins as required in Subsection 501.07. Storage shall be accomplished in such a manner as to minimize segregation and loss of temperature of the aggregate. In the event the plant operation is interrupted and the temperature of the material in the hot storage cools to 25°F

Table V

Type of Mix	Acceptance Limits for Marshall Stability Average of: (Samples)				Control Limits for Flow Average of: (Samples)			
	4	3	2	1	4	3	2	1
Type 1, 2, 4								
AC-3, BC & WC	1200 Min.	1150 Min.	1050 Min.	900 Min.	15 Max.	15 Max.	15 Max.	18 Max.
AC-5, BC & WC	1100 Min.	1050 Min.	1000 Min.	800 Min.	15 Max.	15 Max.	15 Max.	18 Max.
Type 3								
AC-3 BC	1400 Min.	1350 Min.	1250 Min.	1050 Min.	15 Max.	15 Max.	15 Max.	18 Max.
AC-3 WC	1700 Min.	1600 Min.	1500 Min.	1250 Min.	15 Max.	15 Max.	15 Max.	18 Max.
Type 5 Base Course								
AC-3(A)	1200 Min.	1150 Min.	1050 Min.	900 Min.	15 Max.	15 Max.	15 Max.	18 Max.
AC-3(B)	800 Min.	750 Min.	700 Min.	600 Min.	15 Max.	15 Max.	15 Max.	18 Max.
*AC-5(B)	800 Min.	750 Min.	700 Min.	600 Min.	15 Max.	15 Max.	15 Max.	18 Max.
**Shoulder, BC & WC All types	1000 Min.	950 Min.	900 Min.	800 Min.	8-18	8-18	8-18	6-20

*AC-5 When used under concrete pavement and the mix will be tested using 50 blows of the compaction hammer.
**Shoulder mixes will be tested using 50 blows of the compaction hammer.

or more below the specified mixing temperature, the bins shall be pulled and the material discarded.

502.06 PREPARATION OF ASPHALT AND AGGREGATES. The asphalt and aggregate at the time of mixing shall be heated to a temperature of not less than 275°F and not more than 350°F.

The temperature of the bituminous mixtures, when discharged from the mixer shall be within the limits prescribed in Table II of Subsection 501.02.

The dried mineral aggregate for any of the various type mixtures shall be combined in the plant in the proportionate amount of each fraction of aggregate required to meet the job mix formula. The bituminous material shall be measured and introduced into the mixer. Prior to adding bituminous material, the combined mineral aggregate shall be thoroughly mixed dry, after which the proper amount of asphalt shall be sprayed over the mineral aggregate and mixed to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. The mixing time shall be submitted by the contractor in the job mix formula and approved by the engineer. Suitable locking means shall be provided for this regulation.

Aggregate contaminated with carbon or oil will be rejected.

502.07 TACK COAT. Before constructing each course, a tack of the width indicated on the plans shall be applied if needed at the rate specified by the engineer, but not to exceed 0.05 gallon per square yard. When the bituminous mixture is placed on an asphalt surface, the tack coat may be eliminated if directed. The responsibility for the protection of the tack coat shall rest with the contractor, and spot-patching required shall be made at no extra cost.

The tack coat shall meet the requirements of Section 503.

Asphaltic concrete shall not be applied on the bituminous surfaced or primed base until the surface or tack coat has completely cured to the satisfaction of the engineer.

In the event asphaltic concrete is to be placed on an aggregate type base course, the contractor shall use bituminous primer as described in Section 504 in lieu of the tack coat required herein.

In the event the primer has dried out or is otherwise

insufficient prior to laying the asphaltic concrete, the contractor shall, at his expense, re-prime the base or apply a light tack coat as directed; however, in any event, the primed surface shall be completely cured to the satisfaction of the engineer.

502.08 SPREADING AND FINISHING. Bituminous mixtures, heated and prepared as specified, shall be transported from the mixing plant to the site of the work as specified in Subsection 501.08. No loads shall be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight, unless artificial light is provided. The mixture shall be delivered at a temperature of not more than 25°F below the minimum allowable temperature of the mixture when discharged from the mixer as specified in Subsection 502.06.

The laying operations shall be conducted in the following manner:

(a) Coordination of Production: The contractor shall coordinate and manage the plant production, the transportation of the mix and the laying operation to achieve a high quality pavement. He shall have sufficient transporting vehicles to insure more or less continuous plant and roadway operation with a minimum idle time between loads. The Department reserves the right to order a halt to operation in the event sufficient hauling vehicles are not available. If less than the optimum number of hauling vehicles are available and it is determined that satisfactory quality can be obtained, the contractor will be permitted to work provided the plant production and the hauling vehicles are coordinated to minimize the effect of idle time between loads.

(b) Mechanical Spreaders: The spreaders used shall be approved self-powered and propelled spreading machines and shall be one of the two types: (1) the conventional mechanical spreader or (2) mechanical spreader with electronic screed and slope control devices used in conjunction with a 30-foot traveling stringline or with an erected stringline as specified by the plans, special provisions or as directed by the engineer.

The approved spreading machine shall be capable of spreading and finishing the base, binder and surface courses to required line, grade and cross section without

the use of forms or side supports. Finishing machines shall be operated so that material does not accumulate and remain along the sides of the receiving hopper. Screed shall be equipped with a suitable, controlled heating device to be be used as required.

In the event the spreading and finishing operation is interrupted for a period of time and some of the mixture remaining in the trucks, spreader, spreader hopper, and/or on the roadway cools to where it cannot be laid, finished and/or compacted to the same degree of smoothness and with the same texture and density as the un-cooled mixture, the cooled mixture shall be removed and replaced at the contractor's expense.

Heading (b) is expanded to include the following additional requirements for mechanical spreaders when electronic screed control is required.

(1) Electronic Screed Control with 30-Foot Traveling Stringline: The initial lane of each course to be laid, whether it be wearing, leveling, base, binder, or a combination of any of these courses, shall be constructed in the approximate lifts shown on the plans using the traveling stringline method; however, if field conditions warrant, the portion of the leveling course required to level isolated depressions may be placed without the electronic screed control device.

After the initial lane of each course is finished and compacted, the adjacent lane or lanes on that course shall be laid to the grade of the initial lane, using a small (approximately 6") shoe to control grade and controlling the cross slope with the slope control device.

If field conditions warrant, the traveling stringline may be used to control the grade of any adjacent lane on all courses with the exception of the final wearing course.

In cases where both of the outside edges of the lane being placed are flush with previously placed material, the slope device shall not be used.

When three or more contiguous lanes are to be constructed, the order of construction shall be as directed, and courses placed in lanes which are not adjacent to a lane previously placed with the traveling stringline shall be constructed using the traveling stringline.

In superelevated curves, the cross slope shall be changed from that specified for tangents to that specified for superelevation in gradual increments as the paver is in motion so that smooth transition in grade is obtained. This change in cross slope shall be accomplished within the transition distance specified.

(2) Electronic Screed Control with Erected Stringline: The initial lane of the first course to be laid, whether it be leveling, base, binder or a combination of any of the three, shall be controlled by an erected stringline referenced to grade stakes established by the engineer; however, if field conditions warrant, the portion of the leveling course required to level depressions may be placed without the electronic screed control device.

The paver shall be positioned and operated to closely follow the established line. Only one sensor and the slope control device are necessary for normal crown on tangents. Superelevated curves will require the use of two sensors and two erected stringlines to obtain proper grade and slope; however, if the electronic screed control device furnished by the contractor is equipped with a dial or other device which can be conveniently used to change the cross slope in small increments, superelevated curves may be constructed using this device and one erected stringline.

After the initial lane of the first course is finished and compacted, the adjacent lane or lanes on the first course will be laid to the grade of the inital lane, using a small (approximately 6″) shoe to control grade and controlling the cross slope with the slope control device.

If field conditions warrant, the traveling stringline may be used to control the grade of any adjacent lane on all courses with the exception of the final wearing course.

In superelevated curves, erected stringlines will be used to control the grade of the edge opposite the initial lane; however, if the electronic screed control device furnished by the contractor is equipped with a dial or other device which can be conveniently used to change the cross slope in small increments, superelevated curves may be constructed using this device and one erected stringline. Subsequent courses may be controlled by use of the traveling stringline attached to the

paver, provided all surface and grade tolerances are met on the previous course.

In cases where both of the outside edges of the lane being placed are flush with previously placed material, the slope device will not be used.

In cases where only one course is to be constructed in one lift, the first lane laid will be controlled by use of an erected stringline referenced to grade as described above. The adjacent lane or lanes will be controlled as described above.

When three or more contiguous lanes are to be constructed, the order of construction shall be as directed, and subsequent first course lanes which are not adjacent to a previously placed initial lane shall be considered an initial lane.

Transfer of the asphaltic mixture from the haul truck to the spreader may be made by direct unloading into the spreader hopper, by use of approved mechanical loading devices or by direct dumping on the pavement. When the mixture is dumped directly on the pavement, approved loading equipment will be used to transfer the mixture into the finishing machine, and the equipment shall be constructed and operated in such a manner that substantially all of the mixture deposited on the roadbed is picked up without contamination by foreign material. In any case, the equipment will be so designed and operated that the finishing machine will place the mixture to the required line, grade and surface without resorting to hand finishing. Any operation of the equipment resulting in the accumulation and subsequent shedding of this accumulated material into the asphaltic mixture will not be permitted.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operations, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface shall not be used.

Longitudinal joints and edges shall be constructed to reasonably true line markings. Lines shall be established by the engineer parallel to the centerline of the proposed roadway, and stringlines or other devices will be placed by the contractor for the paver to follow in placing individual lanes. The paver shall be positioned

and operated to closely follow the established line. In backing trucks against the spreader, care shall be taken not to jar the finisher out of its proper alignment. Delivery of material to the paver shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. The adjustment of the screed, tamping bars, feed screws, hopper feed, etc., shall be checked frequently to assure uniform spreading of the mix to the proper line and grade and adequate initial compaction. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

Longitudinal and transverse joints shall be formed as provided in Subsection 501.16.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Edges against which additional material is to be placed shall be reasonably formed to lines and approximately vertical. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed. Indented areas shall be filled with hot mix and finished reasonably smooth. Casting of material over the surface shall not be permitted whenever wearing course is being laid.

The outside edge of the freshly laid mixture shall be tamped behind the spreader prior to rolling to reasonably vertical edge whenever base or binder courses are being laid, and to approximately 45° beveled edge when the wearing courses are being laid.

In the event the spreading and finishing operation is interrupted for a period of time and some of the mixture remaining in the trucks, spreader, spreader hopper, loading equipment and/or on the roadway cools to where it cannot be laid, finished and/or compacted to

the same degree of smoothness and with the same texture and density as the uncooled mixture, the cooled mixture shall be removed and replaced at the contractor's expense.

(c) Hand Spreading: In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. Approved wood or steel forms, rigidly supported to assure reasonably correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross section. Placing by hand shall be performed carefully; the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregates. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed. Material that has formed into lumps and does not break down readily shall be rejected. Following placing and before rolling, the surface shall be checked and all irregularities corrected.

502.09 COMPACTION. After spreading and striking off and while still hot, each course shall be thoroughly and uniformly compacted by rolling.

The highest contact pressure that will give the required density will be used for the pneumatic roller.

The pneumatic-tire roller shall be kept approximately 6 inches from the unsupported center line joint when only one lane is in place. However, when both lanes are down, it shall be overlapped at least 6 inches to get additional sealing of the joint.

Additional rollers may be required as necessary to meet the compaction and smoothness requirements.

Rolling shall be conducted in such sequence and by methods that will obtain the specified density and smoothness requirements. Each roller shall be operated by a competent, experienced operator and, while the work is under way, shall be kept as nearly as practicable in continuous operation.

The motion of the roller at all times shall be slow enough to avoid displacement of the hot mixture. Any displacement occurring as a result of the reversing of the direction of the roller or from any other causes shall be immediately corrected. To prevent adhesion of the mixture to the roller, the

wheels shall be kept properly moistened, but excess water will not be permitted.

Along forms, curbs, headers and walls and at other places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers or with mechanical tampers to obtain a satisfactory density.

The surface of the mixture after compaction shall be smooth and true to the established crown and grade within the tolerances specified. Any mixture that becomes loose, broken, contaminated or in any way defective shall be removed and replaced with fresh hot mixture which shall be immediately compacted to conform with the surrounding area.

Rolling shall continue until all roller marks are eliminated. Upon completion of the rolling procedure, five pavement samples shall be obtained from each compacted lot at locations determined in accordance with the stratified random sampling plan within 24 hours after placement of the mix. In the event this falls on a day the contractor's crews are not working then the sampling will be done the following day. A lot shall be considered as the number of linear feet of mix laid during the day's operation. The linear feet laid during the day shall be subdivided into five sections of approximately equal length and one sample shall be obtained from each of the five sections using random number tables. In no event will the number of samples representing a full day's production or a fraction thereof be less than five. The density requirement for individual samples and for the average of five samples shall be as prescribed in Table VI when determined in accordance with LDH Designation: TR 304.

Payment will be made as outlined in Subsection 502.12 of these specifications. No adjustment in the unit price will be made for density tests outside the limits for individual test.

In the event the sampling location as determined by random sampling procedures indicates obvious bad spots that are to be replaced or falls within two feet of the edge of the pavement, then an additional sampling location shall be determined and used. Any section that is obviously bad and may be detrimental to the roadway shall be corrected or replaced regardless of whether it was selected by random or visual observation.

Table VI

Type of Mix	Acceptance Limits Average 5 Samples	Control Limits Individual Samples
Traffic Lanes..... 1 and 4	95% min. of briq. density	92% min. of briq. density (75 blows)
Traffic Lanes..... 2	92% min. of briq. density	89% min. of briq. density (75 blows)
Traffic Lanes..... 3-WC & BC	95% min. of briq. density	92% min. of briq. density (75 blows)
Traffic Lanes..... 5 A	95% min. of briq. density	92% min. of briq. density (75 blows)
Traffic Lanes..... 5 B	95% min. of briq. density	*92% min. of briq. density (75 blows)
Shoulders ..... 1, 2, 3 & 4	94% min. of briq. density	91% min. of briq. density (50 blows)

*When Type 5 B is to be placed under concrete pavement, briquette density will be obtained by 50 blows of the compaction hammer.

502.10 PROTECTION OF PAVEMENT. Sections of newly finished pavement shall be protected from traffic until the pavement has sufficiently hardened.

502.11 METHOD OF MEASUREMENT. Measurements will be made by one of the following methods as indicated.

(a) Weight Measurements: Aggregates inclusive of mineral filler, and asphalt will be measured by the ton of 2,000 pounds.

When the mixture is produced in a batch plant, measurement of aggregates and asphalt total weight will be determined from the printed weights as provided in Subsection 501.07, Part A, Paragraph 10.

When the mixture is produced in a continuous mixing plant, measurement of the composite mix will be determined from the printed weights as provided in Subsection 501.07, Part B, Paragraph 9.

When the mixture is supplied from storage silos and surge bins, measurement will be determined from the printed weights as provided in Subsection 501.07, Part C, Paragraph 4.

Haul tickets will be issued for each truck load of material delivered. Material lost, wasted, rejected or applied contrary to these specifications will not be measured for payment.

The estimated quantities shown on the plans and in the proposal are based on Type 1 or Type 3 mixes. Should the contractor elect to use any of the other allowable mix types, as shown on the plans, the quantity actually used will be measured and such quantity multiplied by the factor given below for the type used to obtain the quantity for payment.

Type 1, 2 (Clam Shell) and 3	1.000
Type 2 (Reef Shell)	1.039
Type 4	1.325
Type 5	The appropriate factor for the type of aggregate selected.

The aggregate components for each type mixture may vary due to possible variations in specific gravity. No adjustment will be made for aggregate quantity variation inside the type mixture used.

When a combination of clam shell and reef shell are used for the Type 2 mixture the factor used will be 1.000.

(b) Net Section Measurements: Aggregates inclusive of mineral filler and asphalt will be measured by the cubic yard (net section) as indicated on the plans. Measurements will be based on the typical sections shown on the plans and the length will be measured along the surface at the center line of each roadway. Bituminous mixtures for turnouts, ramps, and other irregular sections, if required on the plans, will be calculated volume as constructed and determined by the engineer.

Shoulders, when shown on the plans to be separate from the roadway, will be measured by the cubic yard (net section) from dimensions shown on the plans; however, the actual length of the completed shoulders will be measured along the edge of shoulder adjacent to the roadway travel lane.

502.12 BASIS OF PAYMENT. The accepted quantity of asphaltic concrete will be paid for at the contract unit price per unit of measurement on a lot basis.

Whenever the mix does not conform to the requirements

for acceptance of mixes as provided in Subsections 501.18, 502.04 and 502.09, payment will be made at an adjusted unit price per unit of measurement of asphaltic concrete in accordance with the following.

(a) Adjustment for Stability: When the mix is to be accepted on the basis of the average of four, three, two or one Marshall Stability test results, then the payment per unit price shall be made as outlined in Schedule No. 1-A, 1-B, 1-C, or 1-D respectively for the lot.

(b) Adjustment for Roadway Density: For roadway density, the payment per unit price shall be adjusted as in Schedule No. 2 for the average of five samples in a lot.

(c) Adjustment for Surface Tolerance: For surface tolerances, when measured by a 10 foot rolling straight edge, the payment per unit price shall be adjusted as in Schedule No. 3 for the lot.

(d) Final Adjustment in Unit Price Per Lot:

(1) Wearing Course Mixes: The lower percent of contract price shall be used for final adjustment in unit price for mixes deficient in Marshall Stability, roadway density and surface tolerances.

(2) Base, Binder and Shoulder Mixes: The lower percent of contract price shall be used for final adjustment in unit price for mixes deficient in Marshall Stability and roadway density.

Surface tolerances for base, binder and shoulder mixes will be controlled in accordance with Subsection 501.18 for job control testing.

(e) Asphalt Cement: In addition to the price adjustment for the mix, if the asphalt cement furnished does not conform to the specifications, then the final test results for asphalt cement will be applied to the appropriate schedule of Section 902 for Bituminous Materials for price adjustments and an adjustment in unit price shall be made as specified.

Payment will be made under:

Item No.	Pay Item	Pay Unit
502(5)	Asphaltic Concrete (Type _____) (_____ Course)	Ton
502(6)	Asphaltic Concrete (Net Section) (Type _____) (_____ Course)	Cubic Yard

Schedule No. 1

ADJUSTMENT IN BID PRICE PER UNIT OF MEASUREMENT FOR MARSHALL STABILITY

Type 1, 2, 4 WC, BC Type 5A Base AC-3	Type 1, 2, 4 WC, BC AC-5	Type 3 Binder AC-3	Type 3 Wearing AC-3	Type 5B AC-3 or AC-5	Shoulder Mix AC-5	Percent of Contract Unit Price/Per Lot
A	Average of Four Marshall Stability Results					
1200 & higher	1100 & higher	1400 & higher	1700 & higher	800 & higher	1000 & higher	100% Payment
1100 to 1199	1000 to 1099	1300 to 1399	1550 to 1699	750 to 799	900 to 999	95% Payment
1000 to 1099	900 to 999	1150 to 1299	1350 to 1549	700 to 749	800 to 899	80% Payment
Below 1000	Below 900	Below 1150	Below 1350	Below 700	Below 800	50% or Remove
B	Average of Three Marshall Stability Results					
1150 & higher	1050 & higher	1350 & higher	1600 & higher	750 & higher	950 & higher	100% Payment
1100 to 1149	1000 to 1049	1300 to 1349	1525 to 1599	700 to 749	900 to 949	95% Payment
1000 to 1099	900 to 999	1150 to 1299	1350 to 1524	650 to 699	850 to 899	80% Payment
Below 1000	Below 900	Below 1150	Below 1350	Below 650	Below 850	50% or Remove
C	Average of Two Marshall Stability Results					
1050 & higher	1000 & higher	1250 & higher	1500 & higher	700 & higher	900 & higher	100% Payment
1000 to 1049	950 to 999	1200 to 1249	1425 to 1499	650 to 699	850 to 899	95% Payment
900 to 999	800 to 949	1050 to 1199	1250 to 1424	600 to 649	800 to 849	80% Payment
Below 900	Below 800	Below 1050	Below 1250	Below 600	Below 800	50% or Remove
D	One Marshall Stability Test Result					
900 & higher	800 & higher	1050 & higher	1250 & higher	600 & higher	800 & higher	100% Payment
Below 900	Below 800	Below 1050	Below 1250	Below 600	Below 800	50% or Remove

Schedule No. 2

ADJUSTMENT IN BID PRICE PER UNIT OF MEASUREMENT FOR ROADWAY DENSITY

Average of Five Roadway Samples				
Type 1, 4, 5B	Type 3 WC & BC Type 5A	Type 2 WC & BC	Shoulder Mix	Percent of Contract Unit Price/Per Lot
95 & higher	95 & higher	92 & higher	94 & higher	100% Payment
94 to 94.9%	94 to 94.9%	90 to 91.9%	93 to 93.9%	95% Payment
92 to 93.9%	92 to 93.9%	89 to 89.9%	91 to 92.9%	80% Payment
Below 92%	Below 92%	Below 89%	Below 91%	50% or Remove

Schedule No. 3

ADJUSTMENT IN BID PRICE PER UNIT OF MEASUREMENT FOR SURFACE TOLERANCE

Linear Percent of Sample Exceeding Surface Tolerance		Percent of Contract Unit Price/Per Lot
1/8" Tolerance*	3/16" Tolerance*	
0.0 to 1.0	0.0 to 0.50	100% Payment
1.1 to 1.5	0.51 to 0.75	95% Payment
1.6 to 2.5	0.76 to 1.5	80% Payment
2.6 or More	1.6 or More	50% or Remove

*The individual surface tolerance requirements for various types ofmixes are given in Subsection 501.18.

Section 503

Tack Coat

503.01 DESCRIPTION. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the engineer.

503.02 BITUMINOUS MATERIAL. The tack coat may be either cutback asphalt, Grade RC-70 or RC-250, or emulsified asphalt, Grade SS-1h, SS-1, EA-4, RS-1 or RS-2, as the contractor elects.

The bituminous material shall meet the applicable requirements of Section 902, Bituminous Materials.

503.03 EQUIPMENT. The contractor shall provide equipment for heating and applying the bituminous material and for the proper preparation of the surface to be treated. The equipment shall meet the applicable requirements of Subsection 501.11.

CONSTRUCTION REQUIREMENTS

503.04 PREPARATION OF SURFACE TO BE TREATED. The existing surface shall be cleaned by sweeping or by other approved methods. The edges of existing pavements which are adjacent to the new pavement shall be cleaned to permit the adhesion of the bituminous material.

503.05 APPLICATION OF BITUMINOUS MATERIAL. The bituminous material shall be uniformly applied with a pressure distributor at a rate not to exceed 0.05 gallon per square yard.

The tack coat shall not be applied on a wet surface or when the temperature is below 40°F, or after sunset. The rate of application, temperature of the bituminous material and the areas to be treated shall be approved prior to application.

The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic.

503.06 METHOD OF MEASUREMENT. The number

of gallons of bituminous tack coat placed and accepted will be measured in the distributor by the gallon of 231 cubic inches. Measurement shall be converted to gallonage at 60°F in accordance with Temperature-Volume Correction, Table II, given in Subsection 504.08, or Table II given in Subsection 505.11.

503.07 BASIS OF PAYMENT. The accepted quantities of tack coat will be paid for at the contract unit price per gallon for bituminous material complete in place, except as follows.

If the bituminous material does not conform to the specifications, then the final test results taken at the point of delivery will be applied to the appropriate schedule of Section 902 for price adjustment, and any adjustment in unit price shall be made as specified. If the test results are such that a penalty would result from more than one of the test values, only the price adjustment for the greatest reduction will apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
503(1)	Bituminous Tack Coat	Gallon

Section 504

Prime Coat

504.01 DESCRIPTION. This work shall consist of treating a prepared or existing surface with bituminous material in accordance with these specifications and in reasonably close conformity with lines shown on the plans or established by the engineer.

504.02 BITUMINOUS MATERIAL. The bituminous material used as a prime coat shall be Grade MC-30 or Grade MC-70 Cutback Asphalt, as directed. Cutback asphalt used as a prime coat shall meet the applicable requirements of Section 902, Bituminous Material.

CONSTRUCTION REQUIREMENTS

504.03 WEATHER LIMITATIONS. Bituminous materials shall not be applied on a wet base nor when the temperature of the air is less than 60°F in the shade.

504.04 EQUIPMENT. The contractor shall provide equipment for heating and applying the bituminous material. The equipment shall meet the requirements of Subsection 505.05.

504.05 PREPARATION OF SURFACE. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be compacted to the required density.

Delays in priming will necessitate reprocessing or reshaping to provide a smooth compacted surface.

504.06 APPLICATION OF BITUMINOUS MATERIAL. The primer shall be applied to the prepared base and shall extend 6 inches beyond the width of surfacing shown on the plans. The bituminous primer shall not be applied until the base has been satisfactorily compacted and bonded, and then only when the surface has been properly swept and is firm, compact and dry. The method of application shall be the same as provided under Subsection 505.07. If the course is to be constructed on an existing pavement,

the pavement shall be be primed if so indicated on the plans or directed.

When the prepared base consists of soil cement base or stabilized aggregate base course and where the protective coating of emulsified asphalt has become worn or is otherwise insufficient., the contractor will be required to spot-prime the base course as directed or the prime coat may be reduced or deleted.

The prime coat shall be maintained intact and if required, the primed surface shall be thoroughly cleaned prior to the application of the wearing surface.

Where the prime coat has failed or depressions have occurred, the failure shall be swept clean, brushcoated with cutback asphalt and refilled with a satisfactory bituminous mixture. If the prime coat is generally unsatisfactory, the contractor shall be required to reprime the unsatisfactory surface.

The prime coat shall be applied at the rates and temperatures shown in Table I below. Quantities of bituminous primer shall not vary from that shown in Table I by more than 5 percent, unless otherwise provided herein.

Table I

BITUMINOUS PRIMERS

Prime Application Grade	Primer (Gal. Per Sq. Yd.) Min.	Max.	Temperature of Application Min.	Max.
MC-30	0.25	0.3	60°F	120°F
MC-70	0.25	0.3	100°F	180°F

Temperature-Volume data for asphaltic materials shall be taken from tables as contained in Subsection 504.08, Table II.

504.07 PROTECTION. After the prime coat has been applied, unless it is impractical to detour highway traffic, the contractor shall keep all traffic off the road until the bitmuinous material has properly cured.

In cases where traffic is permitted, the contractor may be required, at his expense, to spread the minimum necessary

amount of approved granular material over the bituminous primer.

504.08 METHOD OF MEASUREMENT. The number of gallons of bituminous primer placed and accepted will be measured by the gallon of 231 cubic inches and shall be measured in the distributor. Measurement shall be converted to gallonage at 60°F in accordance with Temperature-Volume Correction, Table II.

Table II

TEMPERATURE-VOLUME CORRECTIONS FOR ASPHALTIC MATERIALS

Group 1 — Specific Gravity at 60°F of 0.850 to 0.966
Legend: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
0	1.0241	42	1.0072	84	0.9905	126	0.9740	168	0.9578
1	1.0237	43	1.0068	85	0.9901	127	0.9736	169	0.9574
2	1.0233	44	1.0064	86	0.9897	128	0.9732	170	0.9570
3	1.0229	45	1.0060	87	0.9893	129	0.9728	171	0.9566
4	1.0225	46	1.0056	88	0.9889	130	0.9725	172	0.9562
5	1.0221	47	1.0052	89	0.9885	131	0.9721	173	0.9559
6	1.0217	48	1.0048	90	0.9881	132	0.9717	174	0.9555
7	1.0213	49	1.0044	91	0.9877	133	0.9713	175	0.9551
8	1.0209	50	1.0040	92	0.9873	134	0.9709	176	0.9547
9	1.0205	51	1.0036	93	0.9869	135	0.9705	177	0.9543
10	1.0201	52	1.0032	94	0.9865	136	0.9701	178	0.9539
11	1.0197	53	1.0028	95	0.9861	137	0.9697	179	0.9536
12	1.0193	54	1.0024	96	0.9857	138	0.9693	180	0.9532
13	1.0189	55	1.0020	97	0.9854	139	0.9690	181	0.9528
14	1.0185	56	1.0016	98	0.9850	140	0.9686	182	0.9524
15	1.0181	57	1.0012	99	0.9846	141	0.9682	183	0.9520
16	1.0177	58	1.0008	100	0.9842	142	0.9678	184	0.9517
17	1.0173	59	1.0004	101	0.9838	143	0.9674	185	0.9513
18	1.0168	60	1.0000	102	0.9834	144	0.9670	186	0.9509
19	1.0164	61	0.9996	103	0.9830	145	0.9666	187	0.9505
20	1.0160	62	0.9992	104	0.9826	146	0.9662	188	0.9501
21	1.0156	63	0.9988	105	0.9822	147	0.9659	189	0.9498
22	1.0152	64	0.9984	106	0.9818	148	0.9655	190	0.9494
23	1.0148	65	0.9980	107	0.9814	149	0.9651	191	0.9490
24	1.0144	66	0.9976	108	0.9810	150	0.9647	192	0.9486
25	1.0140	67	0.9972	109	0.9806	151	0.9643	193	0.9482
26	1.0136	68	0.9968	110	0.9803	152	0.9639	194	0.9478
27	1.0132	69	0.9964	111	0.9799	153	0.9635	195	0.9475
28	1.0128	70	0.9960	112	0.9795	154	0.9632	196	0.9471
29	1.0124	71	0.9956	113	0.9791	155	0.9628	197	0.9467
30	1.0120	72	0.9952	114	0.9787	156	0.9624	198	0.9463
31	1.0116	73	0.9948	115	0.9783	157	0.9620	199	0.9460
32	1.0112	74	0.9944	116	0.9779	158	0.9616	200	0.9456
33	1.0108	75	0.9940	117	0.9775	159	0.9612	201	0.9452
34	1.0104	76	0.9936	118	0.9771	160	0.9609	202	0.9448
35	1.0100	77	0.9932	119	0.9767	161	0.9605	203	0.9444
36	1.0096	78	0.9929	120	0.9763	162	0.9601	204	0.9441
37	1.0092	79	0.9925	121	0.9760	163	0.9597	205	0.9437
38	1.0088	80	0.9921	122	0.9756	164	0.9593	206	0.9433
39	1.0084	81	0.9917	123	0.9752	165	0.9589	207	0.9429
40	1.0080	82	0.9913	124	0.9748	166	0.9585	208	0.9425
41	1.0076	83	0.9909	125	0.9744	167	0.9582	209	0.9422

Table II (Continued)

Group 1 — Specific Gravity at 60°F of 0.850 to 0.966
Legend: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
210	0.9418	268	0.9201	326	0.8989	384	0.8781	442	0.8578
211	0.9414	269	0.9197	327	0.8985	385	0.8777	443	0.8574
212	0.9410	270	0.9194	328	0.8981	386	0.8774	444	0.8571
213	0.9407	271	0.9190	329	0.8978	387	0.8770	445	0.8567
214	0.9403	272	0.9186	330	0.8974	388	0.8767	446	0.8564
215	0.9399	273	0.9182	331	0.8971	389	0.8763	447	0.8560
216	0.9395	274	0.9179	332	0.8967	390	0.8760	448	0.8557
217	0.9391	275	0.9175	333	0.8963	391	0.8756	449	0.8554
218	0.9388	276	0.9171	334	0.8960	392	0.8753	450	0.8550
219	0.9384	277	0.9168	335	0.8956	393	0.8749	451	0.8547
220	0.9380	278	0.9164	336	0.8952	394	0.8746	452	0.8543
221	0.9376	279	0.9160	337	0.8949	395	0.8742	453	0.8540
222	0.9373	280	0.9157	338	0.8945	396	0.8738	454	0.8536
223	0.9369	281	0.9153	339	0.8942	397	0.8735	455	0.8533
224	0.9365	282	0.9149	340	0.8938	398	0.8731	456	0.8529
225	0.9361	283	0.9146	341	0.8934	399	0.8728	457	0.8526
226	0.9358	284	0.9142	342	0.8931	400	0.8724	458	0.8522
227	0.9354	285	0.9138	343	0.8927	401	0.8721	459	0.8519
228	0.9350	286	0.9135	344	0.8924	402	0.8717	460	0.8516
229	0.9346	287	0.9131	345	0.8920	403	0.8714	461	0.8512
230	0.9343	288	0.9127	346	0.8916	404	0.8710	462	0.8509
231	0.9339	289	0.9124	347	0.8913	405	0.8707	463	0.8505
232	0.9335	290	0.9120	348	0.8909	406	0.8703	464	0.8502
233	0.9331	291	0.9116	349	0.8906	407	0.8700	465	0.8498
234	0.9328	292	0.9113	350	0.8902	408	0.8696	466	0.8495
235	0.9324	293	0.9109	351	0.8899	409	0.8693	467	0.8492
236	0.9320	294	0.9105	352	0.8895	410	0.8689	468	0.8488
237	0.9316	295	0.9102	353	0.8891	411	0.8686	469	0.8485
238	0.9313	296	0.9098	354	0.8888	412	0.8682	470	0.8481
239	0.9309	297	0.9094	355	0.8884	413	0.8679	471	0.8478
240	0.9305	298	0.9091	356	0.8881	414	0.8675	472	0.8474
241	0.9301	299	0.9087	357	0.8877	415	0.8672	473	0.8471
242	0.9298	300	0.9083	358	0.8873	416	0.8668	474	0.8468
243	0.9294	301	0.9080	359	0.8870	417	0.8665	475	0.8464
244	0.9290	302	0.9076	360	0.8866	418	0.8661	476	0.8461
245	0.9286	303	0.9072	361	0.8863	419	0.8658	477	0.8457
246	0.9283	304	0.9069	362	0.8859	420	0.8654	478	0.8454
247	0.9279	305	0.9065	363	0.8856	421	0.8651	479	0.8451
248	0.9275	306	0.9061	364	0.8852	422	0.8647	480	0.8447
249	0.9272	307	0.9058	365	0.8848	423	0.8644	481	0.8444
250	0.9268	308	0.9054	366	0.8845	424	0.8640	482	0.8440
251	0.9264	309	0.9050	367	0.8841	425	0.8637	483	0.8437
252	0.9260	310	0.9047	368	0.8838	426	0.8633	484	0.8433
253	0.9257	311	0.9043	369	0.8834	427	0.8630	485	0.8430
254	0.9253	312	0.9039	370	0.8831	428	0.8626	486	0.8427
255	0.9249	313	0.9036	371	0.8827	429	0.8623	487	0.8423
256	0.9245	314	0.9032	372	0.8823	430	0.8619	488	0.8420
257	0.9242	315	0.9029	373	0.8820	431	0.8616	489	0.8416
258	0.9238	316	0.9025	374	0.8816	432	0.8612	490	0.8413
259	0.9234	317	0.9021	375	0.8813	433	0.8609	491	0.8410
260	0.9231	318	0.9018	376	0.8809	434	0.8605	492	0.8406
261	0.9227	319	0.9014	377	0.8806	435	0.8602	493	0.8403
262	0.9223	320	0.9010	378	0.8802	436	0.8599	494	0.8399
263	0.9219	321	0.9007	379	0.8799	437	0.8595	495	0.8396
264	0.9216	322	0.9003	380	0.8795	438	0.8592	496	0.8393
265	0.9212	323	0.9000	381	0.8792	439	0.8588	497	0.8389
266	0.9208	324	0.8996	382	0.8788	440	0.8585	498	0.8386
267	0.9205	325	0.8992	383	0.8784	441	0.8581	499	0.8383

504.09 BASIS OF PAYMENT. The accepted quantities of prime coat will be paid for at the contract price per gallon complete in place, except as follows.

If the bituminous material does not conform to the specifications, then the final test results for the bituminous material taken at the point of delivery will be applied to the appropriate schedule of Section 902 for price adjustment, and any adjustment in unit price shall be made as specified. If the test results are such that a penalty would result from more than one of the test values, only the price adjustment for the greatest reduction will apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
504(1)	Bituminous Prime Coat	Gallon

Section 505

Bituminous Surface Treatment

505.01 DESCRIPTION. This item shall consist of a wearing surface of mineral aggregate and bituminous materials constructed on a prepared base course or on an existing pavement, as the case may be, in accordance with these specifiications and in reasonably close conformity with the lines, grades and typical cross sections shown on the plans or established by the engineer.

Bituminous surface treatment shall consist of the number of applications of each of the specificed sizes of mineral aggregate and the specificed bituminous material, all as indicated on the plans or in the special provisions.

505.02 BITUMINOUS MATERIAL. The bituminous material shall be grade AC-8, Asphalt Cement and shall meet the applicable requirements of Section 902 of these specifications.

505.03 AGGREGATES. Aggregates shall be uncrushed gravel, crushed aggregate composed of crushed gravel, crushed slag or expanded clay aggregate. Aggregates shall meet the requirements of Subsection 903.06 for sizes specified.

CONSTRUCTION REQUIREMENTS

505.04 WEATHER LIMITATIONS. Bituminous materials shall not be applied on a wet base nor when the temperature of the air is less than 60°F in the shade.

Bituminous materials shall not be applied during the calendar months of November, December, January and February, unless otherwise approved in writing by the Chief Engineer. When approved, one of the following additional requirements shall be met during these referenced months.

(a) All aggregates to be spread shall be mechanically dried and placed in a surface dry condition. The project may then be accepted when all work is complete.

(b) If bituminous materials are placed during the above referenced months without mechanically drying aggre-

gates, the contractor shall be responsible for the project, and the final inspection will not be made until such time after March 1st equal to the time that was actually required to place the surface treatment.

505.05 EQUIPMENT. All equipment for the proper construction of this work shall be in first-class working condition and shall have been approved before construction begins. The equipment shall be maintained in a satisfactory working condition.

The equipment outfit used by the contractor shall be made up of the following units:

(a) A piece of 2 inch diamond mesh chain link fence approximately 10 feet by 15 feet shall be used for dragging operation or broom dragging equipment capable of covering ⅓ to ½ the width of the treatment.

(b) Power distributor shall be in accordance with Subsection 501.11.

(c) Power rollers shall be self-propelled steel wheel rollers or self-propelled pneumatic tire rollers.
The steel wheel rollers may be three wheel type, but tandem type is preferred. The weight of rollers shall not be less than 5 tons nor more than 10 tons.

Pneumatic rollers shall be self-propelled with wheels mounted on 2 axles in such a manner that the rear tires will not follow in the tracks of the forward group. The rollers shall be capable of applying a minimum of 50 psi contact or ground pressure under each tire and shall be of such weight that no damage is caused to the base course or surface treatment.

(d) Power revolving broom or a power blower.

(e) The spreader required shall be an approved self-propelled, pneumatic-tired power spreader, so designed, equipped and operated that the aggregate will be spread uniformly at the designated rate with the application being defined at the edges, or other equipment approved by the engineer.

All storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling bituminous materials shall be kept clean and in good operating condition at all times and shall be operated

in such manner as to avoid any possible contamination of the contents with foreign materials.

505.06 QUANTITIES OF MATERIAL. The quantities of materials per square yard, application temperatures and the sequence of application and spreading for the bituminous surfacing as specified shall be as shown in Table I, unless otherwise directed.

Table I

QUANTITIES OF MATERIAL PER SQUARE YARD

	Gal. of Asphalt at 60°F	Cubic Yards of Aggregate		
	Asphalt Cement	Size 1 Coarse	Size 2 Fine	Size 3 Seal
First Application	0.4			
Spreading		.0200		
Second Application	0.3			
Spreading			.0111	
Third Application	0.2			
Spreading				.0075
Totals	0.9	.0200	.0111	.0075

Temperature of Application	Minimum	Maximum
Asphalt Cement (AC-8)	275°F	350°F

The quantities shown in Table I are approximate only. The actual quantities used shall be as directed by the engineer. Any aggregates spread in excess of 5 percent over the quantity specified by the engineer, per square yard, will not be considered for payment on a cubic yard basis.

The quantities of bituminous material per square yard of treated surface as shown in Table I are based on a temperature of 60°F. All volumetric measurements shall be converted to this temperature in accordance with Table II, Subsection 505.11.

505.07 APPLICATION OF BITUMINOUS MATERIALS. After the prime coat, when required, has been satisfactorily

cured, bituminous material and aggregate shall be applied in the amounts and in the sequence herein specified.

The length of spread of the bituminous material shall not exceed that which can be covered immediately with the aggregate material.

Bituminous material for each application shall be applied uniformly for the full width of the treatment unless, due to the impracticability of detouring highway traffic, the engineer directs that the material be applied to ½ of the roadway at one time. If the contractor should be unable to keep the application of bituminous material consistently within 5 percent of the quantity specified, he shall discontinue operations until he can provide an operator of greater experience or a better distributor, or both, or shall provide such precautions as may be necessary to keep the applications within the allowable variations.

If one or more nozzles should become blocked during the application of the bituminous materials, the distributor shall be stopped immediately and the nozzle or nozzles cleaned out. When the engineer directs that application be made over ½ width of the roadway at one time, all of the nozzles, except the one towards the outside of the roadway, shall have the same size opening; and care shall be taken to see that there is a slight longitudinal overlapping of the 2 applications along the center line of the road, so as to assure complete coverage. The distributor shall be operated along a marked edge in order to keep the surface treatment in a straight line.

In order to secure uniform distribution at the junction of 2 applications, the distributor shall be promptly stopped when the uniform flow decreases, indicating the tank is nearly empty. Building paper shall be placed over the end of the previous application, and the joining application shall start on the building paper. The building paper so used shall be removed and disposed of in a satisfactory manner; however, burning of the building paper will not be permitted on areas that have been recently seeded or sodded, or on any other grassy area within the limits of the right-of-way.

During the application of bituminous material, care shall be taken to prevent spattering adjacent pavements, struc-

tures and trees. The distributor shall not be cleaned or discharged into ditches, borrow pits, on the shoulders or along the right of way.

Any excess of bituminous material at the junction between distributor loads shall be removed and corrected in a satisfactory manner, and any parts of the surface to be treated which are not covered with bituminous materials directly from the distributor shall be covered by means of a hand hose equipped with nozzles or by hand pouring pot.

The contractor is hereby cautioned to exercise extreme care in heating bituminous material to temperatures above flash points for the various types of asphalt.

505.08 SPREADING COVER MATERIAL. The aggregate material shall be uniformly spread over the full width of bituminous material with one or more passes of spreading equipment with the application being sharply defined at the edges. The equipment shall not be driven on the uncovered asphalt. If necessary to obtain uniform coverage, the surface shall be dragged or broomed.

Hand spreading by experienced workmen will be permitted in conjunction with the self-propelled spreaders over areas inaccessible to the spreaders.

505.09 ROLLING COVER MATERIAL. Immediately after spreading and brooming or dragging the cover material, the entire surface shall be rolled with a power roller. Rolling shall proceed in a longitudinal direction, beginning at the outer edges of the treatment and progressing toward the center, each trip overlapping the prior trip about ½ the width of the roller. The first rolling shall be completed within ½ hour after the cover material has been spread. During rolling, the previously spread cover material shall be uniformly broomed or dragged and placed where necessary in such quantity as to completely cover the bituminous surface. Rolling, dragging or brooming and spotting of additional cover material shall be continued until uniform coverage has been obtained. The remaining courses shall be rolled the same as specified for the first course and shall not be placed until the previous course is surface dry.

505.10 PROTECTION. Traffic should not be allowed to use the road, unless otherwise provided, until the final application has been placed and thoroughly rolled.

After the application of the cover coat material, the surface where specified shall be lightly broomed or otherwise maintained for a period of 4 days or as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material, covering any area deficient in cover coat material, and an additional rolling. The maintenance shall be conducted so as not to displace imbedded material. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the engineer.

505.11 METHOD OF MEASUREMENT. The quantities of aggregate and bituminous material incorporated in the completed and accepted bituminous surface treatment will be measured separately. Aggregate will be measured by the cubic yard and bituminous material will be measured by the gallon.

The number of cubic yards of aggregate placed and accepted shall be determined by measurement in vehicles at the point of placing on the road.

The number of gallons of bituminous material placed and accepted will be measured by the gallon of 231 cubic inches and shall be measured in the distributor. Measurement shall be made at a temperature of 60°F, or converted to gallonage at 60°F in accordance with the following table (Table II).

Table II

TEMPERATURE-VOLUME CORRECTIONS FOR ASPHALTIC MATERIALS

Group 0—Specific Gravity at 60° F above 0.966
Legend: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
0	1.0211	57	1.0010	114	0.9813	171	0.9618	228	0.9426
1	1.0208	58	1.0007	115	0.9809	172	0.9614	229	0.9422
2	1.0204	59	1.0003	116	0.9806	173	0.9611	230	0.9419
3	1.0201	60	1.0000	117	0.9802	174	0.9607	231	0.9416
4	1.0197	61	0.9997	118	0.9799	175	0.9604	232	0.9412
5	1.0194	62	0.9993	119	0.9795	176	0.9601	233	0.9409
6	1.0190	63	0.9990	120	0.9792	177	0.9597	234	0.9405
7	1.0186	64	0.9986	121	0.9788	178	0.9594	235	0.9402
8	1.0183	65	0.9983	122	0.9785	179	0.9590	236	0.9399
9	1.0179	66	0.9979	123	0.9782	180	0.9587	237	0.9395
10	1.0176	67	0.9976	124	0.9778	181	0.9584	238	0.9392
11	1.0172	68	0.9972	125	0.9775	182	0.9580	239	0.9389
12	1.0169	69	0.9969	126	0.9771	183	0.9577	240	0.9385
13	1.0165	70	0.9965	127	0.9768	184	0.9574	241	0.9382
14	1.0162	71	0.9962	128	0.9764	185	0.9570	242	0.9379
15	1.0158	72	0.9958	129	0.9761	186	0.9567	243	0.9375
16	1.0155	73	0.9955	130	0.9758	187	0.9563	244	0.9372
17	1.0151	74	0.9951	131	0.9754	188	0.9560	245	0.9369
18	1.0148	75	0.9948	132	0.9751	189	0.9557	246	0.9365
19	1.0144	76	0.9944	133	0.9747	190	0.9553	247	0.9362
20	1.0141	77	0.9941	134	0.9744	191	0.9550	248	0.9359
21	1.0137	78	0.9937	135	0.9740	192	0.9547	249	0.9356
22	1.0133	79	0.9934	136	0.9737	193	0.9543	250	0.9352
23	1.0130	80	0.9930	137	0.9734	194	0.9540	251	0.9349
24	1.0126	81	0.9927	138	0.9730	195	0.9536	252	0.9346
25	1.0123	82	0.9923	139	0.9727	196	0.9533	253	0.9342
26	1.0119	83	0.9920	140	0.9723	197	0.9530	254	0.9339
27	1.0116	84	0.9916	141	0.9720	198	0.9526	255	0.9336
28	1.0112	85	0.9913	142	0.9716	199	0.9523	256	0.9332
29	1.0109	86	0.9909	143	0.9713	200	0.9520	257	0.9329
30	1.0105	87	0.9906	144	0.9710	201	0.9516	258	0.9326
31	1.0102	88	0.9902	145	0.9706	202	0.9513	259	0.9322
32	1.0098	89	0.9899	146	0.9703	203	0.9509	260	0.9319
33	1.0095	90	0.9896	147	0.9699	204	0.9506	261	0.9316
34	1.0091	91	0.9892	148	0.9696	205	0.9503	262	0.9312
35	1.0088	92	0.9889	149	0.9693	206	0.9499	263	0.9309
36	1.0084	93	0.9885	150	0.9689	207	0.9496	264	0.9306
37	1.0081	94	0.9882	151	0.9686	208	0.9493	265	0.9302
38	1.0077	95	0.9878	152	0.9682	209	0.9489	266	0.9299
39	1.0074	96	0.9875	153	0.9679	210	0.9486	267	0.9296
40	1.0070	97	0.9871	154	0.9675	211	0.9483	268	0.9293
41	1.0067	98	0.9868	155	0.9672	212	0.9479	269	0.9289
42	1.0063	99	0.9864	156	0.9669	213	0.9476	270	0.9286
43	1.0060	100	0.9861	157	0.9665	214	0.9472	271	0.9283
44	1.0056	101	0.9857	158	0.9662	215	0.9469	272	0.9279
45	1.0053	102	0.9854	159	0.9658	216	0.9466	273	0.9276
46	1.0049	103	0.9851	160	0.9655	217	0.9462	274	0.9273
47	1.0046	104	0.9847	161	0.9652	218	0.9459	275	0.9269
48	1.0042	105	0.9844	162	0.9648	219	0.9456	276	0.9266
49	1.0038	106	0.9840	163	0.9645	220	0.9452	277	0.9263
50	1.0035	107	0.9837	164	0.9641	221	0.9449	278	0.9259
51	1.0031	108	0.9833	165	0.9638	222	0.9446	279	0.9256
52	1.0028	109	0.9830	166	0.9635	223	0.9442	280	0.9253
53	1.0024	110	0.9826	167	0.9631	224	0.9439	281	0.9250
54	1.0021	111	0.9823	168	0.9628	225	0.9436	282	0.9246
55	1.0017	112	0.9819	169	0.9624	226	0.9432	283	0.9243
56	1.0014	113	0.9816	170	0.9621	227	0.9429	284	0.9240

Table II (Continued)

Group 0—Specific Gravity at 60°F above 0.966
Legend: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
285	0.9236	328	0.9096	371	0.8957	414	0.8819	457	0.8683
286	0.9233	329	0.9092	372	0.8953	415	0.8816	458	0.8680
287	0.9230	330	0.9089	373	0.8950	416	0.8813	459	0.8677
288	0.9227	331	0.9086	374	0.8947	417	0.8810	460	0.8674
289	0.9223	332	0.9083	375	0.8944	418	0.8806	461	0.8671
290	0.9220	333	0.9079	376	0.8941	419	0.8803	462	0.8668
291	0.9217	334	0.9076	377	0.8937	420	0.8800	463	0.8665
292	0.9213	335	0.9073	378	0.8934	421	0.8797	464	0.8661
293	0.9210	336	0.9070	379	0.8931	422	0.8794	465	0.8658
294	0.9207	337	0.9066	380	0.8928	423	0.8791	466	0.8655
295	0.9204	338	0.9063	381	0.8924	424	0.8787	467	0.8652
296	0.9200	339	0.9060	382	0.8921	425	0.8784	468	0.8649
297	0.9197	340	0.9057	383	0.8918	426	0.8781	469	0.8646
298	0.9194	341	0.9053	384	0.8915	427	0.8778	470	0.8643
299	0.9190	342	0.9050	385	0.8912	428	0.8775	471	0.8640
300	0.9187	343	0.9047	386	0.8908	429	0.8772	472	0.8636
301	0.9184	344	0.9044	387	0.8905	430	0.8768	473	0.8633
302	0.9181	345	0.9040	388	0.8902	431	0.8765	474	0.8630
303	0.9177	346	0.9037	389	0.8899	432	0.8762	475	0.8627
304	0.9174	347	0.9034	390	0.8896	433	0.8759	476	0.8624
305	0.9171	348	0.9031	391	0.8892	434	0.8756	477	0.8621
306	0.9167	349	0.9028	392	0.8889	435	0.8753	478	0.8618
307	0.9164	350	0.9024	393	0.8886	436	0.8749	479	0.8615
308	0.9161	351	0.9021	394	0.8883	437	0.8746	480	0.8611
309	0.9158	352	0.9018	395	0.8880	438	0.8743	481	0.8608
310	0.9154	353	0.9015	395	0.8876	439	0.8740	482	0.8605
311	0.9151	354	0.9011	397	0.8873	440	0.8737	483	0.8602
312	0.9148	355	0.9008	398	0.8870	441	0.8734	484	0.8599
313	0.9145	356	0.9005	399	0.8867	442	0.8731	485	0.8596
314	0.9141	357	0.9002	400	0.8864	443	0.8727	486	0.8593
315	0.9138	358	0.8998	401	0.8861	444	0.8724	487	0.8590
316	0.9135	359	0.8995	402	0.8857	445	0.8721	488	0.8587
317	0.9132	360	0.8992	403	0.8854	446	0.8718	489	0.8583
318	0.9128	361	0.8989	404	0.8851	447	0.8715	490	0.8580
319	0.9125	362	0.8986	405	0.8848	448	0.8712	491	0.8577
320	0.9122	363	0.8982	406	0.8845	449	0.8709	492	0.8574
321	0.9118	364	0.8979	407	0.8841	450	0.8705	493	0.8571
322	0.9115	365	0.8976	408	0.8838	451	0.8702	494	0.8568
323	0.9112	366	0.8973	409	0.8835	452	0.8699	495	0.8565
324	0.9109	367	0.8969	410	0.8832	453	0.8696	496	0.8562
325	0.9105	368	0.8966	411	0.8829	454	0.8693	497	0.8559
326	0.9102	369	0.8963	412	0.8826	455	0.8690	498	0.8556
327	0.9099	370	0.8960	413	0.8822	456	0.8687	499	0.8552

Table III

TEMPERATURE-VOLUME CORRECTIONS FOR EMULSIFIED ASPHALTS

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting volumes to the basis of 60°F

t	M	t	M	t	M
60	1.00000	90	.99250	121	.98475
61	.99975	91	.99225	122	.98450
62	.99950	92	.99200	123	.98425
63	.99925	93	.99175	124	.98400
64	.99900	94	.99150	125	.98375
65	.99875	95	.99125	126	.98350
66	.99850	96	.99100	127	.98325
67	.99825	97	.99075	128	.98300
68	.99800	98	.99050	129	.98275
69	.99775	99	.99025	130	.98250
70	.99750	100	.99000	131	.98225
71	.99725	101	.98975	132	.98200
72	.99700	102	.98950	133	.98175
73	.99675	103	.98925	134	.98150
74	.99650	104	.98900	135	.98125
75	.99625	105	.98875	136	.98100
76	.99600	106	.98850	137	.98075
77	.99575	107	.98825	138	.98050
78	.99550	108	.98800	139	.98025
79	.99525	109	.98775	140	.98000
80	.99500	110	.98750	141	.97975
81	.99475	111	.98725	142	.97950
82	.99450	112	.98700	143	.97925
83	.99425	113	.98675	144	.97900
84	.99400	114	.98650	145	.97875
85	.99375	115	.98625	146	.97850
86	.99350	116	.98600	147	.97825
87	.99325	117	.98575	148	.97800
88	.99300	118	.98550	149	.97775
89	.99275	119	.98525	150	.97750
		120	.98500		

505.12 BASIS OF PAYMENT. The number of cubic yards of aggregate and the number of gallons of bituminous material, measured as provided above, shall be paid for at the contract unit prices for the several items complete in place and accepted, except as follows.

If the bituminous material does not conform to the specifications, then the final test results for the bituminous material taken at the point of delivery will be applied to the appropriate schedule of Section 902 for price adjustment, and any adjustment in unit price shall be made as specified. If the test results are such that a penalty would result from more than one of the test values, only the price adjustment for the greatest reduction will apply.

Payment will be made under:

Item No.	Pay Item	Pay Unit
505(1)	Asphalt Cement	Gallon
505(2)	Coarse Aggregate (Size 1)	Cubic Yard
505(3)	Fine Aggregate (Size 2)	Cubic Yard
505(4)	Seal Coat Aggregate (Size 3)	Cubic Yard

PART VI

RIGID PAVEMENT

Section 601

Portland Cement Concrete Pavement

601.01 DESCRIPTION. This work shall consist of constructing a pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the engineer.

601.02 MATERIALS. Materials shall meet the requirements of the following Section or Subsections of Part IX, Materials.

Portland Cement Concrete	901
Sealers	905.01, 905.02
Fillers	905.03
Mesh Reinforcement	909.01
Load Transmission Devices	909.04
Continuous Reinforcement	909.13
Wide Flange Beam	913.24
Curing Materials	911.01
Subgrade Paper	911.02
Cellular Polystyrene Plastic	915.21

The contractor will be permitted to furnish either Type B, C, D or E, Portland Cement Concrete Pavement. However the same type pavement mixture shall be used throughout the project unless otherwise authorized by the engineer in writing.

The contractor will also be permitted to furnish Class A Structural Concrete in lieu of the mixtures listed above. The design and composition of Class A concrete mixture shall be in accordance with the requirements of Section 901.

CONSTRUCTION REQUIREMENTS

601.03 EQUIPMENT. Equipment and tools necessary for handling materials and performing all parts of the work must meet with the approval of the engineer as to design, capacity and mechanical condition. The equipment must be

at the job site sufficiently ahead of the start of construction operations to be examined thoroughly for approval.

(a) Vibrators: Vibrators for full width vibration of concrete paving slabs shall be the internal type with either immersed type or multiple spuds. They must be attached to the spreader, the finishing machine or may be mounted on a separate carriage. They shall not come in contact with joints, load transfer devices, subgrade or side forms. Frequency of the internal vibrators, both tube and spud vibrators, shall be from 7000 to 10,000 impulses per minute. This frequency also applies to spud type internal vibrators, either hand-operated or attached to spreader or finishing machine, that are used adjacent to forms.

Vibrators mounted on any machine or carriage shall be so interlocked with the forward travel mechanism as to automatically start and stop vibrating as that machine starts and stops.

(b) Concrete Saw: When sawing joints is elected or specified, the contractor shall provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions. The contractor shall provide at least one stand-by saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

(c) Forms: Straight side forms shall be made of metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. On long curves (150-foot radius or longer), straight forms of shorter lengths will be permitted. Forms shall have a depth not less than the prescribed edge thickness of the pavement and a base width at least equal to the depth, except as otherwise approved by the engineer. Flexible or curved forms of proper radius shall be used on curves of 150-foot radius or less and shall be of a design acceptable to the engineer. Forms shall be provided with adequate devices for secure setting. Flange braces shall extend outward on the base not less than 2/3 the height of

the forms. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved. When approved by the engineer, built-up forms may be used; however the build-up shall not exceed 2 inches. No limitation will be made on the use of built-up forms or the amount of build-up where the total area of pavement of any specified thickness on the project is less than 2000 square yards. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet and the upstanding leg shall not vary more than ¼ inch from the vertical. The forms shall contain provisions for locking the ends of abutting form sections together tightly and for secure setting.

601.04 PREPARATION OF GRADE. After the roadbed has been graded and compacted, the grade shall be trimmed approximately to correct elevation, extending the work at least 1.0 foot beyond each edge of the proposed concrete pavement and to a greater width as necessary when the slip form paving method is permitted.

Where the subgrade or base course for the concrete pavement is soil cement, stabilized aggregate or other semi-rigid construction, high places in the grade will be cut or planed down. The base course shall be swept, broomed or otherwise cleaned of all loose or surplus material.

601.05. PLACING FORMS.

(a) Base Support: The foundation under the forms shall be firm and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. Imperfections or variations in grade shall be corrected as necessary.

(b) Form Setting: Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked, free from play or movement in any direction. Each form section shall not deviate from true line by more than ¼ inch at any point. No excessive settlement or springing of

forms under the finishing machine will be tolerated. The face and top of the forms shall be cleaned and oiled prior to the placing of concrete. When setting forms on stabilized base, the contractor will be required to drill holes through the base by approved methods for the placing of pins to hold the forms. Driving of pins through the base will not be permitted. Drilled holes shall not be smaller than the size of the pins.

(c) Grade and Alignment: The alignment and grade elevations of the forms shall be checked and corrections made by the contractor prior to placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

601.06 CONDITIONING OF SUBGRADE OR BASE COURSE. When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross section. High areas shall be trimmed to proper elevation. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed. No concrete shall be placed until the subgrade or base course has been approved.

Unless watertight subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it becomes too dry, the subgrade or base course shall be sprinkled but the method of sprinkling shall not be such as to form mud or pools of water.

601.07 PLACING CONCRETE. The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators or nonagitating hauling equipment are equipped with means for discharging and placing of concrete without segregation of the materials, the concrete shall be unloaded and mechanically spread with an approved spreading device in such manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will

be operated upon the existing lane of pavement, that lane shall have attained a minimum age of 10 days, or the concrete shall have attained a flexural strength of 600 psi as shown by a test of standard specimens cured under the same climatic and moisture conditions as the slab in accordance with AASHO Designation: T 97 of the Testing Procedures Manual. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 3 days, exclusive of days when temperature is below 40°F at the job site.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless hopper is well centered on the joint assembly.

Concrete shall be thoroughly consolidated for its full width and against and along the faces of all forms and along the full length and on both sides of all joint assemblies by means of vibrators inserted in the concrete or other acceptable methods. Vibrators shall not be permitted to come in contact with a joint assembly, the grade or a side form. In no case shall the vibrator be operated longer than 15 seconds in any one location.

601.08 TEST SPECIMENS. The contractor shall, at his expense, furnish the concrete necessary for casting test beams and cylinders as required. The test specimens shall be made and cured by the method specified in LDH Designation: TR 226.

601.09 STRIKE-OFF OF CONCRETE AND PLACEMENT OR REINFORCEMENT. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the established elevation. When reinforced concrete pavement is placed in 2 layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete to bring the slab to grade shall be placed as quickly as possible, not to exceed 30 minutes, so

that a truly monolithic slab will be attained. When, due to conditions beyond the control of the contractor, more than 30 minutes time has elapsed before the top layer of concrete is placed, but not in excess of one hour, the location by stations, the temperature and other weather conditions and any other appertaining data will be recorded on the Concrete Inspectors Daily Report. At such locations, core borings will be taken at a later date to determine whether the slab in question is truly monolithic.

Any portion of the bottom layer of concrete which has been in place for more than one hour shall be removed and replaced with fresh concrete at the contractors expense prior to placing the top layer.

When the top layer of concrete is placed after the initial 30-minute period and before the expiration of one hour and core borings indicate a true monolith has not been attained, then the engineer may order the concrete to be removed and replaced at the contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete, after spreading, by mechanical or vibratory means.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil or other organic materials that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both shall be considered satisfactory provided the minimum dimensions and weight of a hand wire brushed test specimen are not less than the tolerance allowed.

601.10 JOINTS. Joints shall be constructed of the type and dimensions and at the locations required by the plans or special provisions.

(a) Longitudinal Joint: Deformed steel tie bars of the specified length, size, spacing and material shall be placed perpendicular to the longitudinal joints; they shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other material or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side forms or other approved types shall be used. Tie bars may be bent at right angles against the

form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed or, in lieu of bent tie bars, approved 2-piece connectors may be used.

(1) The groove for the longitudinal joint shall be formed by using a "T" iron, cutting wheel or any other device that will insure a groove that is true in both vertical and horizontal alignment. All grooves shall be cut to the minimum depth shown on the plans and in such manner that the surface of the freshly placed concrete will not be depressed or otherwise disturbed. Retempering of concrete adjacent to joints will not be permitted.

Strips of approved wood or preformed filler material of the dimensions shown on the plans shall be inserted in the groove. Regardless of the type used, it shall be dusted with limestone dust or other approved material prior to installation in the concrete. After insertion, the top edge of the strip shall be flush with the surface or just slightly below. The joint shall then be aligned and the surface of the pavement floated and checked with a straightedge.

The removal of a portion of the strip from the joint shall be accomplished by cutting with a rotary power saw and abrasive blades. The dimensions of the cut shall be as specified on the plans. All inserted material must be removed from the sides of the cut. Sawing operations shall be delayed as long as possible to permit maximum curing of the pavement. In no event shall the sawing be done sooner than 5 curing days after placing unless otherwise directed by the engineer. The sawing operation should be such that the major portion of each joint is within minus 1/16 or plus 1/8 inch of the specified joint width.

(2) In lieu of sawed joints, a flexible joint forming device of the type or types shown on the plans may be used. Such joints shall be formed in accordance with plan details and the recommendation of the manufacturer. When the contractor desires to use a joint forming device not shown on the plans, the device and the method of installation must be approved in writing by the engineer.

(3) The longitudinal joints in monolithic concrete pavement may be formed by placing a continuous plastic strip of 20 mils thickness which will not react adversely with the chemical constituents of the concrete. The joint insert material shall be of such width and composition that when placed vertically in the concrete it will not bond with concrete and will form an effective weakened plane joint of the required depth as shown on the plans. The joint material shall be inserted with a mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in the joint material will be permitted providing they are effective in maintaining the continuity of the joint material as placed. The joint material shall be placed in such manner that the top of the strip is not more than 1/8 inch below the finish surface of the concrete. The joint material shall not be deformed from a vertical position, either in the installation or in subsequent finishing operations performed on the concrete. The alignment of the finished joint shall be uniformly parallel with the centerline of the pavement and shall be free of any local irregularity which exceeds 3/8 inch, measured by a 10-foot straightedge, except for normal curvature of the center line alignment. The mechanical installation device shall vibrate the concrete during placing the strip sufficiently to cause the concrete to flow evenly about the joint material producing homogeneous concrete free of segregation and rock pockets or voids.

(b) Transverse Expansion Joints: The expansion joint filler shall be continuous from form to form and shaped to the subgrade. Preformed joint fillers shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint fillers shall not be used unless approved by the engineer.

The expansion joint filler shall be held in a vertical position. An expansion installing bar or other device shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than ½ inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs

of concrete shall be permitted anywhere within the expansion space.

(c) Transverse Contraction Joints (Dummy Joints): Transverse contraction joints shall consist of planes of weakness created in cross section of pavement and shall be constructed by one of the following methods:

(1) Install a nonbituminous preformed filler board in a groove in the pavement formed as outlined under (a) (1) above and then sawed to the dimensions specified. The saw shall have sufficient power to saw the specified joint width a minimum 1¼ inch in depth with one pass of the saw.

(2) Install an approved removable joint forming device to form a joint to a width slightly less than the required width and to the required depth. The joint shall then be sawed to proper width and depth.

The joints, when required by the plans or special provisions, shall include load transfer devices.

(d) Transverse Construction Joints: Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet of an expansion joint, contraction joint or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

(e) Load Transfer Devices: Load transfer devices may be either dowel assemblies or cantilever type assemblies as shown on the plans. Dowels when used may be held in positions parallel to the surface and centerline by a metal device that is left in the pavement.

Dowels shall be coated with one coat of an approved paint and thoroughly coated with an approved lubricant to prevent the concrete from bonding to the dowel. In lieu of the painted and lubricated dowels, plastic coated dowel bars in accordance with Subsection 909.03 may be used. An approved sleeve, meeting the requirements contained in Subsection 909.03 (a), shall be furnished with each dowel bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight.

In lieu of using dowel assemblies at contraction joints, load transfer devices may be placed by an approved mechanical device provided satisfactory positioning and alignment is attained.

Cantilever type assemblies, if selected by the contractor, will be in accordance with the type shown on the plans or any approved equal.

Construction joints forming the ends of paving slabs which are to be left exposed for extended periods of time shall be the dowel assembly type.

(f) Where the plans provide that concrete pavement be overlaid with asphaltic concrete pavement, the sawing of longitudinal and transverse joints as hereinbefore specified will not be required.

601.11 FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING.

(a) Sequence: The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straightedging and final surface finish.

In general the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

(b) Finishing at Joints:

(1) The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, also under and around all load transfer devices, joint assembly units and other features designed to extend into the pavement. Concrete adjacent to joints shall be consolidated as required in Subsection 601.07.

(2) After the concrete has been placed and vibrated adjacent to the joints as required in Subsection 601.07, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine to, over and beyond the joint causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segre-

gated concrete shall be removed from in front of and off the joint; the front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter the finishing machine may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

(c) Machine Finishing: Vibrators for full width vibration of concrete paving slabs shall meet the requirement in Subsection 601.03(a). In no case shall vibrators be operated longer than 15 seconds in any one location. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures and throughout the pavement, the contractor will be required to furnish the equipment and methods which will produce pavement conforming to the specifications.

(d) Hand Finishing: Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

Pavement widths not exceeding 16 feet or areas of irregular dimensions where operations of the mechanical equipment is impractical may be finished by hand methods.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape and be constructed either of metal or of other suitable material shod with metal.

Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.

In operation the screed shall be moved forward on the

forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manpulated that neither end is raised from the side forms during the striking off process. If necessary this shall be repeated until the surface is of uniform texture, true to grade and cross section and free from porous areas.

(e) Floating: After the concrete has been struck off and consolidated, it shall be further smoothed, trued and consolidated by means of a float, using one of the following methods as specified or permitted.

(1) Longitudinal Float Method: The mechanical longitudinal float shall be of a design approved by the engineer and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the engineer on each transverse trip. The float shall pass over each area of pavement at least 2 times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.

(2) Pan Float Method: The contractor may use a machine composed of cutting and smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by 4 or more visible wheels riding on, and constantly in contact with, the side forms.

If necessary, following one of the preceding methods of floating, long-handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of or supplementing one of the preceding methods of floating. When strike-off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely

by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped ½ the length of the blade.

(f) Straight-edge Testing and Surface Correction: After the floating has been completed and the excess water removed but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10-foot straightedge. For this purpose the contractor shall furnish and use an accurate 10-foot straightedge swung from handles approximately 3 feet longer than ½ the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than ½ the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across the joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

(g) Final Finish:

(1) Drag Finish: Unless otherwise permitted, the final finish shall be a drag finish. To obtain surface texture with a drag finish, a drag shall be used which shall consist of a seamless strip of damy burlap or cotton fabric which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 4 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom

layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Drags that cannot be cleaned shall be discarded and new drags substituted.

(2) Belt Finish: When permitted or specified, the surface texture shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the road centerline and with a rapid advance parallel to the centerline.

(3) Broom Finish: When permitted or specified, the surface texture shall be a broom finish. It shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1/16 inch in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities and depressions resulting from improper handling of the broom. Brooms shall be of such quality, size and construction and be so operated as to produce a surface finish meeting the approval of the engineer. Subject to satisfactory results being obtained, the contractor will be permitted to substitue mechanical brooming in lieu of manual brooming as herein described.

(h) Edging At Forms and Joints: After the final finish but before the concrete has taken its initial set, the edges of the pavement along each side of each slab and on each side of transverse expansion joints, formed joints, transverse construction joints and emergency construction joints shall be worked with an approval tool and rounded

to the radius required by the plans. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

(i) Where the plans provide that new Portland cement concrete pavement be overlaid with asphaltic concrete pavement and the concrete has been placed and consolidated in accordance with Subsection 601.07, the requirements for the final strike-off and surface finishing as hereinbefore specified will not be required and the pavement will be finished to reasonably close conformity to the lines, grades and typical section, all to the satisfaction of the engineer. Machine finishing and/or hand finishing methods may be employed. The final surface finish shall be approximately equivalent to that normally achieved with a wood float.

601.12 CURING. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material of whatever kind the contractor may elect to use or lack of water to adequately take care of both curing and other requirements shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than ½ hour between stages of curing or during the curing period.

(a) Cotton or Burlap Mats: The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will

extend at least twice the thickness of the pavement beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wet and in position for 72 hours, unless otherwise specified, after the concrete has been placed.

(b) Waterproof Paper: The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at least 18 inches. The paper shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimensions that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement or of pavement width and 2-foot strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wet prior to the placing of the paper.

(c) White Pigmented Impervious Membrane: The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. If the pavement is cured initially with jute or cotton mats and the mats are removed prior to expiration of 72 hours, curing compound shall be applied immediately. The curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but in no case greater than 150 square feet per gallon. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condi-

tion with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by effective mechanical or other approved means. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

(d) White Polyethylene Sheeting: The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

(e) Combined Burlap and White Polyethylene Plastic Material Method: The burlap portion of each sheet shall be thoroughly wet down before use.

After completion of finishing operations and immediately following the disappearance of surface water, the surface of the pavement shall be completely covered with the plastic film side of the material up. The sheets of material shall be so placed and weighted as to cause it to remain in intimate contact with the surface of the pavement and separate sheets shall be lapped at least 6 inches. After removal of side forms, the material shall be folded down over the edges of the pavement and secured by a continuous bank of earth as a seal. The curing shall continue for a period of not less than 72 hours after the concrete has been placed.

(f) Curing in Cold Weather: When concrete is being placed and the air temperature may be expected to drop

below 35°F, a sufficient supply of straw, hay, grass or other suitable blanketing material shall be provided along the work, and any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. The contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the contractor's expense.

601.13 SURFACE TEST. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 10-foot straightedge or other specified devices. Areas showing high spots of more than 1/8 inch on roadways and ¼ inch on ramps and connections, but not exceeding ½ inch in 10 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10-foot straightedge, except deviations of ¼ inch will be permitted on ramps or connections with radii of 250 feet or less and on ramps with grades of 4 percent or more. Where the surface deviation in 10 feet exceeds ½ inch, the pavement shall be removed and replaced by and at the expense of the contractor.

601.14 REMOVING FORMS. Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above. Minor honeycombed areas shall be filled with mortar composed of one part of cement to two parts of fine aggregate. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.

601.15 SEALING JOINTS. The joints shall be sealed

before the pavement is opened to traffic and as soon after completion of sawing period as feasible.

The elastomeric polymers (poured sealers) require the concrete be 28 days or older prior to scaling joints. The sawing shall proceed as normal, and the joints shall be protected during the interval between sawing and sealing. Protection of the joints shall be done by placement of the back-up material immediately after sawing. Traffic may use the pavement while the joints are protected.

Immediately prior to sealant placement, the back-up rod shall be removed, the joint thoroughly cleaned, the backup rod replaced, and the sealant placed. The sealant shall be placed as soon as possible after the required aging of the concrete. Traffic shall not be permitted while pouring and until after the sealant is cured.

All joints shall be free of spalls, fractures, breaks or voids. These areas shall be chipped back to sound concrete and repaired with an approved epoxy resin system in accordance with the manufacturer's recommendations. The joints shall be thoroughly cleaned, using whatever equipment is necessary. Before application of the primer for elastomeric polymers as specified in Subsection 905.01(b) or the lubricant-adhesive for compression seals as specified in Subsection 905.02, the joint faces must be sand-blasted thoroughly until completely clean and dry.

The joint sealants shall be installed in strict accordance with the manufacturer's instructions and construction recommendations. The sealant shall be installed to a depth of ¼ inch ±1/8 inch below the level of the pavement surface.

(a) Longitudinal joints shall be sealed with the following materials unless the joint is formed by the continuous plastic strip method.

	Subsection
Hot Poured Elastic Type 5	905.01(a3), 905.01(a4)
Polyurethane Poured Joint Sealant	905.01(b)

(b) Transverse joints with the exception of transverse expansion joints shall be sealed with Preformed Compression Joint Seal (Mechanical Type), Subsection 905.02. Transverse expansion joints shall be sealed with the following materials.

	Subsection
Hot Poured Elastic Type 5	905.01(a3), 905.01(a4)
Polyurethane Poured Joint Sealant	905.01(b)

(c) Additional requirements concerning elastomeric polymers as specified in Subsection 905.01(b) and preformed compression seals as specified in Subsection 905.02 are as follows:

(1) Elastomeric Polymers, Subsection 905.01(b): Care shall be taken that the material's shelf life is not exceeded and that application is accomplished at a temperature of 70°F or above.

Application shall be by a machine unit with a powered mixing head capable of accurate proportioning and mixing of the separate components.

Primer, if required, shall be applied as directed by the manufacturer; however, it shall be applied the same day as the joint sealer and shall be tack free prior to installation of the joint sealer.

(2) Preformed Compression Seals, Mechanical Type, Subsection 905.02: Dilution of the lubricant-adhesive is to be discouraged; however, a maximum of 10 percent dilution with a material recommended by the manufacturer will be allowed when application is by pump and the viscosity is such that the lubricant-adhesive will not flow through a pump. The lubricant-adhesive shall be applied just prior to installation of the seal and shall be sufficient to completely cover the seal's sidewalls.

Stretching of the seal should be minimal. When installation procedures appear to cause stretching, random checks shall be made. The frequency and thoroughness of the checks shall be as directed by the engineer as he deems necessary in accordance with the adequacy of the installation. The maximum allowable stretch of the compression seal is 5 percent per four foot section.

When the maximum stretch limits are exceeded and the lubricant-adhesive has chemically set, the seal shall be completely removed and cleaned, the joint recleaned and reinstallation made.

Field splicing shall not be allowed unless specifically

noted on the plans to accommodate severe angles in the seal due to planned alignment.

The proper sizes of compression seals to be used are dependent upon the joint width. The following should be used:

Joint Width	Seal Width
5/8"	1 ¼"
7/16"	13/16"

(d) Where the plans provide that new Portland cement concrete pavement be overlaid with asphalt concrete pavement, the sealing of joints as herein specified will not be required.

601.16 PROTECTION OF PAVEMENT. The contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges or crossovers, etc. as necessary. The plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced.

601.17 SPLIT SLAB CONSTRUCTION. When no separate item for split slab construction is included in the plans, payment will be made under the applicable item for the type and thickness of pavement being constructed, which payment shall constitute full compensation for any additional costs incurred by the contractor for constructing the pavement slab by this method. When the use of the split slab method is requested by the contractor for his convenience, written authority of the engineer shall be obtained and no increase in price will be approved.

Longitudinal joints in pavement constructed by the split slab method shall conform to the details shown on the plans and the requirements of Subsection 601.10. Pavement constructed by this method shall in all other respects conform to these specifications.

601.18 SLIP FORM PAVING METHOD. The slip form paving method may be used at the option of the contractor

in accordance with all applicable requirements of this Section.

(a) Grade: After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of a properly designed machine. If the density of the base is disturbed by the grading operations, it shall be corrected by additional compaction before concrete is placed. The grade shall be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete.

(b) Placing Concrete: The concrete shall be placed with an approved slip form paver designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the plans and specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur.

The concrete shall be held at a uniform consistency, having a slump of not less than ½ inch nor more than 2 inches. The slip form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering and spreading concrete shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason it is necessary to stop the forward movement of the paver, the vibrator and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine except that which is controlled from the machine.

(c) Finishing: The surface smoothness and texture re-

quirements shall be the same as when fixed forms are used except that the tolerance for the 6-inch width just inside the edge of the pavement shall be ¼ inch under the 10-foot straightedge except where the edge will be a longitudinal joint in widening the pavement.

(d) Curing: Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsection 601.12. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

(e) Joints: All joints shall be constructed in accordance with Subsection 601.10.

(f) Protection Against Rain: In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than 2 inches and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

601.19 CONTINUOUSLY REINFORCED PAVEMENT. The construction of continuously reinforced pavements shall conform to all applicable requirements of this Section 601 with the following modifications.

(a) Placement of Reinforcement: Reinforcement shall be preset on approved chairs. The arrangement and spacing of chairs shall be such that the reinforcing steel will be supported in proper position during placing and consolidation of concrete, and any deflection of displacement will not exceed the tolerances for the vertical position of the reinforcement in the pavement. They shall have sufficient bearing at their base to prevent overturning or penetration into the base. They shall be designed so as not to

impede the placing and consolidation of concrete. Chairs should not be set so close to other transverse members as to make placing concrete through the space difficult. This is particularly important in lapped areas where there is a concentration of reinforcement. Welding of chairs to transverse bars will be permitted when approved in writing by the engineer.

In the normal 30 inches placement for the transverse bars, chairs shall be placed under every transverse bar. Transverse chair spacing shall be 48 inches maximum. Placement may be staggered so that chairs in alternate rows are centered between chairs in adjacent rows.

A minimum of 10 chairs per mat shall be used under prefabricated deformed mat reinforcing to meet the steel placement requirements.

The contractor shall submit a sample of the chair he proposes to furnish. Unless a specific spacing of chairs is designated on the plans, the contractor shall submit a drawing showing the layout he proposes to use. Chairs and layout shall be subject to the approval of the engineer. If the support system does not maintain the reinforcement in the position required by these specifications during placing and finishing of the concrete, the contractor will be required to increase the number of chairs or take such other steps as may be required to assure proper position of the steel.

When the reinforcement consists of loose bars fabricated on the grade, longitudinal bars shall be secured to transverse bars by wire ties or clips at not less than each alternate intersection for all bars.

Deformed wire mats shall be preassembled and placed at the specified height prior to concrete operations.

Forms shall be oiled prior to placement of reinforcement.

(b) Lap Splices in Reinforcing Steel: Reinforcing bars or prefabricated deformed wire mats used as continuous reinforcement shall be lapped in the longitudinal direction in staggered pattern as shown on the plans. No more than one-third of the longitudinal steel members within a single traffic lane shall terminate within a two-foot distance measured along the centerline of the pavement.

When deformed wire mats are used, the mats shall be

lapped transversely as shown on the plans with sufficient ties to hold them in specified position during concreting operations.

Splices for deformed steel reinforcing bars shall be a minimum of 30 times the nominal diameter of the bar. Bars of high yield steel shall not be bent. If the contractor elects to bend the tie bars, they shall be of structural or intermediate grade steel and spaced on 30-inch centers. All laps in reinforcement shall be tied or otherwise fastened securely.

(c) Placement and Finishing of Concrete: Concrete shall be placed in one lift and struck off to full depth. An approved method of internal vibration shall be employed adjacent to lapped bars and below reinforcing steel to assure proper consolidation.

(d) Transverse Construction Joints: A transverse construction joint shall be installed at the end of each day's work or whenever paving operations must be interrupted for more than 30 minutes. The joint shall be formed by placing the concrete against a header board approved by the engineer. The header board may be set perpendicular to, or skewed with, the centerline of the pavement. Header boards shall not be skewed more than 15° from the pavement centerline. The longitudinal reinforcing steel shall extend through the header board and be properly supported from the grade beyond the header board to prevent deflections during paving operations.

Longitudinal reinforcing steel shall extend a sufficient distance ahead and back of the transverse construction joint so that no splicing steel is closer than 2 feet from the construction joint.

At all lap splices occurring within 8 feet forward of or within 3 feet back of the transverse construction joint in the direction of paving, the length of lap shall be double that normally specified or each splice shall be strengthened by splicing in a 6-foot length of deformed bar or wire of the same nominal size as the longitudinal reinforcement.

Construction joints shall be strengthened by the addition of supplementary deformed bars 4 feet long and of the same nominal size as the longitudinal reinforcement, placed at uniform spacing across the joint. The number

of supplementary bars shall be such as to increase the cross-section area of the steel through the joint by at least 33 percent. Vibration with hand-manipulated mechanical vibrators will be required adjacent to all transverse construction joints.

(e) Longitudinal Construction Joints: If the contractor elects to continue the transverse steel through the joint, tie bars may be deleted.

601.20 OPENING TO TRAFFIC. The engineer will decide when the pavement shall be opened to traffic. The pavement will not be opened to traffic until specimen beams conforming to the requirements of Subsection 601.07 have attained a flexural strength of 600 psi when tested by the third-point method in accordance with AASHO Designation: T 97 of the Testing Procedures Manual or a compressive strength of 3000 psi when tested in accordance with AASHO Designation: T 22 of the Testing Procedures Manual. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete has been placed. The pavement shall be cleaned and joints sealed prior to opening to traffic.

601.21 TOLERANCE IN PAVEMENT THICKNESS. The thickness of the pavement will be determined by measurement of cores in accordance with AASHO Designation: T 148 of the Testing Procedures Manual.

For the purpose of establishing an adjusted unit price for payment, units to be considered separately are defined as 1000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1000 feet plus the fractional part of 1000 feet remaining. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit if not deficient more than 0.2 inch from the plan thickness, full payment will be made. When such measurement is dificient more than 0.2 inch and not more than 1.0 inch from the plan thickness, 2 additional cores at intervals not less than 300 feet will be taken and used in the average thickness for that unit. An adjusted unit price as provided in Subsection 601.23(b) will be paid for the unit represented.

Other areas such as intersections, entrances, crossovers, ramps, etc. will be considered as one unit and the thickness

of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the engineer may select in each unit, one core will be taken for each 1000 square yards of pavement or fraction thereof in the unit. If the core so taken is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the core is deficient in thickness by more than 0.2 inch but not more than 1.0 inch from the plan thickness, 2 additional cores will be taken from the area represented and the average of the 3 cores determined. If the average measurement of these 3 cores is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient more than 0.2 inch but not more than 1.0 inch from the plan thickness, an adjusted unit price as provided in Subsection 601.23(b) will be paid for the area represented by the cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch, and measurements which are less than the specified thickness by more than 1.0 inch will not be included in the average.

When the measurement of any core is less than the plan thickness by more than 1.0 inch, the actual thickness of the pavement in this area will be determined by taking additional cores at not less than 10-feet intervals parallel to the centerline in each direction from the affected location until in each direction a core is found which is not deficient by more than 1.0 inch. Areas found deficient in thickness by more than 1.0 inch shall be evaluated by the engineer; if in his judgement the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price.

601.22 METHOD OF MEASUREMENTS. The yardage to be paid for under this item will be the number of square yards of concrete pavement completed and accepted as measured complete in placed. The width for measurement will be the width of the pavement shown on the typical cross section of the plans, additional widening where called for, or as otherwise directed in writing. The length will be

measured horizontally along the pavement at the plan centerline of each roadway or ramp.

If shown on plans, split slab construction will be measured by the square yard of pavement constructed by this method. Measurement will be made in the same manner as provided above for the pavement slab.

Reinforcement other than dowels and other joint material will be measured by the pound, except as stated elsewhere herein for continuously reinforced pavement.

Continuously reinforced concrete pavement will be measured by the square yard of completed pavement. The width for measurement will be the width of the pavement shown on the plans or as otherwise directed in writing. The length will be measured horizontally along the surface of the pavement at the centerline of each roadway or ramp. All steel reinforcement, all joints other than the wide flange beam joint described herein shall be included in this square yard measurement.

Wide flange installations will be measured by the linear foot transversely for the actual length of the wide flange steel beam, including welded end plates, in place.

601.23 BASIS OF PAYMENT.

(a) General: The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard which price and payment shall be full compensation for furnishing and placing all materials, including any dowels and joint material, provided, however, that for any pavement found deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, only the reduced price stipulated below shall be paid.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.

Reinforcing steel other than as herein will be paid for separately.

Split slab construction will be paid for at the contract unit price per square yard of pavement constructed by this method and accepted. The payment shall constitute full compensation for the additional costs incurred by

the contractor for constructing the pavement slab by this method.

Continuously reinforced pavement will be paid for at the contract price per sqaure yard, which price and payment shall be full compensation for furnishing and placing all materails, including all steel reinforcement, dowels and joint material.

The accepted quantity of wide flange installations will be paid for at the contract price per linear foot, which shall be full compensation for furnishing and installing all materials, including welded end plates, sleeper block and reinforcement; for all excavation and satisfactory disposal of surplus material; and for all labor, equipment, and tools necessary to complete the work.

Payment will be made under:

Item No.	Pay Item	Pay Unit
601(1)	Portland Cement Concrete Pavement (___" thick)	Square Yard
601(2)	Bar Reinforcing	Pound
601(3)	Fabric Reinforcing	Pound
601(4)	Split Slab Construction	Square Yard
601(5)	Portland Cement Concrete Pavement (___" thick) (Continuously Reinforced)	Square Yard
601(6)	Wide Flange Installations	Linear Foot

(b) Price Adjustments: Where the average thickness of pavement is deficient in thickness by more than 0.2 inch but not more than 1.0 inch, payment will be made at an adjusted price as specified in the following table:

CONCRETE PAVEMENT DEFICIENCY

Deficiency in Thickness Determined by Cores Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	90 percent
0.31 to 0.40	85 percent
0.41 to 0.50	80 percent
0.51 to 0.75	70 percent
0.76 to 1.00	60 percent

When the thickness of pavement is deficient by more than one inch and the judgment of the engineer is that the area of such deficiency should not be removed and replaced, payment will be made under the applicable requirements of Section 105.03.

PART VII

INCIDENTAL CONSTRUCTION

Section 701

Culverts and Storm Drains

701.01 DESCRIPTION. This work shall consist of the construction or reconstruction of pipe culverts, pipe arch culverts, storm drains and sewers, hereinafter referred to as "conduit", in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

701.02 MATERIALS. Materials shall meet the requirements specified in the following subsection of Part IX, Materials.

Corrugated Metal Pipe and Pipe Arches	907.06
Bituminous Coated Corrugated Metal Pipe and Pipe Arches	907.07
Corrugated Aluminum Pipe and Pipe Arches	907.12
Bituminous Coated Corrugated Aluminum Pipe and Pipe Arches	907.14
Reinforced Concrete Pipe	906.02
Non Reinforced Concrete Pipe	906.01
Reinforced Concrete Arch Culvert Pipe	906.18
Vitrified Clay Pipe	906.08
Asbestos Cement Pipe	906.12
Joint Mortar	905.05
Asbestos Bonded Metal Pipe and Pipe Arches	907.08
Rubber Gasket	905.06
Flexible Plastic Gasket	905.07
Structural Plate Pipe and Pipe Arches	907.09

When the item "Culvert Pipe" is included in the contract, the contractor may, at his option, furnish culvert pipe of reinforced concrete, asbestos bonded corrugated metal, bituminous coated corrugated metal, or bituminous coated corrugated aluminum, except as otherwise required by the plans or project specifications.

When the item "Pipe Arch" is included in the contract, the contractor may, at his option, furnish pipe arch of reinforced concrete, asbestos bonded corrugated metal, bituminous coated corrugated metal, or bituminous coated cor-

rugated aluminum, except as otherwise required by the plans or project specifications.

Minimum gage or sheet thickness for metal pipe or pipe arch shall meet the requirements of the fill height tables shown on the plans. When other than minimum sheet thickness is required, this data shall be specifically shown on the plans or described elsewhere in the project specifications.

When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

701.03 EXCAVATION. Trenches shall be excavated to a width sufficient to allow for proper joining of the sections of conduit and thorough compaction of the bedding and backfill material under and around the conduit. Where feasible, trench walls shall be approximately vertical.

The completed trench bottom shall be firm for its full length and width. Where required, in the case of cross drains, the trench shall have a longitudinal camber of the magnitude specified.

Where conduits are to be placed in embankment fill, the excavation shall be made after the embankment has been completed to the specified height above the designed grade for those conduits specified on the plans.

The excavated material that is not satisfactory for backfill or is surplus material shall be disposed of by the contractor to the satisfaction of the engineer.

701.04 FORMING BED FOR CONDUIT. The width of trench as required shall be sufficient to permit thorough tamping of the backfill under the haunches and around the conduit.

Unless otherwise specified, a Class C bedding shall be provided as follows: The conduit shall be bedded with

ordinary care in a loosened soil foundation shaped to fit the lower part of the conduit exterior with reasonable closeness for at least 10 percent of its overall height. The shaped foundation shall be loosened soil to a depth of 3 inches. Where rock, in either ledge or boulder formation, is encountered, it shall be removed below grade and replaced with satisfactory material in such a manner as to provide a compacted earth cushion having a thickness under the conduit of not less than ½ inch per foot for height of fill over the top of the conduit with a minimum allowable thickness of 8 inches.

When it has been determined, prior to construction, that a suitable foundation can not be obtained at the established grade, the additional excavation below the established grade and bedding backfill material required shall be placed in accordance with and paid for under the bedding material item elsewhere in the contract.

When it is determined by the engineer, during construction, that a suitable foundation cannot be obtained at the established grade and the item for bedding material has not been included in the specifications, then the unstable soil below the established grade shall be removed and replaced with approved bedding material properly compacted to provide adequate support for the conduit. This work shall be in accordance with the engineer's directions and will be paid for as "Extra Work."

If conduit is not laid in a trench, a uniformly firm bed shall be made in the same manner as above specified for the preparation of the bottom of the trench.

701.05 LAYING CONDUIT. The conduit laying shall begin at the downstream end of the line. The lower segment of the conduit shall be reasonably in contact with the foundation throughout its full length. Bell or groove ends of rigid conduit and outside circumferential laps of flexible conduit shall be placed facing upstream. Flexible conduit shall be placed with longitudinal laps or seams at the sides.

701.06 JOINING CONDUIT. Rigid conduit may be of bell and spigot or tongue and groove design unless one type is specified. The method of joining conduit sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

(a) Joints for Rigid Conduit: Joints shall be made with

Portland cement mortar, Portland cement grout, rubber gaskets, flexible plastic gaskets, oakum and mortar, or oakum and joint compound, by a combination of these types, or any one type, as may be specified.

(1) Motar joints shall be made with an excess of mortar to form a bead around the outside of the conduit and finish smooth on the inside. For grouted joints, molds or runners shall be used to retain the poured grout. Rubber ring gaskets shall be installed so as to form a flexible watertight seal. Where oakum is used, the joint shall be calked with this material and then sealed with the specified material.

(2) When Portland cement mixtures are used, the completed joints shall be protected against rapid drying by suitable covering material.

(3) When "Flexible Watertight Gaskets" are specified in the contract for reinforced concrete pipe or pipe arch, the conduit shall have joints conforming to AASHO Designation: M 198, with modifications and exceptions as contained in these specifications, and the contractor shall have the option of using either rubber gasket or flexible plastic gasket joint material.

a. General: No reinforced concrete pipe used in the Flexible Watertight Gasket System shall have joints with a taper of more than 12 degrees and the maximum allowable differential between the joint taper of the bell and spigot, or tongue and groove, shall be 1 degree.

b. Rubber gasket joints and joint material shall meet the requirements of Subsection 905.06 with the following modifications. The joints for use with the rubber gasket material which have a taper of less than 6 degrees will not require the hydrostatic pressure test. If the taper of the joint exceeds 6 degrees and is not greater than 8 degrees, then its use will be permitted provided it will pass the 10 psi hydrostatic pressure test as described in AASHO Designation: M 198-68.

c. Flexible plastic gasket joints and joint material shall meet the requirements of Subsection 905.07 with the following modifications and exceptions. The joints for use with the flexible plastic gasket material which have a taper of less than 10 degrees will not require the

hydrostatic pressure test. If the taper of the joint exceeds 10 degrees and is not greater than 12 degrees, then its use will be permitted provided it will pass the 10 psi hydrostatic pressure test as described in AASHO Designation: M 198-68.

d. The cement and lubricant used to facilitate the joining of conduit, when rubber gaskets or plastic gaskets are used, shall be that recommended by the manufacturer of the gasket material. The procedure used in joining the conduit shall also be as recommended by the gasket manufacturer.

(b) Joints for Flexible Conduit (Ferrous Metal): Flexible conduit shall be firmly joined by coupling bands meeting the requirements of AASHO Designation: M 36.

When special "Watertight Connecting Bands" are specified for joining flexible pipe, the following specifications shall apply.

(1) General: Watertight connecting bands shall be of the same material as the conduit and shall be fabricated from corrugated metal sheets. The coating shall be the same as used on the conduit. The gage of band may be 2 gages lighter than the conduit gage, but not more than 12 gage nor less than 18 gage thickness.

Bands shall lap up on an equal portion of each of the conduit sections. The longitudinal seam under the connecting bands may be riveted or welded at the option of the contractor.

Band joints shall be sealed with flexible plastic gasket material conforming to Subsection 905.07. Plastic gasket rope shall be placed in 2 corrugation recesses on each side of conduit connection. Plastic gasket material shall also be placed on each band connection in such a manner that there will be no leakage. The gasket material shall be a minimum of ¾ inch diameter for ½ inch corrugation depth and a minimum of 1½ inch diameter for 1 inch corrugation depth, as the case may be, and placed and overlapped in accordance with the manufacturer's instructions.

(2) Circular Pipe Section: Connecting bands shall be 12 inches wide for conduit less than 36 inches in diameter and 24 inches wide for culverts 36 inches in

diameter and greater. Bands shall be drawn tight by a minimum of 4 galvanized ½ inch steel rods and lugs. An equal number of rods shall be placed on each side of conduit connection with sufficient rods used to preserve the conduit alignment. Two steel rods shall be placed over the plastic gasket strips on each side of conduit connection. The galvanization of rods and lugs shall be in accordance with ASTM Designation: A 153.

(3) Arch Pipe Section: Connecting bands shall be 12 inches wide for pipe arch up to a 36 inch by 27 inch arch and 24 inches wide for a 43 inch by 27 inch pipe arch and greater. Bands shall be connected at the ends by approved angle or strap connections. Connecting bands used for 43 inch by 27 inch pipe arch and above shall be 2-piece bands. Hardware shall be galvanized in accordance with ASTM Designation: A 153.

Conduits shall be inspected before any backfill is placed and any found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced at the contractor's expense.

701.07 RELAYING CONDUIT. If indicated or directed, existing conduits shall be removed and all suitable sections shall be relaid, extended, or renewed in the same manner as specified for new conduits.

701.08 BACKFILLING. After the conduit is installed, the trench shall be backfilled on each side of the conduit for the full trench width and to an elevation of 1 foot above the top of the conduit or to natural ground elevation, whichever is greater, with materials meeting the following requirements. The backfill material may be selected material from the trench excavation or from a source of the contractor's choice.

(a) For existing material to be used for backfill, the material must meet the requirements of LDH Designation: TR 423, Groups A-1-a, A-1-b, A-2-4, A-2-5, A-3, A-4 or A-6 with a maximum P.I. of 15.

(b) If existing excavated material does not meet the above classifications, the contractor shall be required to furnish backfill materials of LDH Designation: TR 423, Groups A-1-a, A-1-b, A-2-4, A-2-5, A-3 or A-4.

(c) The backfill material that is used to backfill side

drain conduits for driveway entrances only may be material that is satisfactory to the engineer. All backfill material shall be approved before placement and shall be free from large lumps, clods, rock or other objectionable matter.

When the top of the conduit is even with or below the top of the trench, backfill material shall be placed at or near optimum moisture content and compacted in layers not exceeding 6 inches (compacted) on both sides and to an elevation of 1 foot above the top of the conduit or to natural ground elevation, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the conduit, and material shall be brought up evenly on both sides of the conduit for the full required length of fill.

When the top of the conduit is above the top of the trench, backfill shall be placed at or near optimum moisture content and compacted in layers not exceeding 6 inches (compacted) and shall be brought up evenly on both sides of the conduit for its full length to an elevation 1 foot above the top of the conduit. The width of the backfill on each side of the conduit for the portion above the top of the trench shall be equal to twice the diameter of the conduit or 12 feet, whichever is less. The backfill material used in the trench section and the portion above the top of the trench for a distance on each side of the conduit equal to the horizontal outside diameter and to 1 foot above the top of the conduit shall conform to the requirements for backfill material in the first paragraph of this subsection. The remainder of the backfill shall be material that is satisfactory for normal embankment construction.

The backfill material, placed as described above, shall be compacted by the use of mechanical tampers, rollers or other approved methods to obtain not less than 95 percent of maximum density in the top layer of the completed section unless otherwise specified. The backfill material shall also meet the density requirements of the embankment in which the installation is placed. Maximum density shall be determined in accordance with LDH Designation: TR 418 and the in-place density determined by LDH Designation: TR 401.

The exposed slopes at conduit ends shall be covered by approximately 12 inches of plastic material to protect the granular type backfill from erosion.

The contractor shall, unless otherwise directed by the engineer, complete the construction of the embankment to a minimum of 2 feet above the top of the conduit before heavy construction equipment is allowed to cross the installation. Where practicable, shallow installations with less than 2 feet of cover over the top of the conduit shall be constructed after all heavy hauling is completed over the conduit location. After completion of hauling operations, the contractor shall remove any excess thickness of cover material to grade shown on the plans.

Any conduit which is crushed or damaged during laying, backfilling or by subsequent construction, or by any other cause, shall be removed and replaced in accordance with the specifications at the expense of the contractor.

Upon completion of the project and at the time of the final acceptance, all culverts and stormdrains shall be cleaned of all debris, and all soil shall be removed to the invert elevation of the conduit, or in the case where the invert elevation is lower than the elevation of the outfall, to the elevation of the outfall.

701.09 METHOD MEASUREMENT. The length of conduit of the different types and sizes, both new and relaid, will be measured in linear feet by the following methods: (1) conduit not confined by a fixed structure or structures will be measured by the number of joints at the nominal length of each joint; (2) conduit confined by fixed structures will be measured along the conduit between the termini of the conduit in structure walls; (3) conduit confined by a fixed structure on one end and unconfined at the other end will be measured along the conduit from the terminus of the conduit in the structure wall to the unconfined end of the conduit.

When the contract does not include a bid item for "Furnishing Backfill Material, Conduits," the excavation of material and the furnishing and placing of backfill material from trench excavations for conduits will be considered as incidental to the work and will not be measured or paid for under these items. Any backfill material needed to complete the backfill above the natural ground line and around

conduits that extend above the natural ground line will be measured and paid for under the applicable earthwork item or items.

The excavation of material, and the furnishing and placing of backfill material necessary for the installation of side-drain conduits for driveway entrances will be considered as incidental items but will be paid for under the applicable earthwork items. When no earthwork items are included in the contract, the furnishing and placing of such side-drain conduit backfill will be included in the price bid on the item.

When the contract contains a bid item for "Furnishing Backfill Material, Conduits," the quantity to be paid for will be the number of cubic yards (net section) complete in place and accepted, measured in final position between the following limits:

(a) Measurement will include backfill material in the trench up to the top of the original ground line, but will not include any material placed outside of vertical planes 18 inches outside of and parallel to the outside wall of the pipe at its greatest horizontal dimension.

(b) When the original ground line is less than one foot above the top of the pipe, the measurement will also include the placing of all backfill material above the original ground line adjacent to the pipe for a height of 1 foot above top of pipe and for a distance each side of the pipe not more than the greatest horizontal dimension of the pipe.

701.10 BASIS OF PAYMENT. The accepted quantities of conduit will be paid for at the contract unit price per linear foot, as provided in Subsection 701.09, of the types and sizes specified complete in place.

When the contract does not contain a bid item for "Furnishing Backfill Material, Conduits," payment for backfill material will be considered as included in the payment for the respective conduit item.

Payment will be made under:

Item No.	Pay Item	Pay Unit
701(1)	Structural Plate Pipe Arch (Size)	Linear Foot

701.10

Item No.	Pay Item	Pay Unit
701(2)	Corrugated Metal Pipe (Size)	Linear Foot
701(3)	Corrugated Metal Pipe Arch (Size)	Linear Foot
701(4)	Bituminous Coated Corrugated Metal Pipe (Size)	Linear Foot
701(5)	Bituminous Coated Corrugated Metal Pipe Arch (Size)	Linear Foot
701(6)	Asbestos Bonded Corrugated Metal Pipe (Size)	Linear Foot
701(7)	Asbestos Bonded Corrugated Metal Pipe Arch (Size)	Linear Foot
701(8)	Corrugated Aluminum Pipe (Size)	Linear Foot
701(9)	Bituminous Coated Corrugated Aluminum Pipe (Size)	Linear Foot
701(10)	Corrugated Aluminum Pipe Arch (Size)	Linear Foot
701(11)	Bituminous Coated Corrugated Aluminum Pipe Arch (Size)	Linear Foot
701(12)	Reinforced Concrete Pipe (Class III) (Size)	Linear Foot
701(13)	Reinforced Concrete Pipe (Class IV) (Size)	Linear Foot
701(14)	Reinforced Concrete Arch Culvert Pipe (Class) (Size)	Linear Foot
701(15)	(Blank)	
701(16)	(Blank)	
701(17)	Vitrified Clay Pipe (Size)	Linear Foot
701(18)	Asbestos Cement Pipe (Size)	Linear Foot
701(19)	Culvert Pipe (Size)	Linear Foot
701(20)	Pipe Arch (Size)	Linear Foot
701(21)	Relaying Conduit	Linear Foot
701(22)	Furnishing Backfill Material, Conduits	Cubic Yard
701(23)	Concrete Sewer Pipe (Size)	Linear Foot

Item No.	Pay Item	Pay Unit
701(24)	Structural Plate Pipe (Size)	Linear Foot
701(25)	Asbestos Bonded Corrugated Metal Pipe (Size) (Watertight Bands)	Linear Foot
701(26)	Asbestos Bonded Corrugated Metal Pipe Arch (Size) (Watertight Bands)	Linear Foot
701(27)	Asbestos Bonded Corrugated Metal Pipe (Size) (Smooth Lined) (Watertight Bands)	Linear Foot
701(28)	Asbestos Bonded Corrugated Metal Pipe Arch (Size) (Smooth Lined) (Watertight Bands)	Linear Foot
701(29)	Reinforced Concrete Pipe (Class) (Size) (Flexible Watertight Gaskets)	Linear Foot
701(30)	Reinforced Concrete Arch Culvert (Class) (Size) (Flexible Watertight Gaskets)	Linear Foot

Section 702

Manholes, Inlets and Catch Basins

702.01 DESCRIPTION. This work shall consist of the construction of manholes, inlets, junction boxes and catch basins in accordance with these specifications, and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

702.02 MATERIALS. Concrete for these structures shall be Class A meeting the requirements of Section 901, Portland Cement Concrete. Other materials shall meet the requirements specified in the following subsections of Part IX, Materials.

Clay or Shale Brick	904.01
Concrete Brick	904.01
Joint Mortar	905.05
Frames, Grates and Covers, and Ladder Rungs	915.04
Bituminous Varnish	908.13
Reinforcing Steel	909.01

When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

702.03 CONSTRUCTION REQUIREMENTS. Concrete construction shall conform to the requirements of concrete masonry. Masonry shall conform to the requirements for the respective type. Joints shall be full mortar joints and shall not be more than ½ inch wide. When specified, the outside faces of structures shall be plastered with ½ inch thick cement-sand mortar coat. Unless otherwise provided,

exposed surfaces of concrete and masonry shall be cured with wet burlap or other approved curing methods for a period of not less than 48 hours.

Metal frames shall be set in full mortar bed. Conduit sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the conduit.

When grade adjustment of existing structures is specified, the frames, covers and gratings shall be removed and the walls reconstructed as required. The cleaned frames shall be reset at the required elevation. All metal parts shall be thoroughly cleaned and placed in good repair.

Upon completion, each new or reconstructed structure shall be cleaned of any accumulations of silt, debris, or foreign matter of any kind, and all metal parts shall be coated with an approved bituminous varnish. The structures shall be kept clear of such accumulations until acceptance of the work.

After inspection of the completed structures and when directed, the excavated areas which are not occupied by the structures shall be refilled to the required elevations with materials meeting these requirements. The material and backfilling requirements for backfilling these structures shall be in accordance with Subsection 701.08 of Section 701 entitled Culverts and Storm Drains.

The exposed slopes shall be covered by approximately 12 inches of plastic material to protect the granular type backfill from erosion.

The excavated material that is not satisfactory for backfill or is surplus material shall be disposed of by the contractor to the satisfaction of the engineer.

702.04 METHOD OF MEASUREMENT. Junction boxes, manholes, inlets and catch basins, both new and reconstructed as applicable, will be measured by the unit. The excavation of material and the furnishing and placing of backfill material will not be measured or paid for, but will be included in the price bid for manholes, inlets, catch basins, etc., as the case may be except as stated below.

When the contract contains a bid item for "Furnishing Backfill Material, Conduits" the quantity to be paid for will

be the number of cubic yards (net section) complete in place and accepted. The horizontal measurements will be made to theoretical points and limits established by the plans. No yardage shall be included in the measurement which is outside of a volume bounded by vertical planes 18 inches outside of and parallel to the neat lines of the structure. The depth shall be the actual depth established by the engineer from the established grade in the excavation to the top of fill.

702.05 BASIS OF PAYMENT. The accepted quantities of junction boxes, manholes, inlets, and catch basins will be paid for at the contract unit price per each complete in place.

When the contract does not contain a bid item for "Furnishing Backfill Material, Conduits" payment for backfill material will be considered as included in the unit price for the respective pay items.

When an item for furnishing backfill material is provided by the plans, payment will be made under Item 701(22), "Furnishing Backfill Material, Conduits," as listed under Subsection 701.10.

Payment will be made under:

Item No.	Pay Item	Pay Unit
702(1)	Junction Boxes	Each
702(2)	Manholes	Each
702(3)	Inlets	Each
702(4)	Catch Basins	Each
702(5)	Adjusting Manholes, Catch Basins, etc.	Each

Section 703

Underdrains

703.01 DESCRIPTION. This work shall consist of constructing underdrains using pipe and granular filter material and underdrain pipe outlets in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

703.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX, Materials.

Perforated Corrugated Metal Pipe	907.10
Perforated Bituminous Coated Corrugated Metal Pipe	907.11
Perforated Concrete Pipe	906.03
Perforated Asbestos Cement Pipe	906.13
Perforated Clay Pipe	906.10
Perforated Corrugated Aluminum Pipe	907.13
Perforated Bituminous Coated Corrugated Aluminum Pipe	907.15
Asbestos Cement Pipe	906.12
Perforated Bituminized Fiber Pipe	906.17
Bituminized Fiber Pipe	906.15, 906.16

When an item for "Perforated Pipe Underdrains" is included on the plans or in the proposal, the contractor will be permitted to furnish any of the perforated types listed above, except that if corrugated metal or aluminum pipe is furnished, it shall be bituminous coated.

When an item for "Non-perforated Pipe Underdrains" is included on the plans or in the proposal, the contractor will be permitted to furnish any of the non-perforated types of pipe listed above.

Granular material shall meet the requirements for fine aggregate, Subsection 903.02.

When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with

materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

703.03 PIPE INSTALLATION. Trenches shall be excavated to the dimensions and grade required by the plans or as directed. A minimum 3-inch bedding layer of granular backfill material shall be placed and compacted in the bottom of the trench for its full width and length.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material.

Perforated pipe shall normally be placed with the perforations down, and the pipe sections shall be joined securely with the appropriate coupling fittings or bands.

Non-perforated pipe shall be laid with the bell end upgrade and with open joints, wrapped with suitable material to permit entry of water, or unwrapped as may be specified.

Upgrade ends of all subdrainage pipe installations shall be closed with suitable plug to prevent entry of soil materials.

After the pipe installation has been inspected and approved, granular backfill material shall be placed as shown on the plans or as directed. Care shall be taken not to displace the pipe or the covering at open joints.

703.04 METHOD OF MEASUREMENT. Underdrains will be measured by the linear foot for pipe of the type and size specified.

No measurement will be made for excavation or for any specified granular material, but the cost of this work shall be included in the price bid for the respective pay item for drains of the type and size specified.

703.05 BASIS OF PAYMENT. The accepted quantities of underdrains will be paid for at the contract unit price per linear foot of each kind, and of the types and sizes specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
703(1)	Perforated Corrugated Metal Pipe (Size)	Linear Foot
703(2)	Perforated Bituminous Coated Corrugated Metal Pipe (Size)	Linear Foot
703(3)	Perforated Concrete Pipe (Size)	Linear Foot
703(4)	Perforated Asbestos Cement Pipe (Size)	Linear Foot
703(5)	Perforated Corrugated Aluminum Pipe (Size)	Linear Foot
703(6)	Perforated Bituminous Coated Corrugated Aluminum Pipe (Size)	Linear Foot
703(7)	Perforated Bituminized Fiber Pipe (Size)	Linear Foot
703(8)	Bituminized Fiber Pipe (Size)	Linear Foot
703(9)	Perforated Clay Pipe (Size)	Linear Foot
703(10)	Perforated Asbestos Cement Pipe (Size)	Linear Foot
703(11)	Perforated Pipe Underdrains	Linear Foot
703(12)	Non-perforated Pipe Underdrains	Linear Foot

Section 704

Guard Rail

704.01 DESCRIPTION. This work shall consist of the construction of guard rail in accordance with these specifications, and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

The type of guard rail furnished shall be Beam Type Guard Rail.

The construction of the guard rail shall include the assembly and erection of all component parts and materials complete at the locations shown on the plans or as directed.

704.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX, Materials.

Metal Beam Rail	910.04
Posts and Spacer Blocks	910.10
Hardware	910.12

When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

The contractor, at his option, may furnish either galvanized steel or aluminum guard rail.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has he opportunity to check for compliance prior to or during incorporation of materials in the work.

The manufacturer shall perform tests as specified in AASHO Designation: M 180 and shall submit 7 certified copies of each report to the Department's Materials and Testing Section for approval and distribution.

CONSTRUCTION REQUIREMENTS

704.03 POSTS. Posts shall be set plumb, in hand or

mechanically dug holes, unless driving is permitted. In the latter case the manner of driving shall be such as to avoid battering or distorting of posts. Post holes shall be backfilled with acceptable material placed in layers and thoroughly compacted. Where posts fall within existing surfaced areas, the surface material shall be replaced in kind immediately upon completion of the installation.

Where sections of rail are curved or located on curves, the posts shall be erected in such position as to obtain the designated panel lengths measured along the face of the rail.

704.04 RAIL ELEMENTS. Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts.

Holes for special details may be field-drilled or punched when approved by the engineer.

Galvanized surfaces that are abraded or damaged at any time after the application of the zinc coating shall be repaired in accordance with Subsection 811.15, unless otherwise directed or specified.

704.05 METHOD OF MEASUREMENT. Guard rail including regular end sections, but exclusive of standard ground mounted terminal anchor section and terminal anchor section (bridge end) will be measured by the linear foot along the face of the rail from center to center of end posts for each complete section, including posts and other elements of the completed section. Measurements shall be exclusive of any openings in each line of railing between railing posts.

The guard rail (double face) shall be measured as described in the preceding paragraph except that measurement will be made along the centerline of posts within the limits shown on the plans.

Guard rail terminal anchor sections of the type and size specified on the plans will be counted as a complete unit.

Guard rail terminal anchor sections (bridge ends) will be measured by the linear foot along the face of the rail complete in place.

704.06 BASIS OF PAYMENT. The accepted quantities of guard rail and terminal anchor sections will be paid for at the respective contract unit prices per linear foot and per each for the type specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
704(1)	Deep Beam Highway Guard Rail	Linear Foot
704(2)	Deep Beam Blocked Out Highway Guard Rail	Linear Foot
704(3)	Guard Rail Terminal Anchor Sections	Each
704(4)	Deep Beam Highway Guard Rail (Double Faced)	Linear Foot
704(5)	Deep Beam Blocked Out Highway Guard Rail (Double Faced)	Linear Foot
704(6)	Guard Rail Terminal Anchor Sections (Bridge End)	Linear Foot

Section 705

Fences

705.01 DESCRIPTION. This work shall consist of the construction of fences and gates in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

705.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX, Materials.

Mesh Wire	910.02
Barbed Wire	910.01
Chain Link Fence and Gates	910.03
Fence Posts	910.06
Gates	910.11
Wire Staples	910.08
Braces	910.07
Metal Fasteners for Steel Posts	910.09

When the locations of manufacturing plants allow, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

705.03 CONSTRUCTION REQUIREMENTS. Unless the plans include an item or items for clearing and grubbing, the contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

The contractor's activities and operations shall be confined to the area immediately adajcent to the right-of-way lines and within the right-of-way.

At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of closure indicated.

When the plans require that posts, braces or anchors be embedded in concrete, the contractor shall install temporary guys or braces as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys and bracing set in concrete until 3 days have elapsed from the time of placing of the concrete.

The tops of all posts shall be set to approximately the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the engineer and under the conditions specified by him.

Wire or fencing of the size and type required shall be firmly attached in the manner indicated to the posts and braces. All wire shall be stretched taut and be installed to the approximate required elevations.

Electrical Grounds: All fence shall be grounded by a Copperweld rod 8 feet long and a minimum of 5/8 inch in diameter, driven vertically until the top of it is approximately 6 inches below the top of ground. A No. 6 solid copper conductor shall be firmly attached to the rod and to the fence in such a manner that each element of the fence is grounded. Where a power line passes over the fence, a ground shall be installed immediately below the point of crossing. Otherwise, grounds shall be spaced along the fence at intervals of 500 feet (maximum). No separate payment will be made for electrical grounds, and the cost thereof shall be included in the prices bid for fences and gates under these items.

705.04 REBUILT FENCE. Where indicated on the plans or directed, the contractor will be required to take down, move back and rebuild existing fence. The fence shall be rebuilt in the same manner as specified for new fence. Rebuilt ornamental fence, picket fence or other special types of fence shall be equal in all respects to the existing fence.

705.05 GATES. Design of metal gates shown on the

plans is of a type acceptable to the Department. Gates of any other design may be furnished if prior approval is obtained from the Department.

All gates shall be of rigid construction, and after erection shall not show any sag or warp.

705.06 CHAIN LINK FENCE AND GATES.

(a) Concrete Post Anchorage and Concrete Apron: Posts shall be anchored in cast-in-place concrete footings. A concrete apron shall be placed under the fence as shown on the plans. All concrete for footings and aprons shall be Class R or better and may be with or without air entrainment at the option of the contractor.

Hand mixing of concrete will be permitted for cast-in-place concrete where small quantities are to be mixed and when done to the satisfaction of the engineer. No hand mixed batch shall exceed ½ of a cubic yard. All batches exceeding ½ of a cubic yard shall be machine mixed.

Concrete footings shall be carried down to at least the depth, and shall be not less than the dimensions, shown on the plans. The top of all footings and aprons shall extend slightly above the ground line and shall be steel troweled to a smooth finish with slope to drain away from the post as shown on the plans. Posts, braces, and other units shall be approximately centered in their footings.

Concrete shall be placed promptly, expeditiously, and without segregation after mixing. The contractor shall be required to consolidate and compact the concrete satisfactorily by tamping or vibrating. Exposed edges shall be tooled. All excess excavation from footings and aprons shall be disposed of in a manner satisfactory to the engineer.

(b) Erection of Chain Link Fence: The fence shall be erected to the established lines and grades. The fence shall be approximately true to line, taut and shall comply with the best practice for fence construction of this type.

Posts shall be spaced in line of fence not further apart than 10-foot centers, with a tolerance of minus 2 feet. At locations where breaks in a run of fencing are required,

or at intersections with existing fencing, appropriate adjustments in post spacing shall be made to conform to the requirements for the type of closure indicated. Each post shall be erected plumb and the posts shall line up longitudinally with the specified alignment with no perceptible variation.

Pull posts, as defined above, shall be placed approximately 330 feet apart in straight runs and at each vertical angle point of 20° or more, all as directed. Corner posts shall be placed at each horizontal angle or point of 20° or more. Corner and pull posts shall have a horizontal brace and a tie rod on each side of the posts, extending and connected to the adjacent line posts.

Posts shall be permanently positioned and anchorages firmly set before fabric is placed. The top rail shall also be secured to all posts in a satisfactory manner before fabric is placed. The ends of the fabric shall be secured by the use of stretcher bars threaded through the loops of the fabric and secured to the posts by means of clamps with bolts and nuts. The number of clamps shall be as called for on the plans.

The fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. The degree of tensioning shall be commensurate with air temperatures at the time of installation to prevent undue sagging or tensioning of the mesh because of changing temperatures. The fabric shall be fastened to each line post at approximately equal spaces and to the top rail and bottom tension wire with tie wires or bands as called for on the plans or as directed by the engineer.

(c) Erection of Gates: The gate installation shall include gate frames, stretcher bars, filler fabric, latches, stops, locking device, padlocks, hinges, gate posts with braces, tie rods, turnbuckles, caps and all fittings and details for gates and gate posts, all as specified and as shown on the plans and as required to make a complete installation.

All gates shall be carefully aligned with posts vertical. Where clamps are used for attaching hardware, they shall be made up tight. The bottom of each gate shall clear the ground by at least 3 inches at all points in its swing. The contractor shall modify the existing grade within the area

of swing, if necessary, to meet this requirement when directed. Direction of swing and location of gates will be as indicated on the plans or as otherwise directed. Stops with latches, or other approved means for holding the gate open, shall be provided for all gates and so placed as to prevent damage to the gate or fence by overswing. Unless otherwise instructed, stops shall be provided also to arrest the swing of a closed gate at the centerline of the fence.

(d) Paints and Painting: Metal parts which are protected by galvanizing are not to be painted. After erection is completed, all construction under this item will be inspected, and all parts of fences, gates, etc., (including bolts and nuts) from which the galvanizing has been abraded so that the base metal is exposed, shall be spot-painted with an approved paint. Painting of aluminum surfaces will not be required.

705.07 METHOD OF MEASUREMENT. New fence will be measured by the station of 100 feet or by the linear foot, as the case may be. Measurement will be along the bottom of the fence on its roadside face from outside to outside of end posts, exclusive of gates, for each continuous run of fence.

Gates will be measured as complete units of the size and type specified.

No measurement will be made for new posts, but the cost of new posts required for new fence, rebuilt fence and gates will be included in the respective item.

Rebuilt fence will be measured by the station of 100 feet, as described above, including gates.

705.08 BASIS OF PAYMENT. The accepted quantities of fence, gates and rebuilt fence will be paid for, measured as described above, complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
705(1)	Barbed Wire Fence	Station
705(2)	Combination Mesh & Barbed Wire Fence	Station
705(3)	Single Swinging Walk Gates	Each
705(4)	Single Swinging Driveway Gates	Each
705(5)	Double Swinging Driveway Gates	Double Gate

705.08

Item No.	Pay Item	Pay Unit
705(6)	Chain Link Fence, _____ foot height	Linear Foot
705(7)	_____ Gates, _____ foot height, for chain link fence	_____ Gate
705(8)	Rebuilt Fence	Station

Section 706

Sidewalks

706.01 DESCRIPTION. This work shall consist of the construction of concrete sidewalks, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

706.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Section IX, Materials.

Joint Filler	905.03
Reinforcing Steel	909.01
Curing Materials	911.01

Concrete for sidewalks shall be Class A meeting the requirements of Section 901.

Concrete will be subject to inspection and tests at the mixing plants for compliance with quality requirements.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

706.03 CONCRETE SIDEWALKS.

(a) Excavation: Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm even surface conforming to the section shown on the plans. All soft and yielding material shall be removed and replaced with approved material.

(b) Forms: Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, clean, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

(c) Subgrade: The subgrade shall be thoroughly moistened immediately prior to the placing of the concrete.

(d) Depositing and Finishing: The concrete shall be deposited between the forms on the moist subgrade, struck off and compacted to the required thickness. It shall be tamped sufficiently to bring the mortar to the surface. The surface shall be finished with a wood float or steel trowel, provided that the surface is finally brushed in order to leave a slightly rough finish. All joints and edges shall be rounded with an edging tool having a ¼ inch radius.

(e) Joints: Expansion joints shall be of the dimensions specified, and shall be filled with premoulded expansion joint filler. The sidewalk shall be divided into sections by dummy joints formed by a jointing tool or other acceptable means as directed. The dummy joints shall extend into the concrete for at least ¼ of the depth and shall be approximately 1/8 inch wide.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk. Unless otherwise specified ¼ inch premoulded expansion joint filler shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete sidewalks and any fixed structure such as a building or bridge. This expansion joint material shall extend for the full depth of the walk.

Unless otherwise specified expansion joint filler shall be ½ inch thick and shall be installed every 100 feet or fraction thereof, between intersecting sidewalks and any fixed structure such as a building, bridge or curbing. This expansion joint material shall extend for the full depth of the walk.

(f) Curing: Concrete shall be cured for at least 72 hours. Curing shall be done with the use of liquid membrane curing compound or by other approved methods. During the curing period all traffic detrimental to the structure shall not be permitted. Vehicular traffic shall be excluded for such additional time as the engineer may direct.

706.04 METHOD OF MEASUREMENT. Concrete side-

walks will be measured by the square yard of finished surface.

Reinforcement, if required, will not be measured, but the cost will be included in the price bid on concrete sidewalk.

Excavation and backfill unless otherwise provided for, expansion joint material and other related miscellaneous items will not be paid for separately but the cost thereof shall be included in the cost of the sidewalk.

706.05 BASIS OF PAYMENT. The accepted quantities of sidewalk will be paid for at the contract unit price per square yard for concrete sidewalk.

Payment will be made under:

Item No.	Pay Item	Pay Unit
706(1)	Concrete Sidewalk (_____ Thick)	Square Yard

Section 707

Curbs and Gutters

707.01 DESCRIPTION. This work shall consist of the construction of any of the types of curbs and gutters included in the following list in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions and typical sections shown on the plans or established by the engineer.

Plain Concrete Curb
Plain Concrete Gutter
Combination Curb and Gutter
Integral Concrete Curb
Integral Concrete Lip Curb
Combination Lip Curb and Gutter
Bituminous Curbing
Extruded Concrete Curb

707.02 MATERIALS. Except as provided below the materials shall meet the requirements of the following subseections of Part IX, Materials.

Joint Sealers	905.01, 905.02
Joint Fillers	905.03

(a) Integral Types: All concrete for these items shall be Class A or the same type concrete provided for the roadway slab of which it shall form an integral part.

(b) All Types Except Integral: All concrete for these items shall be Class A meeting the applicable requirements of Section 901.

(c) Bituminous Curbing: The bituminous mixture in this item shall be of the type shown on the plans and shall meet the applicable requirements of asphaltic concrete pavement as provided in Part V of these specifications. All materials will be subject to inspection for acceptance at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work. Tests for density and surface tolerances shall be waived.

(d) Extruded Concrete Curb: All concrete for this curb

shall be Class P mixture (3000 psi, min.) with the following exceptions. The slump of the concrete shall not exceed 1 inch and an approved air entraining agent shall be used to maintain an entrained air content of from 3 to 5 percent. The cost of furnishing and using the air entraining agent shall be included in the bid price for the extruded concrete curb.

CONSTRUCTION REQUIREMENTS

707.03 SUBGRADE. The subgrade shall be shaped to the required depth below the finished surface in accordance with the dimensions shown on the plans and shall be compacted to a firm, even surface. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement slab. All soft and yielding spots or any unstable material encountered shall be removed and replaced with suitable material and thoroughly compacted. When foundation underdrains are to be placed under curbing and gutter, the excavation and backfilling for same shall be completed and compacted before subgrade for curbing and gutter is prepared.

707.04 FORMS. The forms for the curbing or gutter shall be of wood or metal, straight, free from warp and of sufficient strength when staked to resist the pressure of the concrete without springing. All forms shall be cleaned thoroughly and greased or soaped before concrete is placed against them. Forms which have become worn, bent or broken shall not be used until satisfactorily repaired and straightened. Repaired forms shall not be used until inspected and approved by the engineer. An approved mechanical curb forming machine may be used without forms.

707.05 JOINTS. Joints shall be formed in the curbing to correspond with "Dummy Joints" and other transverse joints in the pavement slab. All joints shall extend entirely under the curb section and shall be finished and filled with prescribed filler.

All Types Except Integral: One-quarter inch joints shall be provided at intervals of 20 feet, unless otherwise indicated on the plans, except where shorter sections are necessary for closures. The separation shall be effected by using steel plates ¼ inch in thickness, cut to true section,

and set vertically in the forms until the concrete has set sufficiently to permit withdrawal of the plates.

707.06 DEPOSITING CONCRETE.

(a) Integral Types: After concrete pavement has been struck off, the curb form shall be clamped or otherwise securely fastened in place upon the slab form, and the additional concrete for the curb shall then be deposited and thoroughly tamped. The additional concrete shall be placed within 30 minutes after the pavement slab has been finished, and care shall be taken to secure monolithic construction. All concrete shall be spaded or vibrated sufficiently to eliminate all voids and shall be tamped to bring the mortar to the surface, after which it shall be finished smooth and even with a wooden float. All edges shall be rounded with an approved finishing tool to the radius shown on the plans.

When authorized, curb shown on the plans to be integral type may be placed after completion of the pavement, provided dowels are placed in the pavement of the size, type and spacing shown on the plans. No additional cost to the Department shall result from placing the curb by this method.

(b) All Types Except Integral: The concrete shall be placed on the prepared subgrade, struck off, and compacted to the required thickness. All concrete shall be spaded or vibrated sufficiently to eliminate all voids and shall be tamped to bring the mortar to the surface, after which it shall be finished smooth and even with a wooden float. All edges shall be rounded with an approved finishing tool to the radius shown on the plans.

707.07 FINISHING. The forms shall be removed within 24 hours after the concrete has been placed, and honeycombed areas and other minor defects shall be filled with mortar composed of Portland cement and sand, mixed in the same proportion as provided for the concrete. Plastering will not be permitted on the faces of the curbing or gutter, and all rejected curb or gutter shall be removed and replaced without additional compensation. The top and face of the curb or gutter shall be finished while the concrete is still green by the use of wood float, brush and water.

707.08 BITUMINOUS CURBING. This work shall consist of furnishing extruded bituminous curb to the section

shown on the plans by the use of an approved machine. The contractor shall furnish and apply an approved tack coat as indicated on the plans, cost of which shall be included in the price bid on this item.

707.09 EXTRUDED CONCRETE CURB. This item shall consist of furnishing extruded concrete curb to the sections shown on the plans by the use of an approved mechanical curb forming machine. The concrete shall be uniformly fed to the machine and after extrusion, the concrete will maintain the shape of the section without slumping.

The finished curb shall have a surface free from voids and honeycomb. Any additional surface finishing required shall be performed immediately after extrusion.

When the extruded concrete curb is placed on asphaltic concrete pavement, an approved tack coat shall be applied prior to placement of curb. The cost for tack coat shall be included in the price bid on this item.

707.10 CURING (Except Bituminous Curbing). After finishing, the curb or gutter shall be cured in the same manner and by one of the methods prescribed for Portland cement concrete pavement—Section 601 of these specifications.

707.11 BACKFILLING. After the curb or gutter has set sufficiently, the contractor shall backfill adjacent to the curb or gutter with approved material. This material shall be thoroughly tamped in layers not over 6 inches in depth.

707.12 METHOD OF MEASUREMENT. All curb, combination curb and gutter, and gutter under this item will be measured by the linear foot measured along the face of the curb, or as otherwise indicated on the plans. Excavation, backfill, expansion joint material and other miscellaneous materials will not be paid for separately but shall be included in the cost of the curb and gutter.

When plain concrete gutter is constructed in conjunction with catch basins, the plain concrete gutter will be measured and paid for under Combination Curb and Gutter.

707.13 BASIS OF PAYMENT. Curb and gutter placed and accepted, measured as provided above, will be paid for at the respective contract unit price per linear foot, except as stated below for Bituminous Curbing.

707.13

The accepted quantity of Bituminous Curbing will be paid for at the contract price per linear foot, provided asphaltic concrete mixtures furnished conform to the requirements for 80% payment in Schedule 1 of Section 502. If asphaltic mixtures do not conform to requirements for 80% payment, payment will be made at 50% of the contract unit price per linear foot or either the asphaltic mixtures shall be removed and replaced. Acceptance will be based on Marshall stability only.

Payment will be made under:

Item No.	Pay Item	Pay Unit
707(1)	Plain Concrete Curb	Linear Foot
707(2)	Plain Concrete Gutter	Linear Foot
707(3)	Combination Curb and Gutter	Linear Foot
707(4)	Combination Lip Curb and Gutter	Linear Foot
707(5)	Integral Concrete Curb	Linear Foot
707(6)	Integral Concrete Lip Curb	Linear Foot
707(7)	Bituminous Curbing	Linear Foot
707(8)	Extruded Concrete Curb	Linear Foot

Section 708

Right-of-Way Markers

708.01 DESCRIPTION. This work shall consist of furnishing and erecting right-of-way markers in conformity with the design, dimensions and elevations shown on the plans.

708.02 MATERIALS. The acceptance of concrete shall be based upon the compressive strength of cylinders made according to Subsection 901.07, paragraph (f), and cured in the same manner as the markers. The minimum compressive strength of cylinders shall be 2,000 psi at 7 days and 3,000 psi at 28 days.

Aggregate used in the concrete shall meet all of the applicable requirements of Section 903 except that the gradation shall be optional with the contractor.

Reinforcing steel shall be deformed bars conforming to the applicable requirements of Section 806.

Bronze marker plates, when required, shall contain not less than 85 percent copper and shall be true to pattern in form and dimensions.

CONSTRUCTION REQUIREMENTS

708.03 MARKERS. The markers shall consist of either precast reinforced concrete posts or bronze plates as indicated on the plans. The markers shall be installed on right-of-way lines at points designated on the plans or directed.

(a) Marker Posts: The concrete posts shall be cast, finished and cured in the following manner.

(1) The concrete posts shall be cast in mortar-tight forms: Special care shall be exercised to puddle and tamp the concrete around the reinforcing steel and to avoid the formation of aggregate pockets. Concrete shall be placed continuously in each post.

(2) Finishing: Forms shall be removed as soon as the concrete has hardened sufficiently to prevent damage to marker. Markers shall be given a Class 1, Ordinary Surface Finish, in accordance with Subsec-

tion 805.14 and shall present a neat and uniform appearance.

(3) Curing: As soon as finished, markers shall be cured by an approved method for a period of not less than 3 days.

(b) Bronze Markers: Bronze markers shall be furnished and installed in concrete at locations indicated on the plans in a neat and workmanlike manner as directed.

708.04 BACKFILLING. All posts shall be set to the depth indicated on the plans or as directed. Post holes shall be backfilled and thoroughly tamped as directed.

708.05 METHOD OF MEASUREMENT. Right-of-way markers will be measured by the marker and the number placed and accepted shall be counted.

708.06 BASIS OF PAYMENT. The number of markers placed and accepted shall be paid for at the contract unit price complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
708(1)	Right-of-Way Marker (Concrete Posts)	Each
708(2)	Right-of-Way Marker (Bronze)	Each

Section 709

Steel Rail Cattle Guards

709.01 DESCRIPTION. This work shall consist of the construction of welded steel rail cattle guards at the locations and conforming to the details shown on the plans, and in accordance with these specifications.

These specifications cover portable steel rail cattle guards that can be set in place on the reinforced concrete walls or footings. The plans show types of crossings that are acceptable to the Department. Cattle guards of other types may be furnished if prior approval is obtained from the engineer. If bids are submitted on some other type, it will be necessary to include, with the bid, manufacturer's drawings and specifications for the type the bidder contemplates furnishing for approval by the Department.

709.02 MATERIALS. Steel rails shall be of the unit weight specified on the plans.

Pipe wings shall be standard strength black or galvanized iron pipe, 2 inch diameter or as otherwise specified on the plans. If black pipe is furnished, it shall receive, in the shop, one coat of primer and one coat of top coat paint. Paint and its application shall conform to the applicable requirements of Section 811. Galvanized pipe will not require painting.

Concrete shall be Class A meeting the applicable requirements of Section 901.

Reinforcing steel shall be deformed bars meeting the applicable requirements of Section 806.

Treated timber where required shall be creosoted pine or Douglas fir and shall be Dense No. 1 structural meeting the applicable requirements of Section 812.

Hardware shall be standard quality galvanized, of the size and dimensions recommended by the fabricator of the cattle guard and acceptable to the engineer.

CONSTRUCTION REQUIREMENTS

709.03 EXCAVATION AND BACKFILL. A trench of sufficient width shall be excavated to the line and grade in-

dicated on the plans or as directed. Excavation shall extend a minimum of one foot outside the neat lines of the concrete walls or footings.

The backfill shall be deposited in layers not exceeding 6 inches compacted thickness, and each layer shall be thoroughly compacted with approved mechanical tampers.

709.04 REINFORCED CONCRETE. Class A concrete and reinforcing steel shall be placed in accordance with the plans and applicable requirements of these specifications. The reinforcing steel shall be securely fastened in an approved manner so as not to be displaced during the placing of the concrete.

709.05 PLACING TIMBERS. When timbers are required, they shall be placed as shown on the plans.

709.06 RAILS AND PIPE WINGS. Rails shall be placed in accordance with the details shown on the plans, welded together in an approved manner, and the completed guard rail shall be substantial in every respect.

Pipe wings shall be in accordance with the plan details.

709.07 METHOD OF MEASUREMENT. Steel rail cattle guards, of the type and dimensions shown on the plans or in the proposal, will be measured complete in place and accepted, and each completed cattle guard will be counted.

Excavation or backfill will not be measured, but the cost of this work will be included in the unit price bid on Steel Rail Cattle Guard.

709.08 BASIS OF PAYMENT. The number of cattle guards completed and accepted, as provided above, shall be paid for at the contract price per unit for "Steel Rail Cattle Guards," and shall include all work and materials for the complete installation.

Payment will be made under:

Item No.	Pay Item	Pay Unit
709(1)	Steel Rail Cattle Guard	Each

Section 710

Removal and Relocation of Buildings and Miscellaneous Structures, Moving of Buildings and Miscellaneous Structures and Demolishing Buildings or Structures

710.01 DESCRIPTION. The removing and relocation of buildings and miscellaneous structures shall consist of the removal, preparation for moving and relocation of buildings or structures of all types, together with all existing service connections, appurtenances and accessories; reconstruction of all foundations and appurtenances, all in accordance with the plans and these specifications.

Moving of buildings and miscellaneous structures shall consist of moving units specified under the item "Removal and Relocation of Buildings and Miscellaneous Structures" from the original location to the final location. This item shall include the extension of existing water, gas, sewer and other service lines and utilities and all materials necessary therefor.

Demolishing buildings or structures shall consist of demolishing and disposing of all parts of the building or structure indicated on the plans, including foundations, basements, cisterns, underground tanks, walks, driveways or other artifacts.

CONSTRUCTION REQUIREMENTS

710.02 GENERAL. The Department reserves the right to eliminate from the work to be done by the contractor, the removal of any or all of the buildings, structures, etc., itemized under these items, if deemed advisable by the engineer. Such elimination shall not affect the unit prices bid on the remaining buildings, structures, etc., to be moved, or the unit prices bid on the other items of the contract, and the contractor will not be entitled to any compensation due to such elimination.

In performing work in connection with the removal and relocation of buildings and miscellaneous structures, the

contractor's attention is specifically directed to the requirements of Section 107 of these specifications.

710.03 REMOVAL AND RELOCATION OF BUILDINGS AND MISCELLANEOUS STRUCTURES. Buildings or structures shall be prepared for moving, removed and placed in their new locations, as shown on the plans or as designated, and left plumb and level and in as good condition in all respects as originally found. All units removed and relocated shall be placed on foundations of the same type and character as the original foundations.

Steps, outside stairways, canopies, porches, block or post supports, sills, chimneys on brackets and other appurtenances forming an integral part of the building are to be considered as part of the building and removed and relocated accordingly. Cellars, cellar steps, concrete or masonry porches, concrete floors solid or semi-solid concrete and masonry foundations and supports, septic tanks, fireplaces and chimneys standing on the ground, and other appurtenances attached or connected to the building but not movable as an integral part of the building, shall be removed, relocated and/or replaced with foundations or appurtenances of the same size, type and character as existed before the building was moved.

Wherever sanitary sewers, water, gas, electric, or telephone service lines are connected to the buildings being removed and relocated, the same shall be disconnected without unnecessarily discommoding the occupants of the building being moved. The contractor shall be responsible for all notices to the public utility companies and for all fees charged by them.

All privies, wash houses, garages, and other outbuildings, cisterns, wells, septic tanks and other appurtenances used in conjunction with a building or structure shall be removed and relocated. The contractor shall also remove and rebuild existing yard fences, driveways and walks and extend same as necessary. Existing shrubbery shall be removed and replanted at new locations as designated. All of the above shall be considered as appurtenances and appliances to the buildings or structures indicated on the plans to be removed and relocated.

Relocated wells shall conform to the Sanitary Code of the

State of Louisiana as prepared and promulgated by the Louisiana State Board of Health.

The removal and relocation of a building, any part of which is used as a filling station, unless otherwise noted on the plans, shall include the removal and relocation of all gasoline pumps, tanks, pipes, signs, and other accessories appurtenant to the filling station. Tanks shall be placed the same depth below the ground as existed before moving.

Material in the existing foundations, concrete or masonry floors, chimneys and other appurtenances, where not used in the reconstruction of the appurtenances shall be removed and disposed of as directed.

All new material required by the contractor in performing any of the above operations shall be furnished by the contractor at his expense.

The contents of all buildings or structures shall be removed and relocated along with the building or structure to its new site. In the event that it is not feasible or possible to remove the building or structures together with the contents therein, the contents shall be removed from the building or structure at its original location and same replaced in the relocated building or structure. Such precautions as necessary shall be taken to prevent damage or loss of any kind to the contents thereof.

Removal and relocation of miscellaneous structures. Cattle pens, cane derricks, cattle guards or other similar type structures, detailed under this item, shall be removed and relocated or reconstructed on or beyond the rights of way line as directed. Materials in the existing structures, which are considered suitable for re-use, may be utilized in their reconstruction. All new materials required shall be similar in kind to that in place and shall be furnished by the contractor at his expense.

Removal and/or relocation of liquefied petroleum gas tanks (Butane tanks). Prior to the removal and/or relocation of butane tanks, the contractor shall notify and obtain approval of the Louisiana Liquefied Petroleum Gas Commission, Baton Rouge, Louisiana, in order that said Commission may have a representative present at time of removal should they desire. Should their representative be present and should he require that a new tank be furnished, the contractor shall replace the old tank with such new tank as re-

quired. The contractor will be reimbursed for the actual cost of the new tank furnished upon presentation of the original receipted bill, which payment will be in addition to the price bid under this item. If the removed tank is not to be re-used on this project, it shall be destroyed by the contractor, but in doing so, the contractor is warned of danger from accumulated gas in the old tank. A suggested method is first filling the tank with water and cutting off the neck; however, the Department will not be liable for any damage or loss from such operations. Said operations shall be the full responsibility of the contractor.

The contractor shall furnish the Department with a certificate of release from each property owner, and in the event of separate ownership of building and property, a certificate of release from each owner shall be furnished. This certificate shall state that the buildings or structures removed and relocated are in an acceptable condition and that said owner waives all claims for damages to his property and buildings or structures removed.

710.04 MOVING OF BUILDINGS AND MISCELLANEOUS STRUCTURES. The limits of moving of a building unit shall be the distance from the center of the principal building or structure in its original location, measured along the shortest practical route of moving, to the center of the principal building or structure in its new location. Appurtenances to the principal building or structure will not be considered in the measurement, but shall be moved with the principal building or structure as a unit and re-established at the new location.

710.05 DEMOLISHING BUILDINGS OR STRUCTURES. Unless otherwise specifically provided, all materials in the designated building or structure shall become the property of the contractor. All portions of the building or structure shall be removed from the right-of-way and disposed of by the contractor.

710.06 METHOD OF MEASUREMENT. Removal and relocation of buildings and structures will be measured by the building or structure designated on the plans, and each principal building or structure will be designated on the plans and in the contract by its station number. For the purpose of measurement, each principal building or struc-

ture, together with its appurtenances and appliances, will be considered a complete and separate unit.

The moving of a building unit shall be measured in units of principal building or structure moved one foot which shall be designated a "Building foot."

Demolishing buildings or structures shall be measured by the unit and shall include appurtenances, foundations, etc.

710.07 BASIS OF PAYMENT. Buildings removed, moved, relocated and accepted, measured as provided above, shall be paid for at the contract unit price for "Removal and Relocation of Buildings and Miscellaneous Structures," "Moving of Buildings and Miscellaneous Structures" and "Demolishing Buildings or Structures."

Payment will be made under:

Item No.	Pay Item	Pay Unit
710(1)	Removal and Relocation of Buildings and Miscellaneous Structures	Per Unit
710(2)	Moving Buildings and Miscellaneous Structures	Per Building Foot
710(3)	Demolishing Buildings or Structures	Per Unit

In the event a building or structure that is contained as a complete and separate unit and listed under Item 710(1), for removal and relocation and the contractor enters into an agreement with a property owner for demolishing or other disposition; or in the event it is subsequently determined that said building or structure previously scheduled for removal can remain in place, in whole or in part, with or without minor adjustments; and the contractor enters into an agreement with the property owner, incorporating such revised determination and any accompanying adjustments regarding said building or structure, including any possible elements of damages for leaving the building or structure in place; in either event, the contractor shall furnish the Department with said agreement for approval of the engineer.

The contractor will be paid for the demolishing or other handling of the building or structure at the total amount bid on the complete and separate unit as listed under Item 710(1), Removal and Relocation of Buildings and Miscellaneous Structures.

Where the determination to allow the building or struc-

ture to remain in place involves a decrease in cost to the contractor, including any allowance for damages to the property owner and other adjustment, of the amount originally bid for the removal of said unit under Item 710(1), then an allowance shall be made in such amount as the engineer deems fair and equitable.

If approval is given by the engineer, the contractor shall furnish the Department with a certificate of release from the property owner for the complete and separate unit. In the event of separate ownership of building or structure and property, a certificate of release from each owner shall be furnished. This certificate shall state that said owner or owners waive all claims for damages to his property and building or structure that has been demolished or otherwise handled to the owner's satisfaction.

No measurement or payment will be made under Item 710(2) for any such building or structure handled as provided herein.

Section 711

Riprap

711.01 DESCRIPTION. This work shall consist of furnishing and placing riprap in accordance with these specifications and in reasonably close conformity to the lines, grades and thickness shown on the plans or directed by the engineer. Riprap shall be Random Riprap, Handplaced Riprap or Grouted Riprap.

Special riprap for bank protection, sinking mattresses and pier protection at bridge sites shall be furnished when specified and placed in accordance with details shown on the plans and described in the project specifications.

711.02 MATERIALS.

(a) Riprap other than Special Riprap: Riprap may be stone, waste concrete or broken concrete. Stone shall be durable field or quarry stone, dense, resistant to the action of air and water, and suitable in all respects for riprap purposes. Stone used for hand-placed riprap and grouted riprap shall be approximately rectangular in shape. The volume of the individual stones, except those used for chinking, shall be not less than ¼ of a cubic foot.

Waste concrete or broken concrete may be used for riprap provided it is sound and meets the size requirements for stone.

(b) Special Riprap: Stone furnished under these items shall be hard, durable stone that will not disintegrate upon exposure to the elements or be easily broken from handling. Stone shall be well mixed and reasonably free from earth, dust and other objectionable materials, and shall weigh, by displacement, not less than 140 pounds per cubic foot dry. The gradation of the stone shall be as follows:

(1) Stone for Bank Protection:

	Percent by Weight
Over 125 lbs.	5% to 15%
75 lbs. to 124 lbs.	15% to 40%
25 lbs. to 74 lbs.	25% to 55%
Under 25 lbs.	10% Maximum

Chips and spalls under six (6) pounds shall not exceed 5 percent by total weight.

(2) Stone Ballast for Sinking Mattresses: (10 lbs. to 100 lbs.)

	Percent by Weight
75 lbs. to 100 lbs.	0% to 20%
25 lbs. to 74 lbs.	60% to 100%
10 lbs. to 24 lbs.	0% to 20%

Stone smaller than 10 lbs. shall not exceed 1 percent of total weight.

(3) Stone for Heavy Deposited Riprap: (50 lbs. to 250 lbs.)

	Percent by Weight
250 lbs. Maximum Size	
200 lbs. to 250 lbs.	0% to 20%
100 lbs. to 199 lbs.	60% to 100%
50 lbs. to 99 lbs.	0% to 25%

Stone smaller than 50 lbs. shall not exceed 15 percent of total weight.

Broken concrete or concrete in sacks or bags meeting the above requirements for gradation may be used for ballasting and deposited riprap.

711.03 RANDOM RIPRAP. Random riprap shall be dumped or rolled into place in such a manner that the smaller stones will be uniformly distributed throughout the mass. Sufficient hand work shall be done to procure a neat and uniform surface and to the depth shown on the plans or otherwise specified.

711.04 HAND-PLACED RIPRAP. The area over which the hand-placed riprap is to be placed shall be shaped to conform reasonably to the cross section shown on the plans or otherwise designated. All trees, brush or stumps shall be removed to the elevation of the bed of the riprap and all loose material shall be thoroughly compacted by approved methods. When the riprap is to be laid on a slope, a trench of the required dimension shall be excavated at the toe of the slope and the stone firmly embedded in the trench at the toe thereof, with the axis of each stone most nearly approximating the specified thickness of the riprap, laid perpendicular to the slope. All stones shall be laid in such a manner as to break joints with adjacent stone and shall be

laid with the minimum practicable amount of space between them. After the stones have been laid, all spaces between them shall be chinked with small stones or spalls rammed firmly into place. The finished face of the riprap shall be as smooth and true to the line, grade and section as the material will permit. Unless otherwise specified, the riprap, in place, shall have a minimum thickness of 6 inches, measured at right angles to the face of the riprap.

711.05 GROUTED RIPRAP. Grouted riprap shall conform to the requirements of handplaced riprap and, in addition, all interstices in the stones shall be completely filled with grout throughout the entire thickness of the riprap, after which the surface shall be swept with a stiff broom. The grout shall consist of one part by volume of Portland cement, 3 parts by volume of dry sand and sufficient water to produce the desired consistency. Preformed ¼ inch thick expansion material, meeting the requirements of Subsection 905.03 shall be placed around piles, columns, etc., and all costs of furnishing and placing preformed filler shall be borne by the contractor.

711.06 METHOD OF MEASUREMENT. Random riprap will be measured by the cubic yard of stone in vehicles at the point of delivery on the project.

Hand-placed and grouted riprap will be measured by the square yard in place.

Stone for bank protection, sinking mattresses and heavy deposited riprap will be measured by the ton (2,000 pounds). If stone is delivered by vehicles or railroad cars, measurement will be based on certified weight tickets furnished to the engineer by the contractor. If stone is delivered by barge, measurement will be made by calculation from the barge displacement, based on water weighing 62.4 pounds per cubic foot.

No measurement will be made for any necessary excavation or backfilling, but the cost of this work will be included in the unit price bid on the riprap item.

711.07 BASIS OF PAYMENT. The quantity of riprap placed and accepted, measured as provided above, will be paid for at the contract price per unit for "Random Riprap," "Hand-placed Riprap," "Grouted Riprap," "Stone Bank Protection," "Stone Ballast for Sinking Mattresses" or "Heavy Deposited Riprap," as the case may be.

711.07

Payment will be made under:

Item No.	Pay Item	Pay Unit
711(1)	Random Riprap	Cubic Yard
711(2)	Hand-placed Riprap	Square Yard
711(3)	Grouted Riprap	Square Yard
711(4)	Stone Bank Protection	Per Ton
711(5)	Stone Ballast for Sinking Mattresses	Per Ton
711(6)	Heavy Deposited Riprap	Per Ton

Section 712

Revetments

712.01 DESCRIPTION. This work shall consist of constructing revetments as specified on the plans and in the proposal. The revetment shall be placed against the embankments and along the slopes and bottoms of streams or channels at bridge ends or at other points to be protected as shown on the plans or directed and shall be in accordance with these specifications and in reasonably close conformity with the grades or lines shown on the plans or as directed. Revetments will be Grouted Concrete Block, Cast-in-place Concrete, Sacked Concrete Revetment or Pneumatically Applied Mortar Revetment.

712.02 MATERIALS. Materials shall meet the requirements of the following subsections of Part IX Materials.

Portland Cements	901.03
Fine Aggregate	903.02
Mesh Reinforcement	909.01

The sacks for sacked concrete revetments shall be suitable bags of burlap or other open mesh material approved by the engineer, of 1 or 2 cubic foot capacity and uniform size. Bags shall be new.

712.03 PROPORTIONING AND MIXING. Grouted concrete block, concrete cast-in-place and sacked concrete revetments shall be Class R concrete or better, proportioned and mixed as set forth in Section 901.

The proportions of cement to sand for pneumatically applied mortar shall be based on dry and loose volumes and shall not be less than one part Portland cement to 4.5 parts sand. The water content shall be maintained at a practicable minimum and shall not exceed 3 gallons per sack of cement. The cement and sand shall be thoroughly mixed before being charged into the machine. The sand shall contain not less than 3 nor more than 6 percent moisture by weight.

CONSTRUCTION REQUIREMENTS

712.04 PLACING. All revetment will be placed in the dry unless otherwise directed.

Before placement, preformed ¼ inch thick expansion material, meeting the requirements of Subsection 905.03 shall be placed around piles, columns, etc. All costs of furnishing and placing preformed filler shall be borne by the contractor.

After placement, the surface of the revetments, other than concrete block, shall be kept moist or cured by other approved methods for a period of not less than 3 days.

(a) Grouted Concrete Block Revetment: Blocks shall be of precast concrete, 12″ x 24″, and of the thickness shown on the plans. The placing of concrete blocks shall commence in a trench as shown on the plans, below the toe of the slope, and shall progress upward.

Each block shall be laid by hand perpendicular to the slope, shall be firmly bedded against the slope and against adjoining blocks, and shall be laid with broken joints.

All concrete blocks shall be grouted into place. Grout shall be applied in such a manner as to insure filling all joints and crevices. Grout used shall be of the same material, proportions and consistency as provided for grouted riprap in Subsection 711.05.

(b) Concrete Cast-in-place Revetments: The cast-in-place revetments shall be within reasonably close conformity to the thickness shown on the plans. The placing of cast-in-place revetments shall commence in a trench below the toe of the slope and casting shall progress upward.

(c) Pneumatically Applied Mortar Revetments:

(1) Pneumatically applied mortar shall be a premixed sand and cement pneumatically applied by a suitable mechanism and competent operators, and to which the water is added immediately prior to its expulsion from the nozzle.

(2) The type of machine the contractor furnishes for pneumatic placement of mortar shall be adequate for the purpose and acceptable to the engineer.

(3) Mesh reinforcement, if required, shall be placed in accordance with the plan details. The mortar shall be placed in one layer in reasonably close conformity with the thickness shown on the plans. Pneumatically applied mortar shall not be applied when the air temperature is less than 50°F.

(d) Sacked Concrete Revetment: Immediately prior to the construction or placing of the revetment covering, the embankment slopes, stream bank slopes or other surfaces to be protected shall be prepared to the lines and grades indicated on the plans, or as directed by the engineer, by excavating, filling, dressing, trimming and backfilling where necessary. All materials used in filling shall be thoroughly compacted by approved methods. After the earth bed on which the revetment is to be placed has been dressed and compacted to a true surface and approved by the engineer, the sacked concrete shall be placed by hand and rammed or tamped into final location, while the concrete is still green, in such a manner as to close all crevices between bags, and cause the mortar oozing through the open mesh to form a moderate bond. On slopes, construction shall begin at the bottom of the section to be covered, against a toe wall constructed as hereinafter described. The bags of concrete shall be placed end to end, side to side, or end to side as necessary to stagger in such a manner as to provide a locked construction. They shall be laid in parallel courses and give a fairly uniform construction of the thickness specified on the plans.

The toe of the revetment at the bottom of slopes, stream channels and also the outer edges along the channel sides or slopes shall be laid against a toe wall extending 2 feet below the ground surface. This wall shall be composed of bags of concrete placed in such a manner as to form a wall 8 inches thick for 4 inches thick revetment, and 12 inches thick for 6 inches thick revetment. Outer edges and top of the revetment not requiring heavy toe wall protection shall be formed by placing a single header row of bags of concrete on end and extending below the bottom surface of the revetment at least 6 inches. Unless otherwise provided by plans or directed by the engineer, the surface of the revetment where the construction terminates shall be embedded even with the surface of the adjoining slope or ground.

712.05 METHOD OF MEASUREMENT. Grouted concrete block, concrete cast-in-place and pneumatically applied mortar revetment will be measured by the square yard in place.

Sacked concrete revetment will be measured by the cubic

yard, as determined from the theoretical yield and the actual number of batches used.

No measurement will be made for any necessary preparation of the embankment slopes, excavation, or backfilling, but the cost of this work will be included in the price bid on the respective type of revetment.

712.06 BASIS OF PAYMENT. The quantity of revetment placed and accepted, measured as provided above, shall be paid for at the contract price for "Grouted Concrete Block Revetment." "Concrete Cast-in-place Revetment," "Sacked Concrete Revetment," or "Pneumatically Applied Mortar Revetment," as the case may be.

Payment will be made under:

Item No.	Pay Item	Pay Unit
712(1)	Grouted Concrete Block Revetment (" Thick)	Square Yard
712(2)	Concrete Cast-in-place Revetment (" Thick)	Square Yard
712(3)	Pneumatically Applied Mortar Revetment (" Thick)	Square Yard
712(4)	Sacked Concrete Revetment	Cubic Yard

Section 713

Temporary Signs and Barricades

713.01 DESCRIPTION. This item shall consist of furnishing, installing and maintaining all barricades, suitable lights, danger signals, and signs; providing watchmen; and complying with all other requirements regarding the protection of the work, workmen and safety of the public. It shall also include furnishing and placing such other signs as may be required by the plans. Signs and barricades shall conform to the details and specifications shown on the plans and these specifications.

Signs and barricades, and the arrangements thereof, as shown on the plans, are minimum requirements of the Department. Special conditions shall be treated as such, and appropriate signs shall be furnished and installed as directed. Requirements as to proper signs and barricades, or other safety precautions as may be promulgated by the contractor's insurers, are not negated by these specifications. In no way shall these specifications be construed as relieving the contractor of any of his responsibilities for the safety of the traveling public, for any liability in connection therewith, or compliance with State and local laws or ordinances.

713.02 SIGNS, BARRICADES AND RELATED DEVICES. Materials for use in signs, barricades and related devices shall conform to the requirements of Sections 729 and 917 and the plans.

CONSTRUCTION REQUIREMENTS

713.03 GENERAL. Signs, barricades and related devices will be required during such time as the contractor's work is in progress on the portion, or portions, of the work covered by the work order (partial or full), or when his operations are suspended but the traveled portion of the road is not in such condition as to be safe for the traveling public. During such times that barricades are not in place, appropriate regulatory signs shall be erected and maintained by the contractor.

In the event a partial work order is issued, the contractor

shall immediately begin the erection of signs and barricades over the affected portion, or portions, of the project to the extent necessary to comply with the requirements herein set forth, or herein referred to. When the full work order is issued, barricades shall be erected at the beginning and end of the project, and signing throughout the remainder of the project shall be completed.

In the event a full work order is issued, the contractor shall immediately begin the erection of appropriate signs and barricades over the entire project.

In any event, the erection of the appropriate signs and barricades shall be completed within 10 days after issuance of the work order, or partial work order, as the case may be, over the entire project, or over the portion, or portions, affected by the partial work order.

In no event shall construction work under this contract begin until signs and barricades, as provided above, have been erected and approved.

When all signs to be furnished and erected by the contractor are in place and approved, the Department's district forces will remove any standard highway departmental signs.

The engineer shall cooperate with the contractor's representatives in placing of signs, as well as the representative of the Department's District Engineer charged with removing departmental signs. The work shall be performed in an orderly manner so that at all times an adequate number of appropriate signs are in place.

Signing, as required by the contract, shall be in accordance with the plans and the Louisiana Manual on Uniform Traffic Control Devices, and shall remain in place and shall be maintained by the contractor and supplemented by additional signs as may be required throughout the life of the contract.

Signs placed by the contractor shall not be removed until the contract is finally completed and, in no event, until Department's forces have properly re-erected standard highway department signs along the project. However, it shall be the sole responsibility of the engineer to see that all departmental signs are in place upon completion and acceptance of the project.

Signs, barricades and related devices, furnished and placed

by the contractor, shall, upon removal, become his property.

On projects where the surface course is constructed with bituminous concrete, or with Portland Cement concrete pavement, the centerline striping shall be completed by the Department's forces prior to the removal of barricades.

713.04 METHOD OF MEASUREMENT. Signs, barricades and related devices, shall include furnishing and erecting all signs, barricades, lights and all other items necessary for the protection of the public. It shall also include the removal of all signs and barricades upon completion of the project.

713.05 BASIS OF PAYMENT. Signs, barricades and related devices, as provided above, will be paid for at the lump sum contract price for "Temporary Signs and Barricades."

Payment will be made under:

Item No.	Pay Item	Pay Unit
713(1)	Temporary Signs and Barricades	Lump Sum

Section 714

Slab Sodding

714.01 DESCRIPTION. This work shall consist of furnishing, hauling, planting, fertilizing and liming if required, rolling, watering and maintaining live bermuda grass sod, live carpet grass sod or any other approved grass sod which is native to the area, at locations shown on the plans or designated by the engineer.

714.02 MATERIALS. Slab sod shall be composed of bermuda grass, carpet grass or other approved grass which is native to the locality of the work.

Sod furnished shall be free from noxious weeds and other vegetation and shall be planted as provided in these specifications.

Commercial fertilizer, and agricultural lime, shall meet the requirements of Subsection 915.07.

Water may be obtained from any available source, except brackish or oily water shall not be used.

CONSTRUCTION REQUIREMENTS

714.03 GENERAL. Slab sod shall be cut with approved mechanical or manual sod cutters. The designated area shall be mowed when necessary, and the sod shall be cut to a minimum depth of 2½ inches, and to a uniform width and in convenient lengths for handling. Care shall be exercised at all times to retain the native soil on the roots of the sod during the process of excavating, hauling and planting.

Sod which has been cut more than 48 hours before placing shall not be used.

Sod taken from bare areas that may produce inferior growth will not be accepted.

Any watering required in connection with digging, storing or hauling sod will not be paid for.

714.04 DIGGING AND HANDLING SOD. The contractor may use either a (1) hand method or (2) machine method for digging and handling sod.

(a) Hand Method: When sod is cut in the field, it shall

be placed flat, grass side up on boards of convenient lengths and hauled to the planting site with soil still intact. Only one layer of sod shall be placed on each board and such boards shall be of sufficient thickness to prevent unreasonable bending and of sufficient width so that the slabs of sod shall not hang over the edges. The slabs shall be placed closely without leaving unreasonable spaces between them. In no case shall slab sod be loaded in bulk on vehicles or dumped in bulk on the planting site.

(b) Machine Method: The contractor may use mechanical devices to cut, load, haul and plant sod. Care should be exercised at all times to retain the native soil on the roots of the sod. All sod stacked shall be kept moist and protected from the elements in a manner satisfactory to the engineer. When the machine method is used, final acceptance will not be made until satisfactory growth of sodding has been obtained. Satisfactory growth shall be understood to mean a healthy, living and growing grass turf which has been planted in accordance with the requirements of these specifications.

714.05 PLANTING. All areas to receive slab sod shall be thoroughly scarified and pulverized to a depth of approximately 3 inches and dressed to a reasonable grade. If an item for agricultural lime is included in the contract, the liming shall be done when area is being pulverized. If an item for fertilizer is included in the contract, approximately 90 percent shall be broadcast over the entire area to receive the slab sodding, the remaining 10 percent shall be broadcast over the sod after placing and rolling. Upon delivery to the planting site, the slab sod shall be transferred onto the surface of the soil. The area to be sodded shall be watered as directed. The slabs of sod shall be placed closely, leaving a minimum amount of space between slabs. Slabs which do not fit closely shall be pulled together with suitable tools.

714.06 ROLLING. All slab sod shall be rolled as soon after planting as practicable with plain rollers or cultipackers. Where rolling is impracticable, the sod shall be tamped by approved hand methods.

714.07 WATERING. All slab sodding shall be watered as necessary.

714.08 EQUIPMENT. All equipment necessary for the

satisfactory performance of this work shall be on the project and approved before work will be permitted to begin.

714.09 METHOD OF MEASUREMENT. Slab sodding will be measured by the square yard, and the area to be included in the measurement shall be the actual area sodded as authorized. Water will be measured by the 1000 gallons in tanks used by contractor. Fertilizer and agricultural lime, when required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

714.10 BASIS OF PAYMENT. Sodding planted and accepted, measured as provided above, shall be paid for at the contract unit price.

Water will be paid for at contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
714(1)	Slab Sodding	Square Yard
714(2)	Water	M Gallons

Section 715

Mulch Sodding

715.01 DESCRIPTION. This work shall consist of furnishing, hauling, spreading, fertilizing and liming if required, rolling, watering and maintaining live bermuda or bahia grass roots and topsoil.

715.02 MATERIALS. Mulch sod shall consist of a natural combination of grass roots and topsoil or approved artificial combination as described elsewhere in this section. Mulch sod shall predominate in bermuda grass or bahia grass roots and be reasonably free of weeds and debris. Topsoil shall consist of good loamy topsoil from fields, creek banks, woods or other approved sources and shall be reasonably free of roots, rocks, weeds, trash and other debris.

Commercial fertilizer and agricultural lime shall meet the requirements of Subsection 915.07.

Water shall conform to the applicable requirements of Subsection 714.02.

Seed for approved artificial combination shall conform to the requirements of Subsection 915.08.

CONSTRUCTION REQUIREMENTS

Natural Combination

715.03 DIGGING. The approved source of mulch sod shall be mowed, raked and disked if necessary. The mulch sod shall then be plowed up into rows, the depth of removal not to exceed 6 inches unless otherwise directed. It will then be bladed into windrows or otherwise stockpiled for convenience in loading. The contractor shall not be allowed to disk, plow, windrow or otherwise stockpile the mulch sod on any source area too large for early removal. Mulch sod stockpiled over 48 hours shall not be used.

Mulch sod shall not be contaminated with tree roots, tops, branches or other debris. Such foreign material shall be dug up, cleared and removed before sod is loaded or stockpiled.

Any watering required to facilitate digging the sod or for

other reasons in connection with digging, storing or hauling, shall not be paid for.

715.04 HAULING. Mulch sod shall be loaded with suitable equipment, hauled and dumped on the areas as designated by the plans.

715.05 SPREADING. After dumping, the mulch sod shall be uniformly spread to a depth of approximately 6 inches. The mulch sod shall be spread in such a manner that a minimum amount of roots will be exposed. In no case shall spike tooth harrows or drags be used to spread mulch sod.

All areas to receive mulch sod shall be thoroughly scarified and pulverized to a depth of approximately 3 inches and dressed to grade.

If an item for agricultural lime is included in the contract, the liming shall be done when the area is being pulverized. If an item for fertilizer is included in the contract, fertilizer shall be broadcast over the entire area to be mulch sodded before sod is placed.

715.06 ROLLING. After spreading, the mulch sod shall be rolled with a cultipacker or soil pulverizer until the surface presents a level appearance. In inaccessible places and locations where rolling with the above equipment is impracticable, the soil shall be tamped by suitable hand methods.

CONSTRUCTION REQUIREMENTS

Artificial Combination

715.07 GENERAL. Where a natural combination of suitable grass roots and topsoil is unavailable, the contractor may substitute, (a) a combination of approved grass roots and topsoil, or (b) bermuda grass seed and topsoil, in lieu of mulch sodding.

When bermuda grass seed and topsoil is used, the grass seed shall be sown at the rate of 30 pounds per acre and shall be cultivated until a satisfactory growth of grass is produced prior to the final acceptance of the project. The seeding shall be done in accordance with the applicable requirements of Section 717, Seeding, and no seeding will be permitted between the dates of September 30 and February 15.

715.08 SPREADING. All areas to receive topsoil shall be thoroughly scarified, pulverized and uniformly dressed.

Topsoil shall be uniformly spread to the depth specified in the proposal or on the plans over the areas to be sodded. Where no depth is specified, the depth will be approximately 6 inches.

Topsoil shall be thoroughly disked and all stiff clods, lumps, stones, roots, litter or other foreign matter shall be removed.

Bermuda roots and tops shall be broadcast over all areas where topsoil has been spread. The roots and tops shall be placed closely together on the surface so as to completely cover the ground. All bermuda roots and tops shall be kept moist from the time of digging to that of spreading at the expense of the contractor. All dried out roots will be rejected.

Immediately after spreading, the roots and tops shall be thoroughly disked into the surface so they will be chopped and covered without disturbing the uniform distribution.

After disking, the area thus sodded shall be rolled with a cultipacker or soil pulverizer until the surface presents a level appearance. In inaccessible places and locations where rolling is impracticable, the contractor shall hand tamp such areas in a satisfactory manner. Toothed harrows, rakes, drags with spikes, and other implements would tend to tear out the grass roots and tops shall not be used.

The contractor shall have the right to strip suitable topsoil from surface areas within the limits of construction. The topsoil shall be stockpiled in windrows, or otherwise, for ultimate respreading on areas to be sodded. No topsoil shall be stripped from any areas within the limits of the right of way outside the limits of actual construction. All topsoil stripped as described above shall be replaced with acceptable material from sources beyond the project limits at the contractor's expense.

If an item for agricultural lime is included in the contract, the liming shall be done when the area is being pulverized. If an item for fertilizer is included in the contract, fertilizer shall be broadcast over the entire area of topsoil prior to placing bermuda roots and tops or bermuda grass seed.

715.09 WATERING. All mulch sod, whether natural or artificial mix, shall be watered and kept moist as long as necessary to establish a satisfactory growth.

715.10 EQUIPMENT. All equipment shall be on the

project and in working condition before starting the mulch sodding operations.

Equipment shall consist of the following:

(a) A soil roller or cultipacker weighing not less than 500 pounds and not more than 1500 pounds, either a single or double type.

(b) Necessary plows, disks, scarifiers, rollers and harrows.

(c) Required bulldozers, blades, drags and other tools to complete the work.

(d) Approved water wagons or tanks of sufficient capacity or other sprinkling devices.

715.11 METHOD OF MEASUREMENT. Mulch sod will be measured by the cubic yard in vehicles at the point of delivery on the project.

When an artificial mixture of grass roots and topsoil is used, only the topsoil will be measured.

For natural combination and artificial combination of grass roots and topsoil, water will be measured and paid for as provided in Subsections 714.09 and 714.10. Fertilizer and agricultural lime, if required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

When an artificial mixture of bermuda grass seed and topsoil is used, only the topsoil will be measured. The topsoil will be measured by the cubic yard in vehicles at the point of delivery. All cost for furnishing, planting, watering and otherwise cultivating the seed will be considered incidental and shall be included in the price bid on this item.

715.12 BASIS OF PAYMENT. Mulch sod, placed and accepted as provided above, shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
715(1)	Mulch Sodding	Cubic Yard

Section 716

Vegetative Mulch

716.01 DESCRIPTION. This work shall consist of furnishing and placing an asphalt tacked mulch of straw or hay on areas that have been seeded or mulch sodded.

The intent of these specifications is to insure that all seeding, mulch sodding, or a combination thereof, is protected against erosion.

716.02 MATERIALS.

(a) Types of Mulches: Mulch shall be vegetative in character and shall consist of either stalks or stems of oats, rye, rice, wheat or other approved straw, or hay obtained from various legumes or grasses, such as lespedeza, clover, vetch, soybeans, bermuda, carpet sedge, bahia, fescue or other approved legumes or grasses, or a combination thereof.

Straw of hay shall be dry and reasonably free from Johnson grass or obnoxious weeds. Contractor shall notify the engineer at least 7 days in advance of operations as to the source of the mulch supply, so that the straw or hay can be inspected. The mulch shall be approved before being used.

(b) Storage of Materials: Mulching material shall be delivered to the project in bales of uniform size. If stockpiling of the bales is necessary, they may be stored on the right-of-way. Stockpiling will not be permitted in close proximity to any residence or other building occupying private lands adjacent to the right-of-way. If the contractor desires to stockpile mulching materials on private property and/or in buildings off the right-of-way, he shall furnish the engineer with a copy of agreement signed by property owner. Stockpiles shall be suitably protected from the weather.

(c) Asphalt: Asphalt used as a part of the mulching process shall be an approved emulsified asphalt meeting the requirements of Section 902.

CONSTRUCTION REQUIREMENTS

716.03 GENERAL. Mulching shall closely follow ground preparation, fertilizing, liming, seeding or mulch sodding, or a combination thereof. All mulch shall be placed with mechanical equipment of a conventional type which will distribute the mulch uniformly by blowing it onto the area. The equipment shall be provided with jet nozzles spaced in the muzzle of the blower, through which the asphalt is ejected simultaneously with the mulch, thus coating the mulch uniformly with a spray of asphalt as the mulch is blown through the nozzle.

Spreading the mulch manually and after-spraying with ahphalt will be permitted only in areas which are inaccessible to the equipment or where the asphalt may deface a structure.

716.04 SPREADING RATES. Mulch shall be applied at an approximate rate of 1½ to 2 tons per acre simultaneously with the emulsified asphalt at an approximate rate of 75 to 150 gallons per ton of mulch.

When required, the emulsified asphalt shall be diluted with water in such proportions as is designated, however, measurement and payment will be made only for the emulsified asphalt.

The specific rates of application of mulch and asphalt may vary within the job limits and be contingent on the type areas to be covered and the character of the mulching materials furnished. The rates for these areas shall be specified by the engineer.

716.05 MANUAL SPREADING. Where manual spreading is permitted, the mulch shall be placed in such a manner that a loose, shredded and fluffy condition will prevail, after which the emulsified asphalt shall be sprayed over the surface of the mulch. The rates shall be the same as described in the mechanical operation.

716.06 MULCHING OPERATIONS. Mulching operations shall begin within 24 to 36 hours after completion of seeding and/or mulch sodding, even for the smallest areas, in order to protect such areas from erosion.

In its final position, the asphalt-tacked mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and to reduce the impact of

rainfall on the surface of the soil. Mulching shall begin at the top of slopes and extend downward. Particular attention shall be given to the top of slopes so that such areas will be covered at the junction with the natural ground. Extensions to the blower pipe shall be supplied where high slopes are encountered that cannot be reached by the blower under normal conditions. Windy conditions will have an effect on the uniformity of final mulch placement, and the contractor will be required to make adjustments in his operations to obtain uniform spreading.

Care shall be taken not to get asphalt on structures that are within the mulching area. Any asphalt stains that are unsightly shall be removed and the surface left in a condition acceptable to the engineer.

716.07 EQUIPMENT. Equipment shall consist of the following:

(a) Mulch blowing machine equipped as provided above.

(b) Asphalt tank attached to or accompanying blowing machine.

(c) All rakes, pitchforks and other tools necessary to perform the work.

716.08 METHOD OF MEASUREMENT. Vegetative mulch will be measured by the ton, complete in place and accepted. The weight for measurement will be the product of the number of bales used and the average weight per bale as determined on certified scales provided by the contractor.

Emulsified asphalt placed and accepted will be measured by the gallon at a temperature of 60°F in accordance with Temperature Volume Correction, Table III, given in Subsection 505.11. No measurement or payment will be made for water used in the emulsion.

716.09 BASIS OF PAYMENT. The number of tons of vegetative mulch and the number of gallons of emulsified asphalt, measured as provided above, shall be paid for at the contract unit prices for the items complete in place and accepted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
716(1)	Vegetative Mulch	Ton
716(2)	Emulsified Asphalt	Gallon

Section 717

Seeding

717.01 DESCRIPTION. This work shall consist of preparing seed bed, fertilizing, liming and watering if required, furnishing and sowing grass seed on the areas designated on the plans or as directed.

717.02 MATERIALS. All seed furnished shall conform to the requirements of Subsection 915.08.

Commercial fertilizer and agricultural lime shall meet the requirements of Subsection 915.07.

Water shall conform to the applicable requirements of Subsection 714.02.

CONSTRUCTION REQUIREMENTS

717.03 SELECTION OF SEED. Prior to planting time, the engineer shall contact the Roadside Development Section in order to select the variety or varieties of seed to be used on the project as shown in Table I. The contractor shall abide strictly to this selection and furnish seed in accordance therewith.

717.04 SOIL AREAS. The seed shall be selected for planting on the basis of 5 general soil areas shown as follows:

(1) Alluvial soils of the Mississippi and Red River bottoms.

(2) Mississippi terraces and loessial hill soils.

(3) Coastal plain soils (rolling, hilly and flatwoods areas in central, northern and eastern part of the State).

(4) Coastal prairie soils.

(5) Ouachita valley cone (lying between the Ouachita River bottom on the west and Boeuf River bottom on the east).

Table I

Mixture	Seed To Mix	Approx. Pounds Per Acre	Preferable Soil Areas	Preferable Planting Dates
A	Hulled Bermuda	10	(2) (3) (4) (5)	Feb. 15 thru Sept.
	Carpet Grass	20		
		30		

Table I (Continued)

Mixture	Seed To Mix	Approx. Pounds Per Acre	Preferable Soil Areas	Preferable Planting Dates
B	Hulled Bermuda	15	(1) (2) (3) (5)	Feb. 15 thru Sept.
	Pensacola Bahia	15		
		30		
C	Hulled Bermuda	10	(1) (2) (3) (5)	Feb. 15 thru April
	Common or Kobe Lespedeza*	20		
		30		
D	Hulled Bermuda	6	(2) (3) (4) (5)	Feb. 15 thru April
	Carpet Grass	10		
	Common or Kobe Lespedeza*	14		
		30		
E	Hulled Bermuda	10	(1) (2) (5)	Feb. 15 thru April
	La. White Dutch Clover*	20		
		30		
F	Hulled Bermuda	10	(1) (2) (3) (5)	Feb. 15 thru March
	Dixie Crimson Clover*	20		
		30		
G	Alta or Kentucky 31 Fescue	30	(1) (2) (3) (4) (5)	Sept. thru January
	Dixie Crimson Clover*	10		
		40		
H	Alta or Kentucky 31 Fescue	30	(1) (2) (3) (5)	Sept. thru January
	Pensacola Bahia	10		
		40		
I	Alta or Kentucky 31 Fescue	20	(1) (2) (3) (5)	Sept. thru January
	Dixie Crimson Clover*	10		
	Pensacola Bahia	10		
		40		

When only one variety of grass is to be planted in connection with mulch sod, the following will apply.

J	Hulled Bermuda	15	(1) (2) (3) (4) (5)	Feb. 15 thru Sept.
K	Dixie Crimson Clover*	30	(1) (2) (3) (5)	Sept. thru January
L	Alta or Kentucky 31 Fescue	30	(1) (2) (3) (4) (5)	Sept. thru January
M	La. White Dutch Clover*	15	(1) (2) (3) (5)	Feb. 15 thru April Sept. thru November

*All clovers and lespedezas shall be inoculated with the proper culture before planting.

717.05 PREPARATION OF SEED BED (Bare Areas). The seed bed shall be prepared by breaking, disking, harrowing, blading, dragging or other approved methods. The

soil shall be thoroughly pulverized to a minimum depth of approximately 3 inches and leveled as directed. The surface soil shall be firmed by lightly rolling the area with a cultipacker. If natural firming by rain has occurred, the rolling may be eliminated. All sticks, debris, and other foreign matter must be removed and the soil left in a suitable horticultural condition to receive the seed. If mulch sod, fertilizer, agricultural lime or other materials are required by the specific terms of the contract, such material shall be spread over the areas and incorporated into the soil during the preparation of the seed bed. When required by the plans, newly seeded areas shall be protected against erosion by the placement of vegetative mulch as provided in Section 716.

717.06 PREPARATION OF SEED BED (Grassy Areas). Where seed is to be sown on areas partly covered by grass which has grown during construction, such areas shall be lightly disked or scarified and rolled with a cultipacker as directed.

717.07 SEEDING. Immediately prior to planting, all clovers and lespedezas shall be inoculated with the proper culture for each variety of seed. The inoculated clovers or lespedezas shall then be mixed with other seed in the proportion designated for the various mixtures. If the seed is not planted on the date of inoculation, the inoculation shall be repeated.

All seed shall be planted in the proper season and in the amounts shown in Table I unless written permission is granted for earlier or later plantings. Seed shall be sown with rotary or other mechanical seeders. All seeded areas shall be lightly rolled immediately after seeding so as to press the seed firmly into the soil to prevent drifting.

The application of seed and fertilizer at the same time in a slurry will be permitted provided the correct ratio of seed and fertilizer is used and the operation is satisfactory to the engineer.

717.08 WATERING. After the seed has been planted, the area shall be watered immediately with approved watering tanks unless, in the opinion of the engineer, there is sufficient moisture to eliminate watering. After the first watering operation, other waterings will follow as directed. These watering operations will continue as necessary until

the project is finally accepted. The water for seeding purposes shall be obtained from an approved source.

717.09 EQUIPMENT. Equipment shall be the same as required in Subsection 714.08.

717.10 METHOD OF MEASUREMENT. Seed will be measured by the pound, and the quantity to be measured shall be that actually used on the project. For the purposes of measurement, no differentiation will be made for different types or combinations of types of seed furnished. Water will be measured and paid for as provided in Subsections 714.09 and 714.10. Fertilizer and agricultural lime, if required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

717.11 BASIS OF PAYMENT. The number of pounds of seed sown and accepted shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
717(1)	Seeding	Pound

Section 718

Fertilizer and Agricultural Lime

718.01 DESCRIPTION. This work shall consist of furnishing and applying commercial fertilizer and agricultural lime at the locations shown on the plans in accordance with these specifications and as directed.

718.02 MATERIALS.

(a) Commercial Fertilizer: Fertilizer shall be an approved brand conforming to the requirements of the Louisiana Department of Agriculture, Fertilizer Division. Fertilizer furnished may be either 8-8-8, 9-9-9, 10-10-10, 12-12-12, 13-13-13, 14-14-14, 15-15-15 or 16-16-16 at the option of the contractor in accordance with Subsection 915.07.

(b) Agriculture Lime: Lime shall consist of ground limestone or seashells conforming to the requirements of Subsection 915.07. The material shall be free of foreign matter and large lumps. The material may be delivered to the job site either in sacks or bulk quantity.

CONSTRUCTION REQUIREMENTS

718.03 APPLICATION.

(a) Commercial Fertilizer Application: Fertilizer shall be uniformly broadcast over the area to be fertilized either by hand or machine methods. Unless otherwise provided, the approximate rate of broadcast fertilizer per acre shall be as follows:

Type	Pounds Per Acre
8-8-8	1,000
9-9-9	889
10-10-10	800
12-12-12	667
13-13-13	615
14-14-14	571
15-15-15	533
16-16-16	500

The rate per acre may be increased or decreased as directed.

Fertilizer shall be applied as indicated in Subsections 714.05, 715.08 or 717.05, or as directed.

When fertilizer is applied following surface dressing, it shall be thoroughly incorporated in the soil by light disking or harrowing. Fertilizer may be applied just before final disking or harrowing during the process of surface dressing or, if dressed by hand, it may be applied just before final raking and leveling.

(b) Agricultural Lime Application: Liming, when required, shall be applied to correct the acid conditions encountered in several soil areas to aid in the establishment of a satisfactory grass cover. Soil Areas 2, 3, 4 and 5 as described in Subsection 717.04 are the areas that will normally be specified for liming.

Agricultural lime shall be spread uniformly over the area to be limed at the rate of two tons per acre with an approved spreader. The lime must be applied prior to seeding and may be applied in conjunction with the fertilizer. Several passes may be required to obtain the desired application rate. Soon after application, the entire area must be disked, harrowed, or rototilled in order to incorporate the lime or lime-fertilizer into the top 3 to 6 inches of the soil.

718.04 EQUIPMENT. Required mechanical and hand spreaders, and tillage equipment.

718.05 METHOD OF MEASUREMENT.

(a) Commercial Fertilizer: Fertilizer will be measured by the pound, and the quantitiy to be measured shall be that actually used on the project. The estimated quantity shown on the plans and in the proposal is based on the use of type 8-8-8 fertilizer.

Should the contractor elect to use any of the other types shown herein, the quantity actually used shall be measured and such quantity multiplied by the factor given below for the type used to obtain the quantity for payment.

Type	Factor
9-9-9	1.125
10-10-10	1.25
12-12-12	1.5
13-13-13	1.625

Type	Factor
14-14-14	1.75
15-15-15	1.875
16-16-16	2.0

(b) Agricultural Lime: Agricultural lime shall be measured by the ton, and the quantity to be measured will be that actually used on the project.

718.06 BASIS OF PAYMENT.

(a) Commercial Fertilizer: The number of pounds of fertilizer placed and accepted, measured as provided above, shall be paid for at the contract unit price.

(b) Agricultural Lime: The number of tons of lime placed and accepted, measured as provided above, shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
718(1)	Fertilizer	Pound
718(2)	Agricultural Lime	Ton

Section 719

Jute Matting

719.01 DESCRIPTION. This work shall consist of furnishing and installing jute matting for stabilization of soils on slopes and ditches where shown on the plans.

719.02 MATERIALS. Materials shall meet the requirements of the following Subsections of Part IX, Materials.

Jute Matting	915.14
Staples	915.15

CONSTRUCTION REQUIREMENTS

719.03 GENERAL. The jute matting shall be placed immediately after seeding and mulch sodding operations have been completed except for final rolling.

Beginning at the upgrade end, the matting shall be laid out flat, parallel to, and in the direction of the flow of water. When more than one strip is required to cover the area, they shall overlap on the sides at least 4 inches and the ends shall overlap at least 12 inches, with the unslope sections on top.

The matting shall be spread evenly and smoothly and shall be in contact with the soil or mulch sod at all points.

The upgrade end of each strip shall be buried to a depth of not less than 6 inches in a slot perpendicular to the ground, with the soil tamped firmly against it.

In ditches and on slopes, check slots or junction slots shall occur at 50 foot intervals as shown on the plans or as otherwise directed. Edges of jute matting shall be buried around the edges of catch basins and other structures by placing a tight fold of the matting at least 6 inches vertically into the soil.

719.04 STAPLING. Matting shall be tightly held to the ground by vertically driven staples. Furnishing and installing staples shall be included in price bid on jute matting. Staples shall be spaced not more than 3 feet apart in 3 rows for each strip, with 1 row along each edge and 1 row alternately spaced in the center. On the overlapping edges of

parallel strips, staples shall be spaced not more than 2 feet apart. At all anchor slots, junction slots, and check slots, staples shall be spaced not more than 6 inches apart.

719.05 ROLLING. After installation is complete, the jute matting shall be firmly embedded in the soil or mulch sod surface by tamping or rolling with an approved roller. Rolling shall be accomplished without damage to the matting and the established grades. Matting shall be pressed firmly into the soil or mulch sod and be nearly flush with the ground surface over the entire area.

719.06 MAINTENANCE AND REPAIRS. Jute matting shall be repaired immediately if damaged. Soil in any damaged area shall be restored to original grade and shall be re-fertilized or re-sodded or re-seeded as originally specified. No payment shall be made for such areas repaired.

719.07 EQUIPMENT. Equipment shall include the following:

(a) Approved smooth wheel hand sod roller.

(b) Necessary hammers, rakes and other hand tools.

719.08 METHOD OF MEASUREMENT. The quantity of jute matting shall be measured by the square yard complete in place.

719.09 BASIS OF PAYMENT. Jute matting placed and accepted shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
719(1)	Jute Matting	Square Yard

Section 720

Fiber Glass Roving

720.01 DESCRIPTION. This work shall consist of furnishing and installing fiber glass roving and asphalt for stabilization of soils on slopes and in ditches where shown on the plans or as directed by the engineer.

720.02 MATERIALS.

(a) Fiber Glass Roving: This material shall meet the requirements of Subsection 915.20.

(b) Asphalt Material: The asphalt furnished shall be either asphalt cement grade AC-8 or an approved emulsified asphalt, all meeting the requirements of Section 902.

CONSTRUCTION REQUIREMENTS

720.03 GENERAL. The fiber glass roving shall be applied over the designated area within 24 hours after the normal seeding operations have been completed.

The fiber glass roving shall be spread uniformly over the designated area to form a random mat of continuous glass fibers at the rate of from 0.25 to 0.35 pounds per square yard. This rate may be varied as directed by the engineer.

The fiber glass roving shall be anchored to the ground with the asphaltic material applied uniformly over the glass fibers at the rate of from 0.25 to 0.35 gallons per square yard. This rate may be varied as directed by the engineer.

The upgrade end of the lining shall be buried to a depth of one foot to prevent undermining. The above instructions for slope and ditch protection may be varied by the engineer to fit the field conditions encountered.

720.04 MAINTENANCE AND REPAIRS. The lining shall be repaired immediately, if damaged due to the contractor's operations. Soil in any damaged areas shall be restored to original grade, refertilized and reseeded if originally specified, all at no additional cost to the Department.

720.05 EQUIPMENT. Equipment shall include the following:

(a) Pneumatic ejector capable of applying fiber glass

roving at the rate of 2 pounds per minute (approximately 8 square yards per minute).

(b) Air compressor capable of supplying 40 cfm at 80 to 100 psi. Acceptable air hoses necessary for supplying air to areas not accessible to the compressor.

(c) Approved asphaltic material distributor with necessary hoses and hand spray bar for working on slopes and other areas not accessible to the distributor.

720.06 METHOD OF MEASUREMENT. Fiber glass roving will be measured by the pound. The number of pounds will be determined as the product of the number of spools or packages of fiber glass roving actually used and the average weight of the spools or packages. The average weight will be determined by weighing and averaging random samples of not less than 3 percent of the total number of spools or packages required. In no case shall the samples selected be less than three.

The asphalt cement (AC-8) or emulsified asphalt will be measured by the gallon at the temperature of 60°F in accordance with Temperature Volume Correction, Tables II and III given in Subsection 505.11. The quantity of asphalt to be measured will be that actually used on the project. When required, the asphalt shall be diluted with water in such proportions as designated by the engineer; however, payment will be made only for the asphalt used. Payment will be made for water used in emulsion.

720.07 BASIS OF PAYMENT. The accepted quantities of fiber glass roving and asphalt material will be paid for at the respective contract unit prices.

If the asphalt material does not conform to the specifications, the final test results for the material taken at the point of delivery will be applied to the appropriate acceptance schedule for price adjustment, and any adjustment in unit price will be made as specified.

Payment will be made under:

Item No.	Pay Item	Pay Unit
720(1)	Fiber Glass Roving	Pound
720(2)	Asphaltic Material	Gallon

Section 721

Asphalt Mulch

721.01 DESCRIPTION. This work shall consist of furnishing and placing asphalt on areas that have been seeded or mulch sodded as shown on plans or directed by engineer.

721.02 MATERIALS. The asphalt mulch used shall be an approved emulsified asphalt meeting the requirements of Section 902.

CONSTRUCTION REQUIREMENTS

721.03 GENERAL. Asphalt mulching shall follow seeding or mulch sodding operations as soon as possible in order to protect such areas from erosion. If the areas to receive asphalt mulch have not been sufficiently moistened by rainfall, these areas should be watered to the satisfaction of the engineer. Asphalt shall be spread with a mechanical spreader equipped with approved boon or hand spray nozzles.

721.04 SPREADING RATES. Asphalt shall be spread over the surface of the newly seeded or mulch sodded areas at the rate of 0.2 to 0.3 gallons per square yard. When required, the asphalt shall be diluted with water in such proportions as designated by the engineer; however, payment will be made only for the asphalt used.

721.05 METHOD OF MEASUREMENT. The asphalt mulch will be measured by the gallon at a temperature of 60°F in accordance with Temperature Volume Correction, Table III given in Subsection 505.11. The quantity of emulsified asphalt to be measured will be that actually used on the project. No measurement or payment will be made for water used in the emulsion.

721.06 BASIS OF PAYMENT. The asphalt mulch placed and accepted will be paid for at the contract unit price.

If the emulsified asphalt material does not conform to the specifications, the final test results for the material taken at the point of delivery will be applied to the appropriate acceptance schedule for price adjustment, and any adjustment in unit price will be made as specified.

721.06

Payment will be made under:

Item No.	Pay Item	Pay Unit
721 (1)	Asphalt Mulch	Gallon

Section 722

Field Laboratories

722.01 DESCRIPTION. This work shall consist of furnishing laboratory buildings for the exclusive use of the engineer during construction of embankments, base courses, asphaltic concrete, Portland cement concrete pavement or other phases of the work, as may be required by the plans or directed by the engineer.

722.02 GENERAL. Field laboratories shall be constructed of wood or metal of an approved type and shall be furnished for the purpose of housing and using testing equipment, keeping records of tests made and making reports. Buildings furnished shall meet the following minimum requirements.

(a) Field Laboratory for Plant Site: The laboratory shall consist of a building or room at the plant site, at an acceptable location, and shall have a minimum floor space of 140 square feet. The laboratory shall be suitably weather proofed, air conditioned, heated and ventilated, shall contain a sink with running water and shall be provided with electric lights and power outlets as directed. Electric exhaust fans shall be provided in such size and location to insure continuous removal of fumes resulting from chemicals utilized during testing operations. The building or room shall be equipped with sturdily constructed benches and tables as required, shall have at least one outside door, and its contents shall be secured by suitable locks and catches. All keys shall be under the control of the engineer.

Laboratory buildings or rooms at the plant site that are acceptable and are used on a continuing basis will not be measured or paid for.

(b) Field Laboratory for General Use: Laboratories for use in connection with other construction phases shall be small buildings of the movable type which can be placed near the area of construction. Each building shall have a minimum floor space of 120 square feet. Each building shall be equipped with at least 2 tables or work benches

having a minimum size of 30 inches by 48 inches, or as directed. Each building shall have at least one outside door and sufficient windows to provide satisfactory light in the daytime. If the contractor's operations are carried on at night, adequate artificial lighting shall be provided. Roof, floor and walls shall be weathertight. This building shall be moved to various locations on the project as directed by the engineer.

(c) Buildings shall be adequately maintained during their use.

(d) Laboratory buildings shall become the property of the contractor and be disposed of by him upon completion of the project.

(e) Buildings may be used for successive phases of the project without additional compensation.

722.03 METHOD OF MEASUREMENT. Laboratory buildings furnished and accepted will be measured as complete units of the size and type specified. The measurement shall include all required furnishings and utilities such as electricity, heating, etc., adequate maintenance and removal upon completion of the project.

722.04 BASIS OF PAYMENT. The accepted number of laboratory buildings will be paid for at contract unit price per building of the size and type specified.

Payment will be made under:

Item No.	Pay Item	Pay Unit
722(1)	Field Laboratory for Plant Site	Building
722(2)	Field Laboratory for General Use	Building

Section 723

Granular Material

723.01 DESCRIPTION. This work shall consist of furnishing and placing granular material in accordance with these specifications and in reasonably close conformity with the lines, grades, and typical sections shown on the plans or established by the engineer.

723.02 MATERIALS. Granular material shall conform to the requirements of Subsection 903.08.

723.03 PLACEMENT OF GRANULAR MATERIAL. The material shall be placed, properly shaped, rolled and uniformly compacted so that it conforms to the lines, grades, width, and thickness as shown on the plans; all to the satisfaction of the engineer.

The granular material shall not be displaced during subsequent construction operations.

723.04 METHOD OF MEASUREMENT.

(a) If granular material is specified to be measured by the square yard, the width for measurement will be shown on the plans, unless otherwise specified. The length will be the actual horizontal length of the completed sections.

(b) If granular material is specified to be measured by the cubic yard (net section), measurement will be based on the typical sections shown on the plans and the actual horizontal length of the completed sections.

(c) If granular material is specified to be measured by the cubic yard (vehicular measurement), measurement will be in vehicles at the point of delivery in accordance with the applicable requirements of Subsection 109.01.

723.05 BASIS OF PAYMENT. The accepted quantities measured as specified and provided above, will be paid for at the contract unit price for "granular material."

Payment will be made under:

Item No.	Pay Item	Pay Unit
723(1)	Granular Material	Square Yard
723(2)	Granular Material	Cubic Yard

Section 724

Patching and Widening Existing Pavement

724.01 DESCRIPTION. This work shall consist of patching and widening of existing pavement structures in accordance with these specifications and in conformity with the lines, grades and typical sections shown on the plans, or as directed by the engineer.

The contractor shall perform the patching and widening operations by Method 1 or Method 2 as specified on the plans or in the special provisions. If the method is not specified, the contractor may select either Method 1 or Method 2; however, the same method shall be employed throughout the project. The methods are:

Method 1: Patching and widening with Portland cement concrete pavement.

Method 2: Patching and widening with asphaltic concrete pavement.

724.02 MATERIALS. Materials for use in the method employed for patching and base widening shall comply with the requirements of the specifications and special provisions applying thereto and the following references.

The Portland cement concrete used may be Class A or any of the types of pavement concrete, all in accordance with Section 901. The construction requirements for this concrete shall be in accordance with the applicable requirements of Section 601.

The asphaltic concrete used shall be Asphaltic Concrete (Type 5 with AC-3), with all additional types of asphaltic concrete mixes that are specified on the project as allowable alternates. Only one type mixture shall be used for this item, and materials shall conform to the applicable requirements of Sections 501 and 502.

Granular material used shall conform to the requirements of Subsection 903.08.

724.03 EQUIPMENT. Equipment furnished shall meet the requirements contained in the various specifications for the different types of material used. The necessary equip-

ment shall be on the project, in satisfactory working condition, and approved prior to use.

CONSTRUCTION REQUIREMENTS

724.04 GENERAL. The contractor will be required to perform patching and widening operations in accordance with the applicable requirements of the special provisions for maintenance of traffic elsewhere herein.

When through traffic is being maintained, the contractor will be required to complete the replacing of pavement, or to fill and compact any open areas or trenches, before leaving at the end of the day's operations. In no instance may open areas or trenches be left overnight. All costs involved in the requirements of this paragraph shall be included in the price bid on the item.

The required excavation and compaction of the subgrade shall be in accordance with the plans, or as directed by the engineer. The subgrade shall be compacted uniformly.

The existing surfacing and excess excavation that is removed, unless otherwise directed by the engineer, shall be disposed of beyond the limits of the right of way by the contractor.

724.05 PATCHING AND WIDENING UNDER METHOD 1 (PORTLAND CEMENT CONCRETE). In the event Method 1 is employed by the contractor, the work shall consist of constructing Portland cement concrete pavement for patching and widening in accordance with the plans and shall conform to the applicable requirements of Section 601 and these specifications.

When pavement is to be overlayed with asphaltic concrete pavement, the sawing or crimping, sealing and finishing of transverse and longitudinal joints is not required. Also, the smooth finishing of the slab will not be required and the surface of the concrete shall be left rough. The contractor has the option of machine or hand finishing the concrete.

The following requirements apply to the patching of the existing pavement only:

When required by the plans or special provisions, the top of the subgrade shall consist of a six-inch layer of granular material. The material and construction requirements shall be in accordance with Section 723.

724.06 PATCHING AND WIDENING UNDER METHOD 2 (ASPHALTIC CONCRETE). In the event Method 2 is employed by the contractor, the work shall consist of constructing asphaltic concrete pavement for patching and widening in accordance with the plans and shall conform to the applicable requirements of Sections 501 and 502 and these specifications.

The mixture shall be placed in lifts of such thickness that all requirements of the specifications are complied with.

The contact surfaces of existing pavement shall be cleaned and painted with a thin uniform coating of bituminous tack coat before the asphaltic mixture is placed against them.

The spreading, finishing and compaction of asphaltic concrete shall be such that the surface of the mixture, after compaction, shall be reasonably smooth and level with, or slightly above, the edge of existing pavement. The cross slope shall be in reasonable conformity to that shown on the plans or specified by the engineer. The average densities for the type mix furnished shall be the minimum density specified in Subsection 502.09 under headings entitled "traffic lanes." The sampling and testing for density shall be of the top 4 inches of the finished sections.

The following requirements apply to the patching of the existing pavement only:

The replaced pavement furnished under this item shall be left open to traffic for at least 15 days prior to placing of any additional surfacing, unless otherwise directed by the engineer.

The following requirements apply to the widening construction only:

The contractor may, at his discretion, construct a temporary embankment of the excavated material against the outside edge of the asphaltic concrete widening strip prior to rolling, provided all other requirements of the specifications are met. This operation will provide lateral support and thereby reduce the tendency of the asphalt mixture to push out during compaction.

724.07 METHOD OF MEASUREMENT.

(a) Patching: Patching existing pavement will be measured by the square yard. Areas to be measured shall be the actual areas of existing pavement removed and re-

placed with new Portland cement concrete pavement or asphaltic concrete pavement, as the case may be.

Any required excavation in connection with patching operations will not be measured.

(b) Base Widening: Base widening will be measured by (1) the station of 100 linear feet or (2) cubic yard (net section).

(1) If base widening is specified to be measured by the station of 100 linear feet, the length of measurement will be computed in the following manner: When the total width for widening is constructed on 1 side only of the existing base and surfacing, the length for measurement will be the length along the centerline of the widened section. When the total width for widening is to be constructed ½ or more on 1 side and the remainder on the opposite side of the existing pavement, then both sides will be measured and the quantity to be paid for will be determined by dividing the summation of such length by two. Flares at intersections will be measured along a line ½ the distance from the outside edge of the widened section to the edge of the existing base and surfacing. No differentiation will be made for any additional widening that may be ordered at curves.

(2) If base widening is specified to be measured by the cubic yard (net section), measurement will be based on the typical sections shown on the plans and the actual length of the completed sections. Turnouts, ramps, and other irregular sections, if required on the plans, will be the calculated volume as constructed, as determined by the engineer.

Excavation required for base widening will be paid for under Item 203(1), Unclassified Excavation. The quantity of excavation for base widening may vary dependent on whether Method 1 or 2 is employed and the contractor is hereby advised that the estimated quantity of excavation shown on the plans may be increased or decreased.

724.08 BASIS OF PAYMENT. The accepted quantities for patching existing pavement, measured as provided above, will be paid for at the contract price per square yard, except as stated below for asphaltic concrete mixtures.

The accepted quantities of base widening placed, measured as provided above, will be paid for at the contract unit price per station or cubic yard as specified, except as stated below for asphaltic concrete mixtures.

Asphaltic Concrete Mixtures: The accepted quantity of asphaltic concrete patching or base widening will be paid for at the contract unit price provided the mixtures furnished under these items conform to requirements of 80 percent payment of Schedules 1 and 2 of Section 502. If asphaltic mixtures do not conform to requirements for 80 percent payment, payment will be made at 50 percent of the contract unit price per square yard, or either the asphaltic mixtures shall be removed and replaced. Acceptance will be based on Marshall stability and roadway density only. Five roadway density samples per lot will be taken at locations determined by the engineer, not exceeding 1 sample per patch. If less than 5 patches are placed, average density of samples taken will be applied to Schedule 2.

Payment will be made under:

Item No.	Pay Item	Pay Unit
724(1)	Patching Existing Pavement	Square Yard
724(2)	Base Widening	Station, Cubic Yard
724(3)	Patching Existing Pavement (Portland Cement Concrete)	Square Yard
724(4)	Patching Existing Pavement (Asphaltic Concrete)	Square Yard
724(5)	Base Widening (Portland Cement Concrete)	Station, Cubic Yard
724(6)	Base Widening (Asphaltic Concrete)	Station, Cubic Yard

Section 725

Lime Treatment

725.01 DESCRIPTION. This work shall consist of constructing one or more courses of a mixture of lime and soil, or soil-aggregate, and water in accordance with these specifications, in reasonably close conformity with the lines, grades, thicknesses and sections shown on the plans or established by the engineer.

Lime treatment of existing material or new material for use in the embankment subbases or bases will be designated as Type A, Type B, Type C, Type D, or Type E according to the type of treatment required.

The table included with this section gives a synopsis of the requirements for the types of treatment. This table is for informational purposes only.

Type A Lime Treatment: In the construction of Type A lime treatment, two increments of lime shall be incorporated in the following sequence: spreading the first increment of lime, initial mixing, watering, sealing and mellowing; spreading the second increment of the lime, final mixing, watering as necessary, compacting, finishing and maintaining, all in accordance with these specifications. Material to be used for Type A treatment shall be tested in accordance with LDH Designation: TR 433.

The Type A treatment, when specified, may be for subbase or base course construction.

Type B Lime Treatment: In the construction of Type B lime treatment, one increment of lime shall be incorporated in the following sequence: spreading the lime, initial mixing, watering, sealing and mellowing; and final mixing, compacting, finishing and maintaining, all in accordance with these specifications. Material to be used for Type B treatment shall be tested in accordance with LDH Designation: TR 433.

The Type B treatment, when specified, may be for subbase or base course construction. The Type B lime treatment may also be used as a subbase working table.

Type C Lime Treatment: In the construction of Type C lime treatment, one increment of lime shall be incorporated in the following sequence: spreading the lime, mixing, watering, compacting and finishing to the satisfaction of the engineer, all in accordance with these specifications. Material to be used for Type C treatment shall be tested in accordance with LDH Designation: TR 416, as amended.

The Type C treatment, when specified, may be for conditioning of base course material prior to cement stabilization.

Type D Lime Treatment: The construction of Type D lime treatment shall include the furnishing and spreading of one increment of lime, mixing, watering, compacting and finishing to the satisfaction of the engineer, all in accordance with these specifications.

The Type D treatment, when specified, may be for establishing a working table.

Type E Lime Treatment: The construction of Type E lime treatment shall include the furnishing and spreading of one increment of lime in each lift on those areas specified or delineated and incorporating the lime into the embankment, all in accordance with these specifications.

The Type E treatment, when specified, may be for drying and conditioning of the embankment.

725.02 MATERIAL. Materials shall conform to the requirements of the following subsections of Part IX, Materials.

Lime	915.03
Water	915.01
Emulsified Asphalt (EA-4 & SS-1)	902.03
Cutback Asphalt (MC-30)	902.04

725.03 EQUIPMENT. All necessary equipment as described herein shall be in satisfactory working condition, and approved by the engineer prior to use.

CONSTRUCTION REQUIREMENTS

725.04 GENERAL. In lime treatment, the material shall be kept moist after the lime is applied. Water shall be added during the mixing and remixing operations, during the curing period, and to keep the cured material moist

until covered. The amount of water added shall be under the control of the engineer at all times.

For all types of lime treatment, lime shall not be applied at any time on a frozen foundation. Lime for any type treatment other than Type D and Type E shall not be applied when the descending air temperature in the shade and away from artificial heat reaches 40°F, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

725.05 PREPARING MATERIAL. The surface to be treated shall be prepared in accordance with Section 203. The material shall be reasonably free from deleterious substances such as roots, stumps, grass and turf.

725.06 SPREADING AND MIXING. The percentage of lime shown on the plans or in the special provisions to be incorporated may be approximate, and before construction is started, the laboratory may make an analysis of materials and determine the actual percentage of lime required.

The lime may be furnished in bags or bulk and distributed, either in powder form or in a slurry, in such a manner as to assure obtaining the required proportion. Dry lime shall be prevented from blowing by adding water or other suitable means.

The lime shall be uniformly spread, and shall be thoroughly and uniformly mixed with the soil to the approximate width and depth shown on the plans, or as directed. Any procedure which results in excessive loss or displacement of the lime shall be immediately discontinued.

Lime shall be applied on such areas as can be properly processed during the same working day. Any lime that has been exposed to the open air for a period in excess of 6 hours and lime lost or damaged before incorporation, due to rain, wind or other cause, will be rejected; deducted from measured quantities and shall be replaced by the contractor at no additional cost to the Department.

(a) Type A and Type B Mixing: Lime treatment mixing shall be performed by an approved plant, pugmill or traveling device. The mixture shall be kept moist and manipulated until the requirements of Subsection 725.07 have been met. Mixing equipment shall be equipped with a device that will uniformly introduce the required amount of water when needed.

The first application of lime for Type A lime treatment shall be processed to line and grade and sealed. The second application of lime shall be spread and mixed as described herein for the first application.

(b) Type C Mixing: The lime treated mixture shall be thoroughly manipulated to the satisfaction of the engineer. The mixture shall meet the gradation requirements of Subsection 725.07 prior to subsequent stabilization.

(c) Type D Mixing: The mixing shall be accomplished with ordinary embankment construction methods and equipment.

(d) Type E Mixing: The mixing shall be accomplished with ordinary embankment construction methods and equipment.

725.07 PULVERIZATION. For Type A, Type B and Type C treatment, the pulverized mixture, exclusive of gravel, stone, or other aggregate material, when tested in accordance with LDH Designation: TR 431, shall meet the following gradation requirements:

U. S. Sieve	Percent Passing
¾"	95
No. 4	50

When Type A treatment is specified the requirements for pulverization shall be met prior to the second application of lime.

725.08 COMPACTING AND FINISHING.

(a) Type A Compacting and Finishing: After the second application of lime has been spread and mixed as described in Subsection 725.06, the mixture shall be uniformly compacted by approved rollers of the size, type, shape and weight best suited to do the work. The rate of operation and the number of rollers used shall be sufficient to uniformly compact the mixture for the specified width and depth. All compaction shall be completed within 6 hours after meeting pulverization requirements and/or the last application of lime. Final finishing shall be done as directed.

Compaction shall continue until the entire depth of the lime treated mixture has attained 95 percent of maximum density as set forth in Subsection 725.10 when tested in accordance with LDH Designation: TR 401.

At all places inaccessible to rollers, such as edges adja-

cent to curb and gutter sections, the mixture shall be compacted to required density using mechanical hand tampers, pneumatically operated mechanical tampers, vibrating compactors, or other approved devices that will obtain uniform compaction to required density without damage to the adjacent structures.

When the compaction has been completed, the thickness will be checked. Any deviation noted at this time from the accepted tolerances given in Subsection 725.10 shall be cause for rejection, and such mixture shall be corrected, as directed at the expense of the contractor.

Final finishing shall be done as directed by the engineer. The finish shall have a smooth, uniform, closely knit surface, free from ridges, undulations, loose material or laitance.

(b) Type B Compacting and Finishing: Compacting and finishing of the Type B lime treated materials shall be as described for Type A treatment above, when the Type B base lime treatment is to be used as a base or subbase.

When the Type B lime treated materials are being used as a working table, compaction shall continue until a density of 95 percent of maximum density at optimum moisture has been obtained, unless it is apparent, in the opinion of the engineer, that further compactive effort would be detrimental to the subgrade. In which case, a density of 90 percent of maximum density will be acceptable. A notation in the construction diary will be made by the Project Engineer designating the areas in which movement of the underlying material makes it impossible to obtain a density of 95 percent of maximum density.

(c) Type C Compacting and Finishing: Unless otherwise specified, the Type C lime conditioned materials shall be shaped and uniformly compacted to the required sections.

(d) Type D Compacting and Finishing shall be in accordance with the normal embankment construction procedures of Section 203.

(e) Type E Compacting and Finishing shall be in accordance with the normal embankment construction procedures of Section 203.

725.09 PROTECTION AND CURING.

(a) Type A and Type B (Water Curing): Unless other-

wise specified, the following protection and curing requirements shall apply.

After finishing operations have been completed, no vehicle or equipment other than sprinkling equipment shall be permitted on the lime treated material for a minimum of 72 hours, unless otherwise directed. During the curing period, the lime treated material shall be lightly sprinkled with water at frequent intervals to prevent drying.

Any damage to the lime treated material due to the contractor's operations shall be repaired at no expense to the Department.

(b) Type A and Type B (Asphaltic Curing Membrane): When specified by the plans or project specifications, the following protection and curing requirements shall apply.

After finishing operations have been completed, the material shall be kept protected against rapid drying for a period of 72 hours by applying either emulsified asphalt Grade EA-4, SS-1 or cutback asphalt MC-30 at the minimum rate of 0.10 gallon per square yard. Any additional applications required as hereinafter set forth shall be placed by the contractor at his expense.

The emulsified asphalt diluted with water, or MC-30 diluted with kerosene, as required shall be applied so as to provide a continuous seal. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72-hour curing period. Equipment or traffic shall not be allowed on the completed material during the curing period, unless specifically permitted by the engineer.

In the event traffic is permitted to use the completed surface subsequent to the 72-hour curing period and prior to the construction of the surface course, the base shall be further protected by such additional applications of the curing compound as the engineer may deem necessary and as specified above.

In any event, if traffic is permitted prior to the construction of the surface course, any damages thereto caused by traffic shall be properly corrected without additional compensation.

The requirements of this Subsection for Type C, Type D and Type E lime treatments are waived.

725.10 REQUIREMENTS AND TOLERANCES FOR ACCEPTANCE

(a) General: Except for Type E lime treatment, the completed lime treated courses will be checked for determining acceptance as provided herein. The sampling schedule contained herein shall not prevent the engineer from taking such additional tests as may be required for adequate control of the work in progress, but such tests shall be independent of the tests taken herein for acceptance.

(b) Type A, Type B, Type C and Type D Requirements and Tolerances for Acceptance: Any section not meeting these tolerances shall be reconstructed in accordance with these specifications at the contractor's expense.

(1) Density Requirements: Upon completion of compaction operations, the density of the completed lime treated material, except for Type C, Type D and Type E, will be determined in accordance with LDH Designation: TR 401. A minimum of one density test will be taken per 500 linear feet per roadway. Upon determining that any density test is below the requirements, 2 additional tests will be taken within 5 feet of the location of the failing test and the average of the 3 tests will be used as the value for that test location.

In the event that a test, representing 500 linear feet of roadway, does not meet the required 95 percent compaction, but is not below 93 percent, then this section is acceptable provided the average of this test, the 2 tests of the 2 preceding sections and the 2 succeeding sections meet the 95 percent requirement. In computing this average percent compaction, any test value in excess of 100 percent compaction will be considered as 100 percent.

(2) Thickness Requirements: The thickness of the completed lime treated material will be determined in accordance with LDH Designation: TR 602. The thickness shall not vary in excess of the following tolerance for any individual test.

Plan Thickness	Under Thickness	Over Thickness
6" and less	½"	Waived
Over 6" and less than 8"	¾"	Waived
8" and over	1"	Waived

(3) Width Requirements: Over widths will be waived at no additional cost to the Department. Variations from plan width measured along the surface of the lime treated material shall not be more than minus 3 inches on either side of center line of the dimensions shown on the plans. For shoulder construction, variations from plan width shall not be more than minus 3 inches on the outside edge of each shoulder.

Whenever an individual test is found to exceed the allowable tolerance, 2 additional tests will be taken within 5 feet of the location of the failing test and the average of the 3 tests will be used as the value for that location.

725.11 METHOD OF MEASUREMENT. Hydrated lime incorporated and accepted in Type A, Type B, Type C, Type D and Type E lime treatments will be measured by the ton (2,000 pounds).

A unit weight of 35 lbs./cu. ft. will be used to compute the spread required or in converting the volumetric lime percentage (as indicated on the plans) to the percentage by weight (as used for control of spread in the field). This will be the actual weight of lime spread per unit area regardless of the unit weight of lime used.

If lime is furnished in bags, the number of bags used and the weight per bag will be used in determining measurement.

When lime is furnished in bulk, the contractor shall furnish certified weights for each transport load or furnish certified scales on the project site so each transport delivered and used can be weighed.

Type A, Type B, Type C and Type D lime treatment will be measured by the square yard, complete in place. The width for measurement will be that shown on the plans. The length will be the actual center line length measured horizontally along the center line of each roadway. Lime treatment for turnouts, ramps and other irregular sections

will be the calculated area as constructed, determined by the engineer.

Type E lime treatment acceptably performed in accordance with these specifications, will be measured by the ton of lime used in the construction and no other measurement for payment will be made except as provided under Section 203.

All costs for water used in lime treatment, and asphaltic curing materials, will be incidental to the lime treatment.

725.12 BASIS OF PAYMENT. The accepted quantity of Type A, Type B, Type C and Type D lime treatment will be paid for at the contract unit price per ton for lime and the contract unit price for specified lime treatment item(s) by the square yard.

Type E lime treatment, completed and accepted, will be paid for at the contract unit price per ton for lime.

Payment will be made under:

Item No.	Pay Item	Pay Unit
725(1)	Lime	Ton
725(2)	Lime Treatment (Type A)	Sq. Yd.
725(3)	Lime Treatment (Type B)	Sq. Yd.
725(4)	Lime Treatment (Type C)	Sq. Yd.
725(5)	Lime Treatment (Type D)	Sq. Yd.
725(6)	Lime (Type E Lime Treatment)	Ton

Section 725
Lime Treatment

Type	Use	Treatment	Field Requirement	Type Construction
A	Base & Subbase	Two Applications	1. Pulverization — after 1st application 2. Density control 3. Minimum thickness — minimum width	High type[1], with 72 hour cure after 2nd. application[2]
B	Base, Subbase & Working Table (High Type	One Application	1. Pulverization 2. Density control[3] 3. Minimum thickness — minimum width	High type with 72 hour cure
C	Conditioning for Soil Cement	One Application	1. Pulverization 2. Minimum thickness — minimum width	High type, no cure required
D	Working Table (Low Type)	One Application	1. Moisture & density to satisfaction of Engineer 2. Minimum thickness — minimum width	To satisfaction of Engineer, No cure required
E	Drying, Conditioning & Initial Working Table	One Application (per lift of embankment)	Embankment construction procedures and requirements.	

NOTES: 1. High type construction includes use of pulvimixer, base course type compaction, finishing and maintaining.
2. 72 hour cure period begins after compaction and prior to construction of subsequent courses.
3. 95 percent density requirement for working table waived if unable to obtain.

Section 726

Bedding Material

726.01 DESCRIPTION. This work shall consist of furnishing and placing bedding material to form a suitable foundation below the established grade for culverts and storm drains, reinforced concrete box culverts, headwalls, manholes, inlets, junction boxes and catchbasins, hereinafter referred to as "structure", in accordance with these specifications and in reasonably close conformity with the lines, grades and sections shown on the plans or established by the engineer.

The plans or special provisions will usually indicate which of the bedding materials the contractor may use. If not specified, the bedding material may be any of the types of material listed herein at the option of the contractor. Unless otherwise approved in writing by the engineer, the same type material shall be used throughout the project.

726.02 MATERIALS. Materials shall conform to the requirements of the following Subsections of Part IX, Materials.

Sand Clay Gravel	903.04(a)
Shell and Sand	903.04(b)
Granular Material	903.08

The materials furnished shall be properly proportioned and mixed prior to being placed in the foundation.

726.03 PLACEMENT OF BEDDING MATERIAL. The material shall be placed, uniformly compacted and properly shaped, to form a uniform foundation for the structure to the satisfaction of the engineer.

The excavation that is required, below the established grade of the structure for placement of bedding material, shall be disposed of in accordance with the applicable requirements of Section 203.

When Sand Clay Gravel is the bedding material used, the material shall be compacted to 95 percent of maximum density in accordance with LDH Designation: TR 418.

A layer of approved compacted impervious material ap-

proximately 12 inches thick shall be placed at structure ends for protection against erosion when aggregate is exposed.

Bedding Blanket for Culverts and Storm Drains Only: After compaction and at the time of final shaping of the bedding material, a bedding blanket of fine compressible soil or granular material shall be placed and shaped to fit the lower part of the structure exterior with reasonable closeness, for at least 10 percent of its overall height. The shaped bedding blanket shall be loosened material a minimum of 3 inches deep.

726.04 METHOD OF MEASUREMENT. The bedding material, including impervious material, completed and accepted, will be measured by the cubic yard (net section). The length will be measured horizontally along the structure centerline to the theoretical points established by the plans for bedding material. The width will be measured horizontally to the theoretical points established by the plans. The depth shall be the actual depth established by the engineer below the established grade line as shown on the plans and determined by the engineer.

No measurement will be made for excavation or bedding blanket but cost of this work will be included in the price bid on the "Bedding Material" item.

726.05 BASIS OF PAYMENT. The bedding material, completed and accepted, will be paid for at the contract unit price per cubic yard (net section).

Payment will be made under:

Item No.	Pay Item	Pay Unit
726(1)	Bedding Material	Cubic Yard

Section 727

Mobilization

727.01 DESCRIPTION. When an item for mobilization is included in the contract, this work shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work and operations which must be performed, or costs incurred for mobilization, prior to beginning work on the various construction items on the project.

The contract bid price is limited to an amount up to a maximum of 10 percent of the contractor's total bid, including this item.

727.02 MATERIALS. The contractor shall furnish all materials, supplies and incidentals for this item. These materials, supplies and incidentals will not be considered as a part of the various items of the completed contract.

727.03 METHOD OF MEASUREMENT. When an item is provided in the contract for mobilization, the item will be measured by the lump sum, acceptably performed. When the quantities of work vary or there is extra work or force account work or there are eliminated items, all in accordance with Subsection 109.03, 109.04 and 109.05, these conditions will not be related to this item and the cost of mobilization that may be necessary for the added item of work will be included in the price agreed upon for the added item.

727.04 BASIS OF PAYMENT. Mobilization will be paid for at the contract lump sum price by partial payments in accordance with the following schedule.

(1) When the first partial estimate is earned and submitted for payment, 25 percent of the amount bid for mobilization will be paid.

(2) When 10 percent or more of the original contract amount is earned, an additional 25 percent of the amount bid for mobilization will be paid.

(3) When 25 percent or more of the original contract amount is earned, an additional 25 percent of the amount bid for mobilization will be paid.

(4) When 50 percent or more of the original contract amount is earned, the final 25 percent of the amount for mobilization will be paid.

In the event this contract is cancelled by the Department the contractor will be paid for the actual cost incurred for mobilization at the time of cancellation, which cost will not exceed the total amount bid under the mobilization item.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided by the contract.

Payments will be made under:

Item No.	Pay Item	Pay Unit
727(1)	Mobilization	Lump Sum

Section 728

Jacking or Boring Pipe

728.01 DESCRIPTION. This work shall consist of furnishing and installing of pipe in an embankment at the locations shown on the plans by the methods of jacking or boring in accordance with these specifications.

728.02 MATERIALS. The pipe to be installed under this work shall conform to the applicable requirements of Subsection 701.02 and Part IX, or shall be as specified on the plans or in the contract.

CONSTRUCTION REQUIREMENTS

728.03 GENERAL. In general, pipes of 30-inch diameter and greater shall be jacked and pipes of less than 30-inch diameter shall be bored.

The work shall begin at the outfall end of the pipe whenever possible. In the event the grade at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the operations and for placing the joints of pipe. Adequate sheeting and bracing shall be provided to prevent earth caving.

All work performed in embankments of roadways or railroads carrying traffic shall be conducted so as to cause the least possible interference with traffic. Suitable warning signs, barricades and lights shall be placed to protect the work, the workmen and the traffic.

The method that is used shall be such as not to weaken or damage the embankment or structure. The contractor shall furnish to the engineer for approval a plan showing his proposed method of procedure, including the backstop or jacking frame arrangement, pipe guides, positions of jacks, jacking head, etc. Approval of this plan shall not relieve the contractor from his responsibility to obtain the desired result.

(a) Jacking: Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided in sufficient numbers to overcome the resistance expected to be

encountered. In operating the jacks, even pressure shall be applied to all jacks and shall be transmitted to the pipe end through the use of a properly designed jacking head. The jacking head shall be so designed that the pressure is uniformly applied around the ring of the pipe. The backstop or jacking frame shall be adequate to resist the pressure of the jacks under load. The pipe shall be set on guides, properly fastened together to support the pipe and to direct it in the right direction and at the correct grade.

Material shall be excavated just ahead of the pipe and shall be removed through the pipe. Excavation shall not extend more than 2 feet beyond the forward end of the pipe, and if the character of the embankment material dictates, the distance shall be reduced as is necessary to prevent the embankment from being damaged.

The excavation shall be done on the under side of the pipe, for at least one-third of the circumference of the pipe, to conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe and shall be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

At the option of the contractor, a steel cutting edge may be used around the forward end of the pipe. The cutting edge shall be so constructed that it will fit and will transmit pressures uniformly around the ring of the pipe.

Once begun, the jacking shall continue without interruption, insofar as is practicable, to prevent the pipe from becoming firmly set in the embankment.

The pipe shall not vary laterally nor vertically by more than 1 inch in 10 feet from the line and grade established by the engineer. Any variation shall be regular, and no abrupt changes in direction will be permitted. Any pipe damaged or misaligned in the jacking operations shall be removed and replaced by the contractor at his expense.

(b) Boring: All boring shall be done mechanically and shall be done using a pilot hole of approximately 2 inches in diameter. The pilot hole shall extend through the embankment and shall be checked for line and grade before

boring begins. Variations from line and grade shall not exceed those specified under "Jacking" herein. The pilot hole shall serve as the centerline of the larger diameter hole to be bored.

The use of water and other fluids in connection with the boring operation will be permitted only to the extent necessary to lubricate the cuttings. Jetting will not be permitted.

In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10% of highgrade carefully processed bentonite may be used to consolidate cuttings of the bit, to seal the walls of the hole, and to furnish lubrication for subsequent removal of cuttings and installation of the pipe thereafter.

Overcutting in excess of one inch shall be remedied by pressure grouting the entire length of the installation.

Pipe placed as specified herein shall be joined as specified under Section 701.

728.04 METHOD OF MEASUREMENT. Furnishing and Jacking Pipe or Furnishing and Boring Pipe shall be measured by the linear foot complete in place. Such measurement will be made between the ends of the pipe along the axis of the pipe as installed.

728.05 BASIS OF PAYMENT. Payment will be made at the contract unit price per linear foot, measured as provided herein, for "Furnishing and Jacking Pipe" or for "Furnishing and Boring Pipe" as the case may be, for the size, type, and class of pipe specified on the plans or in the contract, which price shall be full compensation for furnishing and jacking or for furnishing and boring pipe; for all excavation, sheeting, bracing, jacking frame, timber and false work, and all other materials; for all tools, equipment and incidentals, and for the performance of all work necessary to complete the item.

Payment will be made under:

Item No.	Pay Item	Pay Unit
728(1)	Furnishing and Jacking Pipe (size, type, class)	Linear Foot
728(2)	Furnishing and Boring Pipe (size, type, class)	Linear Foot
728(3)	Furnishing, Jacking or Boring Pipe (size, type, class)	Linear Foot

Section 729

Traffic Signs and Devices

729.01 DESCRIPTION. This work shall consist of furnishing and installing traffic signs, markers and delineators, together with accessories, posts and overhead spans of the designated materials, sizes, shapes, weights and designs in conformity with the requirements shown on the plans and contained in these specifications.

In general, the work and materials shall meet the requirements of the "Louisiana Uniform Traffic Control Devices Manual", current on the date of receipt of bids, and the AASHO "Manual of Signing and Pavement Marking of the National System of Interstate and Defense Highways" current on the date of receipt of bids, except as modified by these specifications or as shown on the plans.

Signs shall be fabricated in a properly equipped plant, and contractor shall show evidence of successful experience in fabrication and erection of quality reflectorized multi-panel highway signs.

When the lighting of signs is required by the plans, the specifications for sign lighting will be elsewhere in the specifications.

729.02 GENERAL DESIGN REQUIREMENTS.

(a) After award of the contract and before beginning work, the contractor shall notify the engineer in writing as to what combination of signing materials he proposes to furnish on this project, and the same combination of signing materials shall be used throughout the project.

(1) Single, Double and Triple Post Sign Mountings: The contractor shall have the option of furnishing either steel supports with steel sign faces, aluminum supports with aluminum sign faces or a combination thereof consisting of steel supports with aluminum sign faces or aluminum supports with steel sign faces.

All steel supports for the single, double and triple post sign mountings shall be galvanized after fabrication in accordance with ASTM Designation: A 123 and Subsection 811.15.

(2) Sign Blanks and Backing: Sign blanks and backing for overhead mountings shall be aluminum.

(3) Overhead Sign Mountings: The contractor shall have the option of furnishing either steel or aluminum truss structures.

(b) Detail Drawings: The contractor shall furnish fabrication and erection drawings of ground and structure mounted sign structures and sign face details in accordance with the requirements of Subsection 801.03. Approval of sign face details must be given before approval of sign structure drawings can be made. Fabrication or construction will not be started until drawings have been approved and distributed.

729.03 MATERIALS. All materials shall conform to Part IX, Materials, and specifically as follows:

(a) General Material Requirements: Though certain particular brands, makes of materials, devices and processes may be named herein for the purpose of establishing minimum acceptable standards, it is neither implied nor intended to exclude comparable brands, materials, devices and processes of any other manufacturer or source. When more than 1 brand or standard is cited, they shall be regarded as comparable.

When a particular material is specified, but is unobtainable or undesirable due to obsolescence, an alternate material at least equivalent to the material originally specified may be used, provided the contractor obtains the written approval of the engineer before such alternate is incorporated into the work.

All materials shall be of a new stock and shall be the product of a reputable manufacturer.

The contractor shall furnish the engineer with a Certificate of Compliance or a Certificate of Analysis, or both, stating that the materials comply in all respects with these specifications. In the absence of detailed material specifications, the contractor shall furnish Certificates of Analysis of the material that is proposed for use with their specification requirements. Seven certified copies of each certificate shall be furnished.

The contractor shall also furnish the engineer samples of

the materials specified by the LDH Sampling Manual for testing as may be deemed necessary.

(b) Signs and Markers, Section 917: The specifications cover the materials and the fabrication of sign panels complete with legend, markers, delineators and legend components.

(c) Ferrous Metals:

(1) Protective Coatings: All ferrous metal except reinforcing steel and sheet steel, unless otherwise specified, shall be galvanized after fabrication in accordance with ASTM Designation: A 123 and Subsection 811.15.

All spot welds, sheared or drilled members and galvanizing repairs must be performed in accordance with Subsection 811.15 unless otherwise specified.

The overhead truss and cantilever truss structure units may be galvanized as stated above or painted at the contractor's option. The paint system used may be any one of the approved 2-coat systems described in the project specifications; however, the contractor must utilize the entire system chosen, as no modification, substitution or combining of systems will be allowed. The applicable requirements of Section 811 entitled Painting and Protective Coatings shall be met.

(2) Welding: Welding shall conform to the specifications of the American Welding Society D 2.0 as revised by the Department's current specifications. All welds shall be mechanically cleaned before galvanizing or painting.

(3) Structural Steel: Structural steel for posts, stringers and framing shall be of standard shapes conforming to ASTM Designation: A 36.

Miscellaneous steel shall conform to ASTM Designation: A 36.

(4) Steel Pipe: Steel pipe for the steel truss structures, unless otherwise specified, shall be Schedule 40 (Standard Weight) Seamless Pipe Type S, Grade B, ASTM Designation: A 53 or ASTM Designation: A 36.

(5) Steel Posts for Small Signs and Delineators: Posts shall be steel of the flanged channel type as shown on Standard Plans, galvanized after fabrication in accordance with the requirements of ASTM Designation:

A 123 and Subsection 811.15. Unless otherwise specified, the galvanized posts shall weigh 1.12 pounds per foot, ± 3½ percent tolerance. The tensile strength of the steel shall be determined from a sample strip cut from one of the posts measuring ½ inch in width and 10 inches in length and shall be 60,000 pounds per square inch. Holes measuring 3/8 inch in diameter shall be drilled or punched through the middle of each post on 1-inch centers for a distance of 36 inches from the top of each post.

(6) Reinforcing Steel: Reinforcing Steel used shall conform to Section 909 and shall be placed in accordance with Section 806.

(7) Sheet Steel: Sheet steel shall be continuous coat mill galvanized phosphate coated. Zinc coating shall conform to ASTM Designation: A 525, 2.75-ounce coatings, applied with the continuous coat process in an inert atmosphere. Zinc-coated steel shall be mill phosphated. Phosphate coating shall be tightly adhered and of such character to give adherence of reflective sheeting or paint to the galvanized sheet. Sheet steel shall be stretcher leveled ASTM Designation: A 375, high-strength, low-alloy, weldable structural steel with from 4 to 6 times the atmospheric corrosion resistance of structural carbon steel (A 36). All welds and sheared edges must be coated with 2 coats of zinc-rich paint as specified under Heading 1, Protective Coatings, of this Subsection. Fabrication of sign faces shall be in accordance with Section 917.

(8) Structural Steel for Use in the Built-up Sign Panels System: This steel shall conform to ASTM Designation: A 36 and shall be galvanized in accordance with ASTM Designation: A 123 and Subsection 811.15 after all fabrication has been completed except for welding. All welds must be cleaned and coated in accordance with Subsection 811.15 unless otherwise specified.

(9) Structural Bolts, Nuts and Washers: All bolts shall have hexagonal heads and supplied with 2 flat washers and hexagonal head nut unless otherwise specified. Bevel washers where required shall be of wrought steel. Unless otherwise specified, bolts, nuts

and washers shall be galvanized in accordance with ASTM Designation: A 153 or electroplated in accordance with ASTM Designation: A 164 with a type GS zinc coating.

High strength bolts shall be ASTM Designation: A 325 and after connection has been made shall be painted with an approved organic zinc paint in accordance with Subsection 908.11.

Anchor bolts, unless otherwise specified, shall be ASTM Designation: A 36.

(d) Hardware, Miscellaneous (Steel and Aluminum Signs): When galvanized bolts or stainless steel bolts are specified, the nuts shall be the self-locking type. Stainless steel bolts shall conform to ASTM Designation: A 320, Grade B8, annealed or approved equal.

Fasteners for use in fabricating sign faces, including splice plates for joining 2 panels, sills, and border angles, shall be Huck Pins, Olympic "Oscar Rivets," or an approved equal. The fasteners shall have brasier heads and shall be manufactured from aluminum alloy 2024-T4 or approved equal. Collars shall be of the type and alloy recommended by the manufacturer.

Fasteners for delineator, hazard marker and milepost assemblies. These fasteners shall be vandal resistant aluminum huck bolts, aluminum carriage bolts or aluminum machine bolts as recommended by manufacturer of the sign or reflective unit and shall be approved by the Department prior to use.

(e) Aluminum:

(1) General: All aluminum shall be free from excessive corrosion, white rust, water stains, dirt and grease.

The welding of aluminum alloys shall be in accordance with the specifications for Welding Structural Steel, Steel Pipe and Aluminum Alloys elsewhere in the specifications.

(2) Structural Members and Miscellaneous Aluminum: This material shall be aluminum alloy ASTM Designation: B 221-6061-T6 unless otherwise indicated on the plans.

(3) Base Material for Sign Faces: This material shall

be aluminum alloy ASTM Designation: B 209-6061-T6. Sign dimensions, framing, stiffening and holes shall be in accordance with the plans. Fabrication of sign faces shall be in accordance with Section 917.

CONSTRUCTION REQUIREMENTS

729.04 GENERAL.

(a) Construction Stakes: All signs shall be first located and staked out by the contractor. On notification, the engineer shall approve or relocate the stakes prior to the actual placing of posts, footings or structure mountings.

Required information relating to lines and grades will be furnished by the Department; however, the contractor will be responsible for orientation, elevation, offset and level of all signs erected.

(b) Sign Positioning: The glossy surface on sign faces may produce specular reflection. Signs shall be positioned to eliminate or minimize specular reflection.

(1) Overhead Signs: Signs shall be erected so that the sign face is tilted back 2 or 3 degrees (approximately 1 inch in 2 feet) from the vertical and at right angles to the road, unless otherwise directed by the engineer.

(2) Road Edge Signs: Signs shall normally be erected so the sign face is truly vertical and at 93 degrees away from the center of the lane which the sign serves at the direction of travel. Where lanes divide or on curves or grades, sign faces shall be oriented so as to be most effective both day and night and to avoid the possibility of specular reflection.

(3) Vertical and Horizontal Clearances: In ground installations, signs shall be erected at a minimum height of 6 feet above the edge of the pavement to the bottom of the signs. If, however, a secondary sign is mounted below another sign, the secondary sign shall be at least 4 feet above the level of the pavement edge. Overhead sign mountings shall provide a minimum clearance of not less than 17 feet over the entire width of the pavement and shoulders.

The minimum horizontal clearance from edge roadway to any ground sign or the nearest vertical member of an overhead sign structure shall be in accordance

with current safety standards as shown on the plans or as directed by the engineer.

729.05 EXCAVATION AND BACKFILL. The contractor shall do all excavation of every description for sign installation to the levels and dimensions shown on the plans, or as directed by the engineer. Excavation and backfill shall be made to neat lines and shall be performed in accordance with Section 802.

All excavation for footing for ground overhead sign mountings will be measured and paid for under Item 802(1), Structural Excavation.

Excavation for footings for all other types of ground sign mountings will be considered as incidental to the said mountings and no direct payment will be made.

729.06 FOOTINGS. Foundation piles, concrete, reinforcing steel and anchor bolt assemblies shall conform respectively to Sections 804, 805, 806 and 807.

In all footings for ground overhead sign mountings, all foundation piles, concrete, reinforcing steel and anchor bolt assemblies will be measured and paid for under the applicable pile, concrete and steel items.

In footings for all other ground sign mountings, concrete, reinforcing steel and anchor bolt assemblies will be considered as incidental to said mountings, and no direct payment will be made therefor. The engineer will cooperate with the contractor in determining elevations of the tops of footings.

For structure mounted overhead sign mountings, all concrete, reinforcing steel and anchor bolt assemblies for the brackets will be measured and paid for under the applicable concrete and steel items.

Unless otherwise specified, posts for ground mounted delineator, hazard marker and mile-post assemblies shall be driven; no footings will be required.

729.07 ERECTION OF SIGNS. Erection of signs shall be performed in accordance with the plans and these specifications, to the satisfaction of the engineer.

After installation of signs is complete, they shall be inspected at night by the engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the contractor to eliminate this condition.

729.08 ERECTION OF DELINEATOR, HAZARD MARKER AND MILEPOST ASSEMBLIES. The location of each type of these assemblies shall be as shown on the plans, specified in the Louisiana Uniform Traffic Control Devices Manual, or as directed by the engineer. Unless otherwise specified, they shall be placed 2 feet beyond the outer edge of the roadway shoulder, or 2 feet beyond the face of the curb, or in the line of the guard rail, as the case may be.

Structure mounted assemblies shall be installed in accordance with plan details. The post for the gound mounted assemblies shall be driven and a driving cap used to protect the post. The post shall be vertical.

729.09 METHOD OF MEASUREMENT.

(a) All signs will be computed for payment by the square foot of sign face, complete in place. Material used in blanks and backing incidental to the sign face will not be measured for separate payment, but shall be included in the prices bid on the signs.

In determining the area of sign faces, no deduction will be made for corner radii or mounting holes. The area of octagonal signs, U.S. shields, and Interstate shields will be computed as the area of its smallest rectangle or square. The area of triangular signs will be computed as the area of the triangle.

(b) Post sign mountings, including break-away supports, of the size and shape specified will be measured per each post, complete in place. Each post of a multiple post mounting will be counted.

(c) Overhead sign mountings of the span and type specified will be measured per each structure, complete in place.

(d) Each delineator, hazard marker and mile post assembly furnished, including post, will be measured, per each unit, complete in place.

729.10 BASIS OF PAYMENT.

(a) The accepted quantities of signs of the type, blank and backing and type of sign face specified, measured as provided above, will be paid for at the contract unit price per square foot, which price will be payment in full for furnishing, fabricating, and erecting the signs, in-

cluding the furnishing of all necessary attaching devices.

(b) The accepted quantities of post sign mountings, measured as provided above, will be paid for at the contract unit price per each, which price will be payment in full for furnishing, fabricating and erecting the support complete, ready for affixing the signs. This payment shall also include all structural excavation and concrete footings required.

When the bid item denotes a steel post support size the contractor has the option of furnishing the acceptable aluminum post alternate when the requirements of Subsection 729.02, concerning options, are met.

(c) The accepted quantities of overhead sign mountings measured as provided above, will be paid for at the contract unit price per each, which price will be payment in full for furnishing, fabricating and erecting the structure complete and ready for affixing the signs. The footing and structural excavation or structure mounting (if required) will be paid for and constructed in accordance with Sections 802, 804, 805, 806 and 807.

(d) The accepted quantities of delineator, hazard marker and milepost assemblies, measured as provided above, will be paid for at the respective unit prices per each which shall constitute full compensation for furnishing and erecting all assemblies required.

Payment will be made under:

Item No.	Pay Item	Pay Unit
729(1)	Sign (Type A)	Square Foot
729(2)	Sign (Type B)	Square Foot
729(3)	Sign (Type C)	Square Foot
729(4)	Sign (Type D)	Square Foot
729(5)	Sign (Type E)	Square Foot
729(6)	Sign (Overhead Mounted)	Square Foot
729(7)	Mounting (_____ Size Post)	Each
729(8)	Mounting (Overhead Bridge) (Ground Mounted)	Each
729(9)	Mounting (Overhead Bridge) (Structure Mounted)	Each
729(10)	Mounting (Overhead Cantilever) (Ground Mounted)	Each
729(11)	Mounting (Overhead Cantilever) (Structure Mounted)	Each

Item No.	Pay Item	Pay Unit
729(12)	Delineator Assembly (Ground Mounted)	Each
729(13)	Delineator Assembly (Structure Mounted)	Each
729(14)	Hazard Marker Assembly	Each
729(15)	Milepost Assembly	Each

Section 730

Electrical Systems (General)

730.01 DESCRIPTION. These general specifications, together with project specifications and plans are intended to describe and include all that may be necessary for the complete electrical system of the magnitude indicated on the plans.

This work shall consist of furnishing and installing all electrical equipment, apparatus, conduit, wire, junction boxes, secondary power control units, transformers, control stations and all incidentals necessary for complete electrical control and power systems for buildings, roadway and structure lighting, sign lighting and other electrical systems, other than for movable bridges.

The work shall also include the furnishing and installing of all electrical equipment and materials required to connect to the electrical system all other appurtenances not classified as electrical equipment such as air conditioning equipment and controls, thermostats, pumps, etc.

The installation shall be carried out in strict conformity with all requirements stated or implied in plans and specifications, and upon completion shall present a neat and finished appearance. All work and materials shall be subject to inspection at all times.

730.02 GLOSSARY OF TERMS.

AA	Aluminum Association
IEEE	American Institute of Electrical and Electronics Engineers
AWG	American Wire Gage
EIA	Electronic Industries Association
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineer's Association
MSG	Manufacturer's Standard Gage
NEC	National Electrical Code
UL	Underwriters Laboratories, Inc.

730.03 CODES, PERMITS AND INSPECTIONS. All

materials furnished and all work performed shall be in strict accordance with the latest revisions of the National Electrical Code, the National Electrical Safety Code, the requirements of the local power and telephone companies, and the codes, regulations, and rules prevailing in the area in which the work is being performed, insofar as they apply. The contractor shall secure and pay for all permits and inspections and shall furnish the engineer a certificate of final approval, if required by local regulations.

730.04 DRAWINGS, BROCHURES AND DESCRIPTIVE DATA. The contractor shall furnish detail drawings, brochures and other descriptive data for the work in accordance with the requirements of Subsection 801.03.

730.05 MATERIALS. Material shall meet the applicable requirements of Part IX Materials, project specifications, plans and the following general requirements. All materials shall be of the best quality and workmanship and shall be new and of the most advanced proven design available. Throughout the project all units of any one item shall be made by the same manufacturer, but not all the items are required to be made by the same manufacturer. The above items are lighting standards, luminaires, lamps, transformers, controllers, photoelectric relays, ballasts, circuit breakers, transformer bases, panel boards, switches and starters.

Reference to any name, make or manufacturer's number for an article or material or equipment is intended to be descriptive, but not restrictive, and is intended to indicate the quality of materials that will be acceptable.

The contractor may propose the use of other manufacturer's materials on a basis of equality for the purpose intended. Substitutes which may be offered will be subject in every respect to the requirements set forth, and the contractor shall submit detailed specifications and descriptions of such materials, which will be subject to approval by the engineer.

730.06 GUARANTY. All warranties, guaranties and instruction sheets that are required to be furnished by the manufacturer for materials and supplies and for operation shall be delivered by the contractor to the engineer prior to final acceptance of the project.

CONSTRUCTION REQUIREMENTS

730.07 CONSTRUCTION DETAILS (GENERAL). The installation of the various types of equipment shall be carried out in compliance with the requirements stated in this general section and project specifications for the system specified and in conformity with the details shown on the plans. The contractor shall remove any excess material from excavation, reshape and resod or otherwise repair to the satisfaction of the engineer any portion of the right of way or construction area which may have been disturbed and leave the project in a satisfactory condition.

730.08 POWER SUPPLY. The contractor shall make all arrangements with the utility company, and shall furnish and install the service pole and all the equipment, apparatus, conduit, wire, hardware and incidentals necessary to bring in the service either overhead or underground as shown on the plans. Unless otherwise shown, the service shall be 480 volt, 3 wire, single phase 60 Hertz, AC grounded for lighting systems, and 120/240 volt, 3 wire, single phase, 60 Hertz, AC for buildings.

No direct payment will be made for power used for any reason prior to final inspection. The cost of power used during construction and final testing shall be paid by the contractor and shall be included in the price bid on pay items.

730.09 GROUNDING. The entire system shall be grounded and bonded in accordance with the NEC. All equipment shall be grounded. All ground wire for service poles shall be a minimum AWG No. 6, bare, solid, soft drawn copper, attached to a ¾ inch by 10'-0" copperclad steel ground rod with a bronze clamp.

730.10 WIRING. Unless otherwise provided, all conductors shall be stranded copper, per IPCEA specifications. Conductors smaller than AWG No. 12 shall not be used. Conductors shall conform to the requirements of Subsection 915.12.

Splices in copper conductors at light standards shall be made up by use of Y or straight splice with fused or unfused disconnect tap, as required, and shall be made with approved, field applied, waterproof connector kits. The through legs shall be positively joined but capable of being

disassembled from each other without damage. The tap leg shall be a quick, disconnect connector capable of being disconnected from the through legs without damage. Each fused quick disconnect Y cable connector kit shall contain:

(1) A pair of spring loaded 90 percent minimum conductivity contacts suitable for gripping a 600-volt, 5-amp. or 7 amp., midget, cartridge fuse, two terminal lugs, a bolt and an elastic stop nut. One of the contacts shall be adapted to be crimped to the cable and retained securely in the proper position within a rubber loadside (tap) housing. The second contact shall be preassembled and retained in a rubber Y insert body and shall provide a mounting hole by which the terminal lugs shall be fastened with the bolt and elastic stop nut. Both contacts shall be fully annealed.

(2) A loadside (tap) housing, a Y insert body and a Y housing, each made of water-resisting synthetic rubber capable of burial in the ground or installation in sunlight. The loadside housing shall provide a section to form a water seal around the cable; have an interior arrangement to suitably and complimentarily receive and retain the crimpable copper fuse contact; and a section to provide a water seal between itself and the Y insert body at the point of disconnection. The loadside housing shall be constructed to retain the fuse when disconnected and shall be permanently marked "Loadside". The Y insert body shall retain the second copper fuse contact, shall provide a water seal for the Y housing at the point of disconnection and a water seal for the Y housing at the point of disassembly. The Y housing shall provide sections to form a water seal around two cables and a section to provide a water seal for the Y insert body. Each kit shall be supplied with sufficient silicone compound to lubricate the metal parts and rubber housing for easy assembly, and a disposable mounting pin used in assembling the loadside terminal.

(3) Each kit shall also be provided with complete instructions.

(4) Connector kits not requiring a light tap shall be unfused.

(5) Connector kits at the last standard of a curcuit, or

run, or remote ballast shall be of the straight type with fuse.

(6) Connector kits for double luminaire standards shall consist of unfused Y connectors in the feeders and fused straight connectors in the taps.

All other conductor connections in the electrical system shall be made on high pressure, box lug, barrier type terminals. Splices other than those specified above will not be permitted.

730.11 CONDUIT. All conduit that is above ground or exposed on structures shall be rigid aluminum and shall conform to the requirements of Subsection 915.11. Fittings and covers shall be cast aluminum and covers shall be sealed with neoprene gaskets. Hardware shall be stainless steel.

Underground conduit shall be rigid steel, hot dip galvanized, sheradized or metallized in accordance with Subsection 915.11.

All conduit for buildings shall be rigid steel, hot dip galvanized, sheradized or metallized, or rigid aluminum, or galvanized or aluminum electrical metallic tubing. Electrical metallic tubing shall not be placed in the slab, underground, in moist areas or other hazardous locations.

Fittings and covers for steel conduit shall be cast or malleable iron with neoprene gaskets.

All conduits entering disconnects, starters and panel boards shall have union hubs. All conduits entering standards, equipment, etc., shall have insulated grounding bushings, except where bolted hubs are used. All bushings shall be installed prior to pulling wire. Each unit duct shall be run into the controller in a separate conduit.

Conduit on the structures shall be surface mounted, strapped every 5 feet with galvanized malleable iron clamps, clamp backs and nest backs, so that the minimum clearance between the conduit and the structures will not be less than ½ inch. Each conduit run on the structures, from roadway to bent cap for under structure lights, for under structure crossings, and for under structure runs shall contain a short length of liquid-tight flexible metal conduit with bonding strap for expansion deflection.

Conduit on the service poles shall be clamped at approxi-

mately 5 foot intervals with heavy duty galvanized 2-hole pipe clamps and stainless steel lag bolts with flat washers, except when channels or "z" bars are used for mounting.

All steel conduit joints shall be painted with white or red lead before assembly, and made up tight. Aluminum conduit joints shall be treated with an oxide inhibiting compound before assembly and made up tight.

Expansion joints with bonding straps and clamps shall be used wherever conduit runs across expansion joints in the bridge structure.

The maximum length of conduit run between pull points shall not exceed 100 feet. One-eighth inch diameter drain holes shall be drilled at all low points of all surface conduit runs, including expansion joints, before pulling conductors.

730.12 HARDWARE. Unless otherwise specified hardware shall be as follows:

All hardware used on structures shall be stainless steel. Hardware used for electrical systems in buildings shall be galvanized steel. All bolts shall be hex headed with hex nuts, and shall be fitted with a flat washer and an external tooth lockwasher.

(1) Stainless steel hardware shall be Type 18-8 or approved equal.

(2) Galvanized steel harware shall be galvanized in accordance with ASTM Designation: A 153. Galvanized bolts shall be in accordance with ASTM Designation: A 307.

730.13 JACKING. All conduit required under roadways shall be rigid steel 2 inch diameter minimum size, installed by jacking. A separate conduit shall be installed for each circuit. The method of jacking shall be in accordance with Section 728 and shall be approved by the engineer prior to beginning jacking operations.

730.14 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. The Method of Measurement and Basis of Payment for the electrical system required shall be in accordance with the project specifications.

PART VIII

STRUCTURES

Section 801

General

801.01 DESCRIPTION. This section includes the items of work, specifications and construction requirements for all types of bridges and related structures, and for all combinations of types of structures, all of which shall be built in reasonably close conformity with the lines, profile grades, dimensions and designs shown on the plans, and in compliance with the specifications set forth herein, and other specifications, or contract items, which are to contribute to, and constitute the complete structure, substructure or superstructure in each case.

801.02 BORINGS. Soil borings and other subsoil investigations and soil analyses will be made by the Department for development of subsurface information for bridge foundations. This data, made and developed by experienced personnel, will be included in the plans for informational purposes. Soil samples may not be available for inspection and bidders should make such additional investigations as they consider necessary to determine the subsoil conditions. No additional compensation, other than contract prices on pay items, will be allowed the contractor should it develop during construction of a project that the subsoil material is of a different character from that shown on the plans.

801.03 SHOP DRAWINGS AND WORKING DRAWINGS. The contractor shall be required to submit shop drawings, working drawings and other submittals for approval as hereinafter described. No additional payment will be made for shop and working drawings and other submittals required in this subsection as the cost shall be considered as included in the prices bid for the various contract items.

(a) General: Two prints of required shop or working drawings shall be submitted to the Department's Bridge Design Engineer for checking, one of which will be returned with either approval or required revisions noted thereon. For final approval and distribution, 9 prints of each checked drawing shall be submitted to the Bridge

Design Engineer. Upon completion of fabrication or erection, the original tracings or photographic reproductions of originals of shop and working drawings shall be delivered to the Bridge Design Engineer. Unless otherwise specified, all tracings and subsequent reproductions shall be 22 inches by 36 inches overall with ½ inch margins at top, right and bottom edges and a margin of not less than 1½ inches at the left edge. No trim lines are necessary. Each sheet shall have a title block in the lower right hand corner with the state project number(s), project name, parish(es), fabricator's and contractor's name, sheet number, date and revision block.

(1) Original tracings: Original tracings shall be ink drawings on either Imperial tracing cloth or polyester translucent matte film. Original matte film drawings may have a matte surface on either or both sides and shall not be less than .003 inch nor more than .004 inch in thickness.

(2) Reproductions: Photographic reproductions may be submitted in lieu of ink drawings, provided reproductions are on cloth or on .004 inch translucent polyester film which incorporates a silver halide emulsion image of a permanent type, from which satisfactory prints can be made. All additions or changes will be made with a permanent type or waterproof black ink manufactured specifically for this purpose.

In all cases, the type of reproductions proposed shall be submitted to the Bridge Design Engineer for approval. The final estimate will not be approved for payment until the original tracings or reproductions of a permanent type have been delivered to the Bridge Design Engineer.

(b) Procedures when Shop Drawings and Working Drawings will be Checked and Handled by Consulting Engineers: When specified in the project special provisions, the contractor shall furnish the consulting engineers shop and working drawings for checking, approval and distribution.

Two prints of required shop or working drawings shall be submitted for checking to the consulting engineers whose address is listed in the project special provisions. After all corrections required by the consulting engineers

are made, 9 prints of each checked drawing shall be submitted to the consulting engineers for final approval and distribution. Final checked prints shall be stamped "Approved" and dated by the consulting engineers, and 2 prints of each approved drawing shall be returnd to the contractor: 1 print of each shall be retained by the consulting engineers; the remaining 6 prints of each drawing shall be sent to the Bridge Design Engineer for distribution in the Department.

Upon completion of fabrication or erection, the original tracings or photographic reproductions shall be delivered to the consulting engineers for transmittal to the Department.

During the process of approval, a copy of each transmittal letter from contractor to the consulting engineers shall be sent to the Department's Bridge Design Engineer and the consulting engineers shall in turn send a copy of each letter of reply.

All other applicable requirements of this subsection shall apply.

(c) Falsework: The contractor shall prepare and submit to the engineer, for approval, plans proposed to be used for construction of all items of work requiring temporary supports usually classified as falsework. This requirement shall also apply to false work required for changes in an existing structure necessary for maintenance of traffic. The term "falsework" shall be defined to mean a temporary construction work on which a main work is wholly or partly built and supported until it is strong enough to support itself; a temporary framework used to support a part or all of a structure during demolition.

Approval of falsework drawings shall in no way relieve the contractor of his responsibility under the contract.

(d) Steel Fabrication and Erection: Detail drawings shall be furnished by the contractor for approval. The type, size and procedures for submittal and approval of these drawings shall be as described and required under headings (a) and (b) of this subsection.

(1) Shop Drawings: The contractor shall furnish shop drawings for all steel work for approval and no fabrication shall be started prior to final approval of these

plans; provided, however, that when the project has separate complete structures or has been divided into parts to facilitate construction in accordance with the approved construction schedule, fabrication may be started for a complete structure or a particular part when the final shop details applying thereto have been approved and distributed. These details must conform to the general drawings, stress sheets and specifications, and no deviations from the approved shop plans will be allowed without the written consent of the engineer. The contractor shall be responsible for the correctness of the drawings and for shop fits and field connections, even though the drawings have been approved.

If the structural steel on the project consists only of expansion dams and bearing assemblies, the contractor will not be required to furnish the original tracings or reproductions.

(2) Erection Drawings: Before starting the work of steel erection, the contractor shall inform the engineer fully as to the method of erection he proposes to follow and the amount and character of the equipment he proposes to use, which shall be subject to approval. He shall prepare and submit for approval a key erection diagram and detail erection drawings for the work, all with dimensions and erection marks as appropriate to properly coordinate the erection drawings with the shop drawings for the work.

Approval of the methods, procedures and erection drawings shall in no way relieve the contractor of his responsibility under the contract.

(3) Shipping Statements and Shop Bills: The contractor shall furnish the engineer 6 copies of shipping statements, or notices, as each shipment of structural steel is made to the project. The weights of individual members shall be shown on the shipping statements.

He shall also, at the appropriate time during the project construction, furnish the Bridge Design Engineer with 3 copies of the final shop bills for the structural steel item, which bills shall show the name, piece-mark, and calculated weight for each member. These bills

shall include a summary of the weights of structural steel for the project by grades.

(e) Movable Bridges: Detail drawings shall be furnished by the contractor for approval as follow:

(1) Shop Drawings and Erection Drawings: The contractor shall furnish a complete conduit and wire layout, elementary wiring diagram, detailed working drawings of the switchboard, control desk, junction boxes, machinery houses, operating house, counterweights, including calculations, and machinery and traffic barrier parts and assembly layouts of all items he is to furnish. Certified dimension sheets of motors, brakes, generators, gasoline engines, limit switches, traffic gates and all other such equipment shall be submitted to the Bridge Design Engineer for approval as soon as practicable after the award of the contract so that the engineer and the fabricator will have the information necessary to determine the details of associated parts. Certified dimension sheets shall show complete specifications for the equipment furnished.

All equipment and apparatus shall be as shown on the plans, or the approved equal. The contractor shall submit 9 copies of certified dimension sheets and detailed manufacturer's description of each piece of equipment and apparatus to the Bridge Design Engineer, one of which will be returned approved or with the required revisions noted thereon. If any revisions are required on the original submittal, the contractor shall submit 9 corrected copies for final approval. The name of the project, project number and parish in which the project is located shall be shown on each sheet of every submittal.

Except as otherwise provided herein, the contractor will not be required to furnish samples of the various types of wire and cable but shall be required to furnish 9 copies of detailed manufacturer's description of each of the various types and sizes of wires and cables to the Bridge Design Engineer. The descriptions shall be full and complete and shall include the manufacturer's name, the size of conductor, the type of stranding, the thickness and type of insulation, the thickness

and type of jacket, the identification markings of the jacket and the overall diameter of the wire.

In addition to the above, the description for cables shall include a construction layout sketch, the size and number of conductors, the type and thickness of sheath, the type and size of armor, the type and thickness of jacket, the diameter of the core, the diameter under jute bedding and the overall diameter of the cable. The above descriptions shall be shown on the shipping tags of the various wires and cables delivered to the bridge site. If the information on the shipping tags does not conform to the description approved by the Bridge Design Engineer or if there is reason to believe that the construction and materials of the wires and cables do not conform to the approved descriptions, the engineer reserves the right to obtain samples of the wires and cables delivered to the bridge site and have these samples tested.

The conduit and wire layout shall show the size and approximate length of all conduits, and the number, size, type and identification of all conductors in each conduit run. Identification of the conductors shall be with the same symbols used in the elementary wiring diagram.

The drawings for the control desk and switchboard shall be complete and shall include cabinet dimensions, layout of equipment, nomenclature of equipment, the rating, description, catalog number and name of manufacturer of all equipment and complete wiring diagrams.

The sizes of all conductors larger than No. 12 AWG shall be shown on all drawings, and each conductor and piece of equipment shall be identified with the same symbol wherever shown.

The drawings for the counterweights shall show all dimensions, method of construction and all necessary calculations.

A detailed list of all electrical equipment and devices, all commercial machinery and traffic barrier parts installed on the bridge shall be included in the shop drawings. The list shall be complete and shall include an item number that is the same as that shown on all drawings and the name, ratings, description, service

manufacturer, type, model, catalog and serial number of each item.

The type, size and procedures for submittal and approval of shop drawings and erection drawings and delivery of original tracings of these drawings shall be the same as described and required under headings (a) and (b) of this subsection.

(2) Maintenance and Operation Instruction Booklets: The contractor shall furnish 6 bound copies of a booklet, 8½ inches by 11 inches in size, containing descriptive leaflets and drawings covering all items of the electrical equipment, with catalog numbers indicated, printed or typewritten statements prepared by the manufacturers of the equipment covering the proper method of adjusting, lubricating and otherwise maintaining each item, a concise statement of the necessary operating functions in proper sequence, a detailed description of the functions of each item in connection with the various operating steps, reduced copies of all conduit and wiring diagrams and drawings of the control desk and switchboard. The booklet shall contain a table of contents and shall designate each wire and item of equipment by the numbers and symbols used on the drawings.

The contractor shall also furnish 6 bound copies of a similar booklet for the mechanical and traffic barrier equipment which shall include lubricating charts showing the locations of all lubricating fittings and other points of lubrication, as well as the recommended types of lubricant and frequency of application and changing of lubricants.

The booklet shall also include reduced prints of the machinery and traffic barrier shop drawings.

No additional payment will be made for these booklets; the cost thereof shall be considered as included in the prices bid for the various items.

(f) Precast-Prestressed Concrete Girder Spans: The contractor shall furnish complete fabrication drawings and erection diagrams, and no girders shall be cast prior to final approval of these plans.

Fabrication drawings shall include complete details and

dimensions of the girders, details of the proposed casting bed layout and stressing data and, in pretensioned members, the method of holding draped strands in place, and the method and schedule of release of hold-downs and cable strands.

If the girders are detailed so completely that the design drawings may serve as working drawings, the contractor will not be required to submit drawings for that part of the work, provided he notifies the Bridge Design Engineer in writing that the work is to be done as shown on the design drawings. However the contractor shall submit corrections to plan dimensions due to elastic shortening, shrinkage, girder slope and other causes, and the use of such design drawings will not relieve him of any responsibility placed on him by his contract.

Erection diagrams shall show the location of each girder in each of the prestressed girder spans and shall be coordinated with identifying marks on the girders. Identifying girder marks, showing location and span for which the girder is cast and the date of casting shall be shown on one end of each girder.

The type, size and procedures for submittal and approval of fabrication and erection drawings shall be the same as described and required under headings (a) and (b) of this subsection, except that original tracings will not be required.

(g) **Highway Illumination System:** Detail drawings, brochures and descriptive data shall be furnished by the contractor for approval as follows:

(1) Shop and Working Drawings: The contractor shall furnish a lighting standard and conduit layout, detailed working drawings of all standards and brackets, mounting details of service equipment and a complete equipment listing. The lighting standard and conduit layout shall show the location of each standard or luminaire by station, the circuit number and the number of the service pole. The locations of service poles, all trenches and conduit runs and the sizes and number of cables in each trench or conduit run shall be indicated. The various types and sizes of wires and cables shall be clearly identified on the plans.

The type, size and procedures for submittal and ap-

proval of these drawings shall be the same as described and required under headings (a) and (b) of this subsection.

(2) Equipment and Apparatus: The contractor shall submit nine (9) copies each of required lighting standard details, brochures and descriptive data to the Bridge Design Engineer for approval. This information shall include the type of lighting standards, cables and wire and other equipment and apparatus he proposes to furnish in order to establish that such material is the equivalent of that specified. All submittals shall be originals or copies equal to originals. Each copy of every submittal shall be identified with state project number(s), project name, parish(es), contractor and date.

The lighting standards details shall include details of all connections, bases, welds, anchor bolts and handhold reinforcement.

Detailed manufacturer's descriptions of each of the various types and sizes of wire and cables shall be included. This description shall include manufacturer's name, marking on the insulation, size and stranding of the conductor, thickness and type of insulation, thickness and type of sheath and overall diameter of the wire.

One copy of each original submittal will be returned to the contractor with approval, rejection or required revisions marked thereon. If submittal is marked approved, no additional copies will be necessary. If submittal was rejected, the contractor shall submit nine (9) copies of acceptable data for final checking and approval. If original submittal is marked for revisions, nine (9) copies of the revised submittal shall be returned to the Bridge Design Engineer for final checking and approval.

(h) Traffic Signs and Devices: Detail drawings shall be furnished by the contractor for approval. Fabrication or construction will not be started until drawings have been approved and distributed.

(1) Drawings for Fabrication and Erection of Ground and Structure Mounted Sign Structures: The type, size and procedures for submittal and approval of these

drawings shall be as described and required under headings (a) and (b) of this subsection, except that original tracings will not be required.

Detailed drawings for fabrication and erection of aluminum and steel parts for ground-mounted and structure-mounted sign supporting structures and backing shall include details of all parts of each different type post assembly to be used on the project. Accompanying each of these post details on the same sheet will be a list of the location and description by size and catalog number of the sign or signs to be placed on the post. This table will include all dimensions not shown on the drawing that are required for fabrication and erection. Backing details shall include a rear view of each different type blank with the location and description of the backing members required and the location of splices.

All typical backing details to be used, that are not specifically detailed in the plans, shall be shown.

(2) Sign Face Details: In all cases, sign face details shall be submitted to the Department's Interstate Engineer for approval. The details shall be submitted on legal size sheets of acceptable quality.

Two (2) prints of required sign face details shall be submitted for checking, one of which will be returned with either approval or required revisions noted thereon.

Nine (9) copies of prints shall then be submitted and if approved shall be distributed.

Approval and distribution of these prints shall be required prior to submittal of drawing for fabrication and erection of the corresponding sign structures involved.

(i) **Building or Building Complex:** Detail drawings, brochures and samples for architectural, mechanical and electrical work shall be furnished by the contractor for approval by the Bridge Design Engineer in accordance with the Special Provisions and the following general requirements:

The type, size and procedures for submittal and approval of shop and working drawings shall be as described under

headings (a) and (b) of this Subsection. No fabrication or erection work shall begin until these drawings have been approved by the Bridge Design Engineer. The drawings required shall be in accordance with the Special Provisions. Brochures and samples shall be furnished in accordance with the Special Provisions.

Maintenance and operation instruction booklets shall be furnished in accordance with the Special Provisions.

801.04 BRIDGES OVER NAVIGABLE WATERWAYS. The Department will obtain a permit, or instrument, from the Department of Transportation, U.S. Coast Guard, relating to approval of bridge plans, alteration of obstructive bridges, bridge repairs and approval of bridge regulations in a navigable waterway. The contractor will be furnished a copy of the permit, or instrument, including navigation light permits, on request. The contractor shall conduct his work in conformity with the permit provisions so as not to unreasonably interfere with marine navigation.

The contractor shall prepare, on tracing cloth and/or approved reproducible drawings which comply with the U.S. Coast Guard standards showing falsework construction, test piles or other temporary pile driving and operation of equipment, etc. in the stream. He shall submit these drawings to the Bridge Design Engineer for review and approval and for his transmittal to the U.S. Coast Guard for approval with respect to marine navigational requirements.

Construction of falsework, driving test piles or operation of any construction equipment within the navigable channel limits shall not be commenced until approval of these drawings is received from the U.S. Coast Guard. The contractor will be required to display lights on his equipment operating or berthed or moored in a navigable stream and to provide temporary navigation lights on all temporary construction in the channel in a manner as directed by the U.S. Coast Guard. The contractor shall show, on tracing cloth and/or approved reproducible drawings complying with U.S. Coast Guard standards, all temporary lighting proposed to be installed on the work for the protection of marine navigation. These drawings shall be submitted to the Bridge Design Engineer for review and transmittal to the U.S. Coast Guard for approval. Performance of any work in the navigable channel limits shall not be commenced

until approval of such drawings by the U.S. Coast Guard has been received.

Should the contractor, during the progress of the work, sink, lose or throw overboard any material, plant, machinery or equipment which may be dangerous to, or obstruct navigation, he shall forthwith recover or remove such obstructions. The contractor shall give immediate notice to the proper authorities of such obstructions and, if required, he shall, under the direction of the proper authorities, mark or buoy such obstructions until they are removed. Also, under no circumstances shall excavated material be deposited into the waterway without prior approval of the U.S. Coast Guard.

All operations in connection with the work shall be in accordance with the permits, instruments of approval and rules and regulations of the U.S. Coast Guard and any deviation therefrom shall be only by special permission which the contractor himself must obtain. Failure of the contractor to familiarize himself with all of the terms and conditions of permits, instruments of approval, rules and regulations, applicable to the work shall not relieve the contractor of his responsibility under the contract.

The contractor shall conduct his operations in such manner as to cause minimum interference with marine operations, however, if such interference is necessary, the contractor shall notify the Bridge Design Engineer sufficiently in advance of any interference in order that the Department may notify the U.S. Coast Guard at least 10 days prior to said interference.

Copies or certified transcripts of any special permits must be submitted immediately to the Bridge Design Engineer.

801.05 AIR NAVIGATION. In the event there are structures, or a structure, included in the work classified as a hazard to aerial navigation, the contractor shall prepare, on tracing cloth or approved reproducible drawings, drawings complying with the Federal Aviation Agency's current requirements for temporary lighting for the protection of aerial navigation. These drawings shall be submitted to the Bridge Design Engineer for review and transmittal to the Department of Transportation, Federal Aviation Agency, for approval. All operations in connection with the work for protection of aerial navigation shall be in accordance with the

approved drawings and applicable Federal regulations. Failure of the contractor to familiarize himself with all applicable rules and regulations of the Federal Aviation Agency will not relieve the contractor of his responsibility under the contract.

801.06 HAZARD ZONES. In the event any portion of the work is determined to be within a hazard zone because of aerial navigation, a high voltage powerline which is to remain or because of any other permanent facility deemed to constitute a similar hazard in performance of the work, the presence of such hazards will be noted on the plans or in the special provisions, to the extent that definite information can be obtained on these situations.

It shall be the responsibility of the contractor to arrange, with the agency concerned, for any adjustments relative to his work in the area. Any liability or expense of these arrangements shall be borne by the contractor.

The contractor shall obtain and submit to the Department, a release signed by the agency involved stating that the contractor has satisfactorily discharged his obligations under the terms of the arrangements or agreements involved.

All of this will be noted on the Department's Standard Release form and submitted, with required signatures, to the engineer.

Failure of the Department to determine the presence of any and all hazards and to so note on the plans or in the special provisions shall not relieve the contractor of performing the work in accordance with the project requirements and at contract unit prices.

Section 802

Structural Excavation and Backfill

802.01 DESCRIPTION. This work shall consist of the removal of all materials, of whatever nature, necessary for the construction of retaining walls, foundations and substructures. It shall include the furnishing of all necessary equipment and the construction of all cribs, cofferdams, caissons, dewatering, etc. which may be necessary for the execution of the work. It shall also include the subsequent removal of cofferdams and cribs and the placement of all necessary backfill as hereinafter specified. It shall also include the wasting of excavation material which is not required for backfill in a manner and in locations so as not to affect the carrying capacity of the channel and not be unsightly, all as directed by the Engineer. All work shall be performed in accordance with these specifications and in reasonably close conformity to the lines, grades and dimensions shown on the plans or established by the engineer.

CONSTRUCTION REQUIREMENTS

802.02 GENERAL. Compensation for all clearing and grubbing contained within the area defined by lines connecting the extremities of the substructure units, regardless of whether or not excavation is involved, shall, unless an item or items for clearing and grubbing are included in the contract, be included in the unit price bid for structural excavation.

All substructures, where practicable, shall be constructed in open excavation and, where necessary, the excavation shall be shored, braced or protected by cofferdams in accordance with approved methods. When footings can be placed in the dry without the use of cribs or cofferdams, backforms may be omitted with the approval of the engineer and the entire excavation filled with concrete to the required elevation of the top of the footing. The additional concrete required shall be placed at the expense of the contractor.

802.03 PRESERVATION OF CHANNEL. Unless other-

wise specified or permitted, no excavation shall be made outside of caissons, cribs, cofferdams, steel piling or sheeting, and the natural stream bed adjacent to the structure shall not be disturbed. If any excavation or dredging is made at the site of the structure before caissons, cribs or cofferdams are sunk or in place, the contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with satisfactory material. Material deposited within the stream area from foundation or other excavation or from the filling of cofferdams shall be removed and the stream area freed from obstruction thereby. The contractor's attention is also directed to Subsection 105.14.

802.04 DEPTH OF FOOTINGS. The elevation of the bottoms of footings, as shown on the plans, shall be considered as approximate only and the engineer may order, in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

802.05 PREPARATION OF FOUNDATIONS FOR FOOTINGS. All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped or roughened, as directed. All seams shall be cleaned out and filled with concrete, mortar or grout.

When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the concrete is to be placed.

802.06 COFFERDAMS AND CRIBS.

(a) General: Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for the proper performance of the work which must be done inside them. In general, the interior dimensions of cofferdams and cribs shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted, reset or enlarged so as to provide the

necessary clearance and this shall be at the sole expense of the contractor.

When conditions are encountered which render it impracticable to dewater the foundation before placing concrete, the engineer may require the construction of the concrete foundation seal of such dimensions as may be necessary. The foundation shall then be pumped out and the balance of the concrete placed in the dry. When weighted cribs are employed and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorages such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal and if the cofferdam is to remain in place, it shall be vented or ported at low water level.

(b) Protection of Concrete: Cofferdams or cribs shall be constructed so as to protect green concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure concrete, without written permission.

(c) Drawings Required: Drawings for substructure work shall be furnished in accordance with Subsection 801.03.

(d) Removal: Unless otherwise provided, cofferdams or cribs with all sheeting and bracing shall be removed after the completion of the substructure, care being taken not to disturb or otherwise injure the finished concrete. No sheet piling used as forms shall be removed prior to seven days after placement of concrete.

802.07 PUMPING. Pumping from the interior of any foundation enclosure shall be done in such manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping will be permitted during the placing of concrete or for a period of at least 24 hours thereafter unless it be done from a suitable sump separated from the concrete work by a watertight wall or other effective means.

Pumping to dewater a sealed cofferdam shall not begin until 7 days after placement of concrete seal unless otherwise directed by the engineer.

802.08 INSPECTION. After each excavation is completed, the contractor shall notify the engineer, and no concrete shall be placed until the engineer has approved the depth of the excavation and the character of the foundation material.

802.09 BACKFILL. All material used for backfill shall be of acceptable quality and shall be free from large or frozen lumps, wood, or other extraneous material.

(a) For backfilling cofferdams and cribs, all spaces excavated and not occupied by abutments, piers or other permanent work shall be refilled with earth up to the surface elevation of the surrounding ground in such a manner as to maintain approximately the same elevation on each side so as to avoid unbalanced pressure on the structure.

(b) Backfilling of Reinforced Concrete Box Culverts: The material and backfilling requirements for the backfilling of reinforced concrete box culverts and their attached headwalls shall be in accordance with Subsection 701.08 of Section 701 entitled Culverts and Storm Drains.

The contractor shall provide adequate earth cover over reinforced concrete box culverts before heavy construction equipment may cross the installation. The fill shall be approved by the engineer.

(c) The backfill around structures other than (a) and (b) above shall be deposited in horizontal layers not to exceed 9 inches in thickness (loose measurement) and compacted to the approximate density of the adjacent natural ground. The backfill in front of such units shall be placed first to prevent any wedging action against the concrete, and the slope bounding the excavation shall be stepped or roughened to prevent wedge action. Jetting of the backfill behind the abutments and wing walls will not be permitted.

(d) No backfill shall be placed against any concrete abutment, wing wall or reinforced concrete box culvert until the concrete has been in place 14 days, or until test cylinders show a compressive strength of 3000 psi as determined under Subsection 805.11, Method 1.

802.10 FILLED SPANDREL ARCHES. For filled spandrel arches, the filling shall be carefully placed in such manner as to load the ring uniformly and symmetrically. The filling material shall be acceptable and shall be placed in horizontal layers not to exceed 9 inches in thickness (loose measurement), carefully tamped and brought up simultaneously from both haunches. Wedge shaped sections of filling material against spandrels, wings or abutments will not be permitted.

802.11 APPROACH EMBANKMENTS. When the contract for any bridge structure requires the placement of approach embankments, they shall be constructed and paid for in accordance with the applicable requirements of Section 203.

802.12 CLASSIFICATION OF STRUCTURAL EXCAVATION. Classification, if any, will be indicated on the plans and set forth in the proposal.

802.13 METHOD OF MEASUREMENT. The quantity of structural excavation to be paid for shall be the actual number of cubic yards, measured in its original position, of the material acceptably excavated in conformity with the plans or as directed. No yardage shall be included in the measurement for payment which is outside of a volume bounded by vertical planes 18 inches outside of and parallel to the neat lines of the footing. The cross-sectional area measured shall not include water or other liquids but shall include mud, muck and other similar semi-solids. Measurements for intermediate bents or pier footings will be made on the basis of the depth taken from the elevation of the completed section or natural ground line, whichever is lower, for the pier or bent in question, to the bottom of the footing; however no payment will be made for material not actually excavated.

When it is necessary to carry the foundations below the elevations shown on the plans, the excavation for the first 2 feet of additional depth shall be included in the quantity for which payment will be made at the contract unit price for this item. Excavation below this additional 2-foot depth will be paid for at a price to be determined by multiplying the contract unit price for the item, by the following factors:

For footings or portions thereof lowered more than

2 feet but not more than 4 feet 1.25
For footings or portions thereof lowered more than 4 feet and not more than 6 feet 1.50
For footings or portions thereof lowered more than 6 feet and not more than 8 feet 1.75
For footings or portions thereof lowered more than 8 feet and not more than 10 feet 2.00
For footings lowered more than 10 feet, the quantities below such depth will be paid for as extra work.

Reinforced Concrete Box Culverts: The excavation of material for reinforced concrete box culverts and their attached headwalls will not be measured and payment will not be made.

When the contract does not contain a bid item for "Furnishing Backfill Material, Conduits," the excavation and backfill for reinforced concrete box culverts and their attached headwalls will not be measured and payment will not be made.

When the contract contains a bid item for "Furnishing Backfill Material, Conduits," for reinforced concrete box culverts with attached headwalls, the quantity to be paid for will be the number of cubic yards (net section) complete in place and accepted, measured in final position between the following lines.

(1) Measurement will include backfill material in the trench up to the top of the original ground line but will not include any material placed outside of vertical planes 18 inches outside of and parallel to the outside wall of the box culvert at its greatest horizontal dimension.

(2) When the original ground line is less than 1 foot above the top of the box culvert, the measurement will also include the placing of all backfill material above the original ground line adjacent to the box culvert for a height of 1 foot above top of box culvert and for a distance each side of the box culvert equal to the width of 1 barrel of the box culvert but not to exceed 12 feet.

802.14 BASIS OF PAYMENT. The accepted quantities of structural excavation will be paid for at the contract unit price per cubic yard. It shall include the cost of construction and removing cribs and cofferdams, unless other-

wise provided, and of removing any surplus material which may have been thrown up during the process of excavation and shall include all backfilling.

No payment will be made under this item for excavation for reinforced concrete box culverts or end bents of bridges; the cost of same unless otherwise provided shall be included in contract unit prices for the items that constitute the structure.

Reinforced Concrete Box Culverts: When the contract does not contain a bid item for "Furnishing Backfill Material, Conduits," for reinforced concrete box culverts, payment for this backfill material will be considered as included in the payment under the items that constitute the structure.

When an item for furnishing backfill material for reinforced concrete box culverts is provided by the plans, payment will be made under Item 701(22), Furnishing Backfill Material, Conduits, as listed under Subsection 701.10.

Payment will be made under:

Item No.	Pay Item	Pay Unit
802(1)	Structural Excavation	Cubic Yard
802(2)	Structural Excavation for Intermediate Bents	Cubic Yard
802(3)	Structural Excavation for Piers (Dry)	Cubic Yard
802(4)	Structural Excavation for Piers (Wet)	Cubic Yard

Section 803

Sheet Piles

803.01 DESCRIPTION. This work shall consist of furnishing and driving sheet piling of the type shown on the plans or in the special provisions and covers only sheet piling designated on the plans, or ordered by the engineer to be left in place to eventually become a part of the finished structure.

Sheet piling shall be one of the following types:

Timber Sheet Piles (Untreated)
Timber Sheet Piles (Treated)
Concrete Sheet Piles (Reinforced)
Concrete Sheet Piles (Prestressed)
Steel Sheet Piles

MATERIALS

803.02 TIMBER SHEET PILES.

(a) General: Timber sheet piles shall be untreated unless the plans or special provisions specifically provide for the use of treated timber. The piles shall be of the thickness specified or as directed and shall be provided with tongues and grooves of ample proportions, either cut from the solid material or made by building up the piles of 3 planks securely fastened together. The pile shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together during driving.

Hardware furnished shall be in accordance with the requirements of Section 812 and shall be galvanized unless otherwise indicated on the plans or in the special provisions.

(b) Untreated Timber Sheet Piles: The timber, unless otherwise definitely noted on the plans or in the special provisions to be in accordance with Section 812, may consist of any species which will satisfactorily stand driving. It shall be sawn or hewn with square corners and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions and other defects which might impair its strength or tightness.

(c) **Treated Timber Sheet Piles:** Treated timber may be either Southern Pine or Douglas Fir meeting the applicable requirements of Section 812. Timber shall be treated with creosote oil in conformity with the applicable requirements of Sections 812 and 914.

All cuts in treated timber and all abrasions after having been carefully trimmed shall be covered with 2 applications of a mixture of 60 percent creosote oil and 40 percent roofing pitch or brush coated with at least 2 applications of hot creosote oil and covered with hot roofing pitch.

803.03 CONCRETE SHEET PILES.

(a) **General:** Where conventionally reinforced or prestressed concrete sheet piles are required, they shall be fabricated in strict accordance with the detailed design. The requirements governing the manufacture and installation of concrete sheet piling shall conform, in general, to those governing precast-prestressed concrete bearing piles in Sections 804 and 805.

(b) **Concrete:** Concrete shall meet applicable requirements of Sections 805 and 901.

(c) **Reinforcing Steel:** Reinforcing steel shall be "Deformed Reinforcing Steel" meeting the applicable requirements of Section 806.

803.04 STEEL SHEET PILES. Steel sheet piles shall be of the type and weight indicated on the plans or designated in the special provisions conforming to the requirements of Subsection 913.12. All piling shall conform in other respects (tests, specimens, number of tests, finish, marking and inspection) to the requirements of Section 807.

803.05 PAINT. Any paint required for sheet pile shall conform to applicable requirements of Sections 811 and 908.

CONSTRUCTION REQUIREMENTS

803.06 DRIVING SHEET PILES. Sheet piles shall be driven with adequate hammers as necessary to drive the piles to the required depth in satisfactory condition.

In order to maintain satisfactory alignment, the sheet piles shall be driven in such increments of penetration as may be found necessary to prevent distortion, twisting out

of position or pulling apart at the interlocks. To facilitate closure, it may be advantageous to set up the piles for a complete length of wall before initial driving; the piles thus set up, then can be progressively driven in short increments of penetration.

803.07 JETTING SHEET PILES.

(a) The use of jets will not be permitted at locations where the stability of embankments or other improvements would be endangered.

(b) In case it is necessary, to obtain the penetration desired, the contractor may supply and operate one or more high pressure water jetting systems to erode the material adjacent to the pile and thereby facilitate driving the sheet piles. The pumping capacity provided shall deliver a minimum of 150 psi pressure at each jet nozzle.

(c) The jetting may be done ahead of the actual driving operation or simultaneously with the driving operation. If jets and hammer are used simultaneously, the jets shall be withdrawn and the final penetration of the sheet pile obtained by driving with the hammer alone for at least the last foot of penetration.

(d) Payment for jetting sheet piles will not be made unless so designated on the plans or in the proposal.

803.08 CUT-OFFS.

(a) The tops of sheet piling shall be cut-off or driven down to a straight line at the elevation indicated on the plans or as directed.

(b) If the heads of the sheet piles are appreciably distorted or otherwise damaged below cut-off level, the damaged portions shall be removed and replaced at the contractor's expense.

(c) The tops of all timber sheet piles, after cut-off, shall be brush-coated with 2 applications of a mixture of 60 percent creosote oil and 40 percent roofing pitch after which a cover of 20 gage galvanized iron sheeting, 6 inches wider than the overall thickness of the sheet piles, shall be bent down at least 3 inches on each side and nailed to the vertical surface of the sheet piles with large headed galvanized roofing nails.

(d) Any sheet pile damaged during driving by reason of internal defects or improper driving or which is driven

either out of its proper position or below cut-off elevation shall be withdrawn and replaced with a new pile at the contractor's expense.

803.09 PAINTING. Before driving, the surfaces of steel sheet piling, to be backfilled or immersed, shall have both the immersed and backfilled surfaces satisfactorily cleaned and painted with 2 coats of approved bitumastic paint from a point 10 feet below stream bed to a point 2 feet below cut-off level for backfilled areas and 2 feet above low water or higher at the discretion of the engineer for these areas to be immersed. However, after driving, the entire surface of the sheet piling exposed to view in bulkheads and retaining walls from a point 2 feet above low water or from a point 2 feet below ground surface to cut-off level or bottom of concrete cap, as the case may be, shall be satisfactorily cleaned and given the first, second and third field coats of paint in accordance with Subsection 811.03.

803.10 METHOD OF MEASUREMENT. Timber, concrete and steel sheet pile wall shall be measured by the square foot of wall complete in place and accepted.

803.11 BASIS OF PAYMENT. The number of square feet of timber, concrete or steel sheet pile wall shall be paid for at the contract unit price complete in place and accepted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
803(1)	Untreated Timber Sheet Pile Wall	Square Foot
803(2)	Treated Timber Sheet Pile Wall	Square Foot
803(3)	Concrete Sheet Pile Wall	Square Foot
803(4)	Steel Sheet Pile Wall	Square Foot

Section 804

Bearing Piles

804.01 DESCRIPTION. This work shall consist of furnishing and driving piles of the kind and size designated, to the required penetration in accordance with these specifications and in reasonable close conformity with the lines and spacings shown on the plans or established by the engineer.

804.02 MATERIALS.

(a) Precast Concrete Piles: Materials for precast concrete piles shall conform to the applicable requirements of Sections 901 and 909.

(b) Cast-In-Place Concrete Piles: The steel in the shell or pipe shall conform to the requirements of Subsection 907.05, or to other shells as shown on the plans or in the special provisions. Concrete for cast-in-place concrete piles shall be Class "A", conforming with the applicable requirements of Section 901. Reinforcing steel shall conform to the applicable requirements of Section 909.

Unless otherwise specified the steel pipe piles shall conform to ASTM Designation: A 252, Grade 2.

(c) Timber Piles: Timber piles, treated or untreated, shall conform to the applicable requirements of Section 914.

(d) Steel Bearing Piles: Steel bearing piles shall consist of structural steel shapes of the section specified. The steel shall conform to the applicable requirements of Section 913.

CONSTRUCTION REQUIREMENTS

804.03 PREPARATION FOR DRIVING.

(a) Excavation: In general, piles shall not be driven until after the excavation is complete. Any material forced up between the piles shall be removed to correct elevation without cost to the Department before concrete for the foundation is placed.

(b) Embankment: Unless otherwise specified or shown

on the plans, the embankment at bridge ends shall be constructed and thoroughly compacted as provided for in Subsection 203.10, prior to driving the piles affected.

(c) Driving Caps: When the nature of driving is such that requires protection for heads of concrete and timber piles, the pile driving heads shall be cushioned by an approved cap. The approved cap shall have a rope or other suitable cushion next to the pile head and fitting into a casting which supports a timber shock block. When the area of the head of any timber pile is greater than that of the face of the hammer, a suitable cap shall be provided to distribute the blow of the hammer throughout the cross section of the pile.

Special driving heads, mandrels or other devices (in accordance with the manufacturer's recommendations) shall be provided for special types of piling so that the pile may be driven without injury.

For steel piling, the heads shall be cut squarely. A driving cap shall be provided during the driving sequence to hold the axis of the pile in line with the axis of the hammer.

(d) Collars: Collars, bands or other approved devices to protect timber piles against splitting or brooming shall be provided where necessary or as required by the engineer.

(e) Pointing: Timber piles or steel bearing piles shall be pointed where soil conditions require. The pointing shall be as approved by the engineer.

(f) Splicing Piles:

(1) Precast concrete piles shall be furnished and driven in full lengths. Driving after splicing will not be permitted.

(2) Cast-in-Place concrete pile shells may be field spliced, but sections which in the opinion of the engineer are too short shall not be used. Field splices of shell sections shall be made in accordance with the manufacturer's recommendations and to the satisfaction of the engineer. Welding, where used, shall conform to the applicable requirements of Section 807, except that the prequalification test for field welders will not be required unless specifically directed by the engineer.

(3) Steel bearing piles shall be furnished and driven in full lengths unless splices are specified or authorized. When authorized, splices shall be limited to not more than 2 per pile. Splicing of steel bearing piles shall be made by welding in accordance with the applicable requirements of Section 807.

(4) Timber piles shall be furnished and driven full length where practicable. Splicing of timber piles may be made only by written permission of the engineer and in accordance with the splicing detail furnished or approved by the engineer.

(g) Painting of Piling: Unless otherwise specified, foundation piling, either of steel or the steel shells of cast-in-place concrete piles, shall not be painted.

That area of steel piles, or the exterior surface of the steel shell of cast-in-place concrete piles, extending above the ground line or stream bed shall be satisfactorily cleaned and shall be protected with two coats of an approved bitumastic paint.

The approved bitumastic paint shall be applied in conformance with the manufacturer's recommendations.

(h) Transportation of Precast Concrete Piling: Precast-prestressed concrete piles may be transported provided the piles are supported at each of the pick-up points as shown on the plans for the particular lengths of piling. The supports shall not be more than one foot from the theoretical position of each support, nor shall the distance between the two supports be more than one foot from the theoretical required distance between supports, unless otherwise approved by the engineer.

(i) Supporting Holes for Piles: Piles may be set in supporting holes but in no case shall the depth of the holes be more than 5 feet for piles up to 50 feet in length, or more than 10 percent of the designated penetration of the piles for piles over 50 feet in length. If additional support is required, templates or falsework above the ground shall be furnished. After the piles are driven, such supporting holes shall be backfilled to the level of the finished ground or base of footing, as the case may be, with an approved granular material.

804.04 METHODS OF DRIVING.

(a) Description: Piles shall be driven with an approved type hammer that will obtain the required penetration without damaging the piles, except that gravity hammers will be permitted only when driving timber piles. The minimum energy to be developed by the hammer used shall be as shown for the various types of piles listed hereunder. One of the conditions of approval for a type of hammer proposed shall be that the pile capacity can be determined under the hammer by an acceptable formula.

(b) Hammers for Timber Piles: Gravity hammers for driving timber piles shall weigh not less than 2,000 pounds, preferably 3,000 pounds, but in no case shall the weight of the hammer be less than the combined weight of driving head and pile. The fall shall be so regulated as to avoid injury to the piles and in no case shall it exceed 15 feet. When timber piles are driven with steam, air or diesel hammers, either single or double acting, the total energy developed by the hammer shall not be less than 9,000 nor more than 15,000 foot-pounds per blow.

(c) Hammers for Concrete Piles: Unless otherwise provided, precast concrete piles or shells for cast-in-place concrete piles will be driven with an approved hammer which shall develop an energy at each full stroke of the piston of not less than 1 foot-pound for each pound of weight driven. In no case shall the total energy developed by the hammer be less than 15,000 foot-pounds per blow.

(d) Hammers for Steel Piles: Unless otherwise provided, steel piles will be driven with an approved hammer developing an energy of not less than 1 foot-pound for each pound of weight driven. The minimum energy shall be developed at each full stroke of the piston. The total energy developed by the hammer shall be no less than 15,000 foot-pounds per blow.

(e) Additional Equipment: In case the required penetration of the pile is not obtained by the use of a hammer complying with the above requirements, the contractor shall, with approval of the engineer, resort to one or both of the following listed methods in combination with the hammer.

1. Use pilot holes.

2. Use water jets.

(f) Leads, Templates or a Combination Thereof: Equipment shall be constructed in such manner as to afford freedom of movement of the hammer and to drive piles to the tolerances specified without injury to the piles. Either fixed leads or swinging leads may be used. Swinging leads, when used, shall be in combination with a rigid template which provides pile support that meets the approval of the engineer. Inclined leads shall be used in driving batter piles.

(g) Followers and Underwater Hammers: The use of followers or underwater hammers for driving piling shall be permitted by written approval of the engineer. When a follower or underwater hammer is used, 1 pile in each group of 10 shall be furnished sufficiently long to permit being driven without a follower or underwater hammer and shall be used as a test pile to determine the average bearing power of the group. Test piles so designated will not be classified as such nor will any payment be made for load tests.

(h) Pilot Holes: Pilot holes required or permitted during driving of permanent piles shall be bored or dug to sufficient size and depth to permit pile penetration into hard soil. In general, pilot holes shall have a diameter equal to ⅔ the face width of a square pile or ⅔ the average diameter of a round pile but shall, however, be of a size which will provide the desired results. The pile will then be driven to the required penetration and bearing capacity.

In no case shall the pilot hole extend to within 5 feet of the tip elevation of the pile.

(i) Pilot Holes in Embankments: Where specified, pilot holes shall be used in embankments. In general, pilot holes shall have a diameter 4 inches greater than the diagonal of a square piling and 6 inches greater than the diameter of a round piling. The depth of the pilot hole shall be equal to the embankment height. The pile will then be placed within the pilot hole and driven to the required penetration and bearing capacity. The annular space around the pile shall be filled with sand or pea gravel at the contractor's expense.

(j) Water Jets: When water jets are required or allowed, the number and size of jets and the volume and pressure of water at the jet nozzles shall be sufficient to erode the material adjacent to the pile. The pump shall have sufficient capacity to deliver at all times at least 150 pounds per square inch pressure at two ¾-inch jet nozzles. Before the desired penetration is reached, the jets shall be withdrawn and the piles shall be driven with the hammer to secure the final penetration. Jetting shall not be permitted within 5 feet of the tip elevation of the pile. The use of jets where the stability of embankments or other improvements would be endangered will not be permitted.

(k) Accuracy of Driving: All piles shall be driven at locations as shown on the plans or as ordered in writing by the engineer. The centroid of the pile (for pile bents) at cut-off elevation, having the plan location as its center, shall be within a 6 inch diameter circle. For foundation piling, the centroid of any pile at cut-off shall be within a 12 inch diameter circle having the plan location as its center.

(l) Interrupted Driving: When driving is interrupted before the pile reaches final penetration, the record for resistance shall not be taken until after at least 12 inches of penetration has been obtained after driving is resumed.

(m) Extent of Driving: Driving shall be continued until plan cut-off is reached or until a satisfactory depth of penetration or resistance is obtained. If desired resistance to driving is not obtained at plan cut-off, the driving shall be continued and the additional length of pile required shall be supplied by splicing. Precast concrete piling shall not be redriven after extending.

804.05 CAST-IN-PLACE CONCRETE PILES. Cast-in-place concrete piles shall be steel encased. Steel casings or shells shall be of the diameter and type shown on the plans or in the special provisions. After the shells are driven to the required penetration and any required reinforcing steel is placed the shells shall be filled with concrete, subsequent to their inspection and approval. The contractor shall provide a suitable light for the inspection of each shell after it has been driven to the required penetration. The shell shall

be cleaned of all debris and pumped dry before placing concrete.

Class A Concrete conforming to the requirements of Section 901 shall be placed in the shell. The concrete shall be handled by an approved method and in such a manner as to prevent segregation. All piles shall be filled with concrete to the cut-off elevation. Reinforcing steel, when required, shall be of the size and spacing shown on the plans and shall be securely fastened together so as to form a rigid cage. Care shall be taken to hold the reinforcement in true relative position during the filling of the piles. Concrete blocks or suitable devices may be used to prevent the displacement of the reinforcement cage. Concrete in the shell shall be vibrated from the lower end of the reinforcing cage to the top of the pile. When reinforcing steel is not required, concrete in the top 10 feet of the shell shall be vibrated. Driving of additional piles within a radius of 10 feet of a completed pile will not be permitted until the concrete has been allowed to set for at least 36 hours.

The shells for the cast-in-place concrete piles shall be of sufficient thickness and strength so that the shell will hold its original form and show no harmful distortion after it has been driven, and the driving mandrel, if any, has been withdrawn. It shall be the contractor's responsibility to determine the wall thickness of shell required.

804.06 DEFECTIVE PILES. The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing cracking, crushing or spalling of the concrete, injurious splitting, splintering and brooming of the wood or deformation of the steel. Manipulation of concrete piles to force them into proper position will not be permitted. Any pile found to be unacceptable due to internal defects, by improper driving, driven out of its proper location, driven below the elevation fixed by the plans or by the engineer shall be corrected at the contractor's expense by one of the following methods approved by the engineer for the pile in question:

1. The pile shall be withdrawn and replaced by a new and, if necessary, a longer pile.

2. A second pile shall be driven adjacent to the defective pile.

3. The pile shall be spliced or built up as otherwise pro-

vided herein or a sufficient portion of the footing extended to embed the pile. Timber piles shall not be spliced without specific permission of the engineer. All piles pushed up by the driving of adjacent piles or by any other cause shall be redriven to the desired elevation.

4. The cap or footing shall be redesigned at no cost to the Department and shall be approved by the engineer. Additional compensation will not be allowed the contractor for increased quantities in a bent or footing due to driving additional pile or piles to correct a defective pile or piles.

804.07 DETERMINING PILE BEARING CAPACITY.

(a) General: A pile's bearing capacity may be determined, normally, by comparing penetration, bearing values (theoretical), loading conditions and soil borings with similar conditions known from a representative test pile, previously driven. Where results are obtained through variation in soil conditions and other factors which makes the pile bearing capacity questionable or does not offer a ready comparison to available information, test loading shall be required. The test shall consist of applying a static test load placed upon a suitable platform supported by the pile. The platform must be equipped to accurately measure the test load and the settlement of the pile under each increment of load. In lieu thereof, hydraulic jacks with suitable yokes and pressure gauges may be used.

The test load shall be applied in the various increments as specified. If hydraulic jacks are used to apply the load, they will be calibrated by the Department's laboratory provided the transporting of the jacks to and from the laboratory is furnished by the contractor and, further, that the laboratory has the necessary equipment to conduct the tests; otherwise the contractor shall have the jacks calibrated by a reputable commercial laboratory, in which case certified laboratory reports of the calibration tests shall be furnished to the Department laboratory.

(b) When required, the contractor shall make load tests for the purpose of determining the bearing capacity of piling. Unless otherwise provided, anchor piles shall be at least 5 feet from the test pile.

The contractor shall submit to the engineer, for approval, his proposed method to test load the required piles.

804.08 PILE LOAD TEST. The test piles, after being driven to the required penetration, shall be allowed to stand undisturbed for a period of 7 days or as provided on the plans or in the special provisions before beginning loading operations.

The first increment of load to be placed on the test pile shall be the pile design load. The load on the pile shall then be increased to twice the design load by adding an additional load in 3 equal increments. A period of 6 hours shall intervene between each increment of load, except that in the event that the pile is still settling at the end of the 6 hour period, the interval may be extended at the discretion of the engineer.

When loading increments have reached twice the design load, either Method 1 or Method 2 shall apply as applicable.

Method 1: Upon attaining twice the Design Load on the pile and finding no settlement in the pile, this load shall remain on the pile for a period of 30 hours. Should no settlement be found, then loading shall continue until a gross settlement of ¼ inch or 2½ times the design load is reached with 2½ times the design load being no greater than a maximum of 250 tons.

Method 2: Upon attaining twice the design load on the pile or upon finding a gross settlement of ¼ inch in the pile, if this should occur before the loading is complete up to twice the design load, the loading shall be halted and the pile allowed to stand under this load for a period of 48 hours. At the end of the 48-hour period, providing there has been no settlement during the last 24 hours, the load shall be removed and the pile allowed to stand for 6 hours without any load. However, should settlement continue into the second 24-hour period, the load shall remain in place a sufficient length of time beyond the expiration of the 48 hours to show that the test load does not cause further settlement during the final 24-hour period. The load shall then be removed and the pile allowed to stand for 6 hours without any load. Readings shall then be taken to determine the amount of rebound and the net settlement.

The safe allowable load of any pile so tested shall be considered equal to ½ that load which does not cause a greater permanent settlement than ¼ inch, measured at the

top of the pile, after a minimum of 48 hours load application, the last 24 hours of which shall be without any increase in settlement.

After completion of the 48-hour test, twice the pile design load shall be replaced on the pile as the first increment and loading continued by increments as described above or as specified in the special provision until a total settlement of 1 inch has been exceeded or a total of 2½ times the design load has been applied with 2½ times the design load being no greater than a maximum of 250 tons.

(a) Pile Formulas: If the safe bearing capacity of piles is to be determined by formulas, the following shall be used as a guide:

$$P = \frac{2WH}{S + 1.0} \text{ for gravity hammers,}$$

$$P = \frac{2WH}{S + 0.1} \text{ for single-acting steam or air hammers,}$$

Where

P = safe bearing power in pounds,
W = weight in pounds of striking parts of hammer,
H = height of fall in feet,
S = the average penetration in inches per blow for the foot involved on test pile and/or the last foot on permanent piling.

The above formulas are applicable only when:

(1) The hammer has a free fall.
(2) The head of the pile is not broomed or crushed.
(3) The penetration is reasonably quick and uniform.
(4) There is no appreciable bounce after the flow.
(5) A follower is not used.

Twice the height of the bounce shall be deducted from "H" to determine its value in the formula.

Diesel hammers will be permitted. The formula applicable to this type hammer, approved for use, will be developed on construction.

804.09 TEST PILES.

(a) When required, the contractor shall drive test piles of the length, number, size and type specified at the location and penetration shown on the plans or as directed. When an item for jetting piles is specified, jetting equip-

ment shall be provided at test sites prior to driving test piles.

In case water jets are required or allowed in connection with the driving, the bearing capacity will be determined by the applicable formulas from the results obtained by driving after the jets have been withdrawn or by static load testing in accordance with Subsection 804.08.

Test piles shall be driven using the same energy, methods and procedures as intended for permanent piles.

(b) When test piles are driven to determine the length of foundation piles required, it will be necessary to excavate a hole from the natural ground to the elevation of the bottom of footing and to keep this hole open during the driving and loading of the test piles so that the driving and loading conditions will be representative of actual conditions of load on the permanent piles. In lieu of the above, the contractor will be permitted to drive the test pile within an approved casing. The casing shall extend to the bottom of the footing or to the elevation on the plans. The contractor shall, at his own expense, provide any bracing of the test pile that may be required during the loading or driving operations.

(c) Unless otherwise provided, cast-in-place concrete test piles shall be filled with concrete in accordance with Subsection 804.05 and the concrete allowed to set for at least 48 hours before the first increment of test load is applied.

(d) The plans or the special provisions will designate whether or not permanent piles are to serve as test piles. Should a permanent pile, so designated, fail under the test load, and should redriving or redriving and reloading be specified or required, the following considerations shall apply:

1. Precast concrete piles shall not be spliced and redriven. If directed by the engineer, the contractor shall remove the failing pile and shall drive a new test pile to the designated depth at the approved location.

2. Steel bearing piles shall have an additional length spliced, if necessary, and the pile redriven to such further depth as may be directed.

3. Timber piles shall not be spliced and redriven. If

directed by the engineer, the contractor shall remove the failing pile and shall drive a new test pile to the designated depth at the approved location.

4. Cast-in-place concrete piles shall not be redriven except by written permission. If ordered, the contractor will drive a new test pile to the designated depth and at the designated location.

(e) If test piles are not to be utilized as permanent piles, they shall be removed to a minimum of one foot below natural ground or stream bed and disposed of as directed.

(f) In the event permanent piles are used for anchor piles, the permanent pile will be no lower than the tip elevation of the test pile and, after completion of test pile installation, the permanent pile shall be reseated.

804.10 ORDER LISTS FOR PILING. The contractor shall furnish piles in accordance with an itemized list, which will be furnished by the engineer, showing the number, size, length and location of all permanent piles. No permanent piles shall be driven prior to receipt of this order list. In determining lengths of piles for ordering and for footage to be included in the contract, the lengths given in the order list shall be based on the lengths which are assumed to remain in the completed structure. The contractor shall, at his own expense, increase the lengths given to provide for fresh heading and for such additional length as may be necessary to suit the contractor's method of operation. The order length may be revised by the engineer when actual driving conditions deviate from test pile results.

804.11 EXTENSION OF PRECAST CONCRETE PILES. The plans show the length of reinforcing steel to be exposed and the additional size and number of reinforcing bars to be spliced where pile extensions are required. The final cut of the concrete shall be perpendicular to the axis of the pile. The concrete shall be of the same quality as that used in the pile. Just prior to placing concrete, the top of the pile shall be thoroughly wet and covered with a thin coating of neat cement or other suitable bonding material. All materials used shall conform to the applicable requirements of Sections 901 and 909.

804.12 CUT-OFFS.

(a) Precast Concrete Piles: Cut-offs for precast concrete

piles shall be made perpendicular to the axis of the pile at the elevation shown on the plans or as directed. Generally the cut-off elevation will be set so as to permit the body of the pile to project at least 6 inches into the footing or cap. Care shall be exercised to avoid unnecessary spalling of the concrete. The reinforcement thus exposed shall remain to engage the body of the footing or cap as the case may be.

(b) Steel Bearing Piles: Steel bearing piles shall be cut off at right angles to the axis of the pile and to the elevation shown on the plans or as directed. The cuts shall be made in clean straight lines and any irregularity due to cutting or burning shall be corrected by deposits of weld material prior to placing bearing caps, should such be required.

(c) Timber Piles:

(1) The tops of timber piling which support concrete footings or concrete caps shall be sawed off at right angles to their axis at the elevation shown on the plans or as directed by the engineer.

(2) Piles which support timber caps shall be sawed to a horizontal plane, or to the slope specified, in such manner as to fit the superimposed structure.

(3) The treatment of pile heads shall conform to the applicable requirements of Section 812.

(d) Cast-in-place Concrete Piles: When pile shells are fully driven, inspected and approved, they shall be neatly cut off at right angles to the axis of the pile at the required cut-off elevation.

804.13 METHOD OF MEASUREMENT.

(a) Piling: Piling driven in the locations designated on the plans will be measured by the linear foot of pile, complete in place, below cut-off elevation. This measurement will include the redriving of permanent piles that are used for anchor piles in accordance with Subsection 804.09.

(b) Cut-offs: Cut-offs made as directed, will be measured by the linear foot. Payment will not be made for the cut-off of any pile unless the length of such cut-off is in excess of one linear foot, nor will payment for cut-offs be made where they have been necessitated by crushing,

brooming, splitting or other injuries resulting from careless driving.

No payment will be made for required cut-offs of steel bearing piling and cast-in-place concrete pile shells; such cut-offs will remain the property of the contractor.

(c) Extensions (Including test piles): Measurement of extensions on precast concrete piles will be made by the linear foot, complete in place and accepted. Measurement will be made as follows: the length of cut-back on the ordered length of pile will be added to the net length of extension to obtain the gross length of extension; the gross length of extension will then be multiplied by 2 to determine the quantity for measurement, which measurement shall include any additional driving required. This additional driving includes any moving back and redriving of permanent piles as directed by the engineer. No deduction will be made from the ordered length of pile driven due to cut-back for splicing.

Measurement of extensions on all other types of piles will be made by the linear foot complete in place, and accepted for that portion of the pile added to the original length of pile driven, which measurement shall include any additional driving that may be required.

No measurement will be made for extensions necessitated by damage to the pile during driving.

(d) Redriving Test Piles: The purpose of this item is to provide compensation for moving back and setting up to redrive a test pile which had been previously driven, if ordered to do so by the engineer. Redriving of test piles shall be measured for each test pile for which redriving is required. In addition to the payment per pile redriven as provided for in this item, payment will be made for extensions as provided in paragraph (c) above.

(e) Splices:

(1) Concrete Piles: Splices for precast concrete piles will not be measured as a splice.

(2) Timber Piles: Measurement of splices on timber piles shall be by the linear foot. The total number of linear feet of piling driven shall be determined by adding 10 feet to the net length of piling for each splice in place in the finished structure. No measurement will

be made for splices except those made at the direction and under the supervision of the engineer.

(3) Steel Bearing Piles: Measurement of splices on steel bearing piles will be made by the linear foot. The total number of linear feet of piling driven shall be determined by adding 2 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made at the direction and under the supervision of the engineer.

(4) Cast-in-place Concrete Piles: Splices for cast-in-place concrete piles will not be measured as a splice.

(f) Jetting: The number of jetted piles to be paid for shall be the number of individual piles of any type jetted as directed.

(g) Unloaded Test Piles: The number of test piles to be paid for shall be the number of individual piles of each type furnished and driven as directed. Cut-offs of test piles shall not be included in any pay footage. Test piles pulled and re-used as permanent piles shall be measured as provided above under paragraph (a).

(h) Loading Test Piles: The number of load tests to be paid for shall be the number of load tests ordered and completed.

(i) Reloading Test Piles: The number of reload tests to be paid for shall be the number of reload tests ordered and completed.

(j) Pilot Holes: The number of pilot holes to be paid for shall be the number of holes completed as ordered.

(k) Pilot Holes in Embankments: The number of pilot holes in embankments to be paid for shall be the number of holes completed as ordered.

(l) Loading Permanent Piles: The number of load tests to be paid for shall be the number of load tests made as directed by the engineer, completed and accepted.

804.14 BASIS OF PAYMENT.

(a) Piling: The number of linear feet of completed and accepted piling, measured as provided above, shall be paid for at the contract unit price per linear foot for "Precast Concrete Piles," "Steel Bearing Piles," "Untreated Timber Piles," "Treated Timber Piles" or "Cast-

in-Place Concrete Piles," as the case may be. This price shall include all materials, labor and incidentals required for bolting, wrapping or fastening timber fender piles and shall include the cost of driving batter piles specified on the plans and shall include the Class A concrete and reinforcing steel in Class A concrete and reinforcing steel in cast-in-place concrete piles. This price shall also include the redriving of permanent piles that are used for anchor piles.

(b) Cut-Offs: Payment for cut-offs, measured as provided above, shall be made at the rate of ½ the contract unit price per linear foot for the particular type of pile which has been cut off.

(c) Extensions (Including Test Piles): Payment for extensions shall be made at the contract unit price per linear foot for the type and size of pile being extended, measured as provided above.

(d) Splices: Payment for splices, measured as provided above, shall be made at the contract unit price per linear foot for the particular type of pile spliced.

(e) Jetting: Payment for jetting piles, measured as provided above, shall be made at the contract unit price per pile jetted.

(f) Unloaded Test Piles: Unloaded test piles, completed and accepted, will be paid for at the contract unit price per each.

(g) Loading Test Piles: Loading test piles, completed and accepted, will be paid for at the contract unit price per each.

(h) Reloading Test Piles: Reloading test piles, completed and accepted, will be paid for at the contract unit price per each.

(i) Loading Permanent Piles: Loading permanent piles, completed and accepted, will be paid for at the contract unit price per each.

(j) Pilot Holes: Payment for pilot holes shall be made at the contract unit price for each hole completed and accepted.

(k) Pilot Holes in Embankments: Payment for pilot holes in embankments will be made at the contract unit price for each hole completed and accepted.

(l) Redriving Test Piles: The number of test piles, redriven and accepted, will be paid for at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
804(1)	Precast Concrete Piles (Size)	Linear Foot
804(2)	Untreated Timber Piles	Linear Foot
804(3)	Treated Timber Piles	Linear Foot
804(4)	Steel Bearing Piles (Size)	Linear Foot
804(5)	Cast-in-Place Concrete Piles (Size)	Linear Foot
804(6)	Jetting Piles	Each
804(7)	Unloaded Concrete Test Piles	Each
804(8)	Unloaded Timber Test Piles	Each
804(9)	Unloaded Steel Bearing Test Piles	Each
804(10)	Unloaded Cast-in-Place Concrete Test Piles	Each
804(11)	Loading Test Piles	Each
804(12)	Reloading Test Piles	Each
804(13)	Pilot Holes	Each
804(14)	Pilot Holes in Embankment	Each
804(15)	Redriving Test Piles	Each
804(16)	Loading Permanent Piles	Each

Section 805

Structural Concrete

805.01 DESCRIPTION. This work shall consist of furnishing and placing Portland Cement concrete masonry for culverts, bridges and incidental construction in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions as shown on the plans or established by the engineer.

805.02 MATERIALS. Materials shall meet the requirements specified in the following Section or Subsection Part IX, Materials.

Portland Cement Concrete	901
Adhesives	911.04
Reinforcing Steel	909
Joint Sealers	905.01, 905.02
Joint Fillers	905.03
Neoprene Bridge Bearing Pads	915.19
Curing Materials	911.01
Special Surface Finish Materials	911.05

CONSTRUCTION REQUIREMENTS

805.03 CLASSES OF CONCRETE. Each class of concrete shall be used in that part of the structure where called for on the plans or when designated. The following requirements shall govern unless otherwise shown on the plans or special provisions.

Class A concrete shall be used except where another class is stipulated on the plans or special provisions.

Class D concrete shall be used for pier footings and for unreinforced sections as required by the plans or special provisions.

Class P concrete shall be used for precast-prestressed bridge members.

Class R concrete shall be used for revetments and for other unreinforced sections, as required by the plans or special provisions.

Class S concrete shall be used for all sections deposited

under water, when so stipulated on the plans or in the special provisions.

Class W concrete shall be used for precast-prestressed piles in lieu of Class P concrete when such an option is allowed on the plans or in the special provisions.

Class X concrete shall be used for nonprestressed precast bridge members in lieu of Class P concrete when such an option is allowed by the plans and special provisions.

Class Y concrete which shall require the addition of an air-entraining admixture and a water reducing admixture, shall be used for all parts of superstructures as required by the plans or special provisions.

805.04 HANDLING AND PLACING CONCRETE.

(a) General: In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not encased in the concrete.

No concrete shall be used which does not reach its final position in the forms within the time stipulated under Subsection 901.12.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization of the engineer. In case an inferior quality of concrete is produced by the use of such devices, the engineer may order discontinuance of their use and the institution of a satisfactory method of placing.

Unless otherwise permitted, open troughs and chutes shall be of metal or metal-lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement of the concrete.

All chutes, troughs and pipes shall be kept clean and free

from coatings of hardened concrete by thoroughly flushing with water after each pour; water used for flushing shall not be discharged within the structure. No aluminum alloy material will be allowed.

When placing operations would involve dropping the concrete more than 5 feet, it shall be deposited through sheet metal or other approved tremie except where deemed impractical by the engineer. After initial set of the concrete the forms shall not be jarred; no strain shall be placed on the ends of reinforcement bars which project from freshly poured concrete.

Concrete, during and immediately after depositing, shall be thoroughly consolidated. The consolidation shall be done by mechanical vibration subject to the following provisions:

(1) The vibration shall be internal unless special authorization of other methods is obtained or as provided herein.

(2) Vibrators shall be of an approved type and design. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4500 impulses per minute.

(3) The contractor shall provide a sufficient number of vibrators to properly consolidate each concrete batch immediately after it is placed in the forms.

(4) Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into the corners and angles of the forms.

Vibrators shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

(5) Vibration shall not be applied indirectly or through

the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation. Vibrators shall not be used to transport concrete in the forms.

(6) Vibration shall be supplemented by such spading as is necessary to insure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

(7) The provisions of this subsection shall apply to filler concrete for steel grid floor except that the vibrator shall be applied to the steel.

(8) The provisions of this subsection shall apply to precast piling, concrete cribbing and other precast members except that, if approved, the manufacturer's methods of vibration may be used.

Concrete shall be placed in horizontal layers. The maximum depth of the horizontal layers shall be determined by the engineer. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding layer has taken initial set.

The concrete, between pours, shall be cleaned of surface laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid irregular joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be finished to a 2-inch grade strip. Where a "featheredge" might be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick, in which case, if permitted, the construction joint may be made at the under site of the coping.

Immediately following the discontinuance of placing

concrete all accumulations of mortar splashed upon the reinforcement steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be mixed in the fresh concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel-bond while cleaning the reinforcement steel.

(b) Reinforced Concrete Box Culvert: In general, the base slab or footings of a box culvert shall be placed and allowed to set before the remainder of the culvert is constructed. Suitable provisions shall be made for bonding the sidewalls to the culvert base by means of raised longitudinal keys so constructed as to prevent, or retard, the percolation of water through the construction joint.

Before concrete is placed in the sidewalls, joint surfaces shall be thoroughly cleaned of all shavings, sticks, sawdust or other extraneous material and the surface carefully chipped and roughened in accordance with the method bonding construction joints as specified in Subsection 805.08.

In the construction of box culverts 4 feet or less in height, the sidewalls and top slab may be constructed as a monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.

In the construction of box culverts more than 4 feet in height, the concrete in the walls shall be placed and allowed to set in accordance with strength or curing time requirements of Subsection 805.11 before the top slab is placed. In this case, appropriate keys shall be provided in the sidewalls for anchoring the top slab.

Each wing wall shall be constructed, if possible, as a monolith. Construction joints where required, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

(c) Girders, Slabs and Columns: Concrete, in girders and slabs shall be deposited by beginning at the center of the span and working from the center toward the ends. Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers.

Concrete in girder haunches less than 3 feet in height shall be placed at the same time as that in the girder stem, and the column or abutment tops shall be cut back to form seats for the haunches. Whenever any haunch of fillet has a vertical height of 3 feet or more, the abutment or columns, the haunch and the girder shall be placed in 3 successive stages; first, up to the lower side of the haunch; second, to the lower side of the girder; and third, to completion.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

The floors and girders of through girder superstructures shall be placed in one continuous operation unless otherwise specified, in which case, special shear anchorage shall be provided to insure monolithic action between girder and floor.

Concrete in T-beam or deck girder spans may be placed in one continuous operation or may be placed in 2 separate operations, each of which shall be continuous; first, to the top of the girder stems; and second, to completion. In the latter case, the bond between stem and slab shall be positive and mechanical and shall be secured by means of suitable shear keys in the tip of the girder stem. The size and location of these keys shall be computed. In general, suitable keys may be formed by the use of timber blocks approximately 2 by 4 inches in cross-section and having a length 4 inches less than the width of the girder stem. These key blocks shall be spaced along the girder stems as required, but the spacing shall not be greater than one foot center to center. The blocks shall be beveled and oiled in such manner as to insure their ready removal, and they shall be removed as soon as the concrete has set sufficiently to retain its shape.

Concrete in columns shall be placed in one continuous operation, unless otherwise directed. The concrete shall be allowed to set as least 12 hours before the caps are placed.

Unless otherwise permitted, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until they

have been in place at least 14 days or until the concrete has attained the required strength.

(d) Arches: The concrete in arch rings shall be placed in such a manner as to load the centering uniformly.

Arch rings shall be cast in transverse sections of such size that each section can be cast in a continuous operation. The arrangement of the sections and the sequence of concrete placement shall be approved and shall be such as to avoid the creation of initial stress in the reinforcement. The sections shall be bonded together by suitable keys or dowels. When permitted, arch rings may be cast in a single continuous operation.

805.05 PNEUMATIC PLACING. Pneumatic placing of concrete will be permitted only if specified in the special provisions or if authorized. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete.

Where concrete is conveyed and placed by pneumatic means, the equipment shall be suitable and adequate in capacity for the work. The machine shall be located as close as practicable to the point of deposit. The position of the discharge end of the line shall not be more than 5 feet from the point of deposit. The discharge lines shall be horizontal or inclined upwards from the machine.

805.06 PUMPING. Placing of concrete by pumping will be permitted only if specified in the special provisions or if authorized. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

805.07 DEPOSITING CONCRETE UNDER WATER. Concrete shall not be deposited in water except with the approval of the engineer and under his immediate super-

vision; in this case the method of placing shall be as hereinafter designated.

Concrete deposited in water shall be Class S. To prevent segregation, it shall be carefully placed in a compact mass in its final position by means of a tremie, or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish; the surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough bonding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set.

A tremie shall consist of a tube having a diameter of not less than 10 inches, and if constructed in sections it shall have watertight couplings. The tremies shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube; the tremie tube shall be kept as full as practicable while pouring the tremie seal. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed.

Dewatering may proceed when the concrete is sufficiently hard and strong, but not for a period of at least 72 hours after placing the concrete. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means which will not injure the surface of the concrete.

805.08 CONSTRUCTION JOINTS.

(a) General: Construction joints shall be made only where located on the plans or shown in the pouring schedule, unless otherwise approved. The face edges of joints exposed to view shall be carefully finished true to line and elevation.

If not detailed on the plans, construction joints shall be placed as directed. Raised shear keys or reinforcing steel

shall be used where necessary to transmit shear or bond the 2 sections together.

(b) Bonding:

(1) Construction Joints: Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required and in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance and saturated with water. To insure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

(2) Epoxy Joints: Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The vertical surfaces of the deck construction joints shall be coated prior to each succeeding pour with a liquid polysulfide/epoxy adhesive conforming to the requirements of Subsection 911.04.

The surface of the joint of old concrete to which new concrete is to be bonded shall be cleaned by sandblasting, hammers or wire brushes so that all foreign material and loose and unsound concrete is removed and only sound concrete remains. If grease or oil are present, they shall be removed with a detergent wash such as trisodium phosphate and the entire area then washed with fresh water and brushed with a stiff brush. If a detergent is not required, washing will only be required as necessary to remove dust and small particles not removed by other cleaning methods.

When all free water has dried from the joint or area to be patched, LP/epoxy adhesive shall be applied by brush or spray to a 5-10 mil. thickness. The adhesive will be allowed to set for 30 to 60 minutes to permit the solvent to escape. If the concrete has absorbed the adhesive, another coat will be applied. When the solvent has escaped but the adhesive is still tacky, the new concrete shall be placed.

805.09 CONCRETE EXPOSED TO SEA WATER. Unless otherwise provided, concrete for structures exposed to sea water shall be Class A concrete. The concrete shall be mixed for a period of not less than 2 minutes and the water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly consolidated and stone pockets shall be avoided. No construction joints shall be formed between levels of extreme low water and extreme high water as determined by the engineer. Between these levels sea water shall not come in direct contact with the concrete for a period of not less than 30 days. The original surface, as the concrete comes from the forms, shall be left undisturbed.

805.10 FALSEWORK AND CENTERING. Detailed plans for falsework and centering will be furnished in accordance with Section 801.

For designing falsework and centering, a weight of 150 pounds per cubic foot shall be assumed for fresh concrete. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. The contractor shall be required to employ screw jacks, hardwood wedges or other approved methods to take up any settlement in the formwork either before or during the placing of concrete.

Falsework which cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven and removed in an approved manner.

Falsework shall be set to give the finished structure the camber specified or indicated on the plans.

Arch centering shall be constructed according to approved centering plans. Provisions shall be made by means of suitable wedges, sand boxes or other devices for the gradual lowering of centers and rendering the arch self-supporting. When directed, centering shall be placed upon approved jacks in order to take up and correct any slight settlement which may occur after the placing of concrete has begun.

(a) Construction: Forms shall be designed and constructed so that they may be removed without injury to the concrete.

All forms shall be of wood or metal and shall be built mortartight and of sufficient rigidity to prevent distortion due to pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

(b) Form Surface: Forms for exposed surfaces shall not adhere or discolor the concrete and shall be made of either metal or dressed lumber of uniform thickness with or without form liner of an approved type, and mortartight. Forms for reentrant angles shall be chamfered and the forms shall be filleted at all sharp corners. The forms shall be given a bevel or draft in the case of all projections, such as girders or copings, to insure easy removal.

The forms shall be so designed that portions where finishing is required may be removed without disturbing portions of forms which are to be removed later and, as far as practicable, so that form marks will conform to the general lines of the structure. For narrow walls and columns, where the bottom of the form is inaccessible, the lower form boards shall be left loose so that they may be removed for cleaning out extraneous material immediately before placing the concrete.

When possible, forms shall be daylighted at intervals not greater than 10 feet vertically, the openings being sufficient to permit free access for the purpose of inspecting, working and spading the concrete.

(c) Metal Ties: Metal ties or anchorages within the forms shall be constructed as to permit their removal to a depth of at least ½ inch from the face without injury to the concrete. In case ordinary wire ties are permitted, all wires upon removal of the forms shall be cut back at least ¼ inch from the face of the concrete with chisels or nippers; for green concrete, nippers are necessary. All fittings for metal ties shall be of such design that upon their removal the cavities which are left will be of the smallest possible size. The cavities shall be filled with

cement mortar and the surface left sound, smooth, even and uniform in color.

(d) Setting and Maintaining: All forms shall be set and maintained reasonably true to the line and grade designated until the concrete is sufficiently hardened. Forms shall remain in place for periods which shall be determined as specified. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected.

(e) Re-Use: The shape, strength, rigidity, mortar-tightness and surface smoothness of re-used forms shall be maintained at all times in a reasonably satisfactory condition. Any warped or bulged lumber must be re-sized before being re-used. Forms which are unsatisfactory in any respect shall not be re-used.

(f) Surface Treatment: All forms shall be treated with an approved form-release agent and saturated with water immediately before placing the concrete. Any release agent which will adhere to or discolor the concrete shall not be used.

Prior to placing the concrete, the interior of all forms shall be cleaned of all dirt, sawdust, shavings or other debris. Forms shall be inspected immediately prior to placing concrete.

Cleanout ports shall be provided at the top surface of concrete where a stoppage of placing occurs.

805.11 REMOVAL OF FALSEWORK, FORMS AND HOUSING. Except as herein provided, forms for surfaces required to be finished shall be removed when the concrete has aged not less than ½ nor more than 2 curing days after the concrete is placed. In order to facilitate slab finishing, forms for inside curb faces on roadway slabs may be removed in not less than 3 hours provided the concrete has set sufficiently and forms are constructed in a manner to permit their removal without damage to the curbs.

The following specifications for the removal of forms and falsework from portions of structures which do not require surface finish shall apply to the forms and falsework under the portions of slabs that cantilever more than one foot beyond the outside beams, to the forms and falsework

under girders and to the forms and falsework under bent caps of framed bents regardless of whether or not those surfaces are required to be finished.

Forms and falsework for the portions of structures which do not require surface finishing shall be removed in accordance with either of the following methods, as the contractor elects.

Method 1: Forms and falsework may be removed as soon as the concrete has attained a flexural strength or compressive strength, as determined by either beam or cylinder tests, indicated in the following table:

Class of Concrete	Required Flexural Strength Lbs. Per Sq. In.	Required Compressive Strength Lbs. Per Sq. In.
A	500	3,000
D	400	2,500
Y	500	3,000
X (for nonprestressed members)	400	2,500
P (for nonprestressed members)	500	3,000

Test specimens shall be made from the same concrete and cured under the same conditions as the portion of the structure involved. For the test beams, AASHO Designation: T 97 of the Testing Procedures Manual shall be used, except the test beam shall be made in the field and sampling of concrete for molding specimens and storing of the test beams shall be done in the same manner as provided for the test cylinders. For the test cylinders, AASHO Designation: T 22 of the Testing Procedures Manual shall be used.

Method 2: If field operations are not controlled by beam or cylinder tests, the following periods, exclusive of days when the temperature is below 40°F, for removal of forms and supports shall be used, except that colder days may be counted if satisfactory provisions is made to maintain the air temperature adjacent to the concrete constantly above 50°F throughout the entire day.

Forms and falsework under slabs or beams or pile caps having span length of 10 feet and less. ..... 7 days

Forms and falsework under slabs or beams or pile caps having span lengths over 10 feet and less than 17 feet	7 days plus one day for each foot of span over 10 feet
Forms and falsework under slabs or beams or pile caps having spans over 17 feet in length.	14 days
Forms and falsework under the portion of slabs that cantilever more than one foot beyond the outside beams.	7 days
Forms for walls, columns, side forms for beams, pile caps and slabs that cantilever one foot or less beyond the outside beam.	1 day
Forms for concrete caissons.	2 days
Precast bridge units (side forms)	1 day

In the determination of the time for the removal of forms and falsework and the discontinuance of heating, consideration shall be given to the location and the character of the structure, the weather and other conditions influencing the setting of concrete and the materials used in the mix.

The foregoing provisions relative to forms and falsework removal, under either method the contractor elects to use, shall apply only to forms or parts of forms which are so constructed as to permit removal without disturbing forms or falsework which are required to be left in place for a longer period on other portions of the structure.

Methods of form removal likely to cause overstressing of the concrete shall not be used. Forms and their supports shall not be removed without approval. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In general, arch centering shall be struck and the arch made self-supporting before the railing or coping is placed.

This precaution is essential in order to avoid jamming of the expansion joints and variations in alignment. For filled spandrel arches, such portions of the spandrel walls shall be left for construction subsequent to the striking of centers as may be necessary to avoid jamming of the expansion joints.

Centers shall be gradually and uniformly lowered in such a manner as to avoid injurious stresses in any part of the structure. In arch structures of 2 or more spans, the sequence of striking centers shall be specified or approved.

805.12 CURING CONCRETE. Concrete surfaces exposed to conditions causing premature drying shall be protected by covering as soon as possible with canvas, straw, burlap, sand or other satisfactory material and kept moist; or if the surfaces are not covered, they shall be kept moist by flushing or sprinkling. Curing shall continue for a period of not less than 7 days after placing the concrete. If high-early strength cement is used, this period may be reduced as directed. Other precautions to insure the development of concrete strengths shall be taken as the engineer may direct.

After placing concrete, bridge decks shall be closed to all vehicular traffic and contractor's equipment such as trucks, concrete mixers, cranes and rail carrying devices for a minimum period of 14 days and for such additional time as may be considered advisable. When the concrete has cured for 2 days, buggies may be permitted to travel over the decks provided that approved runners are placed over sand cushions in the immediate area of the supporting girders or beams.

805.13 EXPANSION AND FIXED JOINTS AND BEARINGS. All joints shall be constructed in accordance with the details shown on the plans, specifications and the following requirements.

(a) Open Joints: Open joints shall be placed in the locations shown on the plans and shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint unless so specified on the plans.

(b) Filled Joints: All joints to be sealed with poured sealants or preformed compression seals shall be formed and constructed similar to open joints. When prefabricated types are specified, the filler shall be in correct position when concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed. Adequate water stops of metal, rubber or plastic shall be carefully placed as shown on the plans.

(c) Joint Sealants: This item shall consist of furnishing and installing these joints all in accordance with the plans and specifications.

The sealants used for bridges are of 2 general types: liquid poured and preformed. Both sealant types shall effectively prevent water leakage and the intrusion of incompressible materials.

Unless otherwise required, the joints are to be sealed full width, including curbs and sidewalks.

(1) Type I–Liquid Poured: The joint seal system shall conform to the requirements of Subsection 905.01(b). The joints shall be thoroughly cleaned, using whatever equipment is necessary. Before application of the poured joint sealer the joint faces must be sandblasted unless otherwise specified. In all cases the joints shall be thoroughly cleaned and dry at the time of installation. The joint sealant shall be installed in strict accordance with the manufacturers instructions and recommendations. Care shall be taken that the material's shelf life is not exceeded and that application is accomplished at 70°F or above. Application shall be done by a machine with a powered mixing device with an accurate method of proportioning and mixing the 2 separate components.

Primers, if required, shall be applied as directed by the manufacturer; however, it shall be applied the same day as the installation and shall be tack free prior to installation of the joint sealer.

Joints shall be backed with expansion joint fillers to obtain the correct depth of sealant. This backing material must not adhere to the sealant material and must be of a character that is recommended by the sealant manufacturer.

(2) Type II–Preformed Elastomeric Compression Joint Seal (Mechanical Type): The joint seal and lubricant-adhesive materials shall conform to the requirements of Subsection 905.02. The joints shall be thoroughly cleaned and free of loose rust using whatever equipment is necessary. Where armored joints are welded for alignment for construction purposes, the weld spots shall be ground smooth prior to seal placement. In all cases the joints shall be smooth faced and thoroughly clean and dry at the time of installation. The joint seal shall be installed in strict accordance with the manufacturer's instructions and construction recommendations.

The lubricant-adhesive shall be applied just prior to installation and shall be sufficient to completely cover the seal's sidewalls. The installation shall be done in a manner that least disturbs the lubricant-adhesive on the joint walls. Dilution of the lubricant-adhesive will not be allowed.

Stretching of the seal should be minimal. When installation procedures appear to cause stretching, random checks shall be made. The frequency and thoroughness of the checks shall be as directed by the engineer as he deems necessary in accordance with the adequacy of the installation. The maximum allowable stretch of the compression seal is 5 percent per 4-foot section. When the maximum stretch limits are exceeded, and the lubricant-adhesive has chemically set, the seal shall be completely removed and cleaned, the joint recleaned and reinstallation made.

One manufacturer's shop splice per 48 foot length shall be allowed provided field performance and laboratory tests indicate satisfactory performance. Field splicing shall not be allowed unless specifically noted on the plans to accommodate severe angles in the seal due to planned alignment.

(d) Premolded Expansion Joint Filler: Nonextruding and resilient types shall conform to the requirements of Subsection 905.03.

Bituminous types shall conform to the requirements of Headings 905.03(a) and 905.03(c).

Nonbituminous types shall conform to the requirements of Headings 905.03(b) and 905.03(e).

(e) Steel Joints: The plates, angles or other structural shapes shall be accurately fabricated to conform to the section of the concrete floor. The fabrication and painting shall conform to the requirements of the specifications covering those items. When called for on the plans or in the special provisions the materials shall be galvanized in lieu of painting. Care shall be taken to insure that the surface in the finished plane is true and free of warping. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be designated on the plans at the prescribed temperature and care shall be taken to avoid impairment of the required clearance in any manner.

(f) Water Stops: Adequate water stops of metal, rubber or plastic shall be placed as shown on the plans. Where movement at the joint is provided for, the water stops shall be of a type permitting such movement without injury. They shall be spliced, welded or soldered to form continuous watertight joints.

(g) Sheet Copper: Sheet copper shall conform to the requirements of Subsection 913.14.

(h) Bearing Devices: Bearing plates, rockers and other expansion devices shall be constructed according to details shown on the plans. The masonry surfaces on which bearings are to be set shall be finished to insure a true and uniform bearing at the grade and elevation shown on the plans. Bronze or copper-alloy plates shall conform to the requirements of Subsection 913.09. Structural steel and painting shall conform to the specifications for those items. When called for on the plans or in the special provisions, the material shall be galvanized in lieu of painting. The rockers or other expansion devices shall be accurately set considering temperature and deflection at the time of erection.

(i) Neoprene Bridge Bearing Pads (Elastomeric Bearings): Elastomeric bearing pads shall conform to the requirements of these specifications and Subsection 915.19. These bearings may be either plain (consisting of elastomer only) or laminated (consisting of layers of elas-

tomer interspersed with nonelastic laminates) as shown on the plans. Bearings shall be specified on the plans by hardness (durometer), size and configuration and, in the case of laminated bearings, by the thickness of individual layers of elastomer and the size and position of special connection members, of any, required to be vulcanized with the bearing.

805.14 CONCRETE SURFACE FINISHES. Surface finishes shall be classified as follows:

Class 1.	Ordinary Surface Finish
Class 1A.	Special Surface Preparation
Class 2.	Rubbed Finish
Class 2A.	Special Surface Finish
Class 3.	Tooled Finish
Class 4.	Sandblast Finish
Class 5.	Wire Brush or Scrubbed Finish
Class 6.	Bridge Deck Finish
Class 7.	Sidewalk Finish
Class 8.	Precast-Prestressed Concrete Finish

All concrete which does not receive Class 2A Special Surface Finish shall be given Class 1, Ordinary Surface Finish, and in addition, if further finishing is required, such other type of finish as is specified. If not otherwise specified, the following surfaces shall be given a Class 2, Rubbed Finish, or Class 2A Special Surface Finish: the exposed faces of piers, abutments, wing walls, retaining walls, railings and parapets; the outside faces of girders, T-beams, slabs, columns, brackets, curbs, headwalls, arch rings, spandrel walls and parapets; but not on the tops and bottoms of floor slabs and sidewalks, bottoms of beams and girders, sides of interior beams and girders, backwalls above bridge seat or the underside of copings. The surface finish on piers and abutments shall include all exposed surfaces below bridge seat to low water elevation or one foot below finish ground line. Wing walls shall be finished from the top to one foot below the finish slope lines on the exposed face and shall be finished on top and for a depth of one foot below the top on the backfill sides.

Unless otherwise specified, roadway floors shall be given a Class 6, Bridge Deck Finish.

(a) Class 1, Ordinary Surface Finish: Immediately following the removal of forms all fins and irregular projec-

tions shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned and, after having been kept saturated with water for a period of not less than 3 hours, shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished.

An approved resin binder shall be used in the mixing water of the proportions necessary to provide the desired rubbing mortar strength.

Mortar used in pointing shall be not more than one hour old. The mortar patches shall be cured as specified under curing. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The resulting surfaces shall be true and uniform. All surfaces which cannot be satisfactorily repaired shall be "rubbed" as specified for Class 2, Rubbed Finish.

(b) Class 1A, Special Surface Preparation: When it is specified that a Class 2A, Special Surface finish, is to be applied to the concrete surface, special care shall be exercised by the contractor to avoid leaving unsound surface particles such as cement mortar or rubbing powder to remain on the concrete receiving the special surface finish materials. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete being finished. An approved resin binder will be used in the mixing water, of the recommended proportions, to provide the desired mortar strength. The mortar patches shall be cured as specified under curing. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

(c) Class 2, Rubbed Finish: After removal of forms, the

rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished.

An approved resin binder shall be used in the mixing water of the proportions necessary to provide the desired rubbing mortar strength. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. An approved resin binder shall be used in the mixing water of the proportions necessary to provide the desired rubbing mortar strength. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed, the surface shall be left free from all unsound patches, paste, powder and objectionable marks.

(d) Class 2A, Special Surface Finish: The Class 2A, Special Surface Finish, is required as described for Class 8, Precast-Prestressed Concrete Finish, and unless otherwise specified the Special Surface Finish shall be allowed as a contractor's alternate in lieu of the Class 2, Rubbed Finish. When the Special Surface Finish is used for other than as required for Precast-Prestressed Concrete Finish, it shall be used throughout the project in lieu of the Class 2, Rubbed Finish.

The Special Surface Finish shall not relieve the contractor of full responsibility for performing the Class 1A, Special Surface Preparation as required immediately following the removal of forms. However, should it be

impracticable to perform the setting, non-shrink patching mortar may be used if approved by the engineer.

Application of the Special Surface Finish shall not be started until all other work which might damage or mar the surface finish is complete nor until finishing operations can be carried out continuously from beginning to completion on any one bridge.

The mixture used shall be one of the approved mixtures described in Subsection 911.05. The same materials and methods shall be used for all surfaces on the project that are given this Special Surface Finish.

(e) Class 3, Tooled Finish: Finish of this character for panels and other like work may be secured by the use of a bushhammer, pick, crandall or other approved tool.

Air tools, preferably, shall be employed. No tooling shall be done until the concrete has set for at least 14 days and as much longer as may be necessary to prevent the aggregate particles from being "picked" out of the surface. The finished surface shall show a grouping of broken aggregate particles in a matrix of mortar, each aggregate particle being in slight relief.

(f) Class 4, Sand-Blasted Finish: The thoroughly cured concrete surface shall be sand-blasted with hard, sharp sand to produce an even fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.

(g) Class 5, Wire Brushed or Scrubbed Finish: This type of finish shall be produced by scrubbing the surface of a green concrete with stiff wire or fiber brushes, using a solution of muriatic acid in the proportion of one part acid to 4 parts water. As soon as the forms are removed and while the concrete is yet comparatively green, the surface shall be thoroughly and evenly scrubbed as above described until the cement film or surface is completely removed and the aggregate particles are exposed, leaving an even pebbled texture presenting an appearance grading from that of fine granite to coarse conglomerate, depending upon the size and grading of aggregate used. As soon as the scrubbing has progressed sufficiently to produce the texture desired, the entire surface shall be thoroughly washed with water to which a small amount

of ammonia has been added to remove all traces of the acid.

(h) Class 6, Bridge Deck Finish:

(1) Striking Off: After the concrete is placed as specified under Subsection 805.04, the surface shall be carefully struck off with an approved screed to conform to the cross section and grade shown on the plans. Proper allowance shall be made for camber, if required. The screed may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the support forms or guide rails during the process. In lieu of a manual screed, an approved mechanical vibratory screed may be used. A slight excess of concrete shall be kept in front of the screed cutting edge, at all times.

When atmospheric conditions (temperature, humidity and wind) are such that rapid evaporation of mixing water from the concrete is likely to occur, the contractor shall furnish and apply water to the concrete in the form of a fine fog mist. The water shall be applied in sufficient quantity, as determined by the engineer, as may be necessary to curb the harmful effects which would result from rapid drying out of the concrete and to cool the concrete.

(2) Floating: After striking off and consolidating as specified above, the surface shall be made uniform by longitudinal or transverse floating or both.

(3) Straightedging: After the floating has been completed, the slab surface shall be tested for trueness with a straightedge. For this purpose, the contractor shall furnish and use an accurate 10-foot straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. The straightedge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab has the required grade and contour, until there are no deviations of more than ⅛ inch under the 10-foot straightedge.

(4) Final Finishing: When the concrete has hardened sufficiently, the surface shall be given a final finish by either the transverse or longitudinal method as follows:

Transverse Method:

Drag Finish: Unless otherwise permitted, the final finish shall be a drag finish. To obtain surface texture with a drag finish, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of bridge roadway. For bridge roadways 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the full width of bridge deck surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance free from grooves over ⅛ inch in depth. Drags that cannot be cleaned shall be discarded and new drags substituted.

Belt Finish: When permitted or specified, the surface texture shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the bridge deck width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the centerline and with a rapid advance parallel to the centerline.

Broom Finish: When permitted or specified, the surface texture shall be a broom finish. It shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the bridge deck with adjacent strokes slightly overlapping. The brooming operation shall

be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than ⅛ inch in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom. Brooms shall be of such quality, size and construction and be so operated as to produce a surface finish meeting the approval of the engineer. Subject to satisfactory results being obtained, the contractor will be permitted to substitute mechanical brooming in lieu of manual brooming as herein described.

Longitudinal Method:

Belt Finish: Unless otherwise permitted, the final finish shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete has become nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the section of bridge slab being finished. The belt shall be operated with short longitudinal strokes parallel to the bridge centerline and shall be kept sufficiently taut to reduce bowing of belt at center to a dimension not greater than one percent of the length of bridge section being finished. Belts shall be kept clean and pliable.

Drag Finish: When permitted or specified, the final finish shall be a drag finish. To obtain acceptable surface texture, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform surface of gritty texture as the drag is pulled transversely across the bridge deck. The drag shall be mounted on a bridge which travels on the same support forms used for operation of the longitudinal strike-off screed. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the bridge deck surface for the full length of the bridge section being finished. The

drag shall consist of not less than 2 layers of the material with the bottom layer at least 6 inches wider than the upper layer. The drag shall be maintained and operated in such a condition and way that the resultant surface is of uniform appearance and reasonably free from grooves over ⅛ inch in depth. Drags that cannot be cleaned and kept pliable shall be discarded.

Broom Finish: When permitted or specified, the surface shall be given a broom finish. This finish shall be applied at the proper time following operations of the longitudinal screed and after the surface has been made uniform by such floating and straightedging as needed. The broom shall be of an approved type and shall be drawn transversely from the edge of bridge deck or curb, perpendicular to the centerline and in the same direction as the strike-off operation, with adjacent and adjoining strokes slightly overlapping. The brooming operations shall be so performed that the corrugations produced shall be uniform in appearance all across the bridge deck and not more than 1/8 inch in depth. Brooming shall be completed while the concrete is in such condition as to avoid undue tearing or roughening of the surface. The surface thus finished shall be free from rough and porous areas, irregularities and depressions resulting from improper handling of the broom. Subject to satisfactory results being obtained, the contractor will be permitted to substitute mechanical brooming in lieu of manual brooming described herein.

(i) Class 7, Sidewalk Finish: After the concrete has been deposited in place, it shall be compacted and the surface shall be struck off by means of a strike board and floated with a wooden or cork float. An edging tool shall be used on all edges and at all expansion joints. The surface shall not vary more than 1/8 inch under a 10-foot straightedge. The surface shall have a granular or matte texture which will not be slick when wet.

(j) Class 8, Precast-Prestressed Concrete Finish: All concrete for precast-prestressed bridge members shall be given Class 1A Special Surface Preparation at the plant

as soon as possible after casting and before delivery. It is recognized that it is not feasible to eliminate entirely the formation of small cavities due to trapped air in the concrete surfaces next to steel forms and the repair of a reasonable number of these cavities will not be required. However the manufacturer of precast members will be required to adopt measures to reduce the number and size of trapped air cavities to a reasonable minimum and an excessive number of these cavities will be cause for rejection of the precast member. In all other respects, the concrete finish for precast-prestressed bridge members shall be given Class 1A Special Surface Preparation by the manufacturer.

After completion of the structure, all construction damage shall be repaired so as to restore the Class 1A, Special Surface Preparation. The exposed surfaces of precast-prestressed concrete piles shall be cleaned to produce a uniform color. The cleaning shall not be done in a manner to destroy the somewhat glazed surface of the concrete resulting from the use of metal forms.

During the pouring of the decks, the contractor shall keep girders clean by washing and shall remove any materials that adhere to the surface and mar the finish of the girders.

The Class 2A, Special Surface Finish, shall be applied to the outside faces of all exterior girders unless otherwise specified on the plans. The mixture used shall be one of the approved mixtures described in Subsection 911.05. A test pattern of the mixture shall be made to obtain a color compatible with other finished concrete parts of the structure. The same materials and methods shall be used for all surfaces that are given the Special Surface Finish.

805.15 PRESTRESSED CONCRETE.

(a) Description: The construction of prestressed concrete members shall conform to the requirements of preceding subsections in this section except those requirements which are modified or supplemented by the provisions which follow.

(b) Supervision and Inspection: Unless otherwise specifically permitted, the contractor or fabricator shall provide a technician skilled in the use of the system of prestressing to be used who shall supervise the work and

give the engineer such assistance as in his judgment may be necessary.

Free access to all parts of the contractor's or manufacturer's plant engaged in the fabrication of prestressed concrete bridge members shall be afforded the engineer at all times while prestressed members are being fabricated. All areas where inspection is required shall be kept clean and free of debris so as to provide safe access to the work.

Inspection of prestressed concrete bridge members shall be in accordance with the current Interim Manual for the inspection of prestressed concrete bridge members of the AASHO with latest amendments. Upon abandonment of the Interim Manual and adoption of a permanent Manual, inspection shall be in accordance with the current adopted Manual for Inspection of prestressed concrete bridge members of the AASHO with latest amendments. All required finishing repairs and curing shall be accomplished immediately after casting and before placing the members into (permanent) storage.

The Contractor or Fabricator shall furnish a concrete cylinder breaking machine of minimum 250,000 lbs. capacity which will meet the requirements of ASTM Designation: C 39 for use by the inspector. Suitable facilities for the use of this machine shall also be furnished. These testing machines shall be calibrated by an approved laboratory at the manufacturer's expense prior to initial use and at 1 year intervals thereafter. If during the use of the machine it appears to be giving erratic results, recalibration will be required at that time.

(c) Equipment and Stressing Requirements—General: The contractor or fabricator shall provide all equipment necessary for the construction and the prestressing. Prestressing shall be done with approved equipment. If hydraulic jacks are used, the shall be equipped with accurate reading pressure gages.

In all methods of tensioning, the stress induced in the tendons shall be measured both by jacking gages and by elongations of the reinforcement, and the results shall check within reasonable limits. Means shall be provided for measuring the elongation of reinforcement to the nearest 1/32 inch.

Prior to use in manufacture of prestressed members under these specifications, all jacks to be used, together with their gages, shall be calibrated by an approved laboratory. For jacks up to 200 tons capacity and which can be placed within the available testing machine, the calibration will be performed without charge by the Department's Testing Laboratory, provided the jacks are delivered there by the contractor. For larger jacks, calibration by proving ring or other acceptable method, performed by an established testing company at the expense of the contractor, will be required. During progress of the work, if any jack or gage appears to be giving erratic results or if gage pressure and elongations indicate materially differing stresses, recalibration will be required.

It is anticipated that there may be a possible difference in indicated stress between jack pressure and elongation of about 5 percent. In such event, the error shall be so placed that the discrepancy shall be on the side of a slightly overstress. In the event of an apparent discrepancy between gage pressure and elongation of as much as 10 percent, the entire operation shall be carefully checked and the source of error determined before proceeding further.

The amount of stress to be given each stressing element shall be as shown on the plans.

Pretensioning of all tendons will be in prescribed stages to allow for stress equalization throughout the tendon.

(d) Concrete: Concrete for all prestressed members shall be Class "P" or Class "W" as specified.

The design of the concrete mix within the limits of these specifications shall be the sole responsibility of the contractor subject to approval by the engineer of the mix and materials, but such approval shall not relieve the contractor of the responsibility for the product furnished.

In all other respects the concrete shall be controlled, mixed and handled as specified in subsections of Sections 805 and 901.

Concrete shall not be deposited in the forms until the engineer has inspected the placing of the reinforcement, conduits, anchorages and prestressing tendons and has given his approval.

The concrete shall be vibrated internally or externally or both, as ordered by the engineer. The vibrating shall be done with care in such manner as to avoid displacement of reinforcing, conduits or tendons.

Tops of prestressed beams shall be rough floated. At approximately the time of initial set, the entire top of beams shall be scrubbed transversely with a coarse wire brush to remove all laitance and to produce a roughened surface for future bonding.

(e) Forms and Forming for Bridge Girders: The prestressed members shall be cast in steel forms. Bolted form joints shall be so spaced that no exterior girder shall have more than 2 bolted joints or seams. All bolted joints or seams shall be thoroughly sealed to minimize bleeding.

Prior to the final preparation of forms for the placement of concrete, the forms shall be thoroughly cleaned and uniformly coated with an approved form-release agent specially formulated for metal forms. The release agent shall be of a nonstaining type that will not impair the bonding of paints, mortar or other concrete surface coatings and will not be readily washed away by rain or spraying water.

Forms that have become heated shall be cooled by spraying with water immediately prior to pouring concrete in each section.

Girder ends shall be coated with a suitable bituminous material to protect strand ends.

Prestressed members shall be finished in accordance with Subsection 805.14(j).

(f) Curing: To establish the adequacy of the curing methods used and to determine whether the concrete has attained the required minimum compressive strength for the various operations, 7 test cylinders will be made and cured under the same conditions as the members. Two cylinders will be made and cured under the same conditions as the members. Two cylinders will be broken at the end of 28 days. The remaining 5 cylinders will be broken at any time requested by the contractor. However in the event all 5 cylinders are broken at the request of the contractor and the concrete has not yet attained the required strength, the members involved will be held at the plant until the 28-day cylinders are broken. If the

concrete has not yet attained the required strength, all members involved will be rejected.

Steam Curing: Steam curing, when selected by the contractor, shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If retarders are used, the waiting period before application of the steam shall be increased from 4 to 6 hours. The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam the ambient air temperature shall increase at a rate not to exceed 40°F per hour until an optimum temperature range of from 140°F to a maximum of 160°F is reached. This temperature shall be held until the concrete has reached the required compressive strength. In discontinuing the steam, the ambient air temperature shall not decrease at a rate to exceed 40°F per hour until a temperature has been reached about 20°F above the temperature of the air to which the concrete will be exposed. The recording thermometer showing the time-temperature relationship shall be furnished at the rate of 1 for each 200 feet of bed.

(g) **Transportation and Storage:** Precast girders should be transported in an upright position, and points of support and directions of the reactions with respect to the girder should be approximately the same during transportation and storage as when the girder is in its final position.

Care shall be taken during storage, hoisting and handling of precast units to prevent cracking or damage. Units damaged by improper storing or handling shall be replaced by the contractor at his expense.

All members may be handled immediately after completion of stressing. In the event that stressing is not done in a continuous operation, members shall not be handled before they are sufficiently stressed, as determined by the engineer, to sustain all forces and bending moments due to handling.

All prestressed members shall be held at the plant until the concrete has attained a compressive strength of 5000 psi.

Prestressed members may be installed at any time after completion of stressing and grouting, providing the concrete has attained a strength of 5000 psi, except for the driving of prestressed piling.

Prestressed piling may be driven after the concrete has attained a compressive strength of 5000 psi, but in no event before the expiration of 10 days after casting if steam cured or 14 days after casting if conventionally cured.

(h) Pretensioning Method: The prestressing elements shall be accurately held in position and stressed by jacks. A record will be kept of the jacking force and tendon elongation produced. Several units may be cast in 1 continuous line and stressed at 1 time. Sufficient space shall be left between ends of units to permit access for cutting after the concrete has attained the required strength. No bond stress shall be transferred to the concrete nor shall end anchors be released until the concrete has attained a compressive strength of at least 4000 psi as shown by standard cylinders made and cured identically with members. The elements shall be cut or released in such an order that lateral eccentricity of prestress will be a minimum.

All cables to be prestressed in a group shall be brought to a uniform initial tension prior to being given their full pretensioning. This uniform initial tension of approximately 1000 to 2000 pounds shall be measured by a dynamometer or other approved means so that its amount can be used as a check against elongation computed and measured.

After this initial tensioning, the group shall be stressed until the required elongation and jacking pressure are attained and confirmed with the limits hereinbefore specified.

With the cables stressed in accordance with the plan requirements and the foregoing specifications and with all other reinforcing in place, the concrete shall be cast to the desired lengths.

(i) **Posttensioning Method:** The tensioning process shall be conducted so that the tension being applied to the tendon and its elongation may be measured at all times. The friction loss shall be estimated as provided below. A record shall be kept of gage pressures and elongations at all times and submitted to the engineer for his approval. Loads shall not be applied to the concrete until it has attained the compressive strength as specified in (h) for the pretensioning method.

Posttensioning tendons of straight members may be tensioned from one end. Posttensioning tendons of curved members shall be stressed by simultaneous jacking from both ends of the stressing element unless otherwise provided on the plans or in the special provisions.

Friction Losses: Friction losses in post-tensioned steel shall be based on experimentally determined wobble and curvature coefficients, and shall be vertified during stressing operations. The values of coefficients assumed for design, and the acceptable ranges of jacking forces and steel elongations shall be shown on the plans. These friction losses shall be calculated as follows:

$$T_o = T_x \times {}_e (KL + \mu\alpha)$$

When $(KL + \mu\alpha)$ is not greater than 0.3, the following equation may be used:

$$T_o = T_x \times (1 + KL + \mu\alpha)$$

In which

T_o = Steel stress at jacking end.

T_x = Steel stress at any point x.

E = Base of Naperian logarithms.

K = Friction wobble coefficient per foot of prestressing steel.

L = Length of prestressing steel element from jacking end to point x, in feet.

μ = Friction curvature coefficient.

α = Total angular change of prestressing steel element in radians from jack to point x.

The following values for K and μ may be used when experimental data for the materials used are not available:

Type of Steel	Type of Duct	K	μ
Wire or ungalvanized strand	Bright Metal Sheathing	0.0020	0.30
	Galvanized Metal Sheathing	0.0015	0.25
	Greased or asphalt-coated and wrapped	0.0020	0.30
	Galvanized rigid	0.0002	0.25
High-strength bars	Bright Metal Sheathing	0.0003	0.20
	Galvanized Metal Sheathing	0.0002	0.15

Friction losses occur prior to anchoring but should be estimated for design and checked during stressing operations. Rigid ducts shall have sufficient strength to maintain their correct alignment without visible wobble during placement of concrete. Rigid ducts may be fabricated with either welded or interlocked seams. Galvanizing of the welded seam will not be required.

(j) **Grouting of Bonded Steel:** Posttensioning prestressed members shall be of the bonded type in which the tensioned steel is installed in holes or flexible metal ducts cast in the concrete and bonded to the surrounding concrete by filling the tubes or ducts with grout. The grout shall consist of a mixture of one part Portland cement, 0.25 part fly ash containing not more than 6 percent carbon, 0.75 part screened and washed sand (at least 95 percent passing a No. 30 sieve), with 4 to 6 gallons of water per bag of cement. At his option, however, the contractor may substitute a grout mixture containing 1.75 parts Portland cement and 0.25 part fly ash, provided that the grout meets all of the other requirements of this specification.

All prestressing reinforcement to be bonded shall be free of dirt, loose rust, grease or other deleterious substances. Before grouting, the ducts shall be free of water, dirt or any other foreign substances. The ducts shall be blown out with compressed air until no water comes through the duct. For long members with draped strands, an open tap at the low point of the duct may be necessary.

The grout shall be fluid (consistency of thick paint) but proportioned so that free water will not separate out of the mix. Unpolished aluminum powder may be added in an amount of one to two teaspoons per sack of cement. Commercial plasticizers used in accordance with the

manufacturer's recommendations may be used provided they contain no ingredients that are corrosive to steel. Pressure used in grouting shall be that recommended for the system being used.

(k) Prestressing Reinforcement: Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand or high-tensile-strength alloy bars as called for in the plans or in the special provisions. Prestressing reinforcement shall conform to the applicable requirements of Section 909.

(l) Sampling and Testing Prestressing Reinforcement and Anchorages: Sampling and testing of prestressing reinforcement and anchorages shall be performed in accordance with the applicable requirements of Section 909.

Ends of pretensioned strands not to be encased in end diaphragms shall be cut off flush with ends of beam and shall be coated with a suitable bituminous material.

Should the contractor desire to substitute 270K high strength stress relieved 7-wire strand for ASTM Designation: A 416 grade strand he shall submit complete details to the Bridge Design Engineer to show that the design he proposes to use is essentially the same as the design plans and as described in these specifications. The design submitted shall correspond in total prestressing force and location of prestressing force in all essential requirements to the design drawings. The Bridge Design Engineer shall be the sole judge as to the requirements of Subsection 909.05 and such strands shall be clearly marked for position identification of strand type.

805.16 PLACING ANCHOR BOLTS. All necessary anchor bolts in piers, bents, abutments or pedestals shall be set carefully in Portland cement mortar at the location and in the manner described herein.

The locations of anchor bolts to be built into the concrete shall be verified by the contractor prior to setting. In this case great care shall be exercised to insure the proper setting of the bolts and any inaccuracies detrimental to the structure shall be corrected by approved means.

When anchor bolts are called for on the plans, the anchor bolts shall be set in preformed holes having a minimum diameter of 3 inches to allow for adjustment and sufficient

in depth to admit the anchor bolt. The holes may be formed by the insertion in the fresh concrete of oiled wooden plugs or sheet metal sleeves or other approved devices which are subsequently withdrawn after the concrete has partially set. All such holes shall be adequately protected against the formation of ice while open. When erecting the members, the contractor shall first set the members and shoes in place; then the preformed holes shall be filled sufficiently with grout so that when the anchor bolts are placed to the required depth, the grout will completely fill the holes.

Should the contractor elect to set anchor bolts, either at initial casting or by drilling, he will be required to verify the centerline to centerline spacing between the anchor bolt holes of each fabricated member before setting the anchor bolts. If bolt holes are drilled, the diameter of the drilled holes shall not be less than ½ inch larger than the diameter of the bolts.

805.17 METHOD OF MEASUREMENT. The yardage to be measured shall be the number of cubic yards of concrete of the several classes, complete in-place and accepted. In computing the concrete yardage for payment, the dimensions used shall be those shown on the plans or ordered in writing by the engineer. No measurement or other allowance will be made for forms, falsework, cofferdams, pumping or bracing. No measurement or allowance will be made for expansion joint materials and joint fillers or for structural excavation unless otherwise specifically provided in the plans.

No deductions in quantities of concrete shall be made for the enclosed reinforcing bars in counterweights and adjusting blocks, but the volume of structural steel so enclosed shall be deducted from the volume of concrete. Measurement will be based on the actual dimensions of the finished counterweights, including adjusting blocks.

No deductions will be made for the volume of reinforcing steel, water pipes and electrical conduits, steel angles forming armored joints in roadway slabs, weep holes or cast-iron drains.

Deductions will be made for the volume of steel beams and beam and girder flanges embedded in concrete, for all expansion joints and for all pile heads embedded in concrete. In computing the volume to be deducted for concrete pile

heads embedded in concrete, nominal butt dimensions will be used. In computing the volume to be deducted for timber pile embedded in concrete, a butt diameter of 12 inches shall always be used, regardless of size and length of pile.

The quantity of concrete involved in fillets, scorings and chamfers 1½ square inches or less in cross-sectional areas shall not be deducted from the quantities to be measured.

If an item is included for (1) concrete railing or (2) concrete barrier railing the following shall apply. (1) That portion of the concrete railing above the top of the roadway curb or sidewalk curb, as the case may be, shall not be included in the yardage of concrete but shall be measured as railing. (2) That portion of concrete barrier railing above the pavement slab shall not be included in the yardage of concrete but shall be measured as railing. Railing shall be paid for in accordance with Section 810.

The length of prestressed concrete members to be measured shall be the total length out to out in linear feet measured along the centerline of the various classes of precast-prestressed concrete girders, beams or other bridge members, except piling, complete in-place and accepted. The dimensions used shall be those shown on the plans or ordered in writing by the engineer. Precast concrete piling shall be measured and paid for as provided in Section 804.

When payment for expansion joint filler is called for on the plans, the length to be measured shall be the length of the joint, including the length on curbs and sidewalks, that is to be filled.

805.18 BASIS OF PAYMENT. The number of cubic yards of completed and accepted concrete of the several classes shall be paid for at the contract price per cubic yard for the various items of Class A, Class D, Class R, Class S or Class Y, as the case may be, complete in-place, but shall not constitute payment for reinforcing steel, nor for metal expansion joints.

The number of linear feet of completed and accepted prestressed concrete members of the various types shall be paid for at the contract unit price per linear foot of "Type I, Type II, Type III, Type IV, Type V or Type VI Precast-Prestressed Concrete Girders" or other members as provided on the plans and in the special provisions, as the case may be. Payment shall include concrete, prestressed and non-

prestressed reinforcement, masonry, anchor plates, plain or laminated elastomeric bearings, metal or other bearing plates and assemblies or other appurtenances indicated or necessary in the fabrication, handling and erection of prestressed bridge members. Payment for tie rods, nuts and washers for Precast-Prestressed Concrete Girders shall be included as miscellaneous steel under Item 807(1).

The number of linear feet of completed and accepted expansion joint seal shall be paid for at the contract unit price per linear foot, complete in place.

No payment will be made for steel punchings used in counterweights and adjusting blocks; cost of same to be included in price bid on concrete.

Metal expansion joints shall be paid for as pounds of structural steel complete in place and accepted.

Reinforcing steel shall be paid for under the pay item of that name.

Payment will be made under:

Item No.	Pay Item	Pay Unit
805(1)	Class A Concrete	Cubic Yard
805(2)	Class A Concrete for Superstructures	Cubic Yard
805(3)	Class A Concrete in Pipe Headwalls	Cubic Yard
805(4)	Class A Concrete in Box Culverts	Cubic Yard
805(5)	Class A Concrete in Box Girders	Cubic Yard
805(6)	Class A Concrete in Bents	Cubic Yard
805(7)	Class A Concrete in Footings	Cubic Yard
805(8)	Class A Concrete in Piers above Footings	Cubic Yard
805(9)	Class A Concrete in Retaining Walls	Cubic Yard
805(10)	Class A Concrete in Counterweights	Cubic Yard
805(11)	Class D Concrete	Cubic Yard
805(12)	Class R Concrete	Cubic Yard
805(13)	Class S Concrete	Cubic Yard
805(14)	Class Y Concrete	Cubic Yard
805(15)	Type I Precast-Prestressed Concrete Girders	Linear Foot

805.18

Item No.	Pay Item	Pay Unit
805(16)	Type II Precast-Prestressed Concrete Girders	Linear Foot
805(17)	Type III Precast-Prestressed Concrete Girders	Linear Foot
805(18)	Type IV Precast-Prestressed Concrete Girders	Linear Foot
805(19)	Expansion Joint Seal	Linear Foot
805(20)	Type V Precast-Prestressed Concrete Girders	Linear Foot
805(21)	Type VI Precast-Prestressed Concrete Girders	Linear Foot

Section 806

Reinforcement

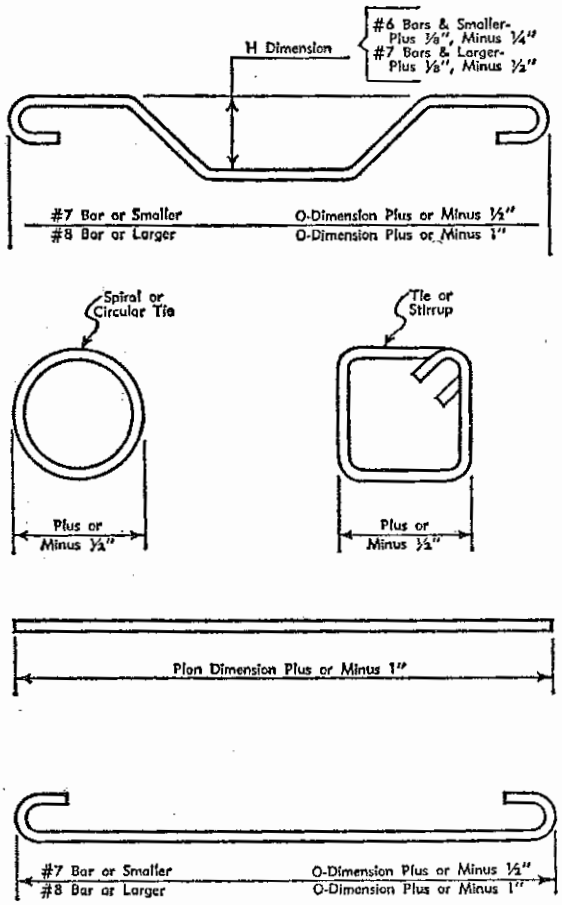
806.01 DESCRIPTION. This work shall consist of furnishing and placing reinforcing steel in accordance with the specifications and in conformity with the plans.

806.02 MATERIALS. All materials shall conform to the applicable subsections of Section 909.

806.03 STEEL LISTS. Before placing reinforcing steel, 2 copies of a list of all reinforcing steel showing the location, mark number, size and type bend shall be furnished to the engineer at the site for his use in administering the contract. Furnishing such lists to the engineer shall not be construed to mean that the lists will be reviewed for accuracy. The contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing all bar reinforcing steel in accordance with the details shown on the plans and as specified.

The contractor shall also furnish the engineer 2 copies of a placing plan for all structures where reinforcing steel is involved unless the plans contain sufficient detail for proper placement of reinforcing steel. Placing plans shall show the location, type and spacing of supports.

806.04 TOLERANCES. Fabricating tolerances for bars shall not be greater than that shown in figures below:



806.05 PROTECTION OF MATERIAL. From its delivery to the job until used, reinforcing steel shall be stored above the surface of the ground upon platforms, skids or other supports. It shall be protected at all times from damage.

The various sizes and lengths shall be plainly marked and tagged by the contractor to facilitate inspection and checking.

806.06 FABRICATION. Bent bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements.

Stirrups and tiebars shall be bent around a pin having a diameter not less than 2 times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness except for bars larger than one inch, in which case the bends shall be made around a pin of 8 bar diameters.

Heat bending of reinforcing steel will not be permitted.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordrance with the Code of Standard Practice of the Concrete Reinforcement Steel Institute.

806.07 PLACING AND FASTENING. All steel reinforcement shall be placed as near as practicable in the position shown on the plans and firmly held during the placing and setting of the concrete. When placed in the work, it shall be free from dirt, loose rust, loose scale, paint, oil, grease or other foreign material. Thin powdery rust and tight rust is not considered detrimental and need not be removed. Bars shall be tied at all intersections with No. 14 or No. 16 gage wire except where spacing is less than one foot in each direction, then alternate intersections shall be tied.

Distance from the forms shall be maintained by means of metal chairs, truncated precast mortar or concrete blocks, ties, hangers or other approved supports. The blocks shall be cast with the sides beveled in such manner that the size of the block increases away from the area to be placed against the forms. Except in unusual cases and when specifically otherwise authorized by the engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Metal chairs in contact with the exterior surface of the concrete shall be hot-dipped galvanized, plastic-coated or stainless steel. Layers of bars shall be separated by precast mortar blocks or by other approved devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks will not be permitted. All supports and spacers shall be approved types. Precast mortar blocks shall be furnished with suitable tie wire in each block for anchoring the block to avoid displacement when placing concrete. Vertical stirrups shall always pass around main tension members and

shall be securely attached thereto. The minimum spacing center to center of parallel bars shall be 2½ times the diameter of round or 3 times the side dimensions of square bars, but in no case shall the clear distance between the bars be less than 1½ times the maximum size of the coarse aggregate. The minimum covering, measured from the surface of the concrete to the face of any reinforcement bars, shall not be less than 2 inches except as follows: top of slab—1½ inches; bottom of slab—1 inch; stirrups and ties in T-Beams—1½ inches. Additional coverage as shown on the plans shall be provided for reinforcement in the bottom of footings or where exposed to salt water or unusual corrosive or abrasive conditions. Reinforcement in any member shall be placed and then inspected and approved before placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required.

806.08 SPLICING. All reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without written approval. Splices shall be staggered as far as possible. Unless shown on the plans, bars shall be lapped 35 diameters. Construction joints shall not be made within the limits of the lapped bars. In lapped splices the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the minimum clear distance to other bars and the minimum distance to the surface of the concrete as specified in Subsection 806.07. Welding of reinforcement steel shall be done only if detailed on the plans or if authorized by the engineer in writing. Welding shall conform to the latest Specifications for Welded Highway and Railway Bridges of the American Welding Society and the requirements of Section 916.

806.09 SUBSTITUTIONS. Substitutions of different size bars will be permitted only with specific authorization by the engineer. If steel is substituted, it shall have cross-sectional and surface areas equivalent to the design areas or larger.

806.10 METHOD OF MEASUREMENT. Steel reinforcement incorporated in the concrete masonry will be measured by the pound. The measurement will be based on the total computed weight for the sizes and length of bars as shown on the plans.

The weight of plain or deformed bars will be computed from the theoretical weight of plain round or square bars of the same nominal size and area as shown in the following table:

Bar Size Number	Nominal Area Sq. In.	Weight Per Linear Foot
2	0.05	0.167
3	0.11	0.376
4	0.20	0.668
5	0.31	1.043
6	0.44	1.502
7	0.60	2.044
8	0.79	2.670
9	1.00	3.400
10	1.27	4.303
11	1.56	5.313
14S	2.25	7.65
18S	4.00	13.60

When wire is ordered by gage numbers, the following relation between number and diameter, in inches, shall apply unless otherwise specified:

Gage Number	Equivalent Diameter Inches	Gage Number	Equivalent Diameter Inches
0	.3065	8	.1620
1	.2830	9	.1483
2	.2625	10	.1350
3	.2437	11	.1205
4	.2253	12	.1055
5	.2070	13	.0915
6	.1920	14	.0800
7	.1770		

The weight of reinforcement used in railings shall not be measured for payment when railings are paid for on a linear foot basis.

The weight of reinforcement in precast piles and in other items, where the reinforcement is included in the contract price for the items, shall not be measured for payment.

No allowances will be made for spaces in column spirals, clips, wire separators, chairs and other material used in fastening the reinforcing in place. If bars are substituted upon the contractor's request and as a result more steel is used than specified, only the amount specified shall be measured for payment.

When laps are made for splices other than those shown on the plans for the convenience of the contractor, the extra steel shall not be included.

Reinforcing steel furnished for testing purposes shall not be included.

Structural shapes used as reinforcement shall be measured as provided for in Subsection 807.58 and paid for as structural steel.

806.11 BASIS OF PAYMENT. The accepted quantities of reinforcing steel will be paid for at the contract price per pound complete in place.

Item No.	Pay Item	Pay Unit
806(1)	Deformed Reinforcing Steel	Pound

Section 807

Structural Steel

807.01 DESCRIPTION. This work shall consist of furnishing and placing structural steel for structures or portions thereof in accordance with the details shown on the plans and these specifications.

807.02 MATERIALS. All materials shall conform to the applicable subsections of Section 913.

807.03 DRAWINGS. Shop drawings and working drawings shall be furnished in accordance with Subsection 801.03.

FABRICATION

807.04 INSPECTION.

(a) Normal Inspection Requirements: The department will inspect all structural steel.

The engineer will examine the material before it is worked in the shop and will have authority to reject all materials or workmanship not in conformity with the plans and specifications. The contractor or fabricator shall give the Chief Construction and Maintenance Engineer at least 10 days notice before commencing the fabricating of any structural steel. The engineer shall be furnished with 6 complete copies of all mill orders including material orders. Heat number markings will be shown steel die stamped on main material. Round rods and certain bar shapes that are shipped, bundled and tagged with the heat number from the mill shall have this heat number transferred steel die stamped to each piece as it arrives at the fabrication plant in the presence of our inspector when these pieces are main members. Main material used from stock shall show steel die stamped heat numbers along with test reports.

In the fabricating shop the transferring of heat numbers shall be steel die stamped for all pieces of main material. In case of doubt as to the grade of steel being used, samples will be taken by the inspector for submittal to

the Department of Highways Testing Laboratory in Baton Rouge for tests to establish the grade of steel in question. A color code system shall be required for all steel to be used in structures for the Department as specified by the latest AASHO requirements. This color shall be placed on material upon entering the shop and carried on all pieces to final fabrication.

Identification Color Codes

A 242	Blue	
A 440	Brown	
A 441	Yellow	
A 514	Red	
A 517	Red and Blue	
A 572	Grade 42	Green and White
	Grade 45	Green and Black
	Grade 50	Green and Yellow
	Grade 55	Green and Brown
	Grade 60	Green and Gray
	Grade 65	Green and Blue
A 588	Blue and Yellow	

Other steels, except A 36 steel, not covered above nor included in the ASTM: A 6 Specification shall have an individual color code which shall be established and on record for the Engineer.

The contractor shall furnish means and assistance for the testing of all materials and workmanship. The engineer shall have free and safe access at all times to any portion of the shops where work is being done under these specifications.

The acceptance of any material or finished member shall not preclude their subsequent rejection if found defective. Rejected material shall be promptly replaced.

The contractor or fabricator shall furnish the engineer adequate office space so that he may be able to perform his paperwork in a convenient manner. This office space shall contain desk, chair, telephone and file cabinet with lock. The office shall be located where there is not excessive noise and preferably private. Toilet facilities and a place to change clothes should be convenient.

Steel fabrication work requiring Departmental inspection shall be performed in a plant or shop within the continental United States.

(b) Additional Inspection Requirements: When Consulting Engineers are Required to Perform Inspection Services, these requirements will apply when it is so stated in the project special provisions.

(1) Mill Inspection: In accordance with usual procedures of the Department, mill inspection of structural steel materials will not be made; however, certified copies of mill test reports on chemical and physical tests are required and shall be submitted directly to the Materials and Testing Engineer for approval and distribution. Seven certified copies of these reports shall be submitted.

(2) Shop Inspection: The normal procedure will be for shop inspection of fabrication and assembly of structural steel, castings and other metal items, to be performed by engineers of the Construction Section of the Department. Accordingly, a schedule of fabrication for the metal items required for the project including location of the shop and the dates inspection service will be required shall be furnished to the Chief Construction and Maintenance Engineer. This information shall be provided a minimum of 10 days in advance of commencement of layout work on fabricated material and/or pattern making for castings.

807.05 TYPE OF FABRICATION. Riveted, bolted and welded construction shall be so noted on the plans. High tensile bolts or steel lock-pin and collar fasteners may be substituted for rivets in either shop or field unless otherwise specified on the plans. Contractor shall not mix nuts and bolts from different manufacturers. Each connection shall have the same type of fasteners.

807.06 QUALITY OF WORKMANSHIP. Workmanship and finish shall be equal to the best general practice in modern bridge shops as interpreted by the engineer.

807.07 HANDLING AND STORING MATERIALS. Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease and other foreign matter and shall be protected as far as practicable from corrosion. It shall be properly drained.

Girders and beams shall be placed upright and stored. Long members, such as columns and chords, shall be sup-

ported on skids placed near enough together to prevent injury from deflection.

807.08 STRAIGHTENING MATERIAL AND CURVING ROLLED BEAMS AND WELDED GIRDERS.

(a) Straightening Material: Rolled material, before being laid off or worked, must be straight. If straightening is necessary, it shall be done by methods that will not injure the metal. Heat straightening of ASTM A514/A517 steel shall be done only under rigidly controlled procedures, each application subject to the approval of the engineer. In no case shall the maximum temperature of the steel exceed 1125°F. Sharp kinks and bends shall be cause for rejection of the material.

(b) Curving Rolled Beams and Welded Girders:

(1) Materials: Steels that are manufactured to a yield point greater than 50,000 psi shall not be heat curved.

(2) Type of Heating: Beams and girders may be curved by either continuous or V-type heating as approved by the engineer. For the continuous method, a strip along the edge of the top and bottom flange shall be heated simultaneously; the strip shall be of sufficient width and temperature to obtain the required curvature. For the V-type heating, the top and bottom flanges shall be heated in truncated triangular or wedge-shaped areas having their base along the flange edge and spaced at regular intervals along each flange; the spacing and temperature shall be as required to obtain the required curvature, and heating shall progress along the top and bottom flange at approximately the same rate.

For the V-type heating, the apex of the truncated triangular area applied to the inside flange surface shall terminate just before the juncture of the web and the flange is reached.* When the radius of curvature is 1000 feet or more, the apex of the truncated triangular heating pattern applied to the outside flange surface shall extend to the juncture of the flange and web. When the radius of curvature is less than 1000 feet, the apex of the truncated triangular heating pattern

* To avoid unnecessary web distortion, special care shall be taken when heating the inside flange surfaces (the surfaces that intersect the web) so that heat is not applied directly to the web.

applied to the outside flange surface shall extend past the web for a distance equal to ⅛ of the flange or 3 inches, whichever is less. The truncated triangular pattern shall have an included angle of approximately 15 to 30 degrees, but the base of the triangle shall not exceed 10 inches. Variations in the patterns prescribed above may be made with the approval of the engineer.

For both types of heating, the flange edges to be heated are those that will be on the inside of the horizontal curve after cooling. Heating both inside and outside flange surfaces is only mandatory when the flange thickness is 1¼ inches or greater, in which case, the two surfaces shall be heated concurrently. The maximum temperature shall be as prescribed below.

(3) Temperature: The heat-curving operation shall be conducted in such a manner that the temperature of the steel does not exceed 1150°F as measured by temperature indicating crayons or other suitable means. The girder shall not be artificially cooled until after naturally cooling to 600°F; the method of artificial cooling is subject to the approval of the engineer.

(4) Position for Heating: The girder may be heat-curved with the web in either a vertical or a horizontal position. When curved in the vertical position, the girder must be braced or supported in such a maner that the tendency of the girder to deflect laterally during the heat-curving process will not cause the girder to overturn.

When curved in the horizontal position, the girder must be supported near its ends and at intermediate points, if required, to obtain a uniform curvature; the bending stress in the flanges due to the dead weight of the girder must not exceed the usual allowable design stress. When the girder is positioned horizontally for heating, intermediate safety catch blocks must be maintained at the midlength of the girder within 2 inches of the flanges at all times during the heating process to guard against a sudden sag due to plastic flange buckling.

(5) Sequence of Operations: The girder shall be heat-curved in the fabrication shop before it is painted. The heat curving operation may be conducted either before

or after all the required welding of transverse intermediate stiffeners is completed. However, unless provisions are made for girder shrinkage, connection plates and bearing stiffeners shall be located and attached after heat curving. If longitudinal stiffeners are required, they shall be heat-curved or oxygen-cut separately and then welded to the curved girder. When cover plates are to be attached to rolled beams, they may be attached before heat curving if the total thickness of one flange and cover plate is less than 2½ inches and the radius of curvature is greater than 1000 feet. For other rolled beams with cover plates, the beams must be heat-curved before the cover plates are attached; cover plates must be either heat curved or oxygen-cut separately and then welded to the curved beam.

(6) Camber: Girders shall be cambered before heat curving. Camber for rolled beams may be obtained by heat-cambering methods approved by the engineer. For plate girders, the web shall be cut to the prescribed camber with suitable allowance for shrinkage due to cutting, welding, and heat curving.* However, subject to the approval of the engineer, moderate deviations from specified camber may be corrected by a carefully supervised application of heat.

(7) Measurement of Curvature and Camber: Horizontal curvature and vertical camber shall not be measured for final acceptance before all welding and heating operations are completed and the flanges have cooled to a uniform temperature. Horizontal curvature shall be checked with the girder in the vertical position by measuring off-sets from a string line or wire attached to both flanges or by using other suitable means; camber shall be checked by adequate means.

807.09 FINISH. Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately and shall be ground to a neat finish.

807.10 RIVET HOLES. All holes for rivets shall be

* The heat-curving process may tend to change the vertical camber present before heating. This effect shall be most pronounced when the top and bottom flanges are of unequal widths on a given transverse cross section.

either punched or drilled. Material forming parts of a member composed of not more than 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the rivets whenever the thickness of the metal is not greater than ¾ inch for structural carbon steel or ⅝ inch for alloy steel.

When there are more than 5 thicknesses or when any of the main material is thicker than ¾ inch in structural carbon steel or ⅝ inch in alloy steel or when required under Subsection 807.13, all the holes shall be subpunched or subdrilled 3/16 inch smaller and, after assembling, reamed 1/16 inch larger or drilled from the solid to 1/16 inch larger than the nominal diameter of the rivets.

807.11 PUNCHED HOLES. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch. If any holes must be enlarged to admit the rivets they shall be reamed. Holes must be clean cut without torn or ragged edges. Poor matching of holes will be cause for rejection; any repair shall be witnessed by the engineer.

807.12 REAMED OR DRILLED HOLES. Reamed holes shall be cylindrical, perpendicular to the member and not more than 1/16 inch larger than the nominal diameter of the rivets. Where practicable, reamers and drills shall be directed by mechanical means. Drilled holes shall be 1/16 inch larger than the nominal diameter of the rivet. All burrs shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist reamers or twist drills. If required, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match-marked before disassembling.

807.13 SUBPUNCHING, REAMING AND SHOP ASSEMBLY. Unless otherwise specified, holes in all field connections and field splices of main truss of arch members, continuous beams, towers (each face), bents, plate girders and rigid frames shall be subpunched or subdrilled if subdrilling is required according to Subsection 807.10 and reamed while assembled in the shop. The assembly, including camber, alignment, accuracy of holes and milled joints, shall be approved before reaming is commenced.

Unless otherwise authorized each individual (full length)

truss, arch, continuous beam, tower (each face), bent or girder shall be assembled in the shop before reaming is commenced.

All holes for floor beam and stringer field end connections shall be subpunched and reamed to a steel template or reamed while assembled.

If additional subpunching and reaming is required, it shall be specified in the special provisions or on the plans.

807.14 ACCURACY OF PUNCHED AND DRILLED HOLES. All holes punched full size, subpunched or subdrilled shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin ⅛ inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If the requirement is not fulfilled the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched holes, this will be cause for rejection.

807.15 ACCURACY OF REAMED AND DRILLED HOLES. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

All steel templates shall have hardened steel bushings in holes accurately dimensioned from the centerlines of the connection as inscribed on the template. The centerlines shall be used in locating accurately the template from the milled or scribed ends of the members.

807.16 SHOP ASSEMBLING.

(a) **General:** Shop assembly of trusses, arches, continuous beam spans, bents, towers (each face), and plate girders shall be according to Subsection 807.13, except partial assembly as described herein will be allowed when specified on the plans or in the special provisions. Complete shop assembly of an entire structure, including floor system, which may be necessary in the case of complicated designs, shall be done when shown on the plans or when stipulated in the special provisions. The requirements of Subsection 807.13 shall be modified as follows

when "partial assembly" is permitted by the special provisions or by notes on the plans. The panels of trusses and open-spandrel arches and the columns of bents and towers shall be reamed or drilled with at least 3 abutting panels,and in no case less than 150 feet of length assembled and with milled ends of compression members in full bearing. Connections of web members shall be reamed or drilled steel to templates.

(b) Reaming and Drilling Through Templates:

(1) Reaming or drilling full size of field connections through templates shall be done after the templates have been located with the utmost care as to position and angle and firmly bolted. Templates used for the reaming of matching members, or of the opposite faces of one member, shall be exact duplicates. Templates for connections which duplicate shall be so accurately located that like members are duplicates and require no match-making.

(2) When templates are used to ream field connections of web members of a truss, arch, bent or tower, at least one end of each web member shall be milled or scribed normal to the long axis of the member and the templates shall be accurately set at both ends from this milled or scribed end. Templates for reaming gussets of a truss shall be accurately set and located before reaming or drilling to their true geometric dimensions as shown on the shop plans.

(c) The fabricator shall have the option of making complete assembly. A camber diagram shall be furnished by the fabricator based on calculated values.

Surfaces of metal in contact shall be cleaned with a high cycle wire brush sander or disc grinder before assembling. The parts of a member shall be assembled, well pinned and firmly drawn together with bolts before reaming or riveting is commenced. Assembled pieces shall be taken apart for the removal of burrs and shavings produced by the reaming operation at the discretion of the engineer. The member shall be free from twists, bends and other deformation.

Preparatory to the shop riveting of full-sized punched material the rivet holes, if necessary, shall be spear-reamed for the admission of the rivets. The reamed holes

shall not be more than 1/16 inch larger than the nominal diameter of the rivets.

807.17 CAMBER DIAGRAM. A camber diagram shall be furnished the engineer, showing the camber at each panel point for each truss girder or beam taken from actual measurements at assembly.

807.18 DRIFTING OF HOLES. The drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets they shall be reamed.

807.19 MATCH-MARKING. Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked with steel stencils and a diagram showing such marks shall be furnished to the engineer.

807.20 RIVET OR BOLT HOLES MADE BY ALTERNATE METHODS. The use of numerically-controlled equipment will be allowed for making rivet or bolt holes provided that the requirements of these specifications for quality and dimensional accuracy of both the individual hole and assembled connection are met for each classification of hole established by these specifications. The drilling by numerically-controlled equipment of holes full size from the solid through individual pieces or any combination of pieces will be allowed.

When the fabricator elects to use the numerically-controlled method, he may, at the request of the engineer, be required to demonstrate the ability of this method to consistently produce holes and connections meeting all requirements of quality and dimensional accuracy. This demonstration shall consist of assembling with no match marking, in the manner described hereinafter, not more than ten percent of the partial assemblies delineated hereafter in which this procedure under consideration is used. For each partial assembly to be assembled in the shop, the engineer shall so notify the fabricator a minimum of thirty days prior to the earliest scheduled shipment of any piece involved in the assembly. This requirement for assembly shall apply only to connections of main members of trusses, arches, towers, plate girders, continuous beams and rigid frames.

A partial assembly shall consist of any three contiguous shop sections (i.e. sections between field splices) or all sections in any three contiguous panels, whichever is greater, of any chord of any truss or open spandrel arch or any arch rib or any leg of any tower or any assembly, as previously defined, which is assembled in the shop and which contains connections for other classes of main members of the same primary structural element (e.g. web members of the same truss to which the chord being assembled belongs), the accuracy of these connections may be checked, at the discretion of the engineer, either by precisely positioning accurate templets of the connections or by adding to the partial assembly, in its correct geometric relation, each of the main members of another class which is associated with the particular partial assembly.

Each Partial Assembly which is assembled in the shop shall be supported at sufficient intervals to preclude any significant deformation due to any loads then present, including the weights of the members. While thus supported the members of the partial assembly shall be arranged in their true unstressed geometric relationships, including geometric angles at the joints, as shown on the approved working drawings.

807.21 BOLTS AND BOLTED CONNECTIONS. The specifications of this subsection do not pertain to the use of high-tensile-strength bolts. Bolted connections fabricated with high-tensile-strength bolts shall conform to Subsection 807.22.

(a) **General:** Bolts shall be unfinished, turned, or an approved form of ribbed bolt. Bolted connections shall be used only as indicated by the plans or special provisions. Bolts shall have single self-locking nuts or double nuts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis.

Except as otherwise provided in this subsection, construction shall conform to applicable specifications for rivited structures.

(b) **Unfinished Bolts:** Unfinished bolts shall be standard bolts (ordinary rough or machine bolts) as described in the applicable part of Section 913.

(c) **Turned Bolts:** Holes for turned bolts shall be care-

fully reamed and the bolts turned to a light driving fit with the threads entirely outside of the holes and a washer shall be used. Turned bolts shall be finished by a finishing cut. Heads and nuts shall be hexagonal.

(d) Ribbed Bolts: Ribbed bolts shall make a driving fit with the holes. If for any reason the bolt twists before drawing tight, the hole shall be carefully reamed and an oversize bolt used as a replacement. Nuts shall be hexagonal.

807.22 CONNECTIONS USING HIGH-TENSILE-STRENGTH BOLTS.

(a) General: This specification covers the assembly of structural joints using ASTM Designation: A 325 high strength steel bolts tightened to a high tension. The bolts are used in holes 1/16 inch larger than the nominal bolt size.

Construction shall conform to the applicable specifications for riveted or welded structures of wrought iron, carbon structural steel and high strength steel, except as otherwise provided herein.

(b) Lock-Pin and Collar Fasteners: When specified or approved by the engineer lock-pin and collar fasteners shall meet the requirements of Subsection 913.10(c). The installation of lock-pin and collar fasteners shall be by methods and procedures approved by the engineer.

(c) Bolts, Nuts and Washers: Bolts, nuts and washers shall conform to AASHO Designation: M 164 (ASTM Designation: A 325), except as hereinafter provided.

Bolt dimensions shall conform to the current requirements for regular semi-finished hexagon bolts of ANS standard B 18.2 except as hereinafter provided. Alternatively, bolts may be furnished meeting one of the following descriptions:

(1) Hexagon head having same height as regular semi-finished hexagon bolt but having width across flats equal to corresponding heavy semi-finished hexagon bolt.

(2) Interference-body bolts with heads conforming to the dimensions for driven button heads of ANS standard B 18.4 for large rivets of the same nominal diameter, except that the head may be flattened to the

same height as the head of the regular semi-finished hexagon bolts. Interference-body bolts are not to be used in other than A 36 steels.

(3) Nut dimensions shall conform to current requirements for heavy semi-finished hexagon nuts of ANS standard B 18.2. Alternatively, finished hexagon nuts, conforming to ANS standard B 18.2 and meeting the requirements of ASTM Designation: A 194, Grade 2 H, may be used instead of heavy semi-finished hexagon nuts.

Circular washers shall be flat and smooth and their nominal dimensions shall be not less than those given in Table I of this specification with ANS standard B 27.2, Type A washer tolerances applied to these nominal dimensions. Beveled washers shall be square or rectangular, taper in thickness and conform to the dimensions given in Table I. Where necessary, washers may be clipped on one side to a point not closer than ⅞ of the bolt diameter from the center of the washer.

Table I

WASHER DIMENSIONS[a]

	Circular Washers				Square or Rectangular Beveled Washers for American Standard Beams and Channels		
Bolt Size D	Nominal Outside Diameter[b]	Nominal Diameter of Hole	Thickness Min.	Thickness Max.	Minimum side Dimension	Mean Thickness	Slope or taper in Thickness
1/2	1-1/16	17/32	.097	.177	1-3/4	5/16	1:6
5/8	1-5/16	21/32	.122	.177	1-3/4	5/16	1:6
3/4	1-15/32	13/16	.122	.177	1-3/4	5/16	1:6
7/8	1-3/4	15/16	.136	.177	1-3/4	5/16	1:6
1	2	1-1/16	.136	.177	1-3/4	5/16	1:6
1-1/8	2-1/4	1-1/4	.136	.177	2-1/4	5/16	1:6
1-1/4	2-1/2	1-3/8	.136	.177	2-1/4	5/16	1:6
1-3/8	2-3/4	1-1/2	.136	.177	2-1/4	5/16	1:6
1-1/2	3	1-5/8	.136	.177	2-1/4	5/16	1:6
1-3/4	3-3/8	1-7/8	.178	.28	.....	.....	....
2	3-3/4	2-1/8	.178[c]	.28[c]	.....	.....	....
Over 2 to 4 incl.	2D-1/2	D+1/8	.24[d]	.34[d]	.....	.....	....

[a]Dimensions in inches
[b]May be exceeded by ¼ in.
[c]3/16 in. nominal
[d]¼ in. nominal

(d) Bolted Parts: Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. Holes may be punched, subpunched and reamed, or drilled, as required by the applicable specification and shall be of a nominal diameter not more than 1/16 inch in excess of the nominal bolt diameter.

When assembled all joint surfaces, including those adjacent to the washers, shall be cleaned with high cycle wire brush sander or disc grinder and be free of scale, burrs, and other defects that would prevent solid seating of the parts.

Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

(e) Installation: Bolts shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. A hardened washer shall also be used under the head of regular semi-finished hexagon bolts and under finished hexagon nuts, even when these are not the elements turned in tightening. The washer may be omitted under the head of heavy semi-finished hexagon bolts and interference-body bolts, and under heavy semi-finished hexagon nuts, when these are not the elements turned. A flat washer may be used when the abutment surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for lack of parallelism.

All fasteners shall be tightened to give at least the required minimum bolt tension values shown in Table II on completion of the joint. Tightening shall be done with properly calibrated wrenches or by the "turn-of-nut" method.

Table II

BOLT TENSION

Bolt Size	ASTM A 325 Proof Load	Required Min. Bolt Tension (lb.*)	Recommended Bolt Tension for Calibrating Wrenches (lb.)	Approx. Equivalent Torque for Required Min. Bolt Tension (lb. ft.)
1/2	12,050	10,850	12,500	90
5/8	19,200	17,300	20,000	180
3/4	28,400	25,550	29,000	320
7/8	36,050	32,450	37,000	470
1	47,250	42,500	49,000	710
1-1/8	56,450	50,800	58,000	960
1-1/4	71,700	64,500	74,000	1,350
1-3/8	85,450	76,900	89,000	1,760
1-1/2	103,950	93,550	108,000	2,340

* Equal to the proof load of bolt given in ASTM Designation: A 325.

(f) Calibrated Wrenches: When calibrated wrenches are used to provide the bolt tension specified in Table II, their setting shall be such as to induce a bolt tension slightly in excess of this value. These wrenches shall be calibrated by tightening, in a device capable of indicating actual bolt tension, not less than 3 typical bolts from the lot to be installed. Power wrenches shall be adjusted to stall or cut-off at the selected tension. If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to "touch up" bolts previously tightened which may have been loosened by the tightening of subsequent bolts until all are tightened to the prescribed amount.

Turn-of-nut: Before final tightening of the bolts by this method, the several parts of the joint shall be properly compacted by bringing a sufficient number of bolts to a snug, tight condition such as can be produced by a few blows of an impact wrench or by an ordinary spud wrench. All bolts shall be tightened in accordance with the provisions given in Table III, progressing from the most rigid part of the joint towards the free edges, after being brought to a snug, tight fit.

Table III

Bolt Diameter in inches	From snug, tight rotate nuts *	
	½ turn for grips	¾ turn for grips
¾	5 in. and under	above 5 in.
⅞	5 in. and under	above 5 in.
1	8 in. and under	above 8 in.
1⅛	8 in. and under	above 8 in.
1¼	8 in. and under	above 8 in.
1⅜	8 in. and under	above 8 in.
1½	8 in. and under	above 8 in.

*Permissible tolerance: ¼ turn over, nothing under.

Impact wrenches shall be of adequate capacity and sufficiently supplied with air to perform the required tightening in approximately 10 seconds.

If required because of bolt entering and wrench operation clearances, tightening by either procedure may be done by turning the bolt while the nut is prevented from rotating provided both bolt head and nut bear against surfaces having slopes not greater than 1:20.

(g) Inspection: The engineer shall satisfy himself that all requirements of this specification are met.

The engineer shall approve the procedure for calibration of wrenches and installation of bolts and shall further observe the field installation to determine that these procedures are followed.

Spot checks should be made with a manual torque wrench that has been calibrated as previously specified herein.

807.23 RIVETS AND RIVETING. The size of rivets called for on the plans shall be the size before heating. Rivet heads shall be of standard shape unless otherwise specified and of uniform size for the same diameter of rivet. They shall be in full contact with the surface of the member.

Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. Any rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from

slag, scale and other adhering matter. Any rivet which is scaled excessively will be rejected.

All rivets that are loose, burned, badly formed or otherwise defective shall be removed and replaced with satisfactory rivets. Any rivet whose head is defective in size or whose head is driven off center will be considered defective and shall be removed. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recupping or double gunning of rivet heads will not be permitted.

Shop rivets shall be driven by direct-acting rivet machines when practicable. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of a direct-acting rivet machine is not practicable pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when the size and length of the rivets warrant their use.

Rivets may be driven cold provided their diameter is not over ⅞ inch.

807.24 PLATE CUT EDGES.

(a) Edge Planning: Sheared edges of plate more than ⅝-inch in thickness and carrying calculated stress shall be planed to a depth of ¼-inch. Re-entrant corners shall be filleted to a minimum radius of ¾-inch before cutting.

(b) Visual Inspection and Repair of Plate Cut Edges: In the repair and determination of limits of internal defects visually observed on sheared or flame cut edges and caused by entrapped slag or refractory, deoxidation products, gas pocket or blow holes, the amount of metal removed shall be the minimum necessary to remove the defect or to determine that the permissible limit is not exceeded. Plate edges may be at any angle with respect to the rolling direction. All repairs of the defects made by welding shall conform to the applicable provisions of Section 916, Welding.

The limits of acceptability and the repair of visually observed edge defects in plates 4" and under in thickness shall be in accordance with the following table in which the length of defect is the visible long dimension on the plate cut edge and the depth is the distance that the defect extends into the plate from the cut edge.

Table IV

Description of discontinuity	Repair required
Any discontinuity 1" in length or less	None—need not be explored.
Any discontinuity over 1" in length and ⅛" maximum depth.	None—depth should be explored by random spot grinding.
Any discontinuity over 1" in length with depth over ⅛" but not greater than ¼".	Remove—need not weld.
Any discontinuity over 1" in length with depth over ¼" but not greater than 1".	Completely remove and weld. Aggregate length of welding not over 20% of plate edge length being repaired.
Any discontinuity over 1" in length with depth greater than 1".	Subject to approval by the engineer. Gouge out to 1" and block off by welding. Aggregate length of welding not over 20% of plate edge length being repaired unless approved by engineer.

807.25 SHOP WELDING. Shop welding of steel structures, when authorized or shown on the plans, shall conform to Section 916, Welding.

807.26 OXYGEN CUTTING. Steel and weld metal may be oxygen cut, provided a smooth and regular surface free from cracks and notches is secured, and provided that an accurate profile is secured by the use of a mechanical guide. Hand cutting shall be done only where approved by the engineer.

Mill scale and extraneous material shall be removed from the torch side of A514/A517 steel plates along the lines to be flame cut, when necessary to obviate excessive notches.

All oxygen cutting shall be in accordance with Section 916, Welding. Occasional notches or gouges in edges of A514/A517 steel shall not be repaired by welding except under the following conditions:

(a) Cutting defects not more than 3/16 inch deep in plate edges which will form the faces of a groove weld joint and which will subsequently be completely fused

with the weld may be repaired by welding. Nonmetallic stringers or pipes opening to these edges shall be removed to a depth of ¼ inch below the surface by grinding or chipping and the gouge repaired by welding. Laminations opening to these edges shall be removed to a depth of ½ inch below the surface by grinding and chipping and the gouge repaired by welding.

(b) Cutting defects not more than 3/16 inch deep in plate edges which will form a fillet-welded corner joint shall be repaired by welding only on the part of the edge which will become the faying surface for the joint and the fusion zone of the fillet weld. The part of the defect outside the toe of the completed fillet weld shall be removed by machining or grinding, and faired with the surface of the cut on a bevel of 1 to 6 or less.

(c) All welding for these repairs shall be made by suitably preparing the defect, welding with low hydrogen electrodes not exceeding 5/32 inch in diameter, and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Oxygen cut edges of ASTM A440 steel ½ inch or greater in thickness* shall be removed to a depth of at least ⅛ inch by machining or grinding except that machine flame cut edges may be used without such removal if the edges are softened after cutting: (a) by heating the cut edge uniformly and progressively to a red heat, visible in ordinary shop light (1,150°F to 1,250°F) to a depth of at least 1/16 inch; or (b) by means of a post heating torch attached to and following the cutting torch with the tips, gas pressure, speed of travel, and the distance of the post heating torch from the kerf regulated to the thickness of the steel. Bend test specimens 1½ inches wide and of the full thickness of the material or with thickness reduced to ¾ inch in accordance with Paragraph 6.8 of ASTM A6 and having edges flame cut and flame softened in accordance with this article shall meet the bend test requirements specified in ASTM A440 for the thickness of material under consideration.

Oxygen cut surfaces of members carrying calculated

* ASTM A242 steel not approved for welded construction requires this treatment of oxygen cut edges in all thicknesses and with bend tests, as applicable, conforming to ASTM A242 for the thickness of material under consideration.

stress shall have their corners rounded to 1/16 inch radius by grinding after cutting.

807.27 FACING OF BEARING SURFACES. The surface of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the American National Standards Institute surface roughness requirements as defined in ANS standard B 46.1-55, Surface Roughness, Waviness and Lay, Part I:

Steel slabs	ANS	2,000
Heavy plates in contact in shoes to be welded	ANS	1,000
Milled ends of compression members, stiffeners, and fillers	ANS	500
Bridge rollers and rockers	ANS	250
Pins and pin holes	ANS	125
Sliding bearings	ANS	125

807.28 ABUTTING JOINTS. Abutting joints in compression members and girder flanges and in tension members, where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed ¼ inch.

807.29 END CONNECTION ANGLES. Floor beams, stringers and girders having end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than that shown on the detail drawings.

807.30 LACING BARS. The ends of lacing bars shall be neatly rounded unless another form is required.

807.31 FINISHED MEMBERS. Finished members shall be true to line and free from twists, bends and open joints.

807.32 WEB PLATES. In girders having no cover plates and not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than ⅛ inch below at any point. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates of girders having cover plates may be ½ inch less in width than the distance back to back of flange angles.

Splices in webs of girders without cover plates shall be sealed on the top by welding.

At web splices the clearance between the ends of the web plates shall not exceed ⅜ inch. The clearance at the top and bottom ends of the web splice plates shall not exceed ¼ inch.

807.33 BENT PLATES. Unwelded, cold-bent, load-carrying, rolled-steel plates shall conform to the following:

(a) They shall be so taken from the stock plates that the bend line will be at right angles to the direction of rolling.

(b) Bending shall be such that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are shown in the following table:

Thickness in Inches

	Up to ½	Over ½ to 1	Over 1 to 1½	Over 1½ to 2½	Over 2½ to 4
All grades of structural steel in this specification	2 t	2½ t	3 t	3½ t	4 t

NOTE: Low alloy steel in thicknesses over ½ inch may require hot bending for small radii.

Allowance for springback of A514 and A517 steels should be about 3 times that for structural carbon steel. For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.

If a shorter radius is essential, the plates shall be bent hot at a temperature not greater than 1200°F, except for A514/A517 steel. If A514/A517 steel plates to be bent are heated to a temperature greater than 1125°F, they must be requenched and tempered in accordance with the producing mill's practice. Hot bent plates shall conform to requirement (a) above.

(c) Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch throughout the portion of the plate at which the bending is to occur.

807.34 FIT OF STIFFENERS. End stiffeners of girders and stiffeners intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flange. Intermediate stiffeners shall fit sufficiently tight to exclude water after being painted. As an alternate the stiffeners may be cut short, jammed to the

tension flange and seal welded to the compression flange. Fillers under stiffeners shall fit within ¼ inch at each end.

Welding will be permitted in lieu of milling or grinding if noted on the plans or specified in the special provisions. Welding transversely across the tension flanges of beams or girders, which have a flange stress of more than 75 percent of their designed capacity, will not be permitted.

807.35 EYEBARS. The fabrication of eyebars shall conform to the latest specifications of AASHO unless otherwise provided.

807.36 ANNEALING AND STRESS RELIEVING. Structural members which are indicated in the contract to be annealed or normalized shall have finished machining, boring and straightening done subsequent to heat treatment. Normalizing and annealing (full annealing) shall be as specified in ASTM E44. The temperatures shall be maintained uniformly throughout the furnace during the heating and cooling so that the temperature at no two points on the member will differ by more than 100°F at any one time.

Members of A514/A517 steels shall not be annealed or normalized and shall be stress relieved only with the approval of the engineer.

A record of each furnace charge shall identify the pieces in the charge and show the temperatures and schedule actually used. Proper instruments including recording pyrometers, shall be provided for determining at any time the temperatures of members in the furnace. The records of the treatment operation shall be available to and meet the approval of the engineer. The holding temperature for stress relieving A514/A517 steel shall not exceed 1125°F.

Members, such as bridge shoes, pedestals, or other parts which are built up by welding sections of plate together shall be stress relieved in accordance with the procedure of paragraph 310 of LDH Welding Manual when required by the plans, specifications or special provisions governing the contract.

807.37 PINS AND ROLLERS. Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth and free from flaws.

Pins and rollers more than 7 inches in diameter shall be

forged and annealed. Pins and rollers 7 inches or less in diameter may be either forged and annealed or cold-finished carbon-steel shafting.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling and before being annealed.

807.38 BORING PIN HOLES. Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise required. The final surface shall be produced by a finishing cut.

The distance outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from that specified more than 1/32 inch. Boring of holes in built-up members shall be done after the connections are completed.

807.39 PIN CLEARANCES. The diameter of the pin hole shall not exceed that of the pin by more than 0.020 inch for pins 5 inches or less in diameter or 0.03125 inch for larger pins.

807.40 SCREW THREADS. Threads for all bolts and pins for structural steel construction shall conform to the American National Coarse Thread Series Class 2, free fit, except that the pin ends having a diameter of 1⅜ inches or more shall be threaded 6 threads to the inch.

807.41 PILOT AND DRIVING NUTS. Two pilot nuts and two driving nuts for each size of pin shall be furnished unless otherwise specified.

807.42 CAMBER FOR ROLLED BEAMS IN SIMPLE SPAN. When required on the plans, beams shall be cambered to conform to the vertical curve or level grade as may be required after full dead load is applied. Camber shall approximate a simple regular curve from end to end of beam. The camber ordinate at mid-length of the beam, unless shown otherwise on the plans, shall be equal to the dead load deflection of the beam plus the mid-ordinate of the vertical curve, if the span is on a vertical curve. The camber ordinate may vary from the above by ¼ inch over or ¼ under.

Beams may be cambered cold or may be heated. If heat is used, the tension flange shall be heated uniformly and progressively to not more than a red heat visible in ordinary shop light (1150°F to 1250°F) while the beam is loaded to produce compression in the bottom flange. The contractor shall furnish pyrometers or temperature indicating crayons for checking the desired temperatures. The heating and loading shall be done in such a manner that the permanent camber remaining shall be within the limits specified above or shown on the plans. After the cambering operation has been concluded, the beam shall be left to air cool and no quenching process of any kind shall be permitted.

807.43 STRAIGHTENING OF OTHER MEMBERS. No quenching process of any kind shall be permitted without permission of the engineer.

807.44 ROADWAY JOINT ASSEMBLY. Roadway joint assemblies shall be paired and fitted prior to painting, before shipping.

807.45 SHEAR CONNECTORS.

(a) Description: This item shall consist of furnishing and placing devices known as "shear connectors" and welding them to the top flanges of the welded composite steel girders, all in accordance with these specifications and in conformity with the dimensions, shapes and designs shown on the plans.

Shear connectors furnished under this item may be either ¾ inch or ⅞ inch studs at the contractor's option.

Stud shear connectors shall conform to the following:

(b) Construction Requirements:

(1) Stud shear conectors shall be end welded to steel beams or girders with automatically timed stud welding equipment connected to a suitable power source.

(2) If 2 or more stud welding guns are to be operated from the same power source, they shall be interlocked so that only 1 gun can operate at a time and so that the power source has fully recovered from making 1 weld before another weld is started.

(3) At the time of welding, the studs shall be free from any rust, rust pits, scale, oil or other deleterious matter which would adversely affect the welding operation.

(4) Welding shall not be done when the base metal temperature is below 0°F or when the surface is wet or exposed to rain or snow.

(5) While in operation, the welding gun shall be held in position without movement until the weld metal has solidified.

(6) When necessary to obtain satisfactory welds, the areas on the beam or girder to which the studs are to be welded shall be wire-brushed, peened, prick-punched or ground free of scale or rust.

(7) Longitudinal and lateral spacings of studs with respect to each other and to edges of beam or girder flanges shall not vary more than ½ inch from the dimensions shown on the plans except that a variation of one inch will be permitted where required to avoid obstruction with other attachments on the beam or where a new stud is being welded to replace a defective one. The minimum distance from the edge of a stud to the edge of a beam shall be one inch, but preferably not less than 1½ inches.

(8) The first 2 studs welded on each beam or girder, after being allowed to cool, shall be bent 45° by striking each stud with a hammer. If failure occurs in the weld of either stud, the procedure shall be corrected and 2 successive studs successfully welded and tested before any more studs are welded to the beam or girder. The engineer shall be promptly informed of any changes in the welding procedure at any time during construction.

(9) When the temperature of the base metal is below 32°F one stud in each 100 studs welded shall be bent 45° in addition to the first 2 bent as specified in (8) above.

(10) Studs on which a full 360° weld is not obtained may, at the option of the contractor, be repaired by adding a 3/16 inch fillet weld in place of the lack of weld, using the shielded metal-arc process with low-hydrogen welding electrodes.

(11) If the reduction in the height of studs as they are welded becomes less than normal, welding shall be

stopped immediately and not resumed until the cause has been corrected.

(12) Before welding a new stud where a defective one has been removed, the area shall be ground smooth and flush or in the case of a pullout of metal, the pocket shall be filled with weld metal using the shielded metal-arc process with low-hydrogen welding electrodes and then ground flush. In compression areas of flanges, a new stud may be welded adjacent to the defective area in lieu of repair and replacement on existing weld area. (See Paragraph 7 above).

(c) Inspection Requirements:

(1) If visual inspection reveals any stud which does not show a full 360° weld, any stud which has been repaired by welding or any stud in which the reduction in height due to welding is less than normal, such stud shall be struck with a hammer and bent 15° off the vertical. For studs showing less than 360° weld, the direction of bending shall be opposite to the lack of weld. Studs that crack either in the weld or the shank shall be replaced.

(2) The engineer, at his option, may select additional studs to be subjected to the bend test specified above.

(3) The studs tested that show no sign of failure may be left in the bent position.

(4) If during the progress of the work, inspection and testing indicates that the shear connectors being obtained are not satisfactory, the contractor will be required at his expense to make such changes in welding procedure, welding equipment and type of shear connector as necessary to secure satisfactory results.

(5) At the option and the expense of the purchaser, the manufacturer of the studs may be required at any time to submit sample studs for requalification in accordance with established procedure.

807.46 MARKING AND SHIPPING. Each member shall be painted or marked with an erection mark for identification and an erection diagram shall be furnished with erection marks shown thereon.

Members weighing more than 3 tons shall have the weights marked thereon. Structural members shall be loaded

on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed or otherwise damaged.

Bolts and rivets of one length and diameter and loose nuts or washers of each size shall be packed separately. Pins, small parts and packages of bolts, rivets, washers and nuts shall be shipped in boxes, crates, kegs or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained material shall be plainly marked on the outside of each shipping container.

807.47 PAINTING. Shop and field paints and their application shall comply with the applicabel requirements of Section 811.

ERECTION

807.48 HANDLING AND STORING MATERIALS. Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease and other foreign matter and shall be protected as far as practicable from corrosion. It shall be properly drained.

Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection.

807.49 FALSEWORK. The falsework shall be designed properly, constructed substantially and maintained for the loads which will come upon it.

807.50 BEARING AND ANCHORAGE. Bridge bearings shall be set level, in exact position, and must have full and even bearing on the masonry.

Elastomeric bearing pads, if used, shall be set directly on the concrete masonry.

Cast iron or steel or rolled steel bearings shall be bedded on the masonry with alternate layers of red lead and canvas or a single thickness of sheet lead or preformed fabric bearing pad. The preformed fabric bearing pad shall conform to Subsection 905.06(b).

The Contractor shall drill holes for anchor bolts and set

them in Portland cement grout, or pre-set them as shown on the plans or as specified.

Location of anchors and setting of rockers or rollers shall take into account any variation from mean temperature at time of setting and anticipated lengthening of bottom chord or bottom flange due to dead load after setting; the intention being that, as near as practicable, at mean temperature and under dead load the rockers and rollers shall set vertical and anchor bolts at expansion bearings will center their slots. Care shall be taken that full and free movement of the superstructure at the movable bearings is not restricted by improper setting or adjustment of bearings or anchor bolts and nuts.

Bridge bearings shall not be placed on masonry bearing areas which are irregular or improperly formed.

807.51 STRAIGHTENING BENT MATERIAL AND CAMBERING.

(a) Straightening Bent Material: The straightening of plates, angles, other shapes and built-up members, when permitted by the engineer, shall be done by methods that will not produce fracture or other injury. Distorted members shall be straightened by mechanical means or, if approved by the engineer, by the careful planned and supervised application of a limited amount of localized heat, except that heat straightening of A514/A517 steel members shall be done only under rigidly controlled procedures, each application subject to the approval of the engineer. In no case shall the maximum temperature of the A514/A517 steel exceed 1125°F, nor shall the temperature exceed 950°F at the weld metal or within 6 inches of weld metal. Heat shall not be applied directly on weld metal. In all other steels, the temperature of the heated area shall not exceed 1200°F (a dull red) as controlled by temperature indicating crayons, liquids or bimetal thermometers.

Parts to be heat straightened shall be substantially free of stress and from external forces, except stresses resulting from mechanical means used in conjunction with the application of heat.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

(b) **Cambering:** Correction of errors in camber in welded beams and girders of A514/A517 material shall be done only under rigidly controlled procedures, each application subject to approval of the engineer.

807.52 ASSEMBLING STEEL. The parts shall be accurately assembled as shown on the plans and any matchmarks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully riveted or bolted and all other truss connections pinned and bolted. Rivets or permanent bolts in splices of butt joints of compression members and rivets or permanent bolts in railings shall not be driven or tightened until the span has been swung. Splices and field connections shall have ½ of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before riveting or bolting. Splices and connections carrying traffic during erection shall have ¾ of the holes so filled.

Fitting-up bolts shall be of the same nominal diameter as the rivets or permanent bolts and cylindrical erection pins shall be 1/32 inch larger.

807.53 RIVETING. Pneumatic hammers shall be used for field riveting except when the use of hand tools is permitted. Rivets larger than ⅞ inch in diameter shall not be driven by hand. Cup-faced dollies, fitting the head closely to insure good bearing, shall be used. Connections shall be accurately and securely fitted up before the rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled. In other respects riveting shall conform to Subsection 807.23. Field rivets shall not be smaller than the heads of the shop rivets. In removing rivets, the surrounding metal shall not be injured; if necessary, they shall be drilled out.

807.54 PIN CONNECTIONS. Pilot and driving nuts shall be used in driving pins. They shall be furnished by

the contractor without charge. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

807.55 FIELD WELDING. Field welding of steel structures, when authorized or as shown on plans, shall conform to the latest specifications for Welded Highway and Railway Bridges of the American Welding Society and the requirements of Section 916.

807.56 MISFITS. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the inspector and his approval of the method of correction obtained. The correction shall be made in his presence. If the contract provides for complete fabrication and erection, the contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements. If the contract is for erection only, the inspector with the cooperation of the contractor shall keep a correct record of labor and materials used and the contractor shall render within 30 days an itemized bill for the approval of the engineer.

807.57 SETTING BENCH MARKS. A bench mark bolt, furnished and delivered by the contractor, shall be set by the contractor without extra compensation on each bridge. The bench mark bolt shall be either hex head or square head 4 inch by ⅝ inch threaded galvanized bolt. It shall be located on the downstream side and at the end of the bridge on the right descending bank. If the bridge carries a concrete floor the bench mark plate shall be set at the end of the curb. No permanent plates or markers other than those furnished or specified will be permitted on any structure.

807.58 METHOD OF MEASUREMENT.

General: All structural steel will be measured by the weight of metal in pounds remaining in the completed and accepted structures. The weight shall be computed on the

basis of theoretical net weight from the approved shop detail drawings. No allowance will be made for rivets, bolts, nuts, washers or welds and no deductions will be made for rivet holes, bolt holes, beam copings, cut flanges or edge preparation for welding. Deduction will be made for pin holes. All plates shall be estimated from the sizes billed and deductions made for cut corners.

Such miscellaneous parts as ladders, stairways, platforms, structural supports and brackets for machinery and power equipment including pit pumps, steel framework for counterweights, floor plates, keeper plates and their tap bolts, sheet metal covers for gears, drum switches and other parts where required, shim plates, bearing plates for approach spans of whatever material is required, curb angles, anchor bolts including those for roadway gates and bronze and cast iron for expansion plates will be classified and measured as Structural Carbon Steel (A 36).

No measurement of structural steel of any class will be allowed for temporary work of any kind or for additional weight in members provided for erection purposes.

No allowance will be made in the pay quantity for any items not remaining in the finished structure except as hereinafter provided.

No allowance will be made for shop or field paints.

No allowance will be made for over-run on plates or rolled sections.

When full-sized tests of built-up structural members and eyebars are required by the contract, any full-size members tested to destruction will be measured if the test proves satisfactory. However, if the test proves the member to be unsatisfactory, the members represented by it will be rejected and no measurement or allowance will be made for such members.

Structural Carbon Steel (A 36): Carbon steel shall include all steel classified as such on the contract drawings and unless otherwise noted on the plans, such minor items as anchor materials including pins, rollers, metal railings, steel plates and shapes for expansion joints, ladders, wrought iron sheets, checkered floor plates, bronze castings and plates, steel castings, and iron castings (except cast iron drains in floors) and all other items described under

"General" necessary to complete this portion of the structure.

Manganese Vanadium Steel (A 441): Manganese vanadium steel shall include all steel classified as such on the contract drawings.

Manganese Steel (A 440): Manganese steel shall include all steel classified as such on the contract drawing.

High-Strength Low-Alloy Steel (A 588): High-strength low-alloy steel shall include all steel classified as such on the contract drawings.

Metal weights shall be computed on the following basis:

Aluminum, cast or wrought	173.0 pounds/cu. ft.
Bronze, cast	536.0 pounds/cu. ft.
Copper-alloy	536.0 pounds/cu. ft.
Copper, sheet	558.0 pounds/cu. ft.
Iron, cast	445.0 pounds/cu. ft.
Iron, malleable	470.0 pounds/cu. ft.
Iron, wrought	487.0 pounds/cu. ft.
Lead, sheet	707.0 pounds/cu. ft.
Steel, rolled, cast, copper bearing, silicon, nickel, and stainless	490.0 pounds/cu. ft.
Zinc	450.0 pounds/cu. ft.

Shear connectors will be measured by the lump sum.

807.59 BASIS OF PAYMENT. The number of pounds of completed and accepted steel and other metals of the various categories, measured as provided above, shall be paid for at the contract unit price per pound for Structural Carbon Steel (A 36), Manganese Vanadium Steel (A 441), Manganese Steel (A 440) or High-Strength Low-Alloy Steel (A 588), as the case may be.

Asphaltic concrete filling for recesses in structural steel members, if required, shall be included in the unit prices for the various items of structural steel.

The expense of conducting "full-size tests," if required, shall be borne by the contractor.

Shear connectors installed and accepted shall be paid for at the contract lump sum price.

When the contract price of Structural Carbon Steel (A 36), Manganese Vanadium Steel (A 441), Manganese Steel (A 440), High-Strength Low-Alloy Steel (A 588) or of the combination of these items exceeds $10,000.00, the

number of pounds of the various items to be allowed on the monthly estimates shall be as follows:

Ninety percent of the invoice price for the number of pounds of the various items of structural steel delivered and properly stored at the project site or other designated locations in the vicinity of the construction as provided in Subsection 109.07.

Ninety percent of the contract price for the number of pounds of the various items of structural steel erected in place and connected.

One hundred percent of the contract price for the number of pounds of the various items of structural steel erected complete in place and painted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
807(1)	Structural Carbon Steel (A 36)	Pound
807(2)	Manganese Vanadium Steel (A 441)	Pound
807(3)	Manganese Steel (A 440)	Pound
807(4)	Shear Connectors	Lump
807(5)	High-Strength Low-Alloy Steel (A 588)	Pound

Section 808

Steel Grid Flooring

808.01 DESCRIPTION. This work shall consist of furnishing and installing steel grid flooring of the open type or the concrete-filled type as specified, in accordance with these specifications and in reasonably close conformity with the details shown on the plans.

The floor shall meet the requirements for the design of steel grid floors as contained in the current AASHO Standard Specifications for Highway Bridges. Before fabrication or construction is undertaken, the contractor shall submit complete shop and assembly details to the Bridge Design Engineer for approval. Shop details shall conform to the requirements of Subsection 801.03.

808.02 MATERIALS. The steel grid flooring shall conform to the requirements of Subsection 913.21.

Concrete. All concrete in filled steel grid floors shall be Class A conforming to the applicable requirements of Sections 805 and 901.

Skid Resistance. The upper edges of all members forming the wearing surface of an open type grid flooring shall be fabricated or treated to give the maximum skid resistance.

808.03 FABRICATION. The steel grid floor shall conform to all requirements of these specifications even though the manufacturer's specifications are different. Deviations from these specifications to conform to manufacturer's specifications, where different, will not be permitted without approval of the Bridge Design Engineer.

808.04 NOTICE OF BEGINNING OF WORK. The contractor shall give the Bridge Construction Engineer at least 10 days advance written notice of the beginning of work at the mill or in the shop so that inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. No material shall be manufactured or work done in the shop

before shop drawings have been approved and before the Bridge Construction Engineer has been notified.

808.05 FACILITIES FOR INSPECTION. The contractor shall furnish facilities for the inspection of material and workmanship in the mill and shop and the inspector shall be allowed free access to the necessary parts of the works.

808.06 STORAGE OF MATERIALS. Steel grid flooring shall be stored at the bridge site, above ground, upon platforms, skids or other supports. It shall be kept free from dirt, grease and other foreign matter and shall be protected as far as possible from corrosion. It shall be properly drained.

808.07 STRAIGHTENING MATERIAL. Steel grid flooring sections, before being installed, shall be straight, except for camber if specified. If straightening is necessary, it shall be done by methods that will not injure the metal.

808.08 ARRANGEMENT OF SECTIONS. Where the main elements are normal to centerline of roadway, the units generally shall be of such length as to extend over the full width of the roadway for roadways up to 40 feet, but in every case the units shall extend over at least 3 panels. Where joints are required, the ends of the main floor members shall be welded at the joints over their full cross-sectional area or otherwise connected to provide full continuity.

Where the main elements are parallel to centerline of roadway, the sections shall extend over not less than 3 panels, and the ends of abutting units shall be welded over their full cross-sectional area or otherwise connected to provide full continuity in accordance with the design.

808.09 PROVISION FOR CAMBER. Unless otherwise provided on the plans, provision for camber shall be made as follows:

Steel units so rigid that they will not readily follow the camber required shall be cambered in the shop. To provide a bearing surface parallel to the crown of the roadway, the stringers shall be canted or provided with shopwelded beveled bearing bars. If beveled bars are used, they shall be placed along the centerline of the stringer flange, in which case the design span length shall be governed by the width of the bearing bar instead of by the width of the stringer flange.

Longitudinal stringers shall be mill cambered or provided with bearing strips so that the complete floor after dead-load deflection shall conform to the longitudinal camber shown on the plans.

808.10 FIELD ASSEMBLY. Areas of considerable size shall be assembled before the floor is welded to its supports. The main elements shall be made continuous and sections shall be connected together along their edges by welding of bars or by riveting them. The connections shall meet with the approval of the engineer. The rivets may be cold driven.

808.11 CONNECTION TO SUPPORTS. The floor shall be connected to its steel supports by welding. Before any welding is done, the floor shall either be loaded to make a tight joint with full bearing or it shall be clamped down. The location, length and size of the welds shall be subject to the approval of the Bridge Design Engineer, but in no case shall they be less than the manufacturer's standards.

The ends of all the main steel members of the slab shall be securely fastened together at the sides of the roadway for the full length of the span by means of steel plates or angles welded to the ends of the main members, as shown on the plans.

808.12 WELDING. All shop and field welding shall conform to the Requirements of Section 916.

Surfaces to be welded shall be free from paint, grease, loose scale, rust and other material that will prevent a proper weld. A thin coating of linseed oil, without pigment, need not be removed; however any clinkers or slag caused by flame cutting or other causes shall be removed before welding.

Field welding shall conform to the approved method and location as shown on the shop drawings.

808.13 PAINTING. The open steel grid floor shall be cleaned and receive one shop coat and 3 field coats of paint in accordance with the requirements of Section 811 and the following.

The cleaning shall be done by the Near-White Blast Cleaning Method or Pickling Method at the option of the contractor.

The paint system used shall be the Basic Lead Silico Chromate System.

Painting of concrete-filled grid floor shall be in accordance with the last paragraph of this subsection.

The shop coat of paint may be applied by dipping, spraying or brushing. Paint for the shop coat of composition different from that stipulated in these specifications will be considered and the engineer will advise before bids are received, if requested, whether any particular manufacturer's paint is satisfactory for the shop coat. Particular attention is directed to the cleaning of surfaces to be painted. Slag shall be cleaned from all welds, and spatter, rust, loose mill scale, dirt, oil or grease from all surfaces to be painted before the shop coat of paint is applied.

Field coats may be applied by brushing or spraying. If paint is sprayed, it may be applied with either a single nozzle gun or a gang sprayer appropriately rigged up. Spraying of paint shall be done when the wind is comparatively calm and care shall be taken that movable parts of machinery and concrete surfaces are properly protected during the application of the paint. The flooring shall be sprayed before applying the final field coat to surfaces below the open grid floor.

For the filled type of grid flooring, the underside of the bottom plate and the other faces of headers, trim bars and end bars shall receive one coat of shop paint and 3 coats of field paint.

808.14 USE OF ALTERNATE SECTIONS. If the contractor prefers to use a type of steel grid flooring other than that shown on the special plans for a particular bridge, he will be permitted to substitute another section selected from the various types shown on the standard plan titled "Open Grid Bridge Flooring," included in the project plans. However in each case, the plans will specify which of the alternate sections will be considered equal to the section shown on the special plans and therefore acceptable to the Bridge Design Engineer. If the use of an alternate section requires supporting members in addition to those shown on the special plans, the maximum spacing of such members shall be shown on the standard plan for the section being used. The size of such members shall be determined on the basis of the specified design load, as shown on the plans, and in accordance with the current AASHO Standard Specifications for Highway Bridges for design

methods. In the event an alternate section is used, all structural changes in the design of the floor system necessitated by the substitution shall be incorporated in the shop details covering the grid flooring so that it will be possible to check the entire floor system from the information shown in the shop details.

808.15 CONCRETE FILLER. Where indicated on the plans, concrete filler shall be placed in the open grid. Concrete is to be Class A in accordance with Section 901; however, the maximum size coarse aggregate shall be 3/8 inch.

Floor types with bottom flanges not in contact shall be provided with bottom forms of metal or wood to retain the concrete filler without excessive leakage.

If metal forms are used, they shall fit tightly on the bottom flanges of the floor members and be placed in short lengths so as to extend only about 1 inch onto the edge of each support, but in all cases the forms shall be such as will result in adequate bearing of the slab on the support.

The concrete shall be thoroughly consolidated by vibrating the steel grid floor. The vibrating device and the manner of operating it shall be subject to approval.

808.16 METHOD OF MEASUREMENT. The steel grid flooring shall include all steel which enters into the fabrication, assembling and erecting of the flooring and all welding or riveting required. Structural shapes such as curb plates and angles, risers, etc., if called for on the plans, will not be measured as steel grid flooring but as fabricated carbon steel as provided in Section 807. However base plates for curbs will not be measured separately, but will be included in the area for measurement of the steel grid flooring. If an alternate section is used, no supporting members in addition to those shown on the special plans will be measured as they will be considered an integral part of the alternate flooring.

Measurement will be made by the square foot for the area of steel grid flooring remaining in the completed and accepted structure. Measurements will be made to the outside line of the grid flooring. Opening for manholes, notches for leaf guide casting, etc., will not be deducted.

Concrete used for filling steel grid flooring will be mea-

sured by the cubic yard. Deduction in the quantity of concrete will be made for the volume of steel grid flooring enclosed by the concrete. In order to compute the net volume of concrete, the weight per square foot of the open floor (weight taken from standard plan) shall be converted in volume per square foot of flooring at the rate of 490 pounds per cubic foot.

808.17 BASIS OF PAYMENT. The accepted quantity of steel grid flooring will be paid for at the contract price per square foot complete in place.

Concrete will be paid for under Item 805(1).

Structural steel, when called for on the plans, will be paid for under Item 807(1).

Payment will be made under:

Item No.	Pay Item	Pay Unit
808(1)	Steel Grid Flooring	Square Foot

Section 809

Movable Bridges

809.01 DESCRIPTION. This work shall consist of the furnishing, fabrication and erection of movable span bridges and of all appurtenances required for their operation such as machinery, operating house, traffic barriers, power plant and machinery houses.

The requirements for fixed span bridges, as given in these specifications, shall apply to movable bridges except as herein provided.

809.02 SILENCE OF SPECIFICATIONS. The apparent silence of these specifications as to any detail or the omission from them of a detailed description of any point shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of first quality are to be used in such cases.

809.03 OBJECTION TO SPECIFICATIONS. If the contractor has any objections to any features of the machinery, operating house, traffic barriers or power equipment as required by these specifications, he must state his objections in writing to the engineer before any parts are manufactured.

809.04 GUARANTEE OF MACHINERY, OPERATING HOUSES, TRAFFIC BARRIERS AND POWER EQUIPMENT. All machinery, operating houses, traffic barriers and power plant equipment shall be satisfactory and the contractor shall furnish and install without charge any and all parts which may fail or otherwise prove defective within one year of the date on which the bridge is finally accepted. If it should be found that the parts failed due to defective material or faulty workmanship and if such parts should, within the said one year, cause any breakdown or accident, the contractor will not only be required to furnish and install the defective part but will also be held pecuniarily responsible to the Department for all expense to the latter due to such failure.

809.05 BOND. As a guarantee to cover the replace-

ment of defective or broken parts as stated above, the contractor will be required to furnish satisfactory bonding in full amount of the price bid for machinery, operating houses, traffic barriers and power equipment. This bond shall remain in effect for a period of one year from date of final acceptance of the bridge and shall be filed in the offices of the Louisiana Department of Highways prior to the payment of the final estimate.

809.06 DRAWINGS. Shop drawings, brochures and work drawings shall be furnished in accordance with Subsection 801.03.

809.07 MAINTENANCE AND OPERATION INSTRUCTION BOOKLETS. Maintenance and operation instruction booklets shall be furnished in accordance with Subsection 801.03.

809.08 INSTRUCTOR AND INSTRUCTION TO OPERATORS. The contractor shall notify the engineer when the span, including the power plant, operating house, traffic barriers and machinery, is sufficiently complete so that the span is operable, in order that the permanent bridge operators may be assigned for instruction. At this time, the contractor shall furnish a competent man, experienced in the operation of equipment of this character, for a period of 5 working days of 8 hours each to instruct the owner's bridge operators in the complete and correct operation of the bridge. This 5 day period of instruction shall be prior to final inspection. This provision shall also apply for manually operated movable bridges.

809.09 TOOLS AND MAINTENANCE EQUIPMENT TO BE FURNISHED BY THE CONTRACTOR. The contractor shall furnish a set of tools, tool chest with lock and equipment as may be required for ordinary servicing and maintenance of the bridge. In the absence of further specific requirements, the contractor shall furnish a set of wrenches to fit the heads and nuts of all machinery bolts. The contractor shall also furnish grease guns and oiling equipment to fit all lubrication fittings.

809.10 METALS. All structural and miscellaneous metals to be used in the manufacture of parts for movable bridges shall be as listed in Part IX, Materials and Part XI, Design of Movable Bridges of these specifications, contract special provisions and as shown on the plans.

809.11 WIRE ROPE AND ATTACHMENTS. Wire rope and attachments shall be as specified in Section 909, contract special provisions and as shown on the plans.

CONSTRUCTION REQUIREMENTS

809.12 GENERAL FABRICATION AND ERECTION REQUIREMENTS. Except as otherwise provided herein, the fabrication and erection of structural parts shall conform to the requirements for fixed-span bridges.

809.13 MANUFACTURE AND FABRICATION OF MACHINERY AND TRAFFIC BARRIERS.

(a) Shop Practice: The manufacture of machinery and traffic barrier parts shall be in accordance with the current and best practice of modern foundries and machine shops. The general manufacture of machined parts shall be in accordance with applicable standards of the American National Standards for the various items required.

(b) Inspection: The contractor shall give the engineer 10 days advance written notice before beginning the manufacture of any item, so that inspection may be provided. The contractor shall furnish facilities for the inspection of material and workmanship. The inspectors shall be allowed free access to plant facilities for adequate inspection of the work. This inspection shall be at the option of the Department and shall in no way relieve the contractor of any responsibility placed upon him by his contract.

(c) Fit Tolerances (Plus and Minus) for Accurate Work: The allowances which should be made for different kinds of fits are tabulated hereinafter. They are based on the use of the hole as the nominal size and give the amounts by which the shaft should be less than (minus) or greater than (plus) the nominal hole size. If the shaft is selected as the base, the allowances for the hole will be of the same magnitude but of opposite sign. The permissible tolerance is the difference between the minimum and maximum allowances.

(d) Classifications of Fits and Surface Finishes:

Classifications	ANS Surface Finish
Loose Fit (Class 1), Large Allowance. This fit provides for considerable freedom	

and embraces certain fits where accuracy is not essential. Suitable for ordinary bearings on shafts which are subject to light journal pressures (600 psi or less).	Bearings—16 Journals— 8
Free Fit (Class 2), Liberal Allowance. For running fits with speeds of 600 rpm or over and journal pressure of 600 psi or over. Also use this fit for heavily loaded journals on shafts and trunnions.	Bearings—16 Journals— 8
Medium Fit (Class 3), Medium Allowance. For running fits under 600 rpm and journal pressures less than 600 psi; also for sliding fits.	Bearings—16 Journals— 8
Snug Fit (Class 4), Zero Allowance. This is the closest fit which can be assembled by hand and necessitates work of considerable precision.	125
Wringing Fit (Class 5), Zero to Negative Allowance. This is also known as a tunking fit and is practically metal to metal.	125
Tight Fit (Class 6), Slight Negative Allowance. Light pressure is required to assemble these fits.	125
Medium Force Fit (Class 7), Negative Allowance. Considerable pressure is required to assemble these fits, and the parts are considered permanently assembled.	125
Heavy Force and Shrink Fit (Class 8), Considerable Negative Allowance. These fits are used for steel holes where the metal can be highly stressed without exceeding its elastic limit.	125
Shafts Outside Bearings:	250
Allowances for the various classifications of fits shall be in accordance with the following tables.	

ALLOWANCES FOR VARIOUS TYPES OF FIT

(Allowances, Tolerances and Interference are given in ten-thousandths of an inch).

Size, inches	Loose Fit (Class 1)		Free Fit (Class 2)		Medium Fit (Class 3)		Snug Fit (Class 4)		Wringing Fit (Class 5)		Tight Fit (Class 6)	Med. Force Fit (Class 7)	Heavy Force & Shrink. (Class 8)
	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Tightest fit	Loosest fit	Selected fit	Selected fit	Selected fit
	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Average Interference	Average Interference	Average Interference
	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(−)	(−)	(−)
1-1/16—1-3/16	30	90	15	43	10	26	0	10	4	6	3	6	11
1-3/16—1-3/8	30	90	16	44	10	28	0	10	4	6	3	6	13
1-3/8 —1-5/8	30	90	18	48	12	30	0	12	5	7	4	8	15
1-5/8 —1-7/8	40	100	20	52	13	33	0	12	5	7	4	9	18
1-7/8 —2-1/8	40	100	22	54	14	34	0	13	5	8	5	10	20
2-1/8 —2-3/8	40	100	24	58	15	35	0	13	5	8	6	11	23
2-3/8 —2-3/4	50	110	26	62	17	39	0	13	5	8	6	13	25
2-3/4 —3-1/4	50	130	29	67	19	43	0	15	6	9	8	15	30
3-1/4 —3-3/4	60	140	32	72	21	45	0	15	6	9	9	18	35
3-3/4 —4-1/4	60	140	35	77	23	49	0	16	6	10	10	20	40
4-1/4 —4-3/4	70	150	38	80	25	51	0	17	7	10	11	23	45
4-3/4 —5-1/2	70	150	41	85	26	54	0	17	7	10	13	25	50
5-1/2 —6-1/2	80	180	46	94	30	60	0	18	7	11	15	30	60
6-1/2 —7-1/2	90	190	51	101	33	63	0	19	8	11	18	35	70
7-1/2 —8-1/2	100	200	56	108	36	68	0	20	8	12	20	40	80

(+) denotes clearance or amount of looseness
(−) denotes interference of metal or negative allowance

For larger than 8½" diameter use following:

Formulas for Recommended Allowances and Tolerances

Class of Fit	Method of Assembly	Allowance	Selected Average Interference of Metal	Hole Tolerance	Shaft Tolerance
(1) Loose	Strictly Interchangeable	$0.0025\sqrt[3]{d^2}$		$0.0025\sqrt[3]{d}$	$0.0025\sqrt[3]{d}$
(2) Free	Strictly Interchangeable	$0.0014\sqrt[3]{d^2}$		$0.0013\sqrt[3]{d}$	$0.0013\sqrt[3]{d}$
(3) Medium	Strictly Interchangeable	$0.0009\sqrt[3]{d^2}$		$0.0003\sqrt[3]{d}$	$0.0003\sqrt[3]{d}$
(4) Snug	Strictly Interchangeable	0.0000		$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(5) Wringing	Selective assembly		0.0000	$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(6) Tight	Selective assembly		0.00025d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(7) Medium force	Selective assembly		0.0005d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(8) Heavy force or shrink	Selective assembly		0.001d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$

d = diameter of fit in inches.
The formulas for allowance values give the ideal condition of fit for Classes 1 to 4.
The formulas for selected average interference of metal give the ideal condition of fit for Classes 5 to 8.

809.14 SHAFTS, TRUNNIONS AND JOURNALS. Shafts and trunnions shall be made with fillets where abrupt changes in section occur.

Unless otherwise specified, the journals of shafts and trunnions shall be polished to ANS No. 8 surface finish after being machined. For shafts and trunnions more than 8 inches in diameter, there shall be a hole bored lengthwise through the center. The diameter of the hole shall be approximately 1/5 the diameter of the shaft or trunnion.

809.15 COUPLINGS. The faces of flange couplings shall

be planed to ANS No. 125 surface finish and holes bored in pairs.

809.16 HUBS. Hubs of wheels, pulleys, gears and couplings shall be bored true to center for Class 7 fit upon their shafts or axes. The ends of hubs shall be finished, as required.

809.17 BUSHINGS. Bushings shall be bored to fit the matching shaft or journal to within the tolerances specified.

The bearing housing shall be bored to fit the outside of the bushing.

The contact edges of oil grooves and bushings shall be rounded.

Babbitt metal, when required, shall be poured in the bearing in such a way that the thickness of the bushing after boring will be uniform.

809.18 BEARING HOUSING. The rubbing and bearing surfaces shall have an ANS No. 16 surface finish and the joints between cap and base of bearings shall have an ANS No. 125 surface finish. The holes in cap and base shall be drilled. The holes in bearings, for bolts fastening them to their supports, shall be drilled or reamed to size and bolts turned as required in Subsection 809.24. The holes in the supports shall be reamed to fit after the bearings have been adjusted. Bearings shall be finished on both ends. Trunnion bearings shall be bored parallel with the base.

809.19 GEAR TEETH. The teeth of gears transmitting power for the operation of the bridge shall be machine cut. The periphery and ends of teeth of gears shall be turned. The pitch circle shall be scribed on the teeth. The teeth of the rack may be either cast or cut and finished, as specified.

809.20 BEVEL GEARS. The teeth of bevel gears shall be cut by a planer having a rectilinear motion in lines through the apex of the cone. Rotating milling cutters shall not be used for making bevel gears.

809.21 WORMS AND WORM WHEELS. Threads on worms shall be machine cut and the teeth of worm wheels shall fit the worm accurately with surface or line contact.

809.22 KEY AND KEYWAYS. Keys shall be planed and keyways machine cut. The finish of the keys and keyways shall be such as to give the key a Class 7 fit on all the

sides. Tapered keys shall bear on the top, bottom and sides; parallel faced keys on the sides only.

809.23 CASTINGS. Castings shall be cleaned and all fins and other irregularities removed so that they will have clean, smooth, uniform surfaces suitable for this class of work. Castings which are to be attached to structural steel or other castings shall have their contact surfaces finished to ANS No. 250 surface finish. Unfinished edges of bases, ribs and similar parts shall be neatly cast with rounded corners. Inside angles shall have proper fillets. Bosses shall be finished to the correct plane. Surfaces of castings in contact with masonry shall have ANS No. 2000 finish.

809.24 BOLT HOLES AND TURNED BOLTS. Holes for unfinished bolts shall be drilled or reamed not more than 1/16 inch larger in diameter than the bolt. The diameter of the shank of turned bolts shall be of such size as to make a Class 6 fit for the holed parts.

809.25 AIR BUFFERS. The workmanship on air buffers shall be so accurate that the weight of the cylinder and its attachments will be sustained by the confined air for 6 minutes, with the cylinder lubricated with a light oil and with a piston travel not more than that which occurs during the closure of the bridge. The valves must be closed and the buffers balanced so that the whole weight is carried by the piston rod.

809.26 BRAKES AND BRAKE LININGS. Brake shoes or bands shall be made so as to bear uniformly on the brake wheel. Brake linings shall preferably be attached to the shoes by means of copper rivets or approved bonding and in such manner as to be easily accessible for replacement.

809.27 RACK AND TRACK. In swing bridges, track segments shall be finished on the top and at the ends to ANS No. 250 surface finish. The track centerline shall be scribed on the surface.

The tooth segments forming the rack shall be fitted accurately. Particular care shall be taken to have the pitch of the teeth at the joints accurate and continuous. The tip of rack teeth shall be machine finished to a true circle. The pitch line shall be scribed on the teeth.

The backs of racks which bear on metal surfaces and the surfaces in contact with them shall be finished to ANS No.

1000 surface finish. Surfaces which bear on masonry shall have ANS No. 2000 surface finish.

809.28 PIVOT PEDESTALS. The disc seats shall be so finished as to insure a horizontal position of the span.

809.29 DISCS. Discs for pivot bearings shall be fitted accurately, finished to gage and shall be ground accurately to the final finish. The sliding contact surface of steel and phosphor-bronze discs shall be polished to ANS No. 8 surface finish. Disc centers shall be assembled, fitted accurately and match-marked.

809.30 BALANCE WHEELS. The periphery and faces of balance wheels shall be turned to ANS No. 250 surface finish, the corners shall be rounded and the centerline of the balance wheels shall be scribed on the periphery. The hubs shall be bored accurately and faced on both ends.

809.31 PLANING GIRDERS. In built track girders and segmental girders of rolling bascule bridges the edges of the webs, side plates, and angles shall be planed to ANS No. 250 surface finish so that full bearing on the track plate will be assured.

809.32 TREAD PLATES AND TRACK SEGMENTS. The contact surfaces of tread plates and track segments shall be planed to ANS No. 250 surface finish so that full bearing on the tread plates will be assured.

809.33 OIL OR GREASE GROOVES IN TRUNNIONS. The oil or grease grooves in the surfaces of trunnions and similar large bearings shall be machine cut. After machining, small inequalities may be removed by chipping and filing. The grooves shall be smooth, especially the rounded corners.

809.34 BORING AND ASSEMBLY OF TRUNNION BEARINGS. When trunnion bearings are to be mounted on flexible supports, they shall be so bored that when the trunnion girder or support deflects under full dead load, the axes of the trunnions will be coincident.

Trunnions shall be fitted to their bearings in the manufacturer's shop. If they are to be disassembled for shipment, they shall be match-marked for field erection.

809.35 SHEAVES. The grooves in sheaves shall be turned. The shape of the grooves shall conform as closely as feasible to the rope section so that while the ropes run

freely in the grooves, the sides of the grooves shall prevent the wire ropes from flattening under static loads, as when supporting counterweights. Segmental sheaves shall be completely assembled and, if of welded construction, shall be stress relieved before the grooves are turned. The variation from the required diameter shall not exceed plus or minus 0.01 inch.

Sheaves shall have ANS Class 8 fit on shaft or axle.

Both ends of hub shall be finished as specified.

809.36 HOLES FOR SHEAVES FOR VERTICAL LIFT BRIDGES. In vertical lift bridges, the holes in the girders and columns for the bolts connecting the main sheave bearings to their supporting girders shall be drilled from the solid through cast iron or steel templates on which the bearings were set and accurately aligned when the holes in the bearings were bored. The bolt holes and the bolts shall be the same diameter and the bolts driven in place without injury to the bolts, the bearings, the girders or the columns.

809.37 SHOP ASSEMBLY OF MACHINERY. When specified, machinery parts shall be assembled in the shop on their structural supports. They shall be aligned, adjusted and fitted in their correct relative positions and holes in the structural supports shall be drilled to correctly match the holes in the machinery parts. The parts shall be match-marked before disassembling and they shall be erected in the field in the same relative positions.

When specified, the complete center of swing spans, including rack and track segments, shall be assembled in the shop and aligned, fitted, drilled and the parts match-marked. When specified, the complete gear train shall be assembled in the shop and subjected to a specified time run.

When assembling in the shop is not required, the holes in the structural supports shall be left blank to be drilled in the field after the machinery parts have been set to correct alignment and adjustment or subpunched or drilled ¼ inch smaller and reamed to size in the field after erection.

809.38 HYDRAULIC PIPING. The inside of hydraulic piping shall be bright, clean and free from grease, drawing compounds, oxide, scale and carbon deposits. Any pipe which has been pickled to remove scale shall be treated to

eliminate pickle brittleness. The inside of the pipe shall then be coated with clean oil and the ends of the pipe sealed for protection against corrosion during shipment to and storage at the job site. The corrosion preventive oil used shall be such that after extended storage periods it can be readily removed with an alkaline cleaning solution or with benzine. Welding of hydraulic piping shall conform to the requirements of Section 807.

809.39 PROTECTION OF MACHINERY, POWER PLANT AND TRAFFIC BARRIER PARTS DURING SHIPMENT. All finished rubbing and bearing surfaces of machinery and traffic barrier parts shall be given a protective coating before shipment. The bearing surfaces of trunnions, heavy axles and shafts, in addition to the protective coating, shall be protected by wood lagging securely attached.

The bearing surfaces of other shafts, axles and similar parts shall be covered with burlap or other satisfactory protecting material. Small machinery and traffic barrier parts shall be boxed or crated.

All electrical apparatus shall be thoroughly protected by boxes or crates. Electric motors not designed to be operated fully exposed to the weather shall be protected by waterproof coverings.

809.40 ERECTION.

(a) Position of Span During Erection: Movable bridges may be erected in either the open or closed position, as may be approved by the navigation authorities and the engineer.

(b) Protection of Machinery, Operator House and Traffic Barrier Parts During Erection: Parts which are protected from the weather in the completed structure or during shipment from the shop shall be likewise protected during unloading, field storage and erection. Special care shall be exercised in protecting electrical parts. Wire ropes shall be stored not less than 16 inches above the ground and free from conditions likely to produce corrosion of the wires or decay of the hemp cores. While being unwound or otherwise handled during the operations incident to their installation upon counterweights, sheaves and drums, they shall not be kinked or bent to short radius curves nor shall they be dragged over stones,

rough metal surfaces or other material likely to produce abrasions upon the exposed surfaces of the wires.

(c) General Requirements for Machinery and Traffic Barrier Erection: The alignment and adjustment of machinery, electrical equipment and traffic barriers shall be done by skilled mechanics. Trunnion bearings and all important shaft bearings shall be set using piano wire or optical methods to determine their correct adjustment.

Shims shall be of sheet steel and brass shim stock. The contractor shall have a supply of shims varying in size and thickness with a minimum thickness of 3/1000 of an inch. Shims shall be used for aligning and adjusting machinery to its proper place prior to securing it rigidly in position with bolts or other fastenings. Brass shim stock shall be used for the final adjustment. To prevent localization of stresses in the machinery and traffic barrier parts, the shims shall not be less in dimensions than the bearing area being shimmed.

All minor pockets and depressions formed as a result of erection and which may collect moisture or oil shall be drained even when drainage is not called for on the plans, provided that none of the parts drained are weakened by the drainage openings.

(d) Lubrication: All rotating and sliding parts shall be thoroughly cleaned and well lubricated during erection. All parts shall be properly lubricated before the operating machinery is tested. Counterweight and operating ropes shall be given one coat of an approved lubricant.

(e) Camber, General Requirements: When movable bridges are being erected, care shall be taken to set the camber blocking to the necessary heights, so that the span will be assembled to the proper camber curves when the structural parts are in the unstressed condition. When the camber blocking is struck and the spans swung, the rivets in all main truss connections shall have been driven or the joints 100 percent pinned and bolted so that no slip will occur at the connections.

(f) Camber for Swing Spans: When swing spans are erected upon camber blocking, the blocking shall be set to such elevation as to fulfill the following requirements:

1. When the blocking is removed and the span allowed

to swing free under full dead load at normal temperature, the elevations at the span ends shall be at a distance below grade equal to the specified end lift.

2. When the wedges are fully driven and the structure is acting under full dead load including the deck, the elevation at all panel points shall conform to the specified grade line.

It will be observed that the above method involves the superimposition of 2 cambers. The first is equal to the deflection of the structure as a cantilever under full dead load and the second is equal to the deflection when acting as a continuous or partially continuous span under full dead load and the dead load end reactions.

(g) Alignment of Bascule Leaves: The trusses or girders of a bascule span erected in an open position shall be held to correct alignment and position by means of struts, braces and guys. When required, the punching of laterals shall be left blank until the bridge is lowered so as to permit adjustment of the alignment to insure correct closing and locking.

(h) Alignment and Trunnion Bearings: Special care shall be taken in alignment of trunnion bearings by means of beveled shims or other means provided so that when full deflection of the trunnion girder or bearing support occurs under full dead load, the axes of the trunnions will be coincident.

(i) Alignment of Vertical Lift Spans: Special care shall be taken to assure the proper spacing and aligning of the towers so that the towers and guides will be truly vertical when the dead load of the span and counterweight has been applied.

(j) Service Test of Machinery: A service test of the power operation of the span shall be made by moving the span through a number of complete open and close cycles. The number of cycles required will be determined by the engineer. These cycles of movement shall be executed in succession without intervals of rest between them, so that any tendency of the operating parts to become heated may be discovered. All defects found, in the operation of the span, shall be corrected.

809.41 COUNTERWEIGHTS. The counterweights shall

be sufficient to balance the moving span and its attachments in any position, except that in vertical lift bridges the counterweight ropes shall not be balanced unless otherwise specified.

Counterweights shall be of concrete, supported in a steel box or by a steel frame. Unless otherwise provided, they shall be made adjustable so that variations in the weight of the movable span may be easily provided for. This shall be done by adding or taking off concrete or cast iron blocks in properly located pockets. Concrete blocks weighing not over 100 pounds each shall be used unless otherwise provided and they shall be provided with eye or ring bolts to facilitate handling. Space for 5 percent under and 5 percent above the calculated weight shall be provided. Movable blocks totaling the amount of 7 percent shall be provided. The pockets shall be provided with drain holes not less than 6 inches in diameter. If the counterweights of bascule and vertical lift bridges are located above the floor of the approaches, the vertical clearance between the counterweights and the floor, curbs, sidewalks or handrails shall not be less than 2 feet and 6 inches when the bridge is in the fully open position. In calculating the minimum clearance, the counterweight ropes shall be assumed to stretch 2 percent of their calculated length.

Concrete for counterweight and adjusting blocks shall be Class A, weighing approximately 145 pounds per cubic foot, unless otherwise specified. Steel punchings or scrap metal may be used when necessary to increase the concrete unit weight. If clean steel punchings are used, they shall be placed in layers and grouted with a cement mortar composed of one part Portland cement and 2 parts sand. The maximum available total weight shall not be taken as more than 315 pounds per cubic foot. Such a mixture shall not be used as a coutnerweight which revolves above a horizontal axis, unless retained in place by a surrounding steel box or by walls of reinforced concrete.

The fabricator of the structural steel shall determine the weight and where it is necessary, the location of the center of gravity of the moving span, including all parts attached thereto, and of the counterweights, including their frames. These determinations shall be based on weights carefully computed from approved shop plans and these weights shall

include the structural steel, machinery, flooring and everything attached to the movable parts of the bridge. The adjustment pocket of the counterweights is to be assumed ½ full when determining the size of counterweights.

The determination of the proper mixture for the counterweights in order to give the desired unit weight is especially important and a series of tests shall be made well in advance of the time that placing of the concrete is to begin to determine the unit weight of the concrete which can be obtained from the materials at hand. Test blocks containing not less than one cubic foot shall be made and a record kept showing the weight of the blocks when cast and when 1, 2, 3 and 7 days old. This record of test blocks must be submitted to the engineer for approval before concreting is to begin and these tests shall be made by the contractor in time to have the information available for the fabricator by the time the latter is ready to detail the counterweights.

The unit weight of materials entering into the construction of the floor deck is an important factor in the determination of the volume of the counterweights and the contractor shall furnish the engineer and fabricator with the unit weight of the materials used in the floor. The determination of the unit weights shall be made by actually weighing samples of these materials. If the floor is of concrete, test blocks shall be made as outlined above to determine the unit weight of the floor slab as constructed.

The contractor shall assume full responsibility for the correctness of the center of gravity calculations. He shall also be responsible, where necessary, for the detail drawings of the counterweights and the construction of the counterweights of correct unit weight so that the bridge, when completed, will be in proper balance. The contractor shall be fully responsible for the balancing of the bridge and shall make free of charge, all necessary adjustments and alterations which may be required to obtain a proper balance.

If the contractor sublets the fabrication, such subletting will not relieve him from the full responsibility for the correctness of the counterweight calculations and all other required work, whether performed by him or his subcontractors. This, however, shall not relieve the subcontractor

of any responsibility which he may have under his contract with the contractor.

809.42 POWER PLANT.

(a) General: This item shall be as provided in Part XI, Design of Movable Bridges, of these specifications and as shown on the plans and contract special provisions except as provided herein.

(b) Power Supply: On electrically operated bridges, the contractor shall make all necessary arrangements with the power company for electrical service. The contractor shall furnish and install the service pole and shall bring the electrical power service to the switchboard in the operating house. Unless otherwise provided, the electrical service shall be 110/220 volts, 4 wire delta, 3 phase, 60 Hertz A.C. and shall be brought into the operating house underground in rigid metal conduit.

No direct payment or additional allowance will be made for the power used in the operation of the movable span while testing and adjusting or for power used while instructing the permanent bridge operators or for power used for any other reason while the bridge is being completed prior to final inspection. The cost of power consumed before the final inspection and acceptance by the Department shall be included in the lump sum bid under Item 809(3).

(c) Inspection of Switchboard and Control Desk: Before shipment, the control desk and switchboard shall be tested for operation sequence of devices, grounds and ability to withstand operating voltages and currents in accordance with N.E.M.A. standards. The contractor shall give the engineer ample notice before making final tests so that the engineer may arrange to have an observer present to inspect the switchboard and control desk and to witness these tests. Witnessing of the tests or not shall be at the option of the Department and shall in no way relieve the contractor of any responsibility placed upon him by his contract.

(d) Grounding and Bonding: The entire system shall be grounded and bonded in accordance with the National Electric Code. All conduit runs shall be bonded at the control desk and switchboard as well as throughout the system.

(e) **Wiring:** Unless otherwise provided, all conductors shall be copper and have a rated 600 volt moisture and heat resistant insulation, National Electric Code Designation Type RHH-RHW, XLPE insulation, and shall conform to the requirements of Subsection 915.12.

All conductors, except spares, shall be terminated on high pressure connector barrier type terminal blocks. All conductors shall be identified with adhesive type wire markers, with the proper identification stamped thereon.

Conductors smaller than AWG No. 12 shall not be used. All conductors shall be stranded, per IPCEA specifications.

(f) **Conduit:** The entire conduit system shall be rigid metal conduit, except that a short length of flexible conduit shall be provided at the connections to motors, brakes, limit switches and other equipment as shown on the plans. All underground conduit and conduit embedded in concrete, shall be hot-dipped galvanized, sherardized or metallized rigid steel conduit. All conduit exposed on structures shall be rigid aluminum. All conduit fittings shall be cast aluminum, with cast covers and solid neoprene gaskets. All conduit clamps, clamp backs and nest backs shall be heavy duty malleable iron, hot-dip galvanized, and shall be held with stainless steel hexagon bolts, with hexagon nuts and external tooth lockwashers. Insulated throat metal bushings shall be used at the ends of all conduits to prevent injury to the conductors. One-eighth inch drain holes shall be drilled at the low point of all conduit runs before wire is pulled in the conduit. Threads on steel conduit shall be painted with white or red lead before assembly. Threads on aluminum conduit shall be painted with an approved oxide inhibiting compound. Material used in the manufacture of conduit shall be in accordance with Subsection 915.11.

Stainless steel hardware shall be in accordance with Subsection 915.10.

(g) **Junction Boxes:** Junction boxes shall be made of welded aluminum plate, with a minimum wall thickness of ¼ inch. All corners and edges shall be well rounded and all welds shall be ground smooth. Junction boxes shall have drain and breather fittings, located top and bottom.

Junction boxes shall have sufficient terminal blocks to terminate all conductors except spares. Mounting terminal blocks on the sides, top or bottom of the boxes will not be permitted. A clear distance of at least 6 inches shall be provided between rows on terminal blocks and not less than 6 inches between terminal blocks and the sides of the box. The minimum depth of the junction box shall be twice the diameter of the largest conduit entering the box plus 2 inches, but in no case less than 6 inches. Junction boxes shall have hinged covers, equipped with neoprene gaskets to form watertight seals, and held closed with stainless steel hinged bolts with winged nuts.

Cast aluminum hubs shall be used for conduit attachment to the junction box.

All hardware used to attach hubs or terminal blocks to the box and all other hardware shall be stainless steel.

Materials used in the fabrication of these boxes shall be in accordance with Subsection 915.13.

Hardware shall be in accordance with Subsection 915.10.

(h) Terminal Blocks: Terminal blocks shall be provided for the termination of all conductors, except spares, which do not terminate at devices equipped with terminals. Terminal blocks shall be of the barrier type equipped with high pressure connectors. Black over white plastic marking strips shall be provided and each connector shall be identified by engraving the marking strip with the same identification as the elementary wiring diagram.

(i) Internal Combustion Engines: Internal combustion engines shall be as shown on the plans.

(j) Fuel Tank: Fuel tanks shall be a minimum of 100 gallon capacity and constructed of steel sheet metal not less than ⅛ inch thick. The tank shall be labeled by the Underwriters Laboratory and shall be equipped with drain, vent and filler pipes. The filler pipe shall be so constructed as to permit gauging of the tank with a calibrated stick gauge to be furnished by the contractor.

809.43 OPERATING HOUSE. The operating house shall be constructed in accordance with the plans. All obviously necessary parts or fittings, not specifically shown or called for, shall be furnished by the contractor, as if shown or called for, without extra charge.

809.44 MACHINERY HOUSES. Machinery houses shall be constructed in accordance with the plans. All obviously necessary parts or fittings, not specifically shown or called for, shall be furnished by the contractor, as if shown or called for, without extra charge.

809.45 METHOD OF MEASUREMENT.

(a) Movable Bridge Machinery: Movable bridge machinery will be measured by the lump and the measurement shall include all gears, including gears for operating limit switches, shafts, couplings, bearings, castings, wedges, wedge bases, latches, speed reducers, lubricating system, center pivots, racks and tracks for swing spans, bearing discs, balance wheels, trunnions and trunnion bearings, pins, sleeves, sheaves, wire ropes and their sockets and socket pins, bolts, screws, bolts and nuts connecting machinery parts to structural steel, castings which form an integral part of the machinery, winding drums, tread plates and castings for segmental girders and track girders for rolling lift spans and their connecting bolts, pistons and cylinders, eccentrics, pinions, ring gears, racks, clutches, brakes other than electrical brakes, rollers, valves, locks, toggles, crank arms, cranks, axles, hooks, bearing liners, wrenches, springs, manually operated roadway traffic gates, mechanically operated position indicators and all other similar parts and fittings necessary for the satisfactory operation of the bridge which require machine shop work and which are not included in any other class, and all items which are classified as "Movable Bridge Machinery" on the plans.

(b) Traffic Barriers: Traffic barriers will be measured by the lump. This item shall consist of furnishing all materials and erecting the traffic barriers in accordance with the details shown on the plans, contract special provisions and with these specifications.

(c) Power Plant: Power plant will be measured by the lump and the measurement shall include all electrical motors, internal combustion engines and all incidental parts, electrical generator sets, electrically operated brakes, switchboard and control desk with their attachments and electrical parts, controllers, resistors, limit switches, transformers, circuit breakers, electric navigation lights, navigation sound signals, storage batteries, battery chargers, electrically operated position indicators,

service lighting, traffic warning signals, electrically operated roadway traffic gates, flood lights, wiring, conduits and their fittings, junction boxes, submarine cables, flexible cables, collector rings, contactors, switches, instructors, pit pumps, name plates for each operating element, and all other items and equipment required for the installation of a complete power plant and all items which are classified as "Power Plant" on the plans.

(d) Operating House: The operating house will be measured by the lump and the measurements shall include all obviously necessary parts of the house, including furniture and cabinets. If the house is supported on piling, the piling will be measured as provided under "Bearing Piles," Section 804.

(e) Machinery Houses: Machinery houses will be measured by the lump and the measurement shall include all obviously necessary parts of the houses.

(f) Class A concrete in counterweights will be measured by the cubic yard and the volume section to be paid for shall be determined as provided in Section 805. No deduction in the volume of concrete will be made for steel punchings or scrap metal which may be used when necessary to increase the weight.

Deformed reinforcing steel or structural steel used in counterweights will be measured as provided in Sections 806 and 807.

809.46 BASIS OF PAYMENT. Machinery, traffic barriers, power plant, operating house and machinery houses shall be paid for at the lump sum contract prices for "Movable Bridge Machinery", "Traffic Barriers", "Power Plant", "Operating House" and "Machinery Houses" complete in place and accepted.

Concrete and reinforcing steel or structural steel used in counterweights will be paid for as provided in Sections 805, 806 and 807.

Payment will be made under:

Item No.	Pay Item	Pay Unit
809(1)	Movable Bridge Machinery	Lump
809(2)	Traffic Barriers	Lump
809(3)	Power Plant	Lump
809(4)	Operating House	Lump
809(5)	Machinery Houses	Lump

Section 810

Railing

810.01 DESCRIPTION. This work shall consist of furnishing all materials and constructing railing of the type specified. All work shall be in accordance with these specifications and in reasonably close conformity to the lines, grades and dimensions shown on the plans or established by the engineer.

Pipe in pipe railing or pipe and concrete railing may be either aluminum or steel at the option of the contractor.

810.02 MATERIALS. All materials used in the construction of railings, railing posts, end flares, entrance posts, pylons, etc. shall conform to the applicable subsections of Section 912.

CONSTRUCTION REQUIREMENTS

810.03 CONSTRUCTION, FABRICATION, ERECTION AND PAINTING. All construction, fabrication, erection and painting shall conform to the applicable requirements of Section 806 (Reinforcement), Section 807 (Structural Steel), Section 811 (Painting and Protective Coatings) and as further described hereunder.

810.04 LINE AND GRADE. The line and grade of the railing shall be true to that shown on the plans and shall not follow any unevenness in the superstructure. Unless otherwise specified or shown on the plans, the railing and curbs on bridges, whether superelevated or not, shall be vertical and the railing posts shall be constructed normal to grade.

810.05 EXPANSION JOINTS. Expansion joints shall be so constructed as to permit freedom of movement. After all work is completed, all loose or thin shells or mortar likely to spall under movement shall be removed.

810.06 PLACING RAILING. In no case shall concrete railing be placed until centering or falsework for the span has been released, rendering the span self-supporting.

810.07 METAL RAILING. Metal railing shall be care-

fully adjusted prior to fixing in place to insure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place on the structure at proper grade and alignment.

810.08 METHOD OF MEASUREMENT. Railing will be measured by the linear foot. The length for measurement shall be the actual length of completed railing measured along the face of the railing and end flares, entrance posts or pylons, from end to end of each line of railing between railing posts and between posts and end flares, entrance posts or pylons. This measurement shall include all work constructed above the top of the roadway curb, sidewalk surface or sidewalk curb. Entrance post, flares, pylons and other items integral with the railing shall be included unless otherwise specified.

The reinforcing steel used in construction of this item will not be measured.

810.09 BASIS OF PAYMENT. The accepted quantities of railing will be paid for at the contract unit price per linear foot for the type specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
810(1)	Concrete Railing (Type)	Linear Foot
810(2)	Steel Railing	Linear Foot
810(3)	Steel Channel Railing	Linear Foot
810(4)	Pipe Railing	Linear Foot
810(5)	Steel and Concrete Railing	Linear Foot
810(6)	Pipe and Concrete Railing	Linear Foot

Section 811

Painting and Protective Coatings

811.01 DESCRIPTION. This work shall consist of the painting of all items specified and shall include the preparation of surfaces, the application, protection and drying of the paint coating in accordance with these specifications, supplemental specifications, plans, special provisions and as directed by the engineer.

Unless otherwise specified, the Basic Lead Silico Chromate Paint System shall be used for painting metal surfaces in accordance with these specifications. Colors of the several coats shall be in accordance with standard color samples that are available upon request from the Department's Central Testing Laboratory.

General requirements for the galvanizing and metalizing of metal surfaces are also included in this section.

811.02 MATERIALS. Materials shall meet the applicable requirements of Section 908 of Part IX, Materials, the special provisions and the following listed subsections.

The Basic Lead Silico Chromate Paint System shall meet the requirements of Subsection 908.02.

The Red Lead and Aluminum Paint System shall meet the requirements of Subsections 908.03 and 908.05.

CONSTRUCTION REQUIREMENTS

811.03 PAINTING METAL.

General: The surfaces of metal parts to be painted shall first be properly cleaned and prepared.

Number of Coats, Color and Film Thickness: It is the intent of these specifications that all metal surfaces, whether classified as structural steel, machinery, traffic barriers, power plant or otherwise, shall be painted with the Basic Lead Silico Chromate 4-Coat Paint System, unless otherwise stated or unless painting would interfere with the proper operation of certain movable metal parts.

Basic Lead Silico Chromate Paint System (Basic System):

1. Shop Coat or First Prime Coat—
   Basic Lead Silico Chromate Brown Paint (Shop prime coat or first prime coat for steel on new construction). ..... 1.5 mils minimum

   or

   Basic Lead Silico Chromate Brown Paint (First prime coat for existing steel structures). ..... 1.5 mils minimum
2. Second Prime Coat or First Field Coat—Basic Lead Silico Chromate Maroon Paint. ..... 1.5 mils minimum
3. Third Prime Coat or Second Field Coat—Basic Lead Silico Chromate Gray Paint. ..... 1.5 mils minimum
4. Final—Third Field Coat—
   Basic Lead Silico Chromate Cement Gray Paint. ..... 1.0 mils minimum

The total dry film thickness of all 4 coats shall be 5.5 mils minimum.

Red Lead and Aluminum Paint System:

1. Shop Coat—Red Lead Paint. ..... 1.5 mils minimum
2. First Field Coat—Red Lead Paint tinted with a minimum of one ounce of lampblack, paste form, to one gallon of paint. ..... 1.5 mils minimum
3. Second Field Coat—
   Red Lead Paint. ..... 1.5 mils minimum
4. Third Field Coat—
   Aluminum Paint. ..... 1.0 mils minimum

The total dry film thickness of all 4 coats shall be 5.5 mils minimum.

Special Paint Systems:

When special paint systems are specified, the number of coats, color and film thickness shall be described in the project specifications.

Metal surfaces of stock items, such as gear reducers, electric motors, gasoline engines and the like, which are ordinarily painted by the manufacturer, shall receive only the 3 field coats of paint specified.

Control desks and switchboards shall be painted as described elsewhere. Equipment mounted on the control desks and switchboards is not to be painted unless required elsewhere.

When required, galvanized, sherardized or metallized surfaces of sheet metal, electrical conduit, water, air and gas pipes that are exposed and visible shall be painted with two field coats of the specified paint. All other galvanized, sherardized or metallized surfaces shall not be painted.

Painting of aluminum metal surfaces will not be required unless otherwise specified.

811.04 WEATHER LIMITATIONS. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather with the relative humidity being below 85 percent. Painting will not be permitted when the atmospheric temperature is below 40°F or when it can be anticipated that the atmospheric temperature will drop below 35°F during the drying period, except as provided in the following paragraph for enclosures. If fresh paint is damaged by the elements it shall be replaced by the contractor at his expense.

Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

Subject to the approval of the engineer, in writing, the contractor may provide suitable enclosures to permit painting during inclement weather. Provisions shall be made to control atmospheric conditions artificially inside the enclosure within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring paint and no additional compensation will be allowed.

811.05 CLEANING OF SURFACES.

(a) General: Unless otherwise specified, all metal surfaces to be painted or coated shall be cleaned by blast cleaning in accordance with the Near-White Blast Cleaning Method.

All surfaces of a casting shall be blast cleaned before the casting is machined.

All structural steel to be encased in concrete shall be

blast cleaned, hand tool cleaned or power tool cleaned.

Cleaning for maintenance painting of existing steel structures shall be in accordance with the Commercial Blast Cleaning Method or as otherwise specified.

The Steel Structures Painting Council Preparation Specifications are referred to throughout this Subsection and the contractor shall be cognizant of these requirements.

(b) Near-White Blast Cleaning Method: This method prepares metal surfaces for painting or coating by removing nearly all mill scale, rust, rust-scale, paint or foreign matter by the use of abrasives propelled through nozzles or propelled by centrifugal wheels.

(1) Definition: The near-white cleaned surface finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain. At least 95 percent of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration mentioned above.

(2) Procedures: The Specifications for Near-White Cleaning shall be in accordance with the requirements of Specification SSPC-SP 10-63, Heading 3 (Procedures), sections 3.1 through 3.10.

(3) Safety Precautions: Safety precautions shall be taken in accordance with the requirements of Specifications SSPC-SP 10-63, Heading 4 (Safety Precautions), sections 4.1 through 4.5.

(c) Commercial Blast Cleaning Method: This method prepares metal surfaces for painting or coating by removing mill scale, rust, rust-scale, paint or foreign matter by the use of abrasives propelled through nozzles or propelled by centrifugal wheels.

(1) Definition: The commercial blast cleaned surface is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale and oil paint have been completely removed except for slight sha-

dows, streaks or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain; if the surface is pitted, slight residues of rust or paint may be found in the bottom of pits; at least two-thirds of each square inch of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or tight residues mentioned above.

(2) Procedures: The specifications for Commercial Blast Cleaning shall be in accordance with the requirements of Specifications SSPC-SP 6-63 Heading 3 (Proceures), sections 3.1 through 3.10.

(3) Safety Precautions: Safety precautions shall be in accordance with the requirements of Specifications SSPC-SP 6-63 Heading (Safety Precautions), sections 4.1 through 4.5.

(d) Pickling Method: This method of cleaning structural steel shall not be used unless specified elsewhere in the specifications.

(1) Definition: The pickling method prepares metal surfaces for painting by completely removing all mill scale, rust and rust-scale by chemical reaction. The pickled surface shall be completely free of all scale, rust and foreign matter. Furthermore, the surface shall be free of unreacted or harmful acid or alkali or smut.

(2) Procdures: The Specifications for Pickling shall be in accordance with the requirements of Specification SSPC-SP 8-63 Heading (Procedures), sections 3.1 through 3.7 with the following modifications.

The pickling shall be by chemical reaction methods as described in sections 3.1.2.1, 3.1.2.2 and 3.1.2.3.

(3) Safety Precautions: Safety Precautions shall be in accordance with the requirements of Specifications SSPC-SP 8-63 Heading (Safety Precautions), sections 4.1 through 4.6.

811.06 PROTECTION OF THE PUBLIC AND WORK. The contractor shall protect all parts of the work against disfigurement by spatters, splashes and smirches of paint or of paint materials. The contractor shall be responsible for any damage caused by his operations to vehicles, persons or property, including plants and animals; he shall provide

protective measures at his expense to prevent such damage.

Paint stains which might result in an unsightly appearance shall be removed or obliterated by the contractor at his expense.

If traffic causes an objectionable amount of dust, the contractor shall, at his own expense, allay the dust for the necessary distance on each side of the work and take any other precautions necessary to prevent dust and dirt from coming in contact with freshly painted surfaces or with surfaces before the paint is applied.

811.07 MIXING OF PAINT. Except as may be otherwise specified under Section 908 (Paint Materials), paint shall be premixed at the factory. Paint shall also be thoroughly field-mixed by hand or mechanically before applying and shall be stirred sufficiently while being used to keep the pigments in uniform suspension.

811.08 THINNING PAINT. Paint as delivered in containers, when thoroughly mixed, is ready for use. If it is necessary in cool weather to thin the paint in order that it shall spread more freely, this shall be done only by heating in hot water or on steam radiators and liquid shall not be added nor removed unless permitted.

811.09 APPLICATION.

(a) Basic Lead Silico Chromate Paint shall be applied as airless spray, unless otherwise specified, in a neat and workmanlike manner.

The airless spray equipment shall apply the paint in a fine and even spray without the addition of any thinner. The coating of paint applied shall be smooth and uniform, producing no sags or runs, with no heavy deposit of the wet coat requiring excessive curing time.

On all surfaces which are inaccessible to the airless spray, the paint shall be applied with approved daubers to insure thorough coverage.

No portion of the paint films shall be less than the specified film thickness; however the film thickness shall not be so great that either the appearance or service life of the paint will be detrimentally affected.

Not less than 24 hours shall elapse between applications of coats of paint for the Basic Lead Silico Chromate Paint System.

(b) Red Lead and Aluminum Paint System for shop and field coats may be applied with hand brushes, rollers or sprayer or by a combination of these 3 methods of application. However, by any method, the coating of paint applied shall be smoothly and uniformly spread so that no excess paint will collect at any point. The right is reserved to require the use of hand brushing should the results of spraying be unsatisfactory .

When brushes are used, the paint shall be so manipulated under the brush as to produce a smooth, uniform and even coating in close contact with the metal or with previously applied paint and shall be well worked into all corners and crevices.

Power spraying equipment shall apply the paint in a fine and even spray without the addition of any thinner.

Paint applied with spray equipment shall immediately be followed by hand brushing, when necessary, to secure uniform coverage and to eliminate airholes, blistering, splotches or wrinkling.

On all surfaces which are inaccessible for paint brushes or rollers, the paint shall be applied by sprayers or with approved daubers to insure thorough covering.

No portion of the paint films shall be less than the specified film thickness; however the film thickness shall not be so great that either the appearance or service life of the paint will be detrimentally affected.

Not less than 72 hours shall elapse between applications of coats of paint for the Red Lead and Aluminum Paint System.

811.10 SHOP PAINTING.

(a) Surfaces to be Painted: When fabrication and cleaning are completed, surfaces not previously painted during assembly shall be painted with one coat of the approved specified paint before any damage to the cleaned surface occurs from weather or other exposure. Shop contact surfaces shall not be painted unless otherwise specified. Surfaces to be in contact after field erection shall not be painted unless a coat of lacquer or other protective coating is specified on the plans or fabrication details. Surfaces to be in contact with concrete shall not be painted. Where paint would be detrimental to field weld-

ing operations or field bolted splice areas, the surface shall not be shop painted within a suitable distance from the edges to be welded or spliced.

(b) Erection Marks: Erection marks shall be painted on painted surfaces with paint of contrasting color.

(c) Loading: Material shall not be loaded for shipment until the paint is dry.

(d) Inaccessible Surfaces: Surfaces not to be in contact but which will be inaccessible shall receive the complete paint system prior to assembly or erection.

(e) Machine Finished Surfaces: With the exception of abutting chord and column splices, rocker shoes and bases and column and truss shoe bases, machine-finished surfaces shall be coated with an approved protective material as soon as practicable after being accepted and before removal from the shop. Surfaces of iron and steel castings which are machine-finished for the sole purpose of removing scales, fins, blisters or other surface deformations shall be given the shop coat of paint.

(f) Pins and Pin Holes: All pins and pin holes shall be given a coat of a tallow and white lead mixture for protection. The protective coating shall be removed and replaced with a graphite coating prior to erection.

811.11 FIELD PAINTING. As soon as the field cleaning has been done to the satisfaction of the engineer, the heads of field rivets and bolts and any surfaces from which the shop coat of paint has been worn off or otherwise has become defective shall be covered with one coat of the same paint as was used in the shop. When the paint applied for touching-up rivet or bolt heads and abraded surfaces has become dry, the first field coat may be applied. In no case shall a coat be applied until the previous coat has dried throughout the full thickness of the paint film.

Small cracks and cavities which have not been sealed in a watertight manner by the first field coat shall be filled.

No field coats of paint shall be applied to the steel work below the highway floor level until the concrete roadway slab has been completed and the metal work carefully cleaned. If concreting operations have damaged the paint, the surface shall be cleaned and spot painted as directed by the engineer.

In the event the second field paint coat is applied in advance of the concrete finishing operation, the painted steel surfaces must be protected from drippings or spatter created by the concrete finishing. Damage to the top paint coat shall be repaired as directed by the engineer. The final coat of paint shall not be applied until the concrete finishing operation is complete.

811.12 SPECIAL STENCILING. The date (month and year) of painting and type of paint system used shall be stenciled at 2 locations on all bridge structures in block letters 2½ inches high. The exact locations will be determined by the engineer. The paint used shall form a distinct contrast with the background and shall be compatible with the paint system used.

811.13 PAINTING LUMBER AND TIMBER. Unless otherwise specified, all new lumber and timber requiring painting shall be cleaned to the satisfaction of the engineer and shall be painted with 3 coats of paint. The paint used for various coats will be shown on the plans or specified in these specifications or in the special provisions and if not shown or specified, the paint to be used will be selected by the engineer. Treated timber to be painted shall be processed in accordance with the provisions of Subsection 914.04.

When specified in the contract, timber railings shall be painted with 3 coats of white ready-mix paint meeting the requirements of Subsection 908.04. Each coat shall have a minimum dry thickness of 1.5 mils.

All applicable requirements of this section shall apply to the painting of lumber and timber.

811.14 PAINTING GALVANIZED SURFACES. For the purpose of conditioning galvanized surfaces for painting, the painting shall be deferred as long as posisble in order that the surface may weather.

Galvanized surfaces which are required to be painted shall be treated by an approved method or as follows:

In one gallon of soft water, dissolve 2 ounces each of copper chloride, copper nitrate and sal ammoniac, then add 2 ounces of commercial muriatic acid. This should be done in an earthen or glass vessel, never in tin or other metal receptacle. Apply the solution with a wide flat brush to the

galvanized surface. When dry the surface shall be washed with clear water.

811.15 GALVANIZING OF METAL PARTS AND SURFACES.

General: The following listed criteria shall be properly controlled and shall meet standards that are satisfactory for the galvanizing process:

1. Defects arising from fabrication
2. Thickness and uniformity of coating
3. Adherence of coating
4. Appearance
5. Embrittlement

The handling, stacking, transporting and erecting of the galvanized parts shall be done in such a manner as to protect the coating and coating appearance.

Galvanized parts shall be assembled with non-abrasive equipment.

Drip-holes shall be plugged to the satisfaction of the engineer.

Galvanizing of products fabricated from rolled, pressed and forged steel shapes, plates, bars and strips, ⅛ inch thick and heavier, when specified shall conform to the specifications of ASTM Designation: A 123. Galvanizing shall be performed after fabrication into the largest practicable sections. Fabrication shall include all operations such as shearing, cutting, punching, forming, drilling, milling, bending, welding and riveting. Components of bolted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating.

Galvanizing of iron and steel hardware, when specified shall conform to the specifications of ASTM Designation: A 123 and A 153 with the following quenching requirements. All parts that are hot-dip galvanized shall be quenched immediately after removal from the kettle. The quenching solution shall contain from 0.1 percent to 1 percent chromic acid by volume and shall be maintained at a temperature of 150°F to 160°F, with a maximum allowable temperature of 180°F. Galvanizing shall be performed after fabrication of the hardware. Components of bolted assemblies shall be galvanized separately before assembly.

Galvanized surfaces that are abraded or damaged at any time after the application of the zinc coating, unless otherwise specified, shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be repaired by the application of a low temperature galvanizing repair compound, in the shape of a bar or rod, to the pre-heated 600°F repair surface. The bar or stick shall be rubbed over the pre-heated surface with the melted repair material being brushed over the bare area with a wire brush. The low temperature galvanizing repair compound shall be submitted for approval and shall be in accordance with Federal Specification 0-G-93, 29 November 1949. Zinc coating by the Metallizing process may be allowed when approved by the engineer. The method and extent of repair will be as directed by the engineer.

811.16 METALLIZING OF METAL PARTS AND SURFACES. When specified, Metallizing shall be performed in accordance with the American Welding Society Specification C 2.2 and the thickness of the sprayed zinc coat shall be a minimum of 5 mils. The method of applying the zinc coating shall be approved by the engineer prior to application.

811.17 METHOD OF MEASUREMENT. No measurement will be made for painting or any protective coating, unless specifically provided for in the contract.

811.18 BASIS OF PAYMENT. No direct payment will be made for painting of any of the structures or surfaces described above unless pay items for painting are included in the contract. The contract prices for the various structures and surfaces to be painted shall include the cost of furnishing all materials, labor, etc., to complete all painting or protective coating required in accordance with these specifications.

Section 812

Untreated and Treated Timber

812.01 DESCRIPTION. This work shall consist of furnishing lumber of the sizes and grade specified and of furnishing timber of the stress-grade, sizes and dimensions for the different uses specified, treated or untreated, as called for in the contract and of preparing, framing, assembling and erecting the same, including painting where specified and including also all hardware required by the plans and specifications, all in accordance with these specifications and in conformity with the structure design and details as shown on the plans or designated by the engineer.

812.02 MATERIALS. All materials shall meet the requirements of the following subsections of Part IX, Materials.

Structural Timber and Lumber	914.01
Timber Piling	914.02
Timber Preservatives	914.03
Timber Treatment	914.04
Timber Connectors	915.09
Hardware and Structural Shapes	915.10
Pitch	915.18
Red Lead	908.03
White Paint	908.04
Aluminum Paint	908.05
Black Paint	908.07

812.03 SPECIES OF WOOD TO BE USED.

(a) Permanent Structures: Unless otherwise shown on the plans or provided in the special provisions, all lumber and timber used in the construction of permanent bridges, bridge fenders, and bulkheads may be either Douglas Fir or Southern Pine, provided the same species shall be used throughout each structure, except in bridge structures as hereinafter provided.

Caps and stringers for any bridge structure may be either fir or pine regardless of the species used in the remainder of the structure, however, all caps and string-

ers furnished for any structure shall be the same species.

Lumber and timber shall not be used in exposed structures without preservative treatment unless otherwise indicated on the plans or in the special provisions.

(b) Temporary Structures: Temporary structures may be any species and grade of timber which is satisfactory for the intended purpose.

812.04 GRADES OF STRUCTURAL TIMBER. Structural lumber and timber used for the various structural purposes required, shall be of appropriate stress-grade selected in accordance with the design requirements for the particular structure. The material supplied shall be of equal or greater stress value than the stress-grade specified. The grade to be used shall be as shown on the plans or as specified in the special provisions.

812.05 HARDWARE FOR TIMBER.

(a) Structural Shapes: Rods, plates and shapes shall be of structural steel or wrought iron, as specified. Eyebars shall conform to the requirements for structural steel eyebars.

(b) Castings: Castings shall be cast steel or gray iron, as specified.

(c) Bolts, Drift-bolts and Dowels, etc.: Machine bolts, drift-bolts and dowels may be either wrought iron or medium steel. Washers may be cast 0-gee or malleable castings or they may be cut from medium steel or wrought iron plate, as specified.

Machine bolts shall have square heads and nuts, unless otherwise specified. Nails shall be cut or round wire of standard form. Spikes shall be cut or wire spikes or boat spikes, as specified.

Nails, spikes, bolts, dowels, washers and lag screws shall be galvanized, unless otherwise specified.

Unless otherwise specified all hardware, except malleable iron connectors, for treated timber bridges, shall be galvanized or cadmium plated.

812.06 STORAGE OF MATERIAL. Lumber and timber stored on the site shall be kept in orderly piles or stacks. Untreated material shall be open-stacked on supports at least 12-inches above the ground surface to avoid absorption of ground moisture and permit air circulation and it shall

be so stacked and stripped as to permit free circulation of air between the tiers and courses. When directed, protection from the weather by suitable covering, will be required.

On glued laminated structural members, that are not to be preservatively treated, an approved end sealer shall be applied after end trimming of each completed member.

CONSTRUCTION REQUIREMENTS

812.07 TREATED TIMBER. Treated timber shall be interpreted to mean timber of the species and stress grade called for, treated as stipulated in Subsection 914.04. The various types of preservative permitted for use and the portions of structures where the several types may be used shall be as provided on the plans or in the special provisions.

(a) Workmanship: Workmanship shall be first class throughout. Only competent bridge carpenters shall be employed and all framing shall be true and exact. Unless otherwise specified, nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for removal of the workman causing them. The workmanship on all metal parts shall conform to the requirements specified for steel structures.

(b) Surfacing: All lumber and timber, except bulkhead planks and sway bracing, shall be surfaced on 4 sides (S4S) unless otherwise called for on the plans.

(c) Handling: Treated timber shall be carefully handled without sudden dropping, breaking of outer fibers, bruising or penetrating the surface with tools. It shall be handled with rope slings. Cant hooks, peaveys, pikes or hooks shall not be used.

(d) Framing and Boring: All cutting, framing and boring of treated timbers shall be done before treatment insofar as practicable. When treated timbers are to be placed in waters infested by marine borers, untreated cuts, borings or other joint framings below highwater elevation shall be avoided.

(e) Installation of Timber Connectors: Timber connectors shall be one of the following types, as specified on

the plans—the split ring, the toothed ring, the shear plate or the spike grid. The split ring and the shear plate shall be installed in pre-cut grooves of dimensions as given herein or as recommended by the manufacturer. The toothed ring and the spike grid shall be forced into the contact surfaces of the timbers joined by means of pressure equipment. All connectors of this type at a joint shall be embedded simultaneously and uniformly. Fabrication of all structures using connectors shall be done prior to treatment. When prefabricated from templates or shop details, bolt holes shall not be more than 1/16 inch larger than bolt diameter. Bolt holes shall be bored perpendicular to the face of the timber.

Timber after fabrication shall be stored in a manner which will prevent changes in the dimensions of the members before assembly.

Dimensions of material and details not otherwise specified shall meet with the approval of the engineer.

(f) Cuts and Abrasions: All cuts in treated piles or timbers and all abrasions, after having been carefully trimmed, shall be covered with 2 applications of a mixture of 60 percent creosote oil and 40 percent roofing pitch or brush-coated with at least 2 applications of hot creosote oil and covered with hot roofing pitch.

(g) Bolt Holes: Holes bored in pressure-treated material shall be poured full of preservative. Horizontal holes, such as those for sway brace bolts, shall be filled by pouring the preservative into them with a bent funnel.

All unused bore holes and spike holes shall be poured full of preservative and plugged with tight-fitting, treated plugs.

(h) Temporary Attachment: Whenever, with the approval of the engineer, forms or temporary braces are attached to treated timber with nails or spikes, the holes shall be filled by driving galvanized nails or spikes flush with the surface or plugged as required for bolt holes.

812.08 TREATMENT OF PILE HEADS.

(a) General: Pile heads, after cutting to receive the caps and prior to placing the caps, shall be treated to prevent decay.

The heads of treated timber piles shall be protected by

one of the following methods, as specified on the plans. If not otherwise specified, Method A shall be used.

(b) Method A—Galvanized Metal Covering: The sawn surface shall be thoroughly brush coated with 2 applications of hot creosote oil, after which there shall be placed 2 layers of heavy canvas, size 20" x 20" saturated with hot asphalt, followed by 24" x 24" number 28 gage galvanized metal cover. The cover shall be bent down over the pile at an angle of approximately 45°.

(c) Method B—Fabric Covering: The heads of all piles shall be covered with alternate layers of hot pitch and loosely woven fabric similar to membrane waterproofing, using 4 applications of pitch and 3 layers of fabric. The cover shall measure at least 6 inches more in dimension than the diameter of the pile and shall be neatly folded down over the pile and secured by large headed galvanized nails or by binding with not less than 7 complete turns of galvanized wire securely held in place by large-headed galvanized nails and staples. The edges of the fabric projecting below the wire wrapping shall be trimmed to present a workmanlike appearance.

The heads of untreated piles shall be given one of the following treatments, as may be specified or directed.

(1) The sawed surface shall be thoroughly brush coated with 2 applications of hot creosote oil.

(2) The sawed surface shall be heavily coated with red lead paint, after which it shall be covered with cotton duck, of at least 8 ounce weight which shall be folded down over the sides of the pile and firmly secured thereto with large-headed roofing nails. The edges of the duck shall be trimmed to give a workmanlike appearance. The duck shall then be waterproofed by being thoroughly saturated and coated with one or more applications of red lead paint.

812.09 HOLES FOR BOLTS, DOWELS, RODS AND LAG SCREWS. Holes for round drift-bolts and dowels shall be bored with a bit 1/16 inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift-bolts or dowels, shall be equal to the least dimension of the bolt or dowel.

Holes for machine bolts shall be bored with a bit the

same diameter as the bolt, except as otherwise provided.

Holes for rods shall be bored with a bit 1/16 inch greater in diameter than the rod.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread.

812.10 BOLTS AND WASHERS. A washer of the size and type specified shall be used under all bolt heads and nuts which would otherwise come in contact with wood. Stacked washers shall not be permitted and bolts shall not project more than one inch beyond the nut on work securely tightened. Long bolts shall be saw-cut or clipped, ground smooth and repaired as specified in Subsection 811.15.

The nuts of all bolts shall be effectually locked after they have been finally tightened.

812.11 COUNTERSINKING. Countersinking shall be done wherever smooth faces are required. Horizontal recesses formed for countersinking shall be painted with hot creosote oil and after the bolt or screw is in place, shall be filled with hot pitch.

812.12 FRAMING. All lumber and timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth and tenons shall fit snugly. No shimming will be permitted in making joints nor will open joints be accepted. All mating pieces shall be tightly bound or clamped in position prior to drilling bolt holes.

812.13 PILE BENTS. The piles shall be driven as indicated on the plans and in accordance with the applicable requirements of Section 804.

812.14 FRAMED BENTS.

(a) Mud Sills: Untreated timber used for mud sills shall be of heart cedar, heart cypress, redwood or other durable timber. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place.

(b) Concrete Pedestals: Concrete pedestals for the support of framed bents shall be carefully finished so that the sills or posts will take even bearing on them. Dowels of not less than ¾ inch diameter and projecting at least 6 inches above the tops of the pedestals shall be set in them when they are cast for anchoring the sills or posts.

(c) Sills: Sills shall have true and even bearing on mud sills, piles or pedestals. They shall be drift-bolted to mud sills or piles with bolts of not less than ¾ inch diameter and extending into the mud sills or piles at least 6 inches. When possible, all earth shall be removed from contact with sills so that there will be free air circulation around them.

(d) Posts: Posts shall be fastened to pedestals with dowels of not less than ¾ inch diameter, extending at least 6 inches into the post. Posts shall be fastened to sills by one of the following methods, as indicated on the plans:

(1) By dowels of not less than ¾ inch diameter, extending at least 6 inches into posts and sills.

(2) By drift-bolts of not less than ¾ inch diameter driven diagonally through the base of the post and extending at least 9 inches into the sill.

(e) Design and Construction: Where framed structures will be subjected to earthquake, wind, tractive or centrifugal loads, the connections between members thereof shall be so designed and constructed as to resist the forces resulting therefrom.

812.15 CAPS. Timber caps shall be placed with ends aligned in a manner to secure an even and uniform bearing over the tops of the supporting posts or piles. All caps shall be secured by drift-bolts of not than ¾ inch diameter extending at least 9 inches into the posts or piles. The drift-bolts shall be approximately in the center of the post or pile.

812.16 BRACING. The ends of bracing shall be bolted through the pile, post or cap with a bolt of not less than ⅝ inch diameter. Intermediate intersections shall be bolted or spiked with wire or boat spikes as indicated on the plans. In all cases, spikes shall be used in addition to bolts.

812.17 STRINGERS. Stringers shall be sized at bearings and shall be placed in position so that knots near edges will be in the top portions of the stringers.

Outside stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated at least ½ inch for the circulation of air and shall be

securely fastened by drift-bolting where specified. When stringers are 2 panels in length, the joints shall be staggered.

Cross-bridging between stringers shall be neatly and accurately framed and securely toe-nailed with at least 2 nails in each end. All cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified in the contract, cross-bridging shall be placed at the center of each span.

812.18 PLANK FLOORS. Plank shall be of the grade required as specified. See Subsection 812.04.

Unless otherwise specified, they shall be surfaced 4 sides (S4S).

Single plank floors shall consist of a single thickness of plank supported by stringers or joists. The planks shall be laid heart side down, with ¼ inch openings between them for seasoned material and with light joints for unseasoned material. Each plank shall be securely spiked to each joist. The planks shall be carefully graded as to thickness and so laid that no 2 adjacent planks shall vary in thickness by more than 1/16 inch.

Two-ply timber floors shall consist of 2 layers of flooring supported on stringers or joists. The lower course shall be pressure-treated with creosote oil. The top course may be laid either diagonal or parallel to the centerline of roadway, as specified and each floor piece shall be securely fastened to the lower course. Joints shall be staggered at least 3 feet. If the top flooring is placed parallel to the centerline of the roadway, special care shall be taken to securely fasten the ends of the flooring. At each end of the bridge, these members shall be beveled.

812.19 LAMINATED OR STRIP FLOORS. The strips shall be of the grade required as specified. See Subsection 812.04. The strips shall be placed on edge at right angles to the centerline of roadway. Each strip shall be spiked to the preceding strip at each end and at approximately 18 inch intervals, with the spikes driven alternately near the top and bottom edges. The spikes shall be of sufficient length to pass through 2 strips and at least half-way through the third strip.

If timber supports are used, every other strip shall be

toe-nailed to every other support. The size of the spikes shall be as shown on the plans. When specified on the plans, the strips shall be securely attached to steel supports by the use of approved galvanized metal clips. Care shall be taken to have each strip vertical and tight against the preceding one and bearing evenly on all the supports.

812.20 COMPOSITE WOOD-CONCRETE DECKS.

(a) Slab Spans: Where the tensile strength of wood and the compressive strength of concrete are to be used compositely, the joining of the 2 materials shall be such as to resist all horizontal shear at that plane and provision shall be made to prevent separation of the materials.

The horizontal shear may be resisted by metal devices set into and projecting above the top of the laminated strips or by fabricating the upper edge of the strips in a serrated manner.

Separation of the materials may be resisted by nails driven at an angle in the upper edge of the strips or by certain suitable devices or by grooves or other working of upstanding strips.

(b) "T" Beams: Spans consisting of concrete slabs placed on wood stringers may be designed as "T" beams when the 2 materials are suitably joined so as to resist horizontal shear at their juncture and the materials are in some way bonded permanently together.

A horizontal shear joint may be made using metal devices or by a serrated working of the tops of the stringers.

Separation of the concrete from the stringers may be prevented by driving nails in the top of the stringers at an angle or by other suitable metal devices or by grooving the sides of the stringers near the top or other working of the wood and then forming the concrete into the patterns worked in the wood.

812.21 WHEEL GUARDS AND RAILING. Wheel guards and railing shall be accurately framed in accordance with the plans and erected true to line and grade.

Unless otherwise specified, wheel guards, rails and rail posts shall be surfaced four sides (S4S).

Wheel guards shall be laid in sections not less than 12 feet long.

812.22 TRUSSES. Trusses, when completed, shall show

no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and, in vertical projection, shall show a smooth curve through panel points conforming to the correct camber. All bearing surfaces shall fit accurately. Uneven or rough cuts at the points of bearing shall be cause for rejection of the piece containing the defect.

812.23 TRUSS HOUSING. The carpentry on truss housings shall be equal in all respects to the best house carpentry. The finished appearance of the housing is considered of primary importance and special care shall be taken to secure a high quality of workmanship and finish on this portion of the structure. Workmen wearing shoes with caulks will not be permitted on the roof.

812.24 ERECTION OF HOUSING AND RAILINGS. Unless otherwise directed, housing and railings shall be built after the removal of the falsework and the adjustment of the trusses to correct alignment and camber.

812.25 PAINTING. Rails and rail posts, untreated timber or timber treated with preservative salts shall be painted with 3 coats of paint, as specified in Section 811.

Parts of the structure, other than rails and rail posts, which are to be painted shall be designated on the plans or in the special provisions.

Metal parts, except hardware, shall be given one coat of shop paint and after erection, 2 coats of field paint, as specified in Section 811.

Where timber decks are provided, the top flanges of all stringers and floor beams shall be protected by a covering composed of a heavy layer of bituminous material (tar, asphalt or pitch) applied hot and one thickness of 2-ply tar paper wide enough to project 3 inches beyond the edges of the members. These edges shall be bent down at an angle of 45°.

812.26 METHOD OF MEASUREMENT. The quantity to be paid for shall be the number of thousand feet board measure of lumber and timber, complete in place and accepted. Measurements of lumber and timber will be computed from the net dimensions shown on the plans, unless changes in such dimensions have been authorized in writing by the engineer. The dimensions shown on the plans shall

be interpreted as nominal sizes and shall be used in the computations. The measurement of timber will include only such timber as is a part of the completed and accepted work and will not include timber used for erection purposes, such as falsework, bracing, sheeting etc.

No measurement will be made for hardware required to construct the work in accordance with the plans.

Metal parts, not classified on the plans as "Hardware," will be measured as structural carbon steel (A 36) as provided in Subsection 807.58.

812.27 BASIS OF PAYMENT. The accepted quantities measured as provided above shall be paid for at the contract unit price per thousand feet board measure for "Untreated Timber" or "Treated Timber" as the case may be, complete in place. Structural carbon steel (A 36) will be paid for as provided in Subsection 807.59.

Payment will be made under:

Item No.	Pay Item	Pay Unit
812(1)	Untreated Timber	MFBM
812(2)	Treated Timber	MFBM

Section 813

Concrete Approach Slabs

813.01 DESCRIPTION. This work shall consist of the construction of concrete approach slabs for bridges and overpasses, in accordance with the details and at the locations and of the dimensions shown on the plans.

813.02 MATERIALS. Materials shall meet the requirements of the following applicable Sections and Subsections of Part IX, Materials.

Portland Cement Concrete	901
Carbon Steel (A 36)	913.01
Deformed Reinforcing Steel	909.01
Joint Materials	905

813.03 CONCRETE. Concrete for approach slabs and bolster blocks under approach slabs shall be Class A or one of the concrete pavement types of Section 901. The pavement shall be constructed in accordance with the applicable requirements of Sections 601 and 805.

813.04 REINFORCING STEEL. Reinforcing steel shall be placed in accordance with the applicable requirements of Section 806.

813.05 STRUCTURAL STEEL. When required by the plans, structural steel shall be Structural Carbon Steel (A 36), unless otherwise noted. Structural steel shall be placed in accordance with the applicable requirement of Section 807.

813.06 BOLSTER BLOCKS. Bolster blocks, when required, shall be constructed in accordance with the requirements of these specifications and as indicated on the plans. The contractor shall place 3 layers of approved tar paper or 1 coat of paint or heavy grease between the bolster block and the pavement slab and expansion joint adjacent to the approach slab, all as shown on the plans.

813.07 ROADWAY FINISH. The roadway finish shall be performed as specified in Subsection 601.11.

813.08 EXPANSION JOINTS. Expansion joints of pre-

molded joint filler or poured filler shall be constructed in accordance with the details shown on the plans.

When specified on the plans or in the special provisions, the joint material shall be a poured-in-place, blown urethane foam consisting of a compressible base layer and a flexible cap layer in accordance with Subsection 905.04.

813.09 METHOD OF MEASUREMENT. Concrete approach slabs will be measured by the square yard, complete in place and accepted. The width for measurement will be the width from outside to outside of completed approach slab, in accordance with the plans. The length will be the actual centerline length measured horizontally along the surface from the centerline of joint adjacent to the bridge end to the beginning of the roadway slab and shall include the full width of expansion joints at the outer end of approach slab.

No measurement will be made for concrete in bolster blocks constructed under the approach slab or for reinforcing steel, structural steel and joint materials used in approach slab construction and no payment will be made other than under Item 813(1).

813.10 BASIS OF PAYMENT. The accepted quantity of concrete approach slabs will be paid for at the contract unit price per square yard complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
813(1)	Concrete Approach Slabs	Square Yard

Section 814

Drilled Shaft Foundations

814.01 DESCRIPTION. This work shall consist of the construction of foundations of reinforced concrete shafts with or without bell type concrete footings. Concrete shafts shall be placed in drilled excavation when the shafts are without bell type footings and in drilled and under-reamed excavation when shafts are with bell type footings. Such foundations shall be constructed in accordance with these specifications and in conformance with the details and governing dimensions shown on the plans.

814.02 MATERIALS. All concrete materials and their preparations shall be in accordance with the requirements of Sections 805 and 901. All concrete shall be Class A unless otherwise shown on the plans.

Reinforcing steel shall conform to the requirements of Section 806. The sizes and dimensions shall be as shown on the plans.

814.03 CONSTRUCTION METHODS.

(a) Excavation: The contractor shall do all excavation required for the shafts and bell footings, through whatever substances encountered and to the dimensions and elevations shown on the plans or required by the site conditions. Unless otherwise shown on the plans, all shafts shall be bored plumb to a tolerance of 1½ inches for depths up to and including 10 feet plus an additional tolerance of 0.05 inch per foot for depths in excess of the first 10 feet. When bells are required, they shall be excavated so as to form a bearing area of the size and shape shown on the plans. Shafts and bells may be excavated either by hand or by mechanical methods. Blasting methods shall be used only with permission of the engineer and when used shall be so conducted as to avoid disturbance of the formations below or outside the limits of the proposed shaft concrete.

The plans indicate the expected depths and elevations at which satisfactory bearing material will be encountered

and this information will be used as a basis for the contract. If satisfactory foundation materials are not encountered at plan elevations, the footings may be raised or lowered as determined by the engineer. Alterations in plan depths shall be made as judged proper to satisfactorily comply with the design requirements.

Casings will be required for shaft excavations when such provision is necessary to prevent caving of the material or when necessary to shut off seepage water. Casings shall be of metal and of ample strength to withstand handling stresses, the pressure of concrete and of the surrounding earth or backfill materials and shall be watertight. The inside diameter of casing shall not be less than the nominal size of shaft; otherwise, the size of casing and the size of drilled excavation in which the casing is to be placed will be left to the discretion of the contractor, except as noted below. No extra compensation will be allowed for the concrete required to fill an oversize casing or oversize excavation.

When the drilling operation reaches a point where caving conditions or excess ground water is encountered, no further drilling will be allowed until a construction method is employed which will prevent any caving that tends to make the excavation appreciably larger than the size of casing to be used. Drilling in a mud slurry without removal of cuttings or other construction methods which will control the size of excavation will be permitted.

If the elevation of the top of shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft shall be required to control caving of any material into the freshly placed concrete.

Any excavation for the footing bells or shafts beyond the lines required by the plan dimensions, where casings are not required, shall be backfilled with Class "A" concrete at the contractor's expense. Where casings are used, the contractor will be permitted to backfill around the upper portion of the casing with pea gravel or other granular material. Where a double casing is required for a portion of the shaft, no material shall be placed between the casings, but this area will be filled with Class "A" concrete.

Under normal operations when the casing is to be re-

moved, the removal shall not be started until all concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches or rotating of the casing to insure the breaking of bond of the concrete to the casing will be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. In all cases a sufficient head of concrete shall be maintained at all times above the bottom of the casing to overcome hydrostatic pressure. Extraction of the casing shall be at a slow, uniform rate and the pull shall be in a truly vertical direction. If any upward movement of the concrete or steel inside the casing occurs at any time during the pulling operation, the following criteria shall govern:

(1) If the upward movement is one inch or less, the casing may be left in place and the shaft used if the concrete is vibrated or rodded to reconsolidate the concrete. Vibration or rodding shall not be used to attempt to break the casing loose for extraction unless the entire shaft is to be replaced.

(2) If the upward movement is greater than one inch, all of the material shall be removed and the entire drilled shaft operation shall be redone.

Placing of drilled shaft concrete under water shall not be done without the permission of the engineer. If such permission is granted, underwater concrete shall be placed in accordance with Subsection 805.07 and limited to placement with a tremie.

Material excavated from shafts and bells and not used in the backfill around the completed bents or piers shall be disposed of as directed. The disposal of such material shall be in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

At the time concrete is placed, the excavation shall be free from accumulated seepage water and all loose material shall be removed from the base area. The Contractor shall provide suitable access and lighting for the engineer to inspect the completed foundation excavation and check the dimensions and alignment of drilled shafts and the under-reamed excavation when under-reaming is required.

At any time when a person is in the hole, provisions shall

be made for pumping fresh air to the workman. Any required lighting shall be by electric lights. Any mechanical equipment used in the excavation shall be operated by air or electricity. The use of gasoline driven engines placed in the excavation for pumping or drilling will not be permitted.

In order that the engineer may judge the adequacy of the proposed foundation, the contractor, if requested, shall make soundings or take cores at his expense to determine the character of the supporting materials. The depth of such soundings or cores will not be required to exceed 5 feet below the proposed footing grade. It is the intent of this provision that soundings shall be made or cores taken at the time the excavation in each foundation is approximately complete.

When the plans require drilled shafts in the end bents, the embankment at the bridge ends shall be made to grade as shown and thoroughly compacted as provided in the governing specifications prior to drilling for end bent shafts.

(b) Reinforcing Steel: The reinforcing steel cage for the shaft consisting of longitudinal bars and spiral hooping or lateral ties shall be completely assembled and placed into the shaft as a unit. Generally, the reinforcing steel unit shall not be placed until immediately before concreting operations are to be started.

The longitudinal bars shall be tied or tack-welded to the spiral hooping at intervals not to exceed 12 inches on centers to provide a rigid unit.

For cased shafts where the reinforcing steel cage is over 30 feet in length, the longitudinal bars shall be tied or tack-welded at each intersection of the spiral hooping for a distance of L/5 from the bottom of the case, where L is the length of the spiral cage.

The cage of reinforcing steel shall be supported from the top by some positive method to prevent slumping downward during extraction of the casing.

If uncased shafts, side spacer blocks of concrete shall be used at intervals along the shaft to insure concentric spacing for the entire length of shaft. In cased shafts concrete spacer blocks shall not be used. Metal "chair" type spac-

ers shall be placed vertically at intervals around the steel cage to insure concentric spacing inside the casing.

(c) Concrete: The work shall be performed in accordance with the provisions of Section 805 and in conformance with the requirements herein.

Preferably, concrete shall be placed immediately after all excavation is complete and reinforcing steel placed.

Concrete placing shall be continuous from the beginning of placing in the shaft or footing bell to the top of shaft or to construction joint as may be indicated on the plans. Time intervals will be allowed for pulling casings, for placing forms and other operations necessarily carried on in sequence with the placing operations. The reinforcing steel cage shall be held vertical in some manner to restrain the steel from slumping during the concrete placement operation.

Concrete shall be placed through a suitable tube to prevent segregation of concrete materials and unnecessary splashing on the reinforcing steel cage. The tube shall be made in sections to permit the discharge and raising as the placement progresses.

Wherever a casing is used, the casing shall be smooth and well oiled and shall extend sufficiently above the grade of the finished shaft to provide excess concrete to be placed for the anticipated slump due to the casing removal. Where a casing is to be pulled, the concrete placed in casing shall be of such workability as to require no vibrating or rodding.

Where a cap block or groundline strut is shown on the plans to be placed at the top of the drilled shaft and the cap or strut is shown to be placed monolithic with the drilled shaft, a time interval will be allowed for placing the required form and reinforcing after any necessary casing removal.

After a placement is completed, the top surface shall be cured and any construction joint area shall be treated as prescribed in Section 805.

814.04 TEST HOLES. When shown on the plans or when ordered by the engineer in writing, test holes will be required to establish elevations for "belling" to determine

elevation of ground water or to determine other soil characteristics.

The diameter and depth of test hole or holes shall be as shown on the plans or as directed by the engineer.

814.05 TEST BELLS. When shown on the plans or when ordered by the engineer in writing, the under-reaming of bells on specified test holes will be required to establish the ability to under-ream in the soil strata present.

The diameter and shape of the test bell shall be as shown on the plans or as directed by the engineer.

814.06 METHOD OF MEASUREMENT. Acceptable drilled shafts in place of the specified diameter will be measured by the linear foot. At interior bents and piers, shafts will be measured from a point 6 inches below the ground elevation at the center of shaft unless otherwise indicated on the plans. At highway grade separations and at railroad underpasses, the ground elevation shall be the completed roadway section under the structure. At stream crossings and at railroad overpasses, the ground elevation shall be considered as the elevation existing at the time drilling begins. At abutment bents the length of shaft shall be measured from the bottom of cap elevation.

Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the engineer, will be measured by the cubic yard of concrete in the acceptable footings placed. The bell shall consist of the authorized footing volume outside the dimensions of the drilled shaft, which for the purpose of measurement will be considered as extending to the bottom of the bell.

Test holes of the specified diameter will be measured from the elevation of the ground at the time drilling begins by linear foot of acceptable test hole drilled.

Test bells of the specified diameter and shape will be measured by each test bell acceptably under-reamed.

814.07 BASIS OF PAYMENT. Drilled shafts will be paid for at the unit price bid per linear foot of the specified diameter of "Drilled Shafts" subject to the following limitations for overruns authorized by the engineer.

(a) Payment for individual completed shaft lengths up to and including 5 feet in excess of the maximum plan length shaft as defined herein will be made at the unit

price bid per linear foot of the specified diameter of "Drilled Shafts".

(b) Payment for that portion of individual completed shaft length in excess of 5 feet and up to and including 15 feet more than the maximum plan length shaft, as defined herein will be made at a unit price equal to 115 percent of the unit price bid per linear foot of the specified diameter of "Drilled Shafts".

(c) Payment for individual completed shaft lengths over 15 feet in excess of the maximum plan length shafts as defined herein will be in accordance with Subsection 109.04.

(d) For extra depth drilling for interior bents and piers, the maximum plan length shaft will be considered to be maximum length shaft, regardless of diameter, for all interior piers and bents of all bridges included in the contract.

(e) For extra depth drilling for abutment bents, the maximum plan length shaft will be considered to be the maximum length shaft, regardless of diameter, for all abutment bents of all bridges included in the contract.

Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the engineer, will be paid for at the contract unit price bid per cubic yard for "Bell Footings". Authorized increase in footing bell diameters beyond 3 times the nominal shaft diameter, unless specified on plans, shall be considered as beyond the scope and intent of these specifications and payment for such increased footing bells shall be in accordance with Subsection 109.04.

Test holes of the specified diameter will be paid for at the contract unit price bid per linear foot for "Test Hole".

Test bells of the specified diameter will be paid for at the contract unit price bid for each "Test Bell".

Test holes or test bells required by the engineer but not otherwise specified by the contract plans will be paid for in accordance with Subsection 109.04.

The foregoing unit prices shall be full compensation for making all excavations, for drilling all test holes and test bells, doing any necessary pumping, placing and removing any required casings, furnishing and placing all concrete

and reinforcing steel except as noted below and all backfilling. Where the bottom of drilled shaft is ordered to be placed at an elevation below plan grade and a splice of reinforcement is required, payment will be made at the unit price per pound for "Reinforcing Steel" for the extra reinforcement required to make one 20 diameter lap splice per bar. No extra payment will be made for casings left in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
814(1)	Drilled Shaft (Diameter)	Linear Foot
814(2)	Bell Footing	Cubic Yard
814(3)	Test Hole (Diameter)	Linear Foot
814(4)	Test Bell (Diameter)	Each

PART IX

MATERIALS

PART IX

MATERIALS

PREFACE

Unless otherwise specifically stated in these specifications or on the plans or in the special provisions, all sampling methods and testing methods shall be in accordance with the following documents; precedence shall be in the order as written:

FIRST—Louisiana Department of Highways Materials Sampling Manual and Testing Procedures Manual.

SECOND—Standards published by the American Association of State Highway Officials (AASHO).

THIRD—Standards published by the American Society for Testing and Materials (ASTM).

Section 901

Portland Cement Concrete

901.01 DESCRIPTION. Portland cement concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, admixtures if required and water, proportioned and mixed in accordance with these specifications.

901.02 MATERIALS. Materials shall meet the requirements specified in the following Subsections of Part IX, Materials.

Portland Cement Type I	901.03
Portland Cement Type II	901.03
Portland Cement Type III	901.03
Masonry Cement Type I	901.03
Fine Aggregate	903.02
Coarse Aggregate	903.03
Air-Entraining Admixtures	911.03
Water-Reducing Admixtures	911.03
Water	915.01

901.03 PORTLAND CEMENT. Cement shall conform to the following specifications:

Portland Cement—AASHO Designation: M 85 with these exceptions:

(a) All sampling shall be in accordance with the Department's Materials Sampling Manual.

(b) Testing frequencies for air content will be based on randomly selected samples rather than testing every individual sample for specification requirements.

(c) Routine cement acceptance shall be based on tensile strength measurements; however, in case of dispute, the engineer may use the compressive strength results for acceptance criteria.

(d) Type I Portland Cement shall conform to the following fineness limits:

Turbidimeter Test:	Fineness
Average value, max.	2200
Max. value any one value	2300

Air Permeability Test:	
Average value, max.	4000
Max. value any one sample	4200

Masonry Cement—AASHO Designation: M 150.

Different brands or types of cement or the same brand or type of cement from different mills shall not be mixed during use nor shall they be used alternately unless permitted.

The contractor shall provide suitable means for storing and protecting cement against dampness and contamination. Cement which, for any reason, has become partially set or which contains lumps of caked cement shall be rejected. Cement salvaged from discarded or used bags shall not be used.

901.04 TRANSPORTATION AND STORAGE OF CEMENT. All cement shall be transported in watertight conveyances and stored in watertight buildings, silos or other approved facilities in such a manner that the cement will be protected from dampness or water intrusion at all times during transportation and storage. Whenever possible the cement shall be sampled in the manufacturer's plant or cement plant and approved as pretested cement. In the event the sampling is not done at the plant, storage buildings or silos shall be provided with a capacity for the storage of a sufficient quantity of cement to allow sampling at least 12 days before the cement is to be used. Stored cement shall meet the test requirements at any time after storage when a retest is ordered.

On small jobs, open storage of bagged cement may be permitted when approved in writing, in which case a raised platform and ample waterproof covering shall be provided.

When required by the terms of the contract, the contractor shall keep accurate records of the deliveries of cement and of its use in the work. Copies of these records shall be supplied to the engineer in such form as may be required.

901.05 CARE AND STORAGE OF CONCRETE AGGREGATES. The handling and storage of concrete aggregate shall be such as to prevent segregation and contamination. Aggregates shall be stockpiled at locations approved by the engineer.

When specified, the coarse aggregate shall be separated into 2 or more sizes in order to secure greater uniformity of the concrete mixture. Different sizes of aggregates shall be stored in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

901.06 CLASSES AND TYPES OF CONCRETE. Each class or type of concrete shall be used where called for on the plans or where designated. The classes and types are as follows:

Class A	Type B
Class D	Type C
Class P	Type D
Class R	Type E
Class S	
Class W	
Class X	
Class Y	

901.07 COMPOSITION OF CONCRETE.

(a) Cement and Aggregates: Type 1 or Type 2 cement shall be used at the option of the contractor in general concrete construction. Type 3 cement shall be used when specified in the special provisions or on the plans. The contractor may use Type 3 cement at his option for all prestressed or precast work using Class P or Class X concrete. The contractor shall vary, without charge, the ratio of fine to coarse aggregate as approved by the engineer, but in no case shall it be varied so as to affect materially the unit volume of cement per unit volume of concrete as determined by the original proportions designed to obtain a cement factor of not less than the following:

Structural Concrete	Bags of Cement of 94 lbs. each to one Cu. Yd. of Concrete
Class A Concrete	6.0
Class D Concrete	5.0
Class P Concrete	6.5
Class R Concrete	4.0
Class S Concrete	7.0
Class W Concrete	7.0
Class X Concrete	6.5
Class Y Concrete	6.5

Paving Concrete	Bags of Cement of 94 lbs. each to one Cu. Yd. of Concrete
Type B Concrete	5.8
Type C Concrete	6.0
Type D Concrete	5.4
Type E Concrete	5.0

The contractor's attention is directed to the fact that the specified cement contents indicated in the above tables are the minimum permitted, but are not assured by the Department since the cement content required for any mix is dependent upon the gradation of aggregates within the limits of the specifications for that type gradation. The cement content is based upon the most ideal combination and gradation of both fine and coarse aggregates.

(b) Admixtures: Admixtures shall always be dispensed in a liquid state, and the method of dispensing shall be approved. Air entrainment will be required in concrete used for paving with a slip-form paver or when a central mixing plant is used. The use of admixtures in other classes or types of concrete will be optional with the contractor. When admixtures are used in a concrete mix, the maximum water shall not exceed the laboratory mix design.

When an air-entraining admixture is required or permitted, the concrete mix shall contain 5 percent by volume of entrained air. A variation of ±2 percent will be allowed.

If the contractor desires to use an air-entraining admixture and/or a water-reducing admixture, normal set or set-retarding, unless it is otherwise specified, it will be at his own expense without reducing the cement content, and permission must be obtained from the engineer in writing.

When the atmospheric temperature in the shade and away from artificial heat is above 70°F, the water-reducing admixture shall be of the set-retarding type; when the atmospheric temperature as described above is 70°F or below, the water-reducing admixture shall be of the normal set type. The set-retarding admixture shall be used in the amount sufficient to produce the degree of retardation that is necessary for the particular pour be-

ing made. However, in no case shall the amount used be less than would be necessary to conform to all requirements of Subsection 911.03.

When Class Y concrete is required, an approved air-entraining admixture and an approved water-reducing admixture (normal set or set-retarding) shall be used. The admixtures shall be used in such quantity as is necessary to produce an air content of 7 percent ±2 percentage points, when tested in accordance with LDH Designation: TR 202. The requirements of water-reducing admixtures will be the same as described above.

(c) Water: The maximum amount of water permitted per sack of cement, including the free water but not the absorbed water in the aggregates, for the different classes and types of concrete shall not exceed the quantity shown in the following table. Free water shall be deemed to include all water entering the mix with the aggregate except the water absorbed by the particles of aggregate.

	Maximum Water Per Sack Of Cement
Class A Concrete*	5.5 gallons
Class A Concrete	6.0 gallons
Class D Concrete	6.6 gallons
Class P Concrete	5.0 gallons
Class R Concrete	8.0 gallons
Class S Concrete	6.0 gallons
Type B Concrete	6.0 gallons
Type C Concrete	6.0 gallons
Type D Concrete	6.0 gallons
Type E Concrete	6.5 gallons

Because of the absorptive nature of lightweight aggregate and the inability to obtain a true saturated surface dry condition for determining free moisture, a maximum amount of water cannot be specified for Classes W, X and Y concrete. The consistency requirement will be the governing factor in determining the maximum allowable water.

(d) Coarse Aggregate: Coarse aggregate for the various classes and types of concrete shall be of the grade shown

*Used with a water-reducing admixture when permitted or specified.

in the following table and described in detail under Subsection 903.03.

Class A Concrete	Grade A
Class D Concrete	Grade A, B or D
Class P Concrete	Grade A
Class R Concrete	Grade A, B or D
Class S Concrete	Grade A
Class W Concrete	Grade Y
Class X Concrete	Grade Y
Class Y Concrete	Grade Y
Type B Concrete	Grade B
Type C Concrete	Grade B (Crushed Slag)
Type D Concrete	Grade D
Type E Concrete	Grade E

(e) Consistency: The composition of the combined mixture shall be such as to produce concrete of suitable workability with the specified cement content and not more than the volume of water specified herein.

The quantity of water used shall not be changed without the consent of the engineer.

The consistency of the various classes and types of concrete shall be such as to have slumps within the following ranges when tested in accordance with LDH Designation: TR 207.

Class A Concrete (Vibrated)	2–4 inches
Class A Concrete (Nonvibrated)	2–5 inches
Class D Concrete	1–3 inches
Class P Concrete	2–4 inches
Class R Concrete	1–3 inches
Class S Concrete	4–8 inches
Class W Concrete	1–3 inches
Class X Concrete	1–3 inches
Class Y Concrete	2–4 inches
Type B Concrete	1½–3 inches
Type C Concrete	1½–3 inches
Type D Concrete	1½–3 inches
Type E Concrete	1½–3 inches

The above ranges represent the desirable limits of slump; however, the engineer may authorize an increase in the maximum limits when necessary for the construction of walls 8 inches thick and thinner, as long as the water-

cement ratio is not exceeded. When slip-form paving or extruded curb methods are used, the slump requirements shall be ½–2 inches.

(f) Compressive Strength: Class concrete mixes will be designed with the intent of producing concrete which, when molded and cured in accordance with LDH Designation: TR 226 and tested as prescribed in AASHO Designation: T 22 of the Testing Procedures Manual, shall show a minimum compressive strength in pounds per square inch as follows:

	3 Days	7 Days**	28 Days
Class A Concrete	.....	2,000	3,000
Class D Concrete	.....	1,900	2,500
Class P Concrete	*4,000	4,000	5,000
Class R Concrete	.....	1,200	1,800
Class S Concrete	.....	2,000	3,000
Class W Concrete	*4,000	4,000	5,000
Class X Concrete	.....	2,500	3,750
Class Y Concrete	.....	2,000	3,000

* Steam-Cured
Final acceptance is based upon 28 day results.
** The 7 day compressive strength test is for information only.

Cylinders by which the strength of Class P and Class W concrete is to be determined shall be cured by methods similar to those used in curing the precast-prestressed bridge members.

If the strength required for the class of concrete being produced is not secured with the minimum cement content specified, additional cement shall be used or other aggregate provided at the contractor's expense.

From the concrete being placed, the engineer may require such additional samples as necessary for compression tests to determine that the mix proportions being used produce the required strength.

901.08 SAMPLING AND TESTING. All sampling and testing will be done in accordance with the Department's Sampling and Testing Procedure Manuals.

901.09 TEST SPECIMENS. The contractor shall, at his expense, furnish the concrete necessary for casting test beams and cylinders. The test specimens shall be made and cured by the method specified in LDH Designation: TR 226.

901.10 HANDLING MATERIALS. The batch plant site,

layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than 5 feet in thickness. Aggregates of different grades shall not be stockpiled together. Aggregates of the same grade, regardless of source, whose specific gravities vary by not more than 0.02 may be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods and washed aggregates shall be stockpiled or binned for drainage at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain nonuniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the engineer.

When mixing is at the site of the work, materials shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer with chute, boot or other approved device to minimize loss of cement and arranged to provide positive assurance of the actual presence in each batch of the cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch or between the fine and coarse aggregate. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of bags required by the job mix.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped into the mixer with minimum loss of cement, and when more than 1 batch is car-

ried on the truck, without excessive spilling of material from one batch compartment into another.

901.11 MEASUREMENT OF MATERIALS. Materials shall be measured by weighing except as otherwise specified or where other methods are specifically authorized by the engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose.

Scales shall be accurate to 0.5 percent throughout the range of use. The minimum graduation on the scales shall not exceed 0.1 percent of the rated capacity of the scales. When beam type scales are used, poises shall be designed to be locked in any position to prevent accidental change of position. A tell-tale indicator shall be provided. All measuring devices shall be subject to approval by the engineer.

Scales shall be tested, inspected and sealed at no cost to the Department as often as the engineer may deem necessary to assure their continued accuracy.

Concrete batching plant equipment shall include storage bins, weighing hoppers and scales. The fine aggregate and each size, if more than 1, of coarse aggregate shall be weighed on scales, separately or cumulatively, into weighing hopper from separate bins. If cement is used in bulk, a separate bin and scales system shall be used. The equipment shall be properly sealed and vented to eliminate as much dusting as possible.

Batching plants may be equipped to proportion aggregates and bulk cement by approved automatic weighing devices.

Batching shall be so conducted as to result in the weights of individual aggregates within ±2 percent, and the total weight of the aggregate shall be within ±1 percent of the required weight. The cement, as weighed, shall be within ±1 percent of the required weight. Cement in standard packages (sacks) need not be weighed; however, when sack cement is used, the quantities of aggregates for each batch shall be exactly sufficient for 1 or more full sacks of cement and no batch requiring fractional sacks of cement shall be permitted.

The mixing water shall be measured by volume or weight.

The water measuring device shall be accurate to ±1 percent of the required amount.

Where volumetric measurements are authorized for projects where the amount of concrete is small, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate.

Methods and equipment for adding air-entraining agent or other admixtures into the batch shall be approved by the engineer. The quantity of admixtures shall be measured into the mixer with an accuracy of ±3 percent.

901.12 MIXING CONCRETE.

(a) General: Mixing operation shall begin within 30 minutes after the cement has been added to the aggregate. When cement is charged into a mixer drum containing surface-wet aggregate and when the ambient temperature is above 90°F or when high early strength Portland cement is used, this limit shall be reduced to 15 minutes; the limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgment of the engineer, the aggregates are sufficiently free from moisture so that there will be no harmful effects on the cement.

(b) Mixing at Site: Concrete shall be thoroughly mixed in a batch mixer of an approved size and type which will insure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate water storage and a device for accurately measuring and automatically controlling the amount of water used in each batch. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch shall be deposited simultaneously in the mixer except that a portion of the mixing water shall enter in advance of the

cement and aggregates. No mixer having a rated capacity of less than a 1-bag batch shall be used nor shall a mixer be charged in excess of its rated capacity, except when a concrete paving mixer is used, a 10 percent overload will be allowed.

Concrete mixed in central mix plant shall be mixed for a period of not less than 50 seconds. Mixing time shall begin after all materials, including water, are in the mixer. Mixing time ends when the discharge chute opens. During the period of mixing, the mixer shall be operated at a drum speed for which it has been designed as shown on the manufacturer's name plate on the approved mixer.

Should mixing operations be interrupted, the mixer shall be thoroughly cleaned.

The pick-up and throw-over blades or mixing paddles in the mixing drum or mixing unit shall be replaced when worn beyond wear recommended by the manufacturer or when worn more than ¾ inch from a new condition, whichever is greater. The contractor shall: (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth or (2) provide permanent marks on blades to show points of ¾ inch wear from new conditions. Holes of ¼ inch diameter near each end and at mid-point of each blade are recommended.

(c) Truck Mixing: Truck mixers, unless otherwise authorized, shall be of the revolving drum type, watertight and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured in accordance with Subsection 901.11 and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may be verified. The counters shall be so located as to provide

safe and convenient inspection. The delivery ticket will show the amount of water added.

Each truck mixer shall have attached thereto in a prominent place a metal plate (or plates) on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum in terms of the volume of concrete and the speed of rotation of the mixing drum or blades for both agitating and mixing speeds.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of mixer as stated by the manufacturer and stamped on a metal plate on the mixer. The minimum size batch allowed shall not be less than 1 cubic yard. When a truck mixer is used for complete mixing, each batch shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated as mixing speed by the manufacturer of the equipment on the metal plate on the mixer. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials, including mixing water, shall be in the mixer drum before actuating the revolution counter for determination of the number of revolutions of mixing.

When the prescribed water is added at the batching plant and the slump requirements at the delivery site are not met, upon the authority of the engineer, it will be permissible to add a minimum of 75 percent of the mixing water at the time the cement and aggregates are added at the batch plant and the remaining mixing water at the job site, provided additional mixing is performed at the job site to insure thorough incorporation of the added water into the mix. The truck mixer shall be equipped with means of accurately measuring the amount of water used in each batch. The additional mixing shall be within the range of 20 to 30 revolutions at mixing speed.

(d) Partial Mixing at the Central Plant: When a truck mixer or an agitator provided with adequate mixing blades is used for transportation, the mixing time at the stationary machine mixer may be reduced to 30 seconds and the mixing completed in a truck mixer or agitator. The mixing time in the truck mixer or agitator equipped

with adequate mixing blades shall be as specified for truck mixing.

(e) Plant Mix: Mixing at a central plant shall conform to the requirements for mixing at the site.

(f) Transit Mix: When a batching plant is provided for exclusive use on the project and job conditions permit, on written request by the contractor, the engineer may approve mixing in transit.

(g) Time of Hauling and Placing Mixed Concrete: Concrete may be transported in a truck mixer, agitator or other approved transportation device and shall be discharged at the job and placed in its final position in the forms within 90 minutes after the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, except that in hot weather or under other conditions contributing to quick stiffening of the concrete, the maximum allowable time may be reduced by the engineer. The maximum volume of mixed concrete transported in an agitator and the speed of agitation shall be in accordance with the manufacturer's specified rating. Bodies of nonagitating hauling equipment for concrete shall be smooth, mortartight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection.

(h) Hand Mixing: When hand mixing is authorized, it shall be done on a watertight platform and in such a manner as to insure a uniform distribution of the materials throughout the mass. Mixing shall be continued until a homogeneous mixture of the required consistency is obtained.

(i) Delivery: The organization supplying concrete shall have sufficient plant capacity and transporting apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete and to maintain a live workable surface. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum of rehandling and without damage to the structure or the concrete.

(j) Retempering: The concrete shall be mixed only in such quantities as are required for immediate use and any which has developed initial set shall not be used.

901.13 LIMITATIONS OF MIXING.

(a) General: No concrete shall be mixed, placed or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated. The temperature of the mixed concrete at the time of placing shall be not less than 50°F or greater than 90°F unless authorized in writing by the engineer.

The temperature shall be determined at the job site immediately after placing the concrete by inserting the tip of the thermometer as near as possible to the center of the newly placed material. This temperature shall be an average of 2 or more readings.

(b) Hot Weather Limitations: Hot weather concreting practices will be considered when the job site temperature is 80°F and rising. When the internal temperature of the plastic concrete reaches 85°F, the contractor shall prevent the temperature of the succeeding batches from going beyond the 90°F upper limit by approved methods. If determined necessary, forms or the subgrade shall be precooled by approved methods immediately prior to the placement of concrete.

(c) Cold Weather Limitations: Unless authorized in writing by the engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

The temperature is to be determined at the job site.

When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the materials.

If the air temperature is 35°F or less at the time of placing concrete, the engineer may require the water or

the aggregates to be heated to not less than 70°F nor more than 150°F. No concrete shall be placed on a frozen subgrade nor shall frozen aggregates be used in the concrete.

Section 902

Bituminous Materials

902.01 GENERAL. The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 350°F.

All storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling bituminous materials shall be kept clean and in good operating condition at all times and shall be operated in such manner as to avoid any possible contamination of the contents with foreign materials.

All final test results for the bituminous materials shall be applied to the proper schedule for conformance to the specifications. Any deviation from the specifications will result in an adjustment in unit price, and any adjustment in unit price shall be made as specified.

Schedules No. 1, 2, 3, 4, 5, 6, 7, 8 and 9 shall be used for the purpose of adjusting the appropriate unit prices of bituminous materials. The adjustment in pay for bituminous materials shall be applied only to samples taken at the point of delivery. All samples taken at the refinery shall be in accordance with the specification requirements. Should the sample fail to meet these requirements, the material will be rejected.

The intent of adjustments in pay for point of delivery samples is to allow partial payment for bituminous materials which, in the judgment of the engineer, are satisfactory for use in the work and will serve the purpose intended, but which do not conform to the specifications in every detail.

In the event the engineer finds the bituminous materials not conforming to the requirements listed under 100 percent may have resulted in an inferior or unsatisfactory product, the materials shall be removed and replaced or otherwise corrected by and at the expense of the contractor.

If the test results are such that a penalty would result

from more than 1 of the test values, only the price adjustment for the greatest reduction shall apply.

902.02 ASPHALT CEMENT. Whenever samples of AC-3 and AC-5 taken at the point of delivery or from the hot mix plant storage tanks do not meet the specification requirements as shown in Schedule No. 1, then an adjustment in unit price shall be made according to Schedule No. 1 provided the material is performing satisfactorily.

Whenever samples of AC-8 taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 2, then an adjustment in unit price shall be made according to Schedule No. 2 provided the material is performing satisfactorily. All testing of asphalt cement, unless otherwise directed, shall be in accordance with the test methods given in Schedules No. 1 and 2.

902.03 EMULSIFIED ASPHALT. Whenever samples of anionic emulsified asphalts RS-1 and RS-2 taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 3, then an adjustment in unit price shall be made according to Schedule No. 3 provided the material is performing satisfactorily.

Whenever samples of SS-1 and SS-1h anionic emulsified asphalts taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 4, then an adjustment in unit price shall be made according to Schedule No. 4 provided the material is performing satisfactorily.

Whenever samples of MS-2 (EA-4) anionic emulsified asphalts taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 5, then an adjustment in unit price shall be made according to Schedule No. 5 provided the material is performing satisfactorily.

Whenever samples of cationic asphalt RS-3K and quick-set emulsion for Slurry Seals taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 6, then an adjustment in unit price shall be made according to Schedule No. 6 provided material is performing satisfactorily.

All testing of emulsified asphalts, unless otherwise specified, shall be in accordance with the test methods given in Schedules No. 3, 4, 5 and 6.

902.04 CUTBACK ASPHALT. Whenever samples of cutback asphalts taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 7 for medium curing or Schedule No. 8 for rapid curing, then an adjustment in unit price shall be made according to Schedules No. 7 and 8 for medium curing or rapid curing cutback asphalts respectively provided the material is performing satisfactorily.

All testing of cutback asphalts, unless otherwise specified, shall be in accordance with the test methods given in Schedules No. 7 and 8.

902.05 UNDERSEALING ASPHALT. Whenever samples of the undersealing asphalt taken at the point of delivery do not meet the specification requirements as shown in Schedule No. 9, then an adjustment in unit price shall be made according to Schedule No. 9 provided the material is performing satisfactorily.

All testing of undersealing asphalt shall be in accordance with the test methods given in Schedule No. 9.

Schedule No. 1
ADJUSTMENT IN UNIT PRICE OF ASPHALT CEMENT

Applicable to Asphaltic Concrete Mixtures		AC-3 (*1) Specifications	AC-3 (*1) Deviations		AC-5 (*1) Specifications	AC-5 (*1) Deviations	
		Percent of Contract Unit Price Per Unit of Measurement of Asphaltic Concrete Mix					
		100%	99%	90% Pay or Remove (*2)	100%	99%	90% Pay or Remove (*2)
Applicable to Asphalt Cement as a Separate Item	**Test Methods**	**Percent of Contract Unit Price Per Unit of Measurement of Asphalt Cement Per Shipment**					
		Specifications	**Deviations**		**Specifications**	**Deviations**	
		100%	80%	No Pay or Remove (*5)	100%	80%	No Pay or Remove (*5)
Viscosity							
Saybolt Fural Sec. @ 275°F	ASTM-E102	260+	220-259	219—	200+	160-199	159—
Absolute @ 140°F, Poises	AASHO-T202	3600+	3200-3599	3199—	1800+	1400-1799	1399—
Penetration @ 77°F, 100g, 5 Sec	AASHO-T49	60-70(*3)	(51-53) (77-79)	(50—) (80+)	85-100(*4)	(76-78) (107-109)	(75—) (110+)
Penetration @ 39.2°F, 200g, 60 Sec	AASHO-T49	20+	14-19	13—	30+	24-29	23—
Flash Point, C.O.C. °F	AASHO-T48	450+	No Penalty		450+	No Penalty	
Thin Film Oven Test, Loss % @ 325°F, 5 Hrs	AASHO-T179	0.80—	(0.81-.99)	1.00+	1.00—	(1.01-1.19)	1.20+
Penetration of Residue % Original @ 77°F, 100g, 5 Sec	AASHO-T49	60+	(55-59)	54—	57+	(51-56)	50—
Ductility of Residue @ 77°F, 5 cm/min	AASHO-T51	100+	(51-99)	50—	100+	(76-99)	75—
Solubility in CS_2	AASHO-T44	99.5+	(99.1-99.4)	99—	99.5+	(99.1-99.4)	99—
Spot Test	AASHO-T102	Neg.		Pos.	Neg.		Pos.

*1 All values are inclusive.
*2 If the material does not result in an inferior or unsatisfactory product, it may remain at 90 percent pay.
*3 For samples obtained at the point of delivery, the penetration requirement shall be 54-76.
*4 For samples obtained at the point of delivery, the penetration requirement shall be 79-106.
*5 If the material does not cause unsatisfactory results it may remain in place at no pay.

Schedule No. 2

ADJUSTMENT IN UNIT PRICE OF SURFACE TREATMENT ASPHALT CEMENT

Percent of Contract Unit Price/Gallon of Asphalt Cement Per Shipment

AC-8(*1)

Test Methods	Specifications	Deviations	
	100%	80%	No Pay or Remove (*2)
Percent of Contract Unit Price/Gallon of Asphalt Cement Per Shipment			
Viscosity, SF(Sec.) @ 275°F.....ASTM-E102	125-175	(95-124) (176-205)	(94—) (206+)
Absolute @ 140°F, Poises.....AASHO-T202	600+	450-599	449—
Penetration @ 77°F, 100g, 5 Sec.....AASHO-T49	150-200(*3)	(137-140) (210-213)	(136—) (214+)
Penetration @ 39.2°F, 200g, 60 Sec.....AASHO-T49	45+	38-44	37—
Flash Point, C.O.C. °F.....AASHO-T48	425+	No Penalty	
Thin Film Oven Test, Loss % @ 325°F, 5 Hrs.....AASHO-T179	1.50—	1.51-1.74	1.75+
Penetration of Residue % Original @ 77°F.....AASHO-T49	50+	43-49	42—
Ductility of Residue @ 77°F, 5 cm/min.....AASHO-T51	100+	81-99	80—
Solubility in CS_2.....AASHO-T44	99.5	99.1-99.4	99—
Spot Test AASHO-T102	Neg.		Pos.

*1 All values are inclusive.
*2 If the material is performing satisfactorily, it may be left in place at no pay.
*3 For samples obtained at the point of delivery the penetration requirement shall be 141-209.

Schedule No. 3

ADJUSTMENT IN UNIT PRICE OF ANIONIC EMULSIFIED ASPHALTS

		Percent of Contract Unit Price/Gallon of Asphalt Per Shipment					
		RS-1 (EA-1)			RS-2 (EA-2)		
		Specifications	Deviations		Specifications	Deviations	
	Test Methods	100%	80%	No Pay	100%	80%	No Pay
Viscosity, SF (Sec.) @ 77°F	AASHO-T59	20-100	(10-19) (101-150)	(9—) (151+)			
@ 122°F	AASHO-T59				75-400	(50-74) (401-450)	(49—) (451+)
Residue by Distillation, %	AASHO-T59	57 Min.	52-56	51—	62 Min.	57-61	56—
Settlement, 5 Days, %	AASHO-T59	3 Max.	No Penalty		3 Max.	No Penalty	
Demulsibility, 35 ml of .02N $CaCl_2$, %	AASHO-T59	60 Min.	No Penalty		50 Min.	No Penalty	
Sieve Test, % (Retained on No. 20)	AASHO-T59	0.1 Max.	No Penalty		0.10 Max.	No Penalty	
Tests on Residue Pen. @ 77°F, 100g, 5 Sec.	AASHO-T49	100-200	(88-99) (201-212)	(87—) (213+)	100-200	(88-99) (201-212)	(87—) (213+)
Solubility %, CCl_4	AASHO-T44	97.5 Min.	97.1-97.4	97—	97.5 Min.	97.1-97.4	97—
Ductility, 77°F, cm.	AASHO-T51	40 Min.	26-39	25—	40 Min.	26-39	25—

Schedule No. 4

ADJUSTMENT IN UNIT PRICE OF ANIONIC EMULSIFIED ASPHALT

Test Methods	Percent of Contract Unit Price/Gallon of Asphalt Per Shipment					
	SS-1			SS-1h		
	Specifications	Deviations		Specifications	Deviations	
	100%	80%	No Pay	100%	80%	No Pay
Viscosity SF (Sec.) @ 77°F.....AASHO-T59	20-100	(10-19) (101-150)	(9—) (151+)	20-100	(10-19) (101-150)	(9—) (151+)
Residue by Distillation, %.....AASHO-T59	57 Min.	(52-56)	(51—)	57 Min.	(52-56)	(51—)
Settlement, 5 Days, %.....AASHO-T59	3 Max.	No Penalty		3 Max.	No Penalty	
Cement Mixing.....AASHO-T59	2 Max.	No Penalty		2 Max.		2.1+
Adhesion Sieve Test, %, Retained on No. 20 .....AASHO-T59	0.1 Max.	No Penalty		0.1 Max.	No Penalty	
Test on Residue Penetration @ 77°F, 100g, 5 Sec. AASHO-T49	100-200	(88-99) (201-212)	(87—) (213+)	40-90	(30-39) (91-100)	(29—) (101+)
Solubility in CCl_4, %.....AASHO-T44 (*1)	98 Min.	(97.5-97.9)	(97.4—)	98 Min.	(97.5-97.9)	(97.4—)
Ductility @ 77°F, cm.....AASHO-T51	40 Min.	(26-39)	(25—)	40 Min.	(26-39)	(25—)

*1 Except that carbon tetrachloride is used instead of carbon disulphide as solvent, Method No. 1 in AASHO Method T44.

Schedule No. 5

ADJUSTMENT IN UNIT PRICE OF ANIONIC EMULSION MS-2 (EA-4)

		When Used for Mulching Percent of contract unit price/gallon of asphalt per shipment			When Used on Stabilized Base or Sub-Base Courses Deduction in contract unit price of Stablized Material represented (*1)		
		Specifications	Deviations		Specifications	Deviations	
	Test Methods	100%	80%	No Pay	No Deduction	$0.01	$0.02
Viscosity SF(Sec.) @ 77°F	AASHO-T59	100 Min.	60-99	59—	100 Min.	60-99	59—
Residue by Distillation, %	AASHO-T59	62 Min.	57-61	56—	62 Min.	57-61	56—
Settlement, 5 Days, %	AASHO-T59	3 Max.	No Penalty		3 Max.	No Penalty	
Cement Mixing	AASHO-T59	2 Max.	No Penalty		2 Max.	No Penalty	
Adhesion	LDH-TR311	75 Min.	No Penalty		75 Min.	No Penalty	
Sieve Test, % (Retained on No. 20)	AASHO-T59	0-1 Max.	No Penalty		0.1 Max.	No Penalty	
Tests on Residue		100-200	(88-99)	(87—)	100-200	(88-99)	(87—)
Pen. @ 77°F, 100g, 5 Sec.	AASHO-T49		(201-212)	(213+)		(201-212)	(213+)
Solubility %, CCl_4	AASHO-T44	97.5 Min.	(97.1-97.4)	97—	97.5 Min.	(97.1-97.4)	97—
Ductility, 77°F, cm	AASHO-T51	40 Min.	26-39	25—	40 Min.	26-39	25—

*1 If the unit of pay is not based on the square yard, the deduction shall be converted to an equivalent deduction in terms of the unit of pay.

When used on stabilized base or sub-base courses, the area on which the deduction will be applied shall be calculated by dividing the volume of the nonspecification EA-4 (in gals.) by the rate of 0.10 gal./sq. yd.

Schedule No. 6

ADJUSTMENT IN UNIT PRICE OF CATIONIC EMULSIFIED ASPHALT

		Percent of Contract Unit Price/Gallon of Asphalt Per Shipment					
		RS-3K (Rapid Setting)			Quick Set for Slurry Seal		
		Specifications	Deviations		Specifications	Deviations	
	Test Methods	100%	80%	No Pay	100%	80%	No Pay
Viscosity, SF(Sec.) @ 122°F	AASHO-T59	100-400	(56-99) (401-444)	(55—) (445+)			
Viscosity, SF(Sec.) @ 77°F	AASHO-T59				20-100	(10-19) (101-150)	(9—) (151+)
Residue by Distillation, %	AASHO-T59	65 Min.	61-64	60—	57 Min.	(52-59)	(51—)
Oil Distillate by Volume, %	AASHO-T59	5 Max.	No Penalty				
Particle Charge	LDH-TR311	Pos.		Neg.	Pos.		Neg.
Sieve Test (Retained on No. 20)	AASHO-T59	0.1 Max.	No Penalty		0.1 Max.	No Penalty	
PH	AASHO-T200				6 Max.	(6.1-7.0)	(7.1+)
Settlement, 5 Days, %	AASHO-T59	3 Max.	No Penalty				
Tests on Residue							
Penetration @ 77°F, 100g, 5 Sec.	AASHO-T49	100-250	(84-99) (251-266)	(83—) (267+)	40-90	(30-39) (91-100)	(29—) (101+)
Solubility in CCl_4, %	AASHO-T44	97.0	No Penalty		98 Min.	(97.5-97.9)	(97.4—)
Ductility @ 77°F, cm	AASHO-T51	80 Min.	No Penalty		40 Min.	(26-39)	(25—)
Viscosity @ 275°F, SSF	ASTM-E102	125 Min.	110-124	109—			

Schedule No. 7

ADJUSTMENT IN UNIT PRICE OF MC CUTBACK ASPHALT

		Deduction in Contract Unit Price/Square Yard of Base Course Represented (*1)								
		MC-30			MC-70			MC-250		
		Specifications	Deviations		Specifications	Deviations		Specifications	Deviations	
Test Methods		No Deduction	$0.01	$0.03	No Deduction	$0.01	$0.03	No Deduction	$0.01	$0.03
Flash Point Open Tag, °F	AASHO-T79	100 Min.	No Penalty		100 Min.	No Penalty		150 Min.	No Penalty	
Viscosity, SF (Sec.) @ 77°F,	AASHO-T72	75-150	(58-74) (151-167)	(57—) (168+)						
@140°F,					35-70	(24-34) (71-81)	(23—) (82+)	125-250	(100-124) (251-275)	(99—) (276+)
Distillation Test, Distillate Percentage by Volume of Total Distillate to 680°F,	AASHO-T78		No Penalty			No Penalty			No Penalty	
to 374°F										
to 437°F		0-25			0-20			0-10		
to 500°F		40-70			20-60			15-55		
to 600°F		75-93			65-90			60-87		
Residue from Distillation to 680°F; Percentage Volume by Difference		50 Min.	46-49	45—	55 Min.	51-54	50—	67 Min.	63-66	62—
Tests on Residue; Pen. @ 77°F, 100g, 5 Sec.	AASHO-T49	120-250	(102-119) (251-268)	(101—) (269+)	120-250	(102-119) (251-268)	(101—) (269+)	120-250	(102-119) (251-268)	(101—) (269+)
Ductility @ 77°F, for Residues of 200 Pen. @ 77°F, cm.	AASHO-T51	100 Min.	76-99	75—	100 Min.	76-99	75—	100 Min.	76-99	75—
Ductility @ 60°F, For Residues of 200-300 Pen. @ 77°F, cm.	AASHO-T51	100 Min.	76-99	75—	100 Min.	76-99	75—	100 Min.	76-99	75—
Solubility, % CCl_4	AASHO-T44	99.5	(99.1-99.4)	99—	99.5	(99.1-99.4)	99—	99.5	(99.1-99.4)	99—

*1 If the unit of pay is not based on the square yard, the deduction shall be converted to an equivalent deduction in terms of the unit of pay.

Schedule No. 8

ADJUSTMENT IN UNIT PRICE OF RC CUTBACK ASPHALT

Test Methods	Deduction in Contract Unit Price/Gallon Per Shipment								
	RC-70			RC-250			RC-800		
	Specifications	Deviations		Specifications	Deviations		Specifications	Deviations	
	No Deduction	$0.04	$0.12	No Deduction	$0.04	$0.12	No Deduction	$0.04	$0.12
Flash Point Open Tag, °F AASHO-T79				80 Min.	No Penalty		80 Min.	No Penalty	
Viscosity, SF (Sec.) @ 140°F AASHO-T72	35-70	(24-34) (71-81)	(23—) (82+)	125-250	(100-124) (251-275)	(99—) (276+)	400-800		
Distillation Test, Distillate Percentage by Volume of Total Distillate to 680°F,....AASHO-T78		No Penalty			No Penalty			No Penalty	
to 374°F	10 Min.								
to 437°F	50 Min.			35 Min.			15 Min.		
to 500°F	70 Min.			60 Min.			45 Min.		
to 600°F	85 Min.			80 Min.			75 Min.		
Residue from Distillation to 680°F; Percentage Volume by Difference	55 Min.	51-54	59—	65 Min.	61-64	60—	75 Min.	71-74	70—
Tests on Residue; Pen. @ 77°F 100g, 5 Sec. AASHO-T49	80-120	(66-79) (121-134)	(65—) (135+)	80-120	(66-79) (121-134)	(65—) (135+)	80-120	(66-79) (121-134)	(65—) (135+)
Ductility @ 77°F, for Residues of 200 Pen. @ 77°F, cm AASHO-T51	100 Min.	76-99	75—	100 Min.	76-99	75—	100 Min.	76-99	75—
Ductility @ 77°F, cm....AASHO-T51	100 Min.	76-99	75—	100 Min.	76-99	75—	100 Min.	76-99	75—
Solubility, % CCl_4....AASHO-T44	99.5	(99.1-99.4)	99—	99.5	(99.1-99.4)	99—	99.5	(99.1-99.4)	99—

902.05

Schedule No. 9

UNDERSEALING ASPHALT

		Percent of Contract Unit Price/Gallon of Asphalt		
		Specifications	Deviations	
	Test Methods	100%	80%	No Pay or Remove
Softening Point (Ring & Ball), °F	AASHO-T53	180°-200°	150-159	145—
			200-210	211+
Penetration of Original Sample:				
At 32°F, 200g, 60 Sec.	AASHO-T49	10+	8-9	7—
At 77°F, 100g, 5 Sec.	AASHO-T49	15-40	(10-14)	(9—)
			(41-45)	(46+)
At 115°F, 50g, 5 Sec.	AASHO-T49	90—	91-95	96+
Ductility at 77°F, cms.	AASHO-T51	2+	2.0+	2.0+
Flash Point (Cleveland Open Cup) °F	AASHO-T48	425+	No Penalty	
Solubility CCl_4, %	AASHO-T44 (*1)	99.0+	99.0+	99.0+
Loss @ 325°F, 5 Hrs., %	AASHO-T47	1.0—	1.0—	1.0—
Penetration of Residue % of Original	AASHO-T49	70+	65-69	64—

*1 Except that carbon tetrachloride is used instead of carbon disulphide as solvent, Method No. 1 in AASHO Method T44.

Section 903

Aggregates

903.01 GENERAL. This section covers the specifications for aggregates in general use by the Department.

In order to determine the acceptability of these materials, it will be necessary to perform all of the applicable tests on each sample submitted as specified, with the following modifications:

(a) Los Angeles abrasion test and soundness test where specified shall be run on each new source. Periodic tests shall be run thereafter except that when the material is questionable, tests shall be run.

The abrasion and soundness tests shall be in accordance with AASHO Designations: T 96 and T 104 of the Testing Procedures Manual except that for lightweight aggregate, the abrasion test shall be performed in accordance with LDH Designation: TR 111.

A permanent record of these test results on each source shall be maintained at the Department's Central Laboratory.

When submitting samples of aggregates for testing, it is esesntial that the supplier and geographical source of the material be given.

(b) Tests for deleterious substances shall be run only when it is evident by observation that the sample is contaminated except that it is required to run the colorimetric test on each sand sample submitted for a mix design.

903.02 FINE AGGREGATE. This specification covers fine aggregate for Portland cement concrete of all classes and types, and for mortar.

Sand shall consist of clean, hard, durable grains, graded from coarse to fine; it shall be substantially free from lumps of clay and all vegetable or other deleterious substances. The maximum percentages of deleterious substances shall not exceed the following values:

	Percent (By Weight)
Material Passing the No. 200 Sieve	3.0
Coal or Lignite	0.25
Clay Lumps	0.5

Fine Aggregate shall be uniformly graded from coarse to fine and shall conform to the following grading requirements:

Sieve Size	Percent Passing (By Weight)
⅜"	100
No. 4	95 to 100
No. 16	45 to 90
No. 50	7 to 30
No. 100, Not More Than	7
Sand for Mortar	
No. 4	100
No. 8	95 to 100
No. 100	0 to 25
No. 200	0 to 10

Fine aggregate subjected to the colorimetric test for organic impurities and producing a color darker than the Reference Standard Color Solution shall be subjected to the mortar strength test before acceptance.

Strength: Fine aggregate when subjected to the mortar strength test shall show a strength of 95 percent of the reference mortar.

The test for determining the amount of material passing the No. 200 sieve shall be made prior to and on the same sample as is used for sieve analysis.

Tests shall be in accordance with the following procedures of the Testing Procedures Manual:

Material Passing No. 200 Sieve	LDH–TR112
Colorimetric Test	AASHO–T21
Clay Lumps	AASHO–T112
Sieve Analysis	LDH–TR113
Mortar Strength Test	AASHO–T71
Coal and Lignite	AASHO–T113

903.03 COARSE AGGREGATE FOR CONCRETE. Coarse aggregate shall consist of gravel, crushed stone, crushed slag or a combination of gravel and crushed stone, or light weight aggregate.

(a) Gravel, crushed stone, crushed slag or a combination of gravel and crushed stone:

Crushed slag aggregate shall be used for paving concrete only and shall be thoroughly clean and reasonably free from an excess of thin or elongated pieces or frozen lumps. It shall show a percent loss of not more than 40 by the Los Angeles abrasion test. The crushed slag shall weigh not less than 75 pounds per cubic foot. Because of its high absorption property, slag in stockpiles shall be kept uniformly wet.

All gravel shall consist of clean, tough, durable stone of high resistance to abrasion, reasonably free of clay coating of any character. "Run of Bank" gravel or gravel which contains disintegrated or soft stone or shale, or excess of flat pieces shall not be used. The gravel shall show a percent loss of not more than 40 by the Los Angeles abrasion test.

When subjected to 5 cycles of the magnesium sulfate soundness test, the weighted loss shall not exceed 15 percent.

The maximum amounts of deleterious substances shall be as follows:

	Test Method	Percent (By Weight)
Material Passing the No. 200 Sieve	LDH–TR112	1.0
Clay Lumps	AASHO–T112	0.25
Soft Fragments	AASHO–T189	5.0
Iron Ore (Included in Soft Fragments)		1.5
Max. Retained ¾ in.—		0.5
Max. Passing ¾ in.—		1.0
Coal and Lignite	AASHO–T113	1.0
Sticks (Wet)		0.25
Totals, Clay Lumps, Soft Fragments, Coal and Lignite, and Sticks Shall Not Exeed		5.0

Aggregate Used in Hand Rails Shall Be Free From Lignites.

Crushed stone shall be obtained from clean, tough, sound, durable stone. The particles of stone shall be reasonably

free from dust, vegetable or other deleterious matter, and shall show a percent loss of not more than 40 by the Los Angeles abrasion test. Not more than 3 percent of the stone by weight shall be removed by washing over a number 8 sieve.

The weighted loss shall not exceed 15 percent when subjected to 5 cycles of the magnesium sulfate soundness test.

All coarse aggregate (gravel and/or crushed stone or crushed slag) shall be graded from coarse to fine and when tested in accordance with LDH Designation: TR 113 as contained in the Testing Procedures Manual, shall meet one of the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight) Grade A	Grade B	Grade D	Grade E
2½"	----------	----------	100	*
2"	----------	100	90 to 100	
1½"	100	85 to 100	----------	
1"	90 to 100	----------	40 to 80	
¾"	----------	40 to 88	----------	
½"	15 to 55	----------	----------	
No. 4	0 to 6	0 to 6	0 to 6	

* Gradation of Grade E Aggregate is given below.

For Grade E Mix the smaller size or larger size coarse aggregate may consist of either gravel or crushed stone conforming to the quality requirements of these specifications.

The individual grading of the 2 sizes of coarse aggregate shall be combined to meet the following gradation requirements:

Grade E

U.S. Sieve		Percent (By Weight)
Passing 2½"		100
Passing 2½"	Retained on 1½"	25 to 40
Passing 1½"	Retained on ¾"	20 to 45
Passing ¾"	Retained on No. 4	20 to 35
Passing No. 4, Not More Than		5

Unless written permission is obtained from the engineer, the individual sizes of coarse aggregate will be restricted as follows: The smaller size coarse aggregates for Grade E shall not have more than 10 percent retained on the

one inch sieve, not less than 5 percent retained on the ¾ inch and not more than 8 percent passing No. 4. The larger size coarse aggregate for Grade E shall have 45 to 60 percent retained on the 1½ inch sieve and shall not have more than 20 percent passing the one inch sieve.

(b) Lightweight Coarse Aggregate: This specification covers lightweight coarse aggregate intended for use in structural concrete for which prime considerations of the concrete are lightness in weight, suitable compressive strength, durability and constancy of volume.

The 2 general types of lightweight coarse aggregate are aggregate prepared by expanding clay or shale by the rotary kiln process and aggregate prepared by crushing, screening and cleaning natural lightweight materials such as pumice, scoria or tuff.

In order for a source of lightweight aggregate to be approved, preliminary samples shall be submitted for testing at least 110 days prior to anticipated use. All tests described herein shall be performed on the preliminary sample. Thereafter, only the tests for gradation, unit weight and fineness modulus will be performed for job control. However, a routine production sample will be taken each month as long as material is being supplied to jobs being constructed for or by the Department, and all tests described herein will be performed. These samples will be taken from a stockpile or from a particular day's run. However, if samples are taken from a day's run, the responsibility of shipping material which may fail the long range tests will be upon the supplier. All testing shall be in accordance with LDH Designation: TR 107.

(1) Grading:

a. Lightweight aggregate shall be graded from coarse to fine and shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight) Grade Y
¾"	100
½"	90–100
⅜"	40–70
No. 4	0–15
No. 8	0–5

b. Uniformity of Grading: Samples of coarse aggregate representing the normal product of the plant shall be furnished by the producer for acceptance tests. Other samples shall be taken from shipments at intervals stipulated by the engineer. If the fineness modulus of the aggregate in any shipment differs by more than 7 percent from that of the sample submitted for acceptance tests, the aggregate in the shipment may be rejected.

(2) Unit Weight:

a. The unit weight of lightweight coarse aggregate shall not exceed 55 pounds per cubic foot, dry loose measurement.

b. Uniformity of Weight: If the unit weight of any shipment of lightweight coarse aggregate differs by more than 10 percent from that of the sample submitted for acceptance tests, the aggregate in the shipment may be rejected.

1. Durability: The loss of lightweight coarse aggregate in 5 cycles of the accelerated soundness test shall not be greater than 10 percent when magnesium sulfate is used. In lieu of this sulfate soundness test, a freezing and thawing test may be made on concrete prepared with the aggregate. The mix design shall be as directed by the engineer. Concrete having a cement factor of 6.0, 7.0 or 8.0 bags per cubic yard shall after 300 cycles of freezing and thawing have a durability factor of at least 75, 80 or 85 respectively. Intermediate values may be obtained by interpolation.

2. Abrasion Resistance: Lightweight coarse aggregate shall show an abrasion loss of not more than 45 percent by the Los Angeles abrasion test, when tested according to LDH Designation: TR 111.

3. Concrete Making Properties: Concrete specimens prepared with lightweight coarse aggregate and concrete sand shall have the following properties or meet the following requirements.

a. Compressive Strength and Unit Weight: Concrete cylinders, 6 inches in diameter by 12 inches high, prepared with plastic concrete having unit weights not exceeding those given in

the following table shall at an age of 28 days have at least the minimum compressive strength and not more than the maximum dry unit weight shown. Intermediate values for unit weight and corresponding values for strength may be obtained by interpolation.

Compressive Strength and Unit Weight of Concrete

Plastic, Max. Lbs. per Cu. Ft.	Dry, Max. Lbs. per Cu. Ft.	Compressive Strength 28 days, Min., psi
120	115	4000
115	110	3000

b. Drying Shrinkage: The drying shrinkage of concrete specimens prepared and tested in accordance with Paragraph 2(i)-(1) of LDH Designation: TR 107 shall not exceed 0.10 percent or as tested in accordance with Paragraph 2(i)-(2) of LDH Designation: TR 107 shall not exceed 0.07 percent.

903.04 BASE COURSE AGGREGATES.

(a) Sand Clay Gravel: Sand clay gravel shall be composed of a natural mixture of sand, clay and gravel; an artificial mixture prepared by either the mixing of washed gravel or crushed stone, sand or binder; or by the addition of washed gravel or crushed stone and/or binder to natural sand clay gravel.

The mixture as determined by visual inspection shall be reasonably free from vegetable or other injurious matter.

When tested in accordance with test methods LDH Designations: TR 112 and TR 113 of the Testing Procedures Manual, combined materials shall meet the following requirements:

Percent Passing (By Weight)

U.S. Sieve	Grade A	Grade B
2½"	100	100
No. 4	40 to 60	50 to 75
No. 200	10 to 20	12 to 25

The fraction of sand clay gravel passing the No. 40 sieve, when tested in accordance with test method LDH Designation: TR 428 of the Testing Procedures Manual, shall show the following physical characteristics:

	Grade A	Grade B
Liquid Limit (Max.)	25	25
Plasticity Index (Max.)	6	6

In the event either Grade A or Grade B sand clay gravel is to be used for cement treatment, the maximum allowable liquid limit will be 35 and the maximum allowable plasticity index will be 12.

In the event either Grade A or Grade B sand clay gravel is to be lime treated, the maximum allowable liquid limit is waived. The plastic index shall be within a range of 6-20.

As a matter of information but not limitation, the contractor is advised that the several materials may be combined in approximately the following proportions:

	Grade A	Grade B
Gravel or Crushed Stone, percent	45	35
Sand, percent	40	47½
Binder, percent	15	17½

However, the exact proportion by volume shall be determined in the laboratory from test samples to be furnished.

Washed gravel used in preparing an artificial mixture shall conform to the requirements of Subsection 903.05(a).

The binder material used either for preparation of an artificial mix or as an additive to pit run sand clay gravel shall not have a plasticity index in excess of the plasticity index indicated above for the final product.

Crushed stone used in preparing an artificial mixture shall conform to the requirements of Subsection 903.05(b).

(b) Shell Base Course: The shell may consist of a natural or artificial mixture of any proportions of clam and reef shell except that when shell without binder is to be used for base courses, not more than 70 percent by weight of the final base course mixture shall be clam shell as determined from samples taken prior to compaction. The percentage of clam shell shall be determined in accordance with LDH Designation: TR 110. Where the base course is to consist of shell and sand, the base shall

be a mixture of shell and sand, and the sand content shall not exceed 35 percent by volume as verified by invoices for material placed on the roadbed.

When cement treated shell and sand base course is to be used, the amount of sand shall be from a minimum of 20 percent to a maximum of 35 percent by volume as verified by invoices for the materials placed in the base course.

The clam shell, reef shell, or clam and reef shell mixture may be whole or crushed or a combination thereof and shall consist of dead shell containing no cannery or live shell. The foreign matter content of the shell shall not exceed 5 percent of the dry weight of the sample when tested in accordance with LDH Designation: TR 109.

The binder material shall be of siliceous nature. The binder shall be tested in accordance with LDH Designations: TR 112 and TR 113 and shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
No. 4	85 to 100
No. 40	65 to 100
No. 200	0 to 60

The binder shall not contain more than a total of 4 percent by weight of foreign matter as determined by LDH Designation: TR 413. When tested by LDH Designation: TR 428, the binder shall meet the following physical characteristics:

Liquid Limit (Max.)	25
Plasticity Index (Max.)	6

Unless otherwise approved in writing by the engineer, the same shell base course mixture shall be used throughout the project.

903.05 SURFACE COURSE AGGREGATES.

(a) Washed Gravel: Washed or screen gravel shall consist of hard, durable particles of stone graded from coarse to fine, reasonably free of sticks and other deleterious matter, and when tested in accordance with LDH Designation: TR 113 of the Testing Procedures Manual, shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
1½"	95 to 100
No. 4	0 to 15
Clay & Silt LDH–TR112	2 percent max.

Washed gravel, when tested by the Los Angeles abrasion test, shall show a percent loss of not more than 45.

(b) Crushed Stone: Crushed stone shall consist of fragments of hard, durable particles of stone, excluding schist, shale or slate, showing a percent loss of not more than 45 by the Los Angeles abrasion test, containing not more than 5 percent soft, friable material, and shall be free from an excess of flat or elongated pieces. When tested by LDH Designation: TR 113 of the Testing Procedures Manual, the material shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
1½"	95 to 100
¾"	65 to 95
No. 4	0 to 15

(c) Binder: The binder material shall be of a siliceous nature and when tested in accordance with LDH Designations: TR 112 and TR 113 shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
No. 4	85 to 100
No. 40	65 to 100
No. 200	10 to 60

Binder shall not contain more than a total of 4 percent by weight of foreign matter as determined by LDH Designation: TR 413. When tested by LDH Designation: TR 428, it shall meet the following physical characteristics:

Liquid Limit (Max.)	35
Plasticity Index	4–12

(d) Sand Clay Gravel: Sand clay gravel shall be composed of a natural mixture of sand, clay and gravel; an artificial mix prepared by either the mixing of washed gravel or crushed stone, sand and binder; or by the addition of washed gravel or crushed stone and/or binder to natural sand clay gravel.

The mixture as determined by visual inspection shall be reasonably free from deleterious materials.

When tested in accordance with test methods LDH Designations: TR 112 and TR 113 of the Testing Procedures Manual, the combined materials shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
2½"	100
No. 4	40 to 60
No. 200	10 to 20

The fraction of sand clay gravel passing the No. 40 sieve, when tested in accordance with test method LDH Designation: TR 428, shall show the following physical characteristics:

Liquid Limit (Max.)	35
Plasticity Index	4–12

The binder material used either for preparation of an artificial mix or as an additive to pit run sand clay gravel shall not have a plasticity index in excess of the plasticity index indicated above for the final product.

When tested by the Los Angeles abrasion test, sand clay gravel shall show a percent loss of not more than 45.

(e) Shell: Shell shall consist of reef shell, clam and reef shell, reef shell and sand, clam shell and sand or clam and reef shell and sand. The shell may consist of a natural or artificial mixture of any proportions of clam and reef shell except that not more than 70 percent by weight of the final surface course mixture shall be clam shell as determined from samples taken prior to compaction. The percentage of clam shell shall be determined in accordance with LDH Designation: TR 110. Where the surface course is to consist of shell and sand, the sand content shall not exceed 35 percent by volume as verified by invoices of materials placed on the roadbed.

The clam shell, reef shell or clam and reef shell mixture may be either whole or crushed or a combination thereof and shall consist of dead shell containing no cannery or live shell. The foreign matter content of the shell shall not exceed 10 percent of the dry weight of the sample when tested in accordance with LDH Designation: TR 109.

When shell without binder is to be used, it shall meet all the requirements of this subsection and when tested in accordance with LDH Designation: TR 113, shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
2"	95 to 100
No. 4	10 to 50
No. 16	4 to 25

The binder material shall be of siliceous nature. The binder shall be tested in accordance with LDH Designations: TR 112 and TR 113 and shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
No. 4	85 to 100
No. 40	65 to 100
No. 200	0 to 60

The binder shall not contain more than a total of 4 percent by weight of foreign matter as determined by LDH Designation: TR 413. When tested by LDH Designation: TR 428, the sand shall meet the following physical characteristics:

Liquid Limit (Max.)	35
Plasticity Index	0–10

In the event contamination is evident in the mixture, the preceding characteristics shall also apply.

Unless otherwise approved in writing by the engineer, the same shell surface course mixture shall be used throughout the project.

903.06 BITUMINOUS SURFACE TREATMENT AGGREGATES. Aggregates for bituminous surface treatment may be uncrushed gravel, crushed aggregate (gravel, stone or slag), a combination of crushed and uncrushed gravel or expanded clay aggregate.

(a) Crushed Gravel: This aggregate shall consist of clean, tough, durable stone and shall be crushed and screened to conform to the gradation specified. A minimum of 80 percent of the crushed gravel retained on the No. 10 sieve shall have one or more fractured faces. Crushed gravel shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test and shall show

a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of magnesium sulfate soundness test.

(b) Crushed Stone: This aggregate shall consist of clean, tough, sound, durable particles of stone. The particles of stone shall be reasonably free from dust, vegetable or other deleterious matter and shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test. The stone shall be reasonably free from an excess of flat or elongated particles and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

(c) Crushed Slag: This aggregate shall be air-cooled, blast furnace slag and shall consist of angular fragments reasonably uniform in density and quality and reasonably free from flat or elongated particles, dirt or other deleterious substances. The slag shall not contain more than 10 percent by weight of glassy particles. The crushed slag shall have a weight per cubic foot of not less than 70 pounds. Slag shall show an abrasion loss of not more than 40 percent by the Los Angeles abrasion test.

(d) Uncrushed Gravel: This aggregate shall consist of clean, tough, durable stone reasonably free from sticks and clay coating. Gravel shall be reasonably free from an excess of flat or elongated particles of stone and shall show an abrasion loss of not more than 40 percent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 when subjected to 5 cycles of magnesium sulfate soundness test.

(e) Expanded Clay Aggregate: This aggregate shall be manufactured by the rotary kiln process and shall consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated particles or other deleterious substances. Expanded clay aggregate shall show an abrasion loss of not more than 40 percent by the Los Angeles abrasion test, when tested according to LDH Designation: TR 111. The soundness loss shall not exceed 10 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test using No. 4 to ⅜ inch and ⅜ inch to ¾ inch size aggregate.

(f) Gradation Requirement: All the above types, when

tested with laboratory sieves, shall conform to the gradation requirements specified for the various sizes in Table VI.

Table VI

Percent Passing (By Weight)

	Size 1 (Coarse)		Size 2 (Fine)		Size 3 (Seal)
U. S. Sieve	Uncrushed Gravel or Crushed Aggregate	Expanded Clay Aggregate	Normal Gradation 3 Application Surface Treatment	*Gradation for 2 Application Surface Treatment (Shoulders only)	
1½"	100	100	—	—	—
1"	85–100	95–100	—	—	—
¾"	40– 80	70– 90	100	100	—
⅝"	—	—	95–100	95–100	—
½"	0– 15	—	—	60– 90	100
⅜"	—	—	—	—	95–100
No. 4	—	0– 5	0– 7	0– 10	30– 60
No. 10	—	—	—	—	0– 15
No. 16	—	—	—	—	0– 5

*Size 2 cover material for use with two application surface treatment for shoulders shall conform to the gradation requirements referenced to this note.

903.07 AGGREGATES FOR ASPHALTIC CONCRETE. **(a) Type 1 Mixture:** The aggregate shall consist of crushed gravel, crushed stone, crushed slag, crushed granite, sand and mineral filler or a combination of these materials conforming to the gradation requirements contained in Table VII. These materials shall meet the following requirements.

Crushed gravel shall consist of clean, hard, tough, durable stone fragments and shall be screened and crushed to sizes as necessary to meet the grading requirements specified herein. Gravel shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of magnesium sulfate soundness test. Crushed stone shall consist of clean, hard, tough, durable fragments reasonably free from flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter. Crushed stone shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of magnesium sulfate soundness test.

Crushed granite shall consist of clean, hard, tough, durable fragments reasonably free from flat, elongated pieces, dirt or other objectionable matter. Crushed granite shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

Crushed slag shall be air-cooled, blast furnace slag and shall consist of angular fragments reasonably free from flat or elongated pieces, dirt or other objectionable matter. Crushed slag shall not show an abrasion loss of more than 40 percent by the Los Angeles abrasion test. The slag shall not contain more than 10 percent by weight of glassy particles, and the crushed slag shall have a minimum dry weight of 70 pounds per cubic foot.

Sand shall consist of clean, hard, durable grains graded from coarse to fine and shall be reasonably free from vegetable matter or other deleterious substance. The fraction passing the No. 40 sieve shall be non-plastic.

The sand equivalent value of the fraction passing No. 4 of the fine bin shall not be less than 35.

(b) Type 2 Mixture: The aggregate shall consist of whole clam shell, crushed clam shell, sand and if required, mineral filler, or a combination thereof; or graded or crushed reef shell, sand and if required, mineral filler, conforming to the requirements contained in Table VII. These materials shall meet the following requirements.

Shell shall consist of dead clam shell or dead reef shell. It shall be reasonably free from objectionable material such as sticks or coating of mud or other foreign matter. However, foreign matter such as sand, silt or clay will be permitted in an amount not exceeding 5 percent by weight when dry, as determined by LDH Designation: TR 109, provided such material is dispersed throughout the mass.

Sand shall conform to the requirements as contained in paragraph (a).

(c) Type 3 Mixture: The aggregate shall consist of the following:

(1) Wearing Course Mixture: Crushed gravel, crushed slag, crushed granite combined with crushed gravel, stone, slag, granite or other approved screenings, sand and mineral filler conforming to the requirements given in Table VII.

(2) Binder Course: The aggregate shall be the same as Type 1 binder course, described in paragraph (a) conforming to the requirements given in Table VII.

All materials for Type 3 mixes shall conform to the requirements given in paragraph (a).

Screenings shall be made by crushing any of the approved aggregates which prior to crushing conformed to the requirements given in paragraph (a).

The Type 3 wearing course mixture shall contain a minimum of 15 percent screenings based on total aggregates as approved by the engineer. The contractor is advised, however, that the amount of screenings required may exceed the minimum if deemed necessary in order to meet the optimum physical properties.

The screenings will be a natural crusher run material graded from coarse to fine, meeting the following gradation. When gravel is used for screenings, it shall be washed gravel and shall not have more than 10 percent passing the No. 4 sieve prior to crushing and shall meet the following gradation requirements after crushing.

U.S. Sieve	Percent Passing (By Weight)
3/8"	100
No. 4	90 to 100
No. 40	10 to 45

The screenings shall be stockpiled separately and fed into the plant through a separate cold feed. The percent of screenings used in the mix will be determined volumetrically at the cold feed.

This measurement will be made by the ratios of the gate openings at the cold feed for plants that have a constant feed for all the cold feed bins. For plants that have variable speed cold feed belts, the percent of screenings will be determined by measuring the percent of screenings by volume of the total volume of aggregate on a given section of belt.

The sand shall conform to the requirements given in paragraph (a).

(d) Type 4 Mixture: The aggregate shall consist of expanded clay aggregate, sand and mineral filler, conforming to the requirements contained in Table VII. These materials shall meet the following requirements.

Expanded clay aggregate shall be manufactured by the rotary kiln process and consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated pieces or other deleterious substances. Expanded clay aggregate shall not show an abrasion loss of more than 45 percent by LDH Designation: TR 111 abrasion test. The expanded clay aggregate shall have a dry weight per cubic foot of not more than 67 pounds. The loss on soundness shall not exceed 10 percent after 5 cycles by the magnesium sulfate soundness test.

Sand shall conform to the requirements contained in paragraph (a).

(e) Type 5 Mixtures:

(1) Base Course (A): The aggregate shall consist of gravel, slag, granite, stone, reef shell, clam shell or expanded clay, sand and mineral filler when needed, conforming to the requirements given in Table VII.

(2) Base Course (B): The aggregate shall consist of gravel, slag, granite, stone, reef shell, clam shell, expanded clay and sand or pit run sand clay gravel conforming to the requirements given in Table VII.

All of the aggregates for base courses A and B shall conform to the applicable requirements given in the previous paragraphs of this subsection.

Pit run sand clay gravel shall be composed of a natural mixture of sand, clay and gravel or an artificial mixture prepared by the addition of gravel, stone and/or sand to natural sand clay gravel. The individual aggregate components shall conform to applicable requirements of paragraph (a). The pit run sand clay gravel prior to drying, when tested by AASHO Designation T 89 and T 90, shall meet the following:

Liquid Limit (Maximum)	25
Plasticity Index (Maximum)	6

After drying, the sand equivalent value of the fine bin shall not be less than 35.

(f) Mineral Filler: Whenever mineral filler is used in the asphaltic concrete mixture, it shall meet the following requirements.

Mineral filler shall consist of limestone dust, hydrated lime, silica dust, shell dust, Portland cement or cement stack dust.

The blending of pulverized anhydrous calcium sulfate (anhydrite) with the above mineral fillers will be permitted provided the anhydrite does not constitute more than 30 percent of any blend with one or more of the other approved fillers.

The quantity of anhydrite in a blended filler shall be determined by LDH Designation: TR 501.

The anhydrite shall not be contaminated with clay or other plastic mineral matter and shall conform in all respects to the requirements applying to mineral fillers in general.

That portion of the pulverized anhydrite passing the No. 200 standard sieve shall not constitute more than 25 percent of the total material passing the No. 200 sieve, including natural fines, in any bituminous paving mixture.

Anhydrite shall not constitute more than 2 percent of the total aggregate, including all sizes, for any bituminous paving mixture.

The cement stack dust shall consist of material collected from waste rotary kiln gases discharged through a collector of a cement plant.

Limestone dust, silica dust, shell dust, cement stack dust, or a blend of one of these fillers with anhydrite dust or a blend of anhydrite with hydrated lime or Portland cement shall be obtained from sources approved by the Material Section and shall meet the following gradation requirements.

U.S. Sieve	Percent Passing (By Weight)
No. 30	100
No. 80	95 to 100
No. 200	70 to 100
No. 270	60 to 100

Whenever anhydrite blended fillers is proposed for use in bituminous mixtures, the laboratory shall prepare periodically, mixtures of aggregate filler and asphalt in the proportions required to meet the job mix formula, and this mixture shall have an index of retained Marshall stability of 75 percent or more as determined by LDH Designation: TR 313.

After approval of the source and preliminary samples of limestone, silica, shell dust or cement stack dust are furnished for mineral filler for the project, the laboratory, in an effort to expedite the release of shipments, will approve individual shipments on sieve analysis only.

Whenever Portland cement or hydrated lime is used, tests for gradation requirements will not be made.

(g) All the properties listed in the preceding sections shall be tested using the following test procedures as contained in the Testing Procedures Manual.

AASHO Designation: T 19	Method of Test for Unit Weight of Aggregate
LDH Designation: TR 113	Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHO Designation: T 96	Method of Test for Abrasion of Coarse Aggregate by Use of the Los Angeles Machine
AASHO Designation: T 104	Method of Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
AASHO Designation: T 176	Method of Test for Sand Equivalent
LDH Designation: TR 102	Method of Test for Sieve Analysis of Mineral Filler
LDH Designation: TR 104	Method of Test for Percent of Oil in Fine Aggregate

LDH Designation: TR 111	Method of Test for Abrasion of Lightweight Coarse Aggregate
LDH Designation: TR 306	Percentage of Crushed Particles in Extracted Aggregate
LDH Designation: TR 307	Bitumen Content by Reflux Extractor
LDH Designation: TR 308	Bitumen Content by Centrifuge
LDH Designation: TR 309	Mechanical Analysis of Extracted Aggregate
LDH Designation: TR 428	Methods of Determining Liquid Limit of Soils
LDH Designation: TR 428	Methods of Determining the Plastic Limit of Soils and of Calculating the Plasticity Index of Soils

903.08 GRANULAR MATERIAL. The granular material shall be non-plastic, having clean, hard, durable grains; shall contain not more than a total of 15 percent clay and silt passing the No. 200 sieve as determined by the Laboratory in accordance with LDH Designation: TR 112; and shall meet the following gradation requirements:

U.S. Sieve	Percent Passing (By Weight)
½"	100
No. 10	75–100
No. 200	0– 15

Table VII

Type	1		2	3		4	5	
U.S. Sieve	W.C.	B.C.	W.C. & B.C.	W.C.	B.C.	W.C. & B.C.	Base (A)	Base (B)
	Percent Passing (By Weight)							
1 ½"	–	–	–	–	–	–	100	100
1 ¼"	–	100	–	–	100	–	–	–
1"	100	90–100	100	100	90–100	–	80–100	80–100
¾"	85–100	75–100	90–100	85–100	75–100	100	70–95	–
½"	70–100	55–95	80–100	70–100	55–95	80–100	55–85	–
⅜"	–	–	–	–	–	–	–	–
No. 4	40–70	35–70	50–80	40–70	35–70	55–85	35–60	35–75
No. 10	25–55	20–50	35–65	25–55	20–50	45–75	20–45	–
No. 40	8–30	10–30	15–40	8–30	10–30	20–55	10–30	10–55
No. 80	4–20	5–20	10–25	4–20	5–20	10–25	5–25	–
No. 200	2–10	2–10	4–12	2–10	2–10	2–12	2–10	2–15
Bitumen %	3.5–7.0	3.0–6.0	4.5–7.5	3.5–7.0	3.0–6.0	6.0–8.5	3.0–8.5	3.0–8.5
Mineral Agg. %	93.0–96.5	94.0–97.0	92.5–95.5	93.0–96.5	94.0–97.0	91.0–94.0	91.5–97.0	91.5–97.0
% Mineral Filler (Min.)	3	2	As Needed	2	2	2	As Needed	–
% Crushed Retained on No. 4	75 Min.	60 Min.	–	80 Min.	60 Min.	–	As Needed	–

NOTE: The aggregate gradation based on the composite weight of the aggregate and the proportions by weight of the mineral aggregate and bituminous material for various type mixtures shall be as above.

Section 904

Masonry Units

904.01 SEWER BRICK. Sewer brick may be made from clay or shale or may be concrete meeting the following requirements.

Unless otherwise specified brick made from clay or shale intended for use in inlets, pipe junctions, catch basins, arches, manholes and for backings shall conform to AASHO Designation: M 91, Manhole Brick Grade MM.

Concrete brick shall meet the requirements of ASTM Designation: C 139, except that the minimum thickness of each unit shall not be less than 3⅝ inches.

904.02 BUILDING BRICK.

(a) Building brick made from clay or shale for use in brick masonry shall conform to the requirements of AASHO Designation: M 114, Grade SW.

(b) Concrete building brick for use in masonry buildings shall conform to the requirements of ASTM Designation: C 55, Grade A.

904.03 CONCRETE BUILDING BLOCK. Concrete hollow load-bearing building block shall conform to the requirements of ASTM Designation: C 90. The grade shall be as specified on the plans or in the special provisions.

Section 905

Joint Materials

905.01 POURED JOINT SEALERS. These joint sealers shall be used in sealing joints when specified in accordance with the plans and specifications. If not specified, the contractor may use any of these approved sealants for its intended use. Other sealants may be approved by the Department and specified on the plans or in the specifications for a project.

(a) Asphaltic Types (Liquid Types):

(1) Asphalt with Mineral Filler: Asphalt mineral filler shall be homogeneous and shall be composed of bitumen and mineral filler. The bitumen shall be free from impurities. The asphalt mineral filler shall conform to the following requirements:

	Test Method	Min.	Max.
Softening Point, °F	AASHO–T 53	125	145
Penetration at 32°F, 200g, 1 Min.	AASHO–T 49	14	.....
Penetration at 77°F, 100g, 5 Sec.	AASHO–T 49	50	70
Ductility at 77°F, cm	AASHO–T 51	15	.....
Bitumen Soluble in Carbon Disulphide, %	AASHO–T 44	45	55
Mineral Filler, %	AASHO–T 44	45	55
Water	AASHO–T 55	.....	2

(2) Catalytically Blown Asphalt Joint Sealer: Catlytically blown asphalt shall be uniformly blended with 10 percent diatomaceous earth filler which passes the No. 325 sieve. It shall form a suitable joint and crack sealer which may be melted to pouring consistency in a regular asphalt kettle at a temperature of 450 to 475°F. The material shall meet the following requirements:

Type–Grade	Test Method	68–88 Pen. Min.	68–88 Pen. Max.	38–45 Pen. Min.	38–45 Pen. Max.
Penetration, 77°F, 100g, 5 Sec.	AASHO–T 49	68	88	38	45
Penetration, 32°F, 200g, 60 Sec.	AASHO–T 49	38	.....	.....	.....
Penetration, 115°F, 50g, 5 Sec.	AASHO–T 49	.....	160	.....	.....
Softening Point, R & B., °F	AASHO–T 53	175	200	185	200
Flash, C.O.C, °F	AASHO–T 48	500	.....	500	.....

Type–Grade	Test Method	68–88 Pen. Min.	68–88 Pen. Max.	38–45 Pen. Min.	38–45 Pen. Max.
Ductility, 77°F, 5 cm/min, cms	AASHO–T 51	5	.....	3	.....
Flow, 140–F, cm	AASHO–T 187	.....	0.5	.....	0.5
Ash Weight, %	AASHO–T 111	8	20	8	20
Shock Test, 30°F	AASHO–M 190–5(c) (1)	No cracking		No cracking	

(3) Hot Poured Elastic Type: Hot poured elastic type sealer is intended for sealing joints in concrete pavements, bridges and other structures and shall conform to the requirements of AASHO Designation: M 173, with the exception that the pour point test will be performed only as may be deemed necessary.

(4) Hot Poured Elastic Type (Federal Specifications): This joint sealer shall conform to the requirements of Federal Specifications: SS-S-001401 (DOD-USAF) with the following modifications. Section 6.5 entitled "Field Performance" is not applicable.

(b) Polyurethane Polymers (Liquid Poured): This joint sealer shall be a one or two component, pourable or extrudable material. It shall set up as a solid rubber-like material able to withstand both tension and compression. This sealer shall not flow at temperatures below 160°F.

The joints shall be backed with joint fillers of a type specified by the manufacturer to obtain the correct depth of sealant. This backing material must not adhere to the sealant material.

The primer-adhesive shall be as recommended by the sealant manufacturer for the proper joint interface.

The material shall be machine mixed and machine applied, unless otherwise allowed by the engineer.

The Materials Section shall maintain a qualified products list of primers, back-up materials and elastomeric polymers. Once a product including corresponding primer and back-up material is approved for a joint sealer, these requirements shall continue to be met for every lot produced.

Each container of material shall be properly marked as to material identity, batch number and manufactured date. Seven certified copies of certificates of compliance and analysis shall be furnished for each project and batch.

Shelf life shall be specified by the manufacturer, and the expiration date shall be clearly shown on the container.

All joint sealing compounds furnished under this specification shall have passed all qualification tests which include actual field installation and evaluation. All material furnished under contract shall be equal in composition to the original sample which has been tested and approved as a qualified product. Any deviation in performance of the product shall result in it being removed from the qualified product list.

In addition, for verification purposes the material shall meet the following requirements.

Property	Limits	Test Methods
Bostic Cycles, 37.5% Compression, 67% Expansion (0°F to 160°F)	40 (Min.)	LDH–TR 609
Tack Free Time, Hrs.	72 (Max.)	Federal Spec. TT–S–00227E
Hardness, Shore A		Federal Spec. TT–S–00227E
Heat Aging	20–50	
Standard Condition	5–30	
Weatherometer, 600 Hrs. (Min.)	Pass	LDH–TR 611
Ozone	Pass	ASTM–D 1149
Shrinkage	None	LDH–TR 613
Infra-Red Charts		LDH–TR 610
Activator	Pass	
Base Resin	Pass	

905.02 PREFORMED ELASTOMERIC COMPRESSION JOINT SEAL (MECHANICAL TYPE). The joint seal shall conform to the requirements of ASTM Designation: D 2628 with following modifications.

The joint seal shall be an approved preformed, elastic polychloroprene joint seal which shall be compatible with concrete and steel and shall be resistant to abrasion, oxidation, oils, gasoline, salt and other substances that may be spilled on or applied to the surface.

The Materials Section shall maintain a qualified products list of compression seals. The Department may require a seal to prove its performance through field installation and evaluation prior to placement upon the qualified products list. All material furnished under contract shall be equal in composition, shape and physical characteristics to the original sample which has been tested and approved as a qualified product.

When the seal size is not stated on the plans, the size shall be selected as a seal with a nominal width that is double the joint's theoretical width at maximum closure.

Unless noted otherwise, the width of joint seal to be used shall be determined on the basis of a temperature range between 20°F and 120°F.

The uncompressed depth of the seal shall be approximately equal to or greater than the uncompressed width of the seal. The actual width of the seal shall not be less than the nominal width of the seal.

Each lot of joint sealer submitted for Department approval shall demonstrate that it possesses the inherent capabilities necessary for satisfactory field installation. This property shall be judged by actual installation, and the sealer shall not exhibit any twisting, rolling, misalignment of the opposite top edges, tendencies to trap incompressibles or any other qualities which shall be deemed detrimental to the sealer's proper installation and performance.

(a) ASTM Designation: D 2628, Table I shall be further altered by:

(1) The results of the recovery under the 50 percent deflection test after 22 hours at −20°F may be required by the manufacturer's certification.

(2) The test for Ozone resistance, strain determination may, by option of the Department, be determined by the Bent Loop test method.

(3) When testing compression seals with nominal widths of 4 inches or larger, the required tensile strength as determined by ASTM Designation: D 412 shall be 1800 psi (min.).

In addition to the requirements of ASTM Designation: D 2628, Table I, compression seals shall also be tested for force deflection as determined by LDH Designation: TR 612.

(b) Bridge Use:

(1) Joint Seal: Compression seals whose nominal widths are 2 inches or less shall exert a minimum of 3 pounds per square inch at 80 percent of their nominal width when tested in accordance with LDH Designation: TR 612.

(2) Lubricant-Adhesive: The material shall be compatible with concrete, steel and polychloroprene and must be of a character that is recommended by the sealant manufacturer. The material shall not neces-

sarily be from the same base polymer as the seal; however, each type of lubricant-adhesive shall demonstrate by actual test installation that it possesses the inherent capabilities necessary for satisfactory performance. The lubricant-adhesive shall contain a minimum of 65 percent solids by weight. All material furnished under contract shall be equal in composition to the original sample which has been tested and approved as a qualified product. This shall be certified by affidavit by the manufacturer for each separate lot produced for each project.

The percent solids shall be determined by oven drying at 230°F ±5 degrees for 3 hours.

The lubricant-adhesive shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number, date of manufacture and storage stability.

A qualified products list of lubricant-adhesive shall be maintained by the Department's Materials Section.

(c) Pavement Use:

(1) Joint Seal: Compression seals for pavements shall exert a minimum of 3 pounds per square inch at 80 percent of their nominal width and a maximum of 25 pounds per square inch at 50 percent of their nominal width.

(2) Lubricant-Adhesive: The lubricant-adhesive for pavement use shall meet ASTM Designation: D 2835 specifications.

905.03 JOINT FILLERS. These preformed fillers and sealers shall be used in joints when specified in accordance with the plans and specifications. If not specified, the contractor may use any of these approved preformed fillers and sealers for its intended use. Other preformed fillers and sealers may be approved by the Department and specified on the plans or in the specifications for a project.

The engineer may require the contractor to furnish him with a certificate of compliance or a certificate of analysis or both, stating that the materials comply with these specifications. In the absence of detail material specifications, the contractor shall furnish certificates of analysis of materials proposed for use together with their specification require-

ments and recommended uses. Seven certified copies of each report shall be furnished the Central Laboratory.

(a) Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types): This specification covers preformed strips which have been formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly saturated with a suitable bituminous binder, or strips which have been formed from clean granulated cork particles securely bound together by a suitable bituminous binder and encased between 2 layers of bituminous saturated felt.

The type shall be as specified and shall conform to the requirements of AASHO Designation: M 213.

(b) Preformed Expansion Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Nonbituminous Types): This specification covers preformed expansion joint fillers of the following types:

Type I	Sponge Rubber
Type II	Cork
Type III	Self-expanding Cork

The type shall be as specified and shall conform to the requirements of AASHO Designation: M 153.

(c) Preformed Expansion Joint Filler for Concrete (Bituminous Type): This specification covers bituminous preformed expansion joint filler consisting of bituminous (asphalt or tar) mastic composition, formed and encased between 2 layers of bituminous impregnated felt. The preformed filler shall conform to the requirements of ASTM Designation: D 994.

(d) Wood Fillers: Wood fillers shall be furnished to dimensions specified on the plans and shall meet the requirements of AASHO Designation: M 90-42, with the following exceptions: Other species of wood meeting the specifications may be used in lieu of redwood.

Wood fillers furnished for expansion joints and construction joints shall conform to the above requirements.

Wood fillers furnished for dummy joints shall conform to the above requirements except the test for compression and weight per cubic foot will not be required.

(e) Preformed Nonbituminous Cellular Filler (For Sawed Joints): This product shall consist of preformed strips which have been formed from cane or other suitable fibers of a cellular nature, or laminated fiber board built up to plan thickness. The material forming these strips shall be securely bound together with a suitable nonbituminous binder and formed to the plan dimensions.

Unless otherwise specified on the plans or special provisions and in addition to the above requirements, the preformed strips shall meet the following:

(1) Water Absorption: When tested in accordance with AASHO Designation: T 42, the sample shall not absorb more than 15 percent by volume in 4 hours.

(2) Permissible Variation in Dimensions: The preformed filler shall not exceed the thickness specified by more than ±1/16 inch.

905.04 JOINT MATERIALS FOR APPROACH SLABS. **(a) Urethane Foam Type:** This material shall be a poured-in-place, blown urethane foam consisting of a compressible base layer and a flexible cap layer. Both the base and the cap shall be furnished in 2 components which, when mixed according to the manufacturer's recommendations, shall expand in the joint and be a closed cell water-blown and/or Freon-blown type material. The cap should be at least 2 inches thick and shall be installed to a depth ½ inch ±¼ inch below the level of the pavement surface. The material after mixing shall meet the following requirements.

	Minute	
	Min.	Max.
Cream Time at 80° ±5°F (Cream time is defined as the interval between the beginning of the mixing of the two components and the time the material begins to expand.)	½	5
Expansion Time at 80° ±5°F (Expansion time is the interval between the beginning of the mixing and the completion of the expansion of the material.)	2	10

Tack Free time at 80° ±5°F 20
(The material shall be judged tack free by touching lightly. Tack free time requirement shall begin with the completion of the expansion time.)

The cured separate base and cap material shall conform to the following requirements.

Property	Test Method	Min.	Max.
Unit Weight	AASHO–T 42 (Drying at 220°F shall be omitted)	Base 3 Cap 16	7 lbs./cu. ft.
Linear Compression to 50 Percent Thickness	AASHO–T 42	Base 10 Cap 10	200 lbs./cu. ft. 200
Recovery After Compression	AASHO–M 213	Base 50% Cap 90%	
Moisture Absorption	AASHO–T 42 (Calculated on the basis of exposed area)	Base 0.1	lb./sq. ft. of exposed area
Extrusion at 50 Percent Compression (Combined)	AASHO–T 42		0.3 in.

The material shall be packaged in premeasured units designed to have the correct ratio of material when contents of the smaller container are poured into the larger container. The 2 components are mechanically mixed. Each container shall state the name of manufacturer, batch number, name and type of foam, complete mixing instructions and precautions for handling.

The manufacturer's instructions and recommendations shall be strictly adhered to.

The joint must be thoroughly clean and completely dry immediately prior to placement. The temperature in the shade shall be not less than 75°F during installation and initial cure.

The Department's Materials Section shall maintain an approved products list.

(b) Preformed Elastomeric Compression Joint Seal (Mechanical Type): This material must meet the requirements of Subsection 905.02.

905.05 JOINT MORTAR. Pipe joint mortar shall consist of one part Portland cement and 2 parts approved sand, with water as necessary to obtain the required consistency. Mortar shall be used within 30 minutes after its preparation.

905.06 RUBBER GASKETS. The rubber gaskets for

use in pipe joints shall conform to the requirements of AASHO Designation: M 198.

Each pipe manufacturer or supplier shall furnish certified test reports covering each shipment of gaskets to the Department stating that the gaskets conform in all respects to the above specifications.

905.07 FLEXIBLE PLASTIC GASKET. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross-section and of such size as to fill the joint space when the pipes are laid. The gasket joint sealer shall be protected by a suitable removable 2-piece wrapper. The 2-piece wrapper shall be so designed that ½ may be removed longitudinally without disturbing the other half.

The material shall be obtained from sources approved by the laboratory, and the approval will consist of full scale pressure testing as required elsewhere herein and any additional tests deemed necessary by the Department.

When this type gasket is used as a contractor's alternate for "Flexible Watertight Gaskets," the Department may, in addition to the requirements of this Subsection, require the performance test described in Paragraph 8 of AASHO Designation: M 198.

Flexible plastic gasket shall meet the requirements as stated in the following table:

Composition	Test Method	Min.	Max.
Bitumen (Petroleum Plastic Content)	ASTM–D 4	50	70
Ash-Inert Mineral Matter	AASHO–T 111	30	50
Volatile Matter	ASTM–D 6	—	2.0
Property	**Test Method**	**Min.**	**Max.**
Specific Gravity at 77°F	ASTM–D 71	1.20	1.35
*Ductility at 77°F (cm)	ASTM–D 113	5.0	——
*Softening Point	ASTM–D 36	320°F	
*Penetration 77°F (150 gms) 5 Sec.	ASTM–D 217	50	120

*Due to the nature of the material, each sample to be tested must be manually kneaded, in lieu of heating and pouring, into various molds suggested by ASTM Standards to reduce the void content and improve testing accuracy and reproductibility.

Section 906

Concrete, Clay, Asbestos-Cement and Bituminized Fiber Pipe

906.01 NONREINFORCED CONCRETE PIPE. Nonreinforced or plain concrete sewer pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: C 14.

906.02 REINFORCED CONCRETE PIPE. These specifications cover concrete pipe for use in the construction of pipe culverts, storm drains and/or sanitary sewers.

All reinforced concrete pipe furnished shall conform to the requirements of ASTM Designation: C 76 amended as follows.

(a) Unless otherwise specified, Class III Reinforced Concrete Pipe, Wall B (Table III), shall be furnished.

(b) When extra strength pipe is required, Class IV Reinforced Concrete Pipe, Wall B (Table IV), shall be furnished.

(c) The pipe shall be tested for permeability as specified in ASTM Designation: C 14, Paragraph 6.3.1. When tested by the test procedure given in ASTM Designation: C 497, Paragraph 17, frequency of testing shall be a minimum of one pipe per lot of sizes of up to and including 48 inches in diameter and not to exceed one test per 1000 joints of pipe manufactured. The absorption test specified in ASTM Designation: C 76 will be conducted at the discretion of the engineer in those cases where the pipe exhibits visual porousness.

(d) The pipe, when used with "Flexible Watertight Gaskets," shall have joints conforming to the requirements of Subsection 701.06, Joining Conduit.

906.03 PERFORATED CONCRETE PIPE. Perforated concrete pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: C 444.

906.04 CONCRETE DRAIN TILE. Concrete drain tile shall be of the class and size specified and shall conform to the requirements of ASTM Designation: C 412.

906.05 POROUS CONCRETE PIPE. Porous concrete pipe shall be of the size specified and shall conform to the requirements of AASHO Designation: M 176.

906.06 REINFORCED CONCRETE PIPE (Vitrified Clay Lined). Design for fully lined or half lined pipes of the specified strength and class shall be submitted by the manufacturer for approval.

The applicable requirements of Subsection 906.02 and AASHO Designation: M 65 shall govern. Liner or liner element shall be clay of first quality, sound, thoroughly and perfectly burned, without warps or cracks or other inperfections, and fully and smoothly salt glazed.

906.07 CLAY DRAIN TILE. Clay drain tile shall be of the size and class specified and shall conform to the requirements of ASTM Designation: C 4.

906.08 CLAY SEWER PIPE (Standard Strength). Standard strength clay sewer pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: C 13.

906.09 CLAY PIPE (Extra Strength). Extra strength clay pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: C 200.

906.10 CLAY PIPE PERFORATED (Standard and Extra Strength). Perforated clay pipe shall be of the size and strength class specified (Class I or Class II) and shall conform to the requirements of ASTM Designation: C 211.

906.11 VITRIFIED CLAY PIPE JOINTS USING MATERIALS HAVING RESILIENT PROPERTIES. Vitrified clay pipe having joints manufactured with resilient type jointing materials shall conform in every respect to ASTM Designation: C 425. The manufacturer shall supply certified test reports covering the jointing materials, when tested according to ASTM Designation: D 543.

906.12 ASBESTOS-CEMENT, NON-PRESSURE SEWER PIPE. Asbestos-cement, non-pressure sewer pipe shall be of the size and class specified and shall conform to the requirements of ASTM Designation: C 428.

906.13 ASBESTOS-CEMENT PERFORATED PIPE. Asbestos-cement perforated pipe shall be of the size specified and shall conform to the requirements of AASHO Designation: M 189.

906.14 RUBBER RINGS FOR ASBESTOS-CEMENT PIPE. Rubber or synthetic rubber rings used for coupling asbestos-cement pipe shall be of the type specified and shall conform to the requirements of ASTM Designation: D 1869.

The manufacturer shall supply the Department with certified test reports covering the rubber or synthetic rubber rings.

906.15 HOMOGENEOUS BITUMINIZED FIBER DRAIN AND SEWER PIPE. This pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: D 1861.

906.16 LAMINATED-WALL, BITUMINIZED FIBER DRAIN AND SEWER PIPE. This pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: D 1862.

906.17 PERFORATED BITUMINIZED FIBER PIPE. This pipe shall be of the size specified and shall conform to the requirements of AASHO Designation: M 177. Unless otherwise specified, either Type I or Type II coupling may be furnished.

906.18 REINFORCED CONCRETE ARCH CULVERT, STORM DRAIN AND SEWER PIPE. These specifications cover reinforced arch-shaped concrete pipe of sizes equivalent to 18 to 108 inch circular concrete pipe to be used for the conveyance of sewage, industrial waste and storm water, and for the construction of culverts.

The class of pipe shall be as specified in the contract and shall conform to the requirements of ASTM Designation: C 506, amended as follows:

(a) The geometric shape, wall thickness and reinforcement shall be in accordance with these specifications, and no modified or special designs will be allowed.

(b) Article 3(a), Basis of Acceptance, is expanded to include the following. Random testing, as established by Departmental policy, will be made to assure proper placement of reinforcing steel.

(c) Single line cage reinforcing will be allowed for equivalent diameter pipe 15 through 24 inches. All other pipe arch sizes and types will require double line cage reinforcing.

(d) The producer shall provide detailed fabrication

drawings reflecting the requirements of these specifications prior to pipe inspection.

(e) The pipe, when used with "Flexible Watertight Gaskets," shall have joints conforming to the requirements of Subsection 701.06, Joining Conduit.

Section 907

Metal Pipe

907.01 CAST IRON PIPE FOR CULVERTS. This pipe shall conform to the requirements of ASTM Designation: A 142, for the specified diameters and strength classes. Unless otherwise specified, either smooth, corrugated or ribbed pipe may be furnished. Pipe of diameter in excess of 48 inches shall conform to the ANS standard for Cast Iron Pit Cast Pipe for the specified diameter and strength class.

907.02 CAST IRON PRESSURE PIPE. Cast iron pressure pipe suitable for carrying gas, water and other liquids under pressure shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 377.

907.03 CAST IRON SOIL PIPE AND FITTINGS. Cast iron soil pipe and fittings shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 74.

907.04 BLACK AND HOT-DIPPED, ZINC-COATED (GALVANIZED) WELDED AND SEAMLESS STEEL PIPE FOR ORDINARY USES. Steel pipe for ordinary uses shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 120.

907.05 WELDED AND SEAMLESS STEEL PIPE PILES. Pipe piles shall be of the class specified and shall conform to the applicable requirements of ASTM Designation: A 252, Grade 2.

907.06 CORRUGATED METAL PIPE AND PIPE ARCH. These conduits and coupling bands shall conform to the requirements of Type 1 (culvert pipes, circular section) and Type 2 (culvert pipes, other than circular section) of AASHO Designation: M 36 amended as follows:

(a) The zinc coated iron or steel sheets shall conform to AASHO Designation: M 218.

(b) Helical corrugated pipe with continuous lock or welded seam construction will not be allowed.

(c) The minimum gage or sheet thickness shall be in accordance with Subsection 701.02; however, sheets thicker than that specified will be acceptable when approved by the engineer.

(d) Special sections, such as elbows and flared end sections shall be of the same sheet thickness as the pipe or pipe arch to which they are joined and shall conform to the applicable requirements of these specifications.

(e) Shop-formed elliptical pipe and shop-strutted pipe shall be furnished when specified.

(f) The pipe, when used with "Watertight Connecting Bands," shall have connections conforming to the requirements of Subsection 701.06, Joining Conduit.

(g) When "smooth lined" pipe is specified by the plans or project specifications, the following requirements shall apply. The inside circumference of the pipe shall be paved with bituminous material to minimum depth of ⅛ inch above the crests of the corrugations. The paving shall be applied by centrifugal or other approved methods. The bituminous materials and method of testing shall be in accordance with AASHO Designation: M 190.

907.07 BITUMINOUS COATED CORRUGATED METAL PIPE AND PIPE ARCH. These conduits and coupling bands shall conform to the requirements of AASHO Designation: M 190 amended as follows:

(a) The requirements of AASHO Designation: M 36 are amended in accordance with Subsection 907.06.

(b) The coating shall be Type A, fully bituminous coated, unless otherwise specified.

907.08 ASBESTOS BONDED CORRUGATED METAL PIPE AND PIPE ARCH. Asbestos bonded corrugated metal pipe shall be fabricated from asbestos bonded sheets. The base metal and the fabrication of conduits and coupling bands shall conform to the requirements of Subsection 907.06.

The metal sheets shall be coated on both sides with a layer of asbestos fibers applied by pressing a sheet of asbestos fiber into the molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly impregnated with a bituminous

saturant. The finished sheets shall be of first-class commercial quality, free from blisters and unsaturated spots.

After fabrication the asbestos bonded pipe and pipe arch shall be fully bituminous coated with a Type A coating in accordance with AASHO Designation: M 190.

907.09 STRUCTURAL PLATE FOR PIPE, PIPE ARCH AND ARCH. This material shall conform to the requirements of AASHO Designation: M 167.

907.10 CORRUGATED METAL PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of Type 3 (underdrain pipes) of AASHO Designation: M 36 for the specified diameters. Unless otherwise specified, any of the 4 classes may be furnished.

907.11 BITUMINOUS COATED CORRUGATED METAL PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of Type 3 (underdrain pipes) of AASHO Designation: M 36 as amended by Subsection 907.10 and shall be coated with bituminous material to meet the requirements of AASHO Designation: M 190, Type A coating, except that minimum coating thickness shall be 0.03 inch. Coupling bands shall be fully coated. The specified minimum diameter of perforations shall apply after coating.

907.12 CORRUGATED ALUMINUM PIPE AND PIPE ARCH. Corrugated aluminum pipe and pipe arch shall be of the dimensions and gages specified and shall conform to the requirements of AASHO Designation: M 196.

907.13 CORRUGATED ALUMINUM PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of AASHO Designation: M 197 for the specified diameters. Unless otherwise specified, any of the 4 types may be furnished.

907.14 BITUMINOUS COATED CORRUGATED ALUMINUM PIPE AND PIPE ARCH. The corrugated aluminum pipe and pipe arch shall meet the requirements of Subsection 907.12. Bituminous coating shall conform to the applicable requirements of AASHO Designation: M 190, Type A.

907.15 BITUMINOUS COATED CORRUGATED ALUMINUM PIPE FOR UNDERDRAIN. The corrugated aluminum pipe for underdrains shall conform to Subsection 907.13. Bituminous coating shall conform to the applicable

requirements of AASHO Designation: M 190, Type A, except that the minimum coating thickness shall be 0.03 inch. Coupling bands shall be fully coated. The specified minimum diameter of perforations shall apply after coating.

Section 908

Paints

908.01 GENERAL.

(a) Packaging: All paints covered by these specifications shall be delivered in containers not larger than 5-gallon capacity, unless otherwise specified. Used containers will not be permitted unless they have been reconditioned and thoroughly cleaned.

(b) Identification: Each paint container shall bear a label with the following information thereon: name and address of the manufacturer, trade name or trade mark, kind of paint, number of gallons, batch number, purchaser's order number and project number.

(c) Sampling: All sampling shall be in accordance with LDH Materials Sampling Manual. Acceptance or rejection of shipments of paint will be based on the analyses of these samples. If the sample is taken by the manufacturer or contractor, it shall be accompanied by a notarized certificate which states that the sample represents the material to be used or shipped. Also list the batch number, purchase order number, number of gallons and project number.

The contractor shall therefore secure necessary paint in ample time so that no delay to the work will be caused by the time necessarily used in testing for which 21 days should be allowed from the time the sample is collected by the inspector.

908.02 BASIC LEAD SILICO CHROMATE PAINT.

(a) Description: These specifications set forth material requirements for basic lead silico chromate paint to be used in a 3- or 4-coat paint system over properly prepared structural steel surfaces to be permanently exposed. The 4-coat paint system will use 1st, 2nd, 3rd and 4th coats of paint, and the 3-coat system will use only 1st, 3rd and 4th coats of paint as specified herein.

The shop coat (prime coat) for structural steel on new

construction shall be in accordance with the requirements of A(1).

The first prime coat for existing steel structures shall be in accordance with the requirements of A(2), unless otherwise specified.

The final field coat (4th coat) shall meet the requirements of D(2) "Cement Gray Paint," as specified.

(b) Requirements:

A(1). First Coat Basic Lead Silico Chromate Brown Paint (Shop prime coat or first prime coat for steel on new construction):

a. Pigment: The pigment shall be well ground and be composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	93.2	....
Siliceous Red Iron Oxide (85% Fe_2O_3)	5.0	6.1
*Organo Montmorillonite	0.5	0.7

* Bentone 38

b. Liquid: The liquid shall consist of not less than 52 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be composed of raw linseed oil and alkyd resin combined in the approximate proportions of 1:1 respectively by weight and shall contain a minimum of 15 percent phthalic anhydride. The alkyd resin, furnished as a solution, shall meet the requirements of Federal Specification TT-R-266, Type III. Small quantities of grinding and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	57.0%	.....
Vehicle	.....	43.0%
Weight/Gallon, Pounds @ 77°F	13.5	.....
Water	.....	0.5%
Coarse Particle and Skins (Total Residue Retained on 325 Sieve Based on Paint)	.....	1.0%
Fineness of Grind (North Standard)	4	.....

	Min.	Max.
Viscosity (Stormer-Krebs Units) @ 77°F	72	83
Drying Time:		
Set to Touch, Hours		4
Dry Through, Hours		16

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

	% By Weight
Pigment—58.4% by Weight	
Basic Lead Silico Chromate (ASTM Designation: D 1648)	93.5
Siliceous Red Iron Oxide (85% Fe_2O_3)	5.9
*Organo Montmorillonite	0.6
	100.0

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—41.6% by Weight	
Raw Linseed Oil (AASHO Designation: M 125-60)	26.7
Alkyd Resin (TT-R-266, Type III)	52.3
Mineral Spirits	18.7
6% Zirconium Catalyst	1.2
6% Manganese Naphthenate	0.4
6% Cobalt Naphthenate	0.2
Anti-Skinning Agent	0.2
Methyl Alcohol:Water (95:5)	0.3
	100.0

P V (% pigment by volume in nonvolatile portion of paint): 39.7

Volatile and drier in vehicle: 44.9%

A(2). First Coat Basic Lead Silico Chromate Brown Paint (First prime coat for existing steel structures and maintenance painting):

a. Pigment: The pigment shall be well ground and composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	94.0	....
Siliceous Red Iron Oxide (85% Fe_2O_3)	4.0	5.5
*Organo Montmorillonite	0.5	0.7

* Bentone 38

b. Liquid: The liquid shall consist of not less than 69 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be composed of raw linseed oil and alkyd resin combined in the approximate proportions of 2.3:1 respectively by weight and shall contain a minimum of 7.0 percent phthalic anhydride. The alkyd resin, furnished as a solution, shall meet the requirements of Federal Specification TT-R-266, Type I, Class A or B. A drier combination of 0.14 percent zirconium, 0.04 percent manganese, and 0.02 percent cobalt metals furnished in soluble form based on the nonvolatile vehicle of the paint shall be used. Small quantities of grinding and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	64.0%	.....
Vehicle	.....	36.0%
Weight/Gallon, Pounds @ 77°F	15.0	.....
Water	.....	0.5%
Coarse Particle and Skins (Total Residue Retained on 325 Sieve Based on Paint)	.....	1.0%
Fineness of Grind (North Standard)	4	.....
Viscosity (Stormer-Krebs Units) @ 77°F	72	80
Dry Firm, Hours	18	.....

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

	% By Weight
Pigment—64.58% by Weight	
Basic Lead Silico Chromate (ASTM Designation: D 1648)	94.43
Siliceous Red Iron Oxide (85% Fe_2O_3)	4.97
*Organo Montmorillonite	0.60
	100.00

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—35.42% by Weight	
Raw Linseed Oil (AASHO Designation: M 125-60)	48.46

Alkyd Resin (TT-R-266, Type I, Class A)	30.81
Mineral Spirits	17.94
6% Zirconium Catalyst	1.58
6% Manganese Naphthenate	0.47
6% Cobalt Naphthenate	0.24
Anti-Skinning Agent	0.18
Methyl Alcohol:Water (95:5)	0.32
	100.00

P V (% of pigment by volume in nonvolatile portion of paint): 38.1

Volatile and drier in vehicle: 29.9%

B. Second Coat Basic Lead Silico Chromate Maroon Paint:

a. Pigment: The pigment shall be well ground and be composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	64.0	.....
Siliceous Red Iron Oxide (85% Fe_2O_3)	.....	35.5
*Organo Montmorillonite	0.5	0.7

* Bentone 38

b. Liquid: The liquid shall consist of not less than 72 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be composed of raw linseed oil and alkyd resin combined in the approximate proportions of 2:1 respectively by weight and shall contain a minimum of 7.6 percent phthalic anhydride. The alkyd resin, furnished as a solution, shall meet the requirements of Federal Specification TT-R-266, Type I, Class A or B. A drier combination of 0.14 percent zirconium and 0.04 percent manganese metals furnished in soluble form based on the nonvolatile vehicle of the paint shall be used. Small quantities of grinding and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	62.0%	.....
Vehicle	.....	38.0%
Weight/Gallon, Pounds @ 77°F	14.8	.....
Water	.....	0.5%

	Min.	Max.
Coarse Particles and Skins (Total Residue Retained on 325 Sieve Based on Paint)		1.0%
Fineness of Grind (North Standard)	4	
Viscosity (Stormer-Krebs Units) @ 77°F	74	84
Dry Firm, Hours	18	

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

	% By Weight
Pigment—62.26% by Weight	
Basic Lead Silico Chromate (ASTM Designation: D 1648)	64.62
Siliceous Red Iron Oxide (85% Fe_2O_3)	34.79
*Organo Montmorillonite	0.59
	100.00

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—37.74% by Weight	
Raw Linseed Oil (AASHO Designation: M 125-60)	47.56
Alkyd Resin (TT-R-266, Type I, Class A)	34.44
Mineral Spirits (Hv)	14.76
Anti-Skinning Agent	0.16
6% Zirconium Catalyst	1.80
6% Manganese Naphthenate	0.49
Methyl Alcohol:Water (95:5)	0.30
Soya Lecithin	0.49
	100.00

P V (% pigment by volume in nonvolatile portion of paint): 34.8

Volatile and drier in vehicle: 27.84%

C. Third Coat Basic Lead Silico Chromate Gray Paint:

a. Pigment: The pigment shall be well ground and be composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	65.6	
Chalk Resistant Rutile Titanium Dioxide		16.6

	Min. %	Max. %
Acicular Zinc Oxide		5.8
Fibrous Magnesium Silicate and Tinting Colors (Lampblack and Phthalocyanine Blue) No Iron Blue Permitted		11.5
*Organo Montmorillonite	0.5	

* Bentone 38

b. Liquid: The liquid shall consist of not less than 69 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be composed of raw linseed oil and alkyd resin combined in the approximate proportions of 2:1 respectively by weight and shall contain a minimum of 7.5 percent phthalic anhydride. The alkyd resin, furnished as a solution, shall meet the requirements of Federal Specification TT-R-266, Type I, Class A or B. Small quantities of grinding and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	56.5%	
Vehicle		43.5%
Weight/Gallon, Pounds @ 77°F	13.5	
Water		0.5%
Coarse Particles and Skins (Total Residue Retained on 325 Sieve Based on Paint)		1.0%
Fineness of Grind (North Standard)	4	
Viscosity (Stormer-Krebs Units) @ 77°F	72	82
Dry Firm, Hours	18	

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

	% By Weight
Pigment—57.7% by Weight	
Basic Lead Silico Chromate (ASTM Designation: D 1648)	67.80
Titanox RANC	15.52
Zinc Oxide	5.13
Magnesium Silicate	9.77

	% By Weight
Lampblack	0.81
Phthalocyanine Blue	0.36
*Organo Montmorillonite	0.61
	100.00

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—42.3% by Weight

Raw Linseed Oil (AASHO Designation: M 125-60)	46.83
Alkyd Resin (TT-R-266, Type I, Class A)	33.33
Mineral Spirits	18.00
6% Zirconium Catalyst	1.17
6% Manganese Naphthenate	0.23
Anti-Skinning Agent	0.16
Methyl Alcohol:Water (95:5)	0.28
	100.00

P V (% pigment by volume in nonvolatile portion of paint): 32.5

Volatile and drier in vehicle: 30%

D(1). Fourth Coat Basic Lead Silico Chromate (Bright Green Paint):

a. Pigment: The pigment shall be well ground and be composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	64	....
Titanium Dioxide, Rutile Nonchalking	18	....
Tinting Colors (C.P. Chrome Yellow Light Phthalocyanine Green)	Balance	
*Organo Montmorillonite	0.8	1.0

* Bentone 38

b. Liquid: The liquid shall consist of not less than 47.0 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be an alkyd resin conforming to Federal Specification TT-R-266, Type I, Class A or B. The thinner shall be essentially mineral spirits meeting Federal Specification TT-T-291a, Grade 1. Small quantities of grind and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	30.5%	.....
Vehicle	.....	69.5%
Weight/Gallon, Pounds	9.8	.....
Water	.....	0.5%
Coarse Particles and Skins (Total Residue Retained on 325 Sieve Based on Paint)	.....	1.0%
Fineness of Grind (North Standard)	5	.....
Viscosity (Stormer-Krebs Units)	65	75
Dry Firm, Hours	.....	8

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

	% By Weight
Pigment—31.0% by Weight	
Basic Lead Silico Chromate (ASTM Designation: D 1648)	64.2
Titanox RANC	18.4
Chrome Yellow, Light	11.0
Phthalocyanine Green	5.5
*Organo Montmorillonite	0.9
	100.0

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—69.0% by Weight	
Alkyd Resin (TT-R-266, Type I, Class A)	67.2
Mineral Spirits	30.7
Zirconium Catalyst, 6%	1.2
Cobalt Naphthenate, 6%	0.3
Manganese Naphthenate, 6%	0.3
Anti-Skinning Agent	0.2
Methyl Alcohol:Water (95:5)	0.1
	100.0

P V (% pigment by volume in nonvolatile portion of paint): 20.1

Volatile and drier in vehicle: 53.0%

D(2). Fourth Coat Basic Lead Silico Chromate (Cement Gray Paint):

a. Pigment: The pigment shall be composed of:

	Min. %	Max. %
Basic Lead Silico Chromate (ASTM Designation: D 1648)	39.0	....
Titanium Dioxide, Rutile Nonchalking	57.0	....
Phthalocyanine Blue and Lampblack	Balance	
*Organo Montmorillonite	0.7	0.9

* Bentone 38

b. Liquid: The liquid shall consist of not less than 50 percent nonvolatile vehicle, the balance to be combined drier and thinner. The nonvolatile vehicle shall be an alkyd resin conforming to Federal Specification TT-R-266, Type I, Class A or B. The thinner shall be essentially mineral spirits meeting Federal Specification TT-T-291a, Grade 1. Small quantities of grind and wetting aids may be used if desired.

c. The paint shall consist of:

	Min.	Max.
Pigment	33.0%	.....
Vehicle	.....	67.0%
Weight/Gallon, Pounds @ 77°F	10.0	.....
Water	.....	0.5%
Coarse Particles and Skins (Total Residue Retained on 325 Sieve Based on Paint)	.....	1.0%
Fineness of Grind (North Standard)	5	.....
Viscosity (Stormer-Krebs Units) @ 77°F	68	75
Dry Firm, Hours	.....	8

The material which follows is a suggested batching formulation that will meet the requirements of the prior stated composition.

Pigment—33.6% by Weight	% By Weight
Basic Lead Silico Chromate (ASTM Designation: D 1648)	39.10
Titanox RANC	58.66
*Organo Montmorillonite	0.84
Phthalocyanine Blue	1.40
	100.00

* Pre-wet with 30% by weight of methyl alcohol:water (95:5) before adding to grind.

Vehicle—66.4% by Weight	
Alkyd Resin (TT-R-266, Type I, Class A)	71.9
Mineral Spirits (AASHO Designation: M 128-60)	24.9
6% Zirconium Catalyst	1.4
6% Cobalt Naphthenate	0.3
6% Manganese Naphthenate	0.3
Anti-Skinning Agent	0.2
Methyl Alcohol:Water (95:5)	1.0
	100.0

P V (% pigment by volume in nonvolatile portion of paint): 20.8

Volatile and drier in vehicle: 49.1%

E. Application: Coating must be capable of being applied to the required film thickness by brush, roller or spray application methods without difficulty at temperatures above 40°F and shall exhibit no running, streaking, sagging, wrinkling or other film defects.

F. Color: The color shall be as specified in the contract for the paint of a particular coat. Color chips are available upon request from the Department's Central Materials Laboratory.

G. Hiding Power: Shall be sufficient to obtain complete hiding when applied at normal spreading rates.

H. Packaging and Storage: The material shall be shipped in 5-gallon, full lid, metal containers meeting the latest requirements of the Interstate Commerce Commission for shipping containers for materials, unless other size containers are specified. The containers shall have appropriate descriptive labels with necessary instructional information.

The material as supplied and after one year storage shall show neither skinning, settling, color change nor thickening or livering that cannot be readily brought to stable consistency by normal mixing procedures.

908.03 RED LEAD PAINT. Red lead paint shall conform to the requirements of AASHO Designation: M 72, Type II, except that the first field coat shall be tinted with one ounce of lamp black, paste form, to one gallon of

finished paint. The lamp black shall be incorporated by the manufacturer.

908.04 WHITE READY-MIX PAINT. White paint shall conform to the requirements of AASHO Designation: M 70, Type I, Class A.

908.05 ALUMINUM PAINT. Aluminum paint shall conform to the requirements of AASHO Designation: M 69.

908.06 FOLIAGE GREEN BRIDGE PAINT. This paint shall conform to the requirements of AASHO Designation: M 67.

908.07 BLACK BRIDGE PAINT. This paint shall conform to the requirements of AASHO Designation: M 68.

908.08 ZINC CHROMATE-IRON OXIDE READY-MIXED PAINT. This paint shall conform to the requirements of AASHO Designation: M 142-49.

908.09 LAMP BLACK. This material shall conform to the requirements of ASTM Designation: D 209.

908.10 PROTECTIVE COATING.

(a) Protective Coating—Nonemulsified Type:

(1) General Requirements: This is a black, self-priming, heavy duty protective coating suitable for use when unusually severe corrosive conditions are encountered. As received, it is a heavy paste or plastic-like material. However, on stirring it thins out to brushing or spraying consistency without the use of thinners of any kind. On standing after stirring, it returns to its original pastelike state. It can be applied to steel, concrete or masonry surfaces in exceptionally thick films without sag.

(2) Composition: Non-emulsified type coating is composed of a tar base pitch blended with selected solvents to a heavy paste-like consistency. Natural asphalt or petroleum shall not be used as one of the constituents.

(3) Specifications: This material shall conform to the following detailed requirements by the indicated method of test.

Test	Requirement	Method
1. Sag Test	No Sag	Applied at a rate of 60 sq. ft. per

Test	Requirement	Method
		gallon to a smooth metal surface.
2. Ash, % by weight	15-25	Ignition
3. Distillation % by wt.		ASTM D 20
0-150°C (302°F)	0	
0-235°C (455°F)	20-30	
Distillation Residue Softening Point, °F	205-240	ASTM D 36
Penetration at 77°F 100g, 5 Sec.	5-25	ASTM D 5

(4) Surface preparation and rate of application shall be in accordance with the manufacturer's recommendations.

(b) Protective Coating—Emulsified Type:

(1) General Requirements: This is a thick, heavy duty, cold applied, protective coating of the water emulsion type. It may be applied to metal or concrete surfaces by means of brush, roller or suitable spray equipment. The coating must be applied heavily in all cases and multiple coats are desirable. It may only be applied at atmospheric temperatures in excess of 45°F and in dry weather. This type can be successfully applied over the non-emulsified type which has thoroughly dried.

(2) Composition: Emulsified type coating is comprised of an aromatic hydrocarbon base derived from coal tar and inert mineral filler dispersed in water to produce a stable colloidal suspension. It contains no volatile solvent or asphalt, either petroleum or natural. The winter grade, however, contains an antifreeze to stabilize the emulsion during cold weather shipment and should be applied in enclosed areas only with adequate ventilation.

(3) Specifications: This material shall conform to the

following detailed requirements by the indicated method of test:

Test	Requirement	Method
1. Consistency	Smooth, homogeneous paste suitable for brush, roller or spray application	Visual Examination
2. Weight per gallon, pounds	9.5-10.5	Weighing Cup
3. Ash, % by weight	15-25	Ignition
4. Water, % by weight, Maximum	50	AASHO T 55
5. Sag Test	No Sag	50 sq. ft. per gal. on a vertical, smooth, primed metal surface.

(4) Surface preparation and rate of application shall be in accordance with the manufacturer's recommendations.

908.11 ORGANIC ZINC RICH PRIMERS AND TOPCOATS. This coating system, whenever specified, shall meet LDH Designation: TR 1011, Section A, Paragraph 3, "Method of Test for Salt Fog Exposure," and Section B, "Method of Test for Weatherometer Exposure," before approval as an alternate to "Basic Lead Silico Chromate." Upon successful completion of the accelerated testing period, the product shall be placed on a qualified products list for use on future projects. This coating system shall be used only on old steel and shall require sand blasting to a SSPC-10 "Near-White Blast."

908.12 INORGANIC ZINC PRIMERS AND TOPCOATS. This coating system, whenever specified, shall meet LDH Designation: TR 1011, Section B, Paragraph 3, "Method of Test for Salt Fog Exposure," and Section B, "Method of Test for Weatherometer Exposure," before approval as an alternate to "Basic Lead Silico Chromate." Upon successful completion of the accelerated testing period, the product

shall be placed on a qualified products list for use on future projects. This coating system shall be used only on new steel and shall require sand blasting to a SSPC-5 "White Blast."

908.13 BITUMINOUS VARNISH.

(a) Material: Asphalt varnish shall be composed of hard, native asphalts or asphaltines (gilsonite for example), run (fluxed) and blended with properly treated drying oils, and thinned for suitable solvents together with the necessary amount of drier.

(b) Appearance: The film shall be smooth and homogeneous when examined by pouring some of the thoroughly mixed sample on a clean, clear, glass plate and standing in a vertical position until the excess varnish has drained off. Examine the film by transmitted light.

(c) Color: The color shall be jet black when examined by rejected light.

(d) Nonvolatile Matter: The nonvolatile matter shall be not less than 40 percent by weight.

(e) Drying of Film:

(1) Set to Touch: The film shall set to touch in not more than 8 hours.

(2) Dry Firm: The film shall be dry firm in not more than 36 hours.

(f) Working Properties and Appearance of Dried Film: The varnish shall have good brushing, flowing, covering and leveling properties. The dried film shall be jet black, smooth and free from brush marks, blisters, pinholes and other defects.

(g) Water Resistance: The film shall show no whitening, dulling or other defects after a dried film is immersed in water for 18 hours and air dried for 2 hours.

Section 909

Reinforcing Steel and Wire Rope

909.01 REINFORCING STEEL. The grade of reinforcing steel shall be as specified and shall conform to the requirements of the following specifications:

(a) Deformed Billet-Steel Bars, Grade 40, ASTM Designation: A 615.

(b) Rail Steel Deformed Bars, Grade 50, ASTM Designation: A 616 with the following additional requirements. The bend test as required for rail steel conforming to AASHO Designation: M 42 shall be a part of these specifications.

(c) Axle-Steel Deformed Bars, Grade 40, ASTM Designation: A 617.

(d) Cold-Drawn Steel Wire, ASTM Designation: A 82 with the following amendment: For material testing over 110,000 psi tensile strength in special high strength applications such as spirals and ties, the 25 percent minimum reduction in area shall be reduced 5 percent for each 10,000 minimum psi increment of tensile strength exceeding 110,000 psi; there shall be no requirement for determination of yield strength.

(e) Fabricated Steel Bar or Rod Mats for Concrete Reinforcement, ASTM Designation: A 184.

(f) Welded Steel Wire Fabric for Concrete Reinforcement, ASTM Desisgnation: A 185.

No. 2 bars, when specified, need not be deformed.

909.02 SPIRAL REINFORCING. Spiral reinforcing shall conform to ASTM Designations: A 615, Grade 60; A 616, Grade 60; A 617, Grade 60 or ASTM Designation: A 82 as amended in Subsection 909.01.

909.03 TIE BARS. Tie bars shall conform to ASTM Designations: A 615, A 616 or A 617 and shall conform to Subsection 909.01, except that rail steel shall not be used for tie bars that are to be bent and restraightened during construction.

909.04 LOAD TRANSMISSION DEVICES. Load trans-

mission devices shall be either dowel bars or cantilever type devices, all as shown on the plans.

(a) Dowel bars shall conform to the details on the plans and shall meet the requirements of Subsection 909.01, except that dowel bars shall not be deformed.

The sleeves for dowel bars shall be metal of an approved design to cover 2 inches of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least one inch from the end of the dowel bar. Sleeves shall be of such design that they do not collapse during construction.

Paint to be used for painting dowel bars shall conform to the requirements of AASHO Designation: M 72.

Plastic coated dowel bars shall be permitted in lieu of painted and greased dowel bars at the contractor's option. These bars shall meet the steel bar requirements as stated in this Subsection and shall be undercoated with an adhesive and then given a final outer coat of extruded polyethylene plastic in accordance with the following requirements.

Undercoating:	
Color	Black
Adhesive Material	Modified Rubber Blend
Adhesive Thickness	1 to 8 mils (4 mils nominal)
Total Thickness Outer & Undercoatings	21 mils nominal
Tensile Strength, Min., 2"/Min.	3,000 psi
Elongation, Minimum	100%
Water Vapor Transmission Rate	0.0001 Gr./24 H./100 in.^{2}
Moisture Absorption	0.01%
Penetration, 200 psi Load, ¼ in. Blunt Rod	Negligible
Tear Resistance	Very High
Abrasion Resistance	Excellent
Operating Temperature Range	−40° to 150°F
Outer Coating:	
Color	Opaque Yellow
Coating Material	High Density Polyethylene
Coating Thickness	10 to 20 mils (17 mils nominal)

(b) Cantilever type devices shall be fabricated of cast malleable iron conforming to details shown on the plans. The castings forming each of the 2 sections shall be of material conforming to ASTM Designation: A 47, Grade No. 35018. Each load transmission unit of the cantilever type shall consist of 2 identical castings providing a cantilever arm on which the other half of the unit shall bear, and each casting shall have an upper tension anchor and a lower compression anchor, all constructed in accordance with the general dimensions shown on the plans. The castings shall be cleaned and ground as necessary in order that each may be in conformity with the required dimensions and assembled into a complete unit providing coincidence of bearing on both the vertical and horizontal sliding faces. The castings shall be sufficiently smooth so that there will be no interference with smooth sliding operation.

909.05 STEEL STRAND FOR PRETENSIONING. Strand for pretensioning shall conform to the requirements of ASTM Designation: A 416.

909.06 BARS FOR POST-TENSIONING. Bars shall be high tensile strength steel. They shall be equipped with wedge type end anchorages which will develop the minimum specified ultimate bar stress on the nominal bar area.

The physical properties of the bar steel and the stress-strain curve determined by static tensile test shall conform to the following:

Ultimate Stress	145,000 psi minimum
Stress at 0.7% Elongation	130,000 psi minimum
Stress at 0.3% Elongation	75,000 psi minimum
Elongation in 20 Diameters	4% minimum
Modulus of Elasticity	25,000,000 minimum
Diameter Tolerance	Plus 0.02375 inch or minus 0.010 inch

909.07 PARALLEL WIRE ASSEMBLIES FOR POST-TENSION. Assemblies shall consist of parallel wire of the number and size as shown on the plans. Wire shall be high tensile, hard-drawn, stress-relieved and uncoated, delivered in coils of 54 inches minimum diameter. Ultimate strength requirements for various sizes shall be as follows:

Diameter-Inches	Min. Ult. Stress, psi
0.177	255,000
0.192	251,000
0.225	245,000
0.250	240,000
0.276	236,000

The stress-strain curve for wires shall show the following minimum characteristics based on the minimum ultimate strength requirements:

Proportional limit (0.01% offset from tangent) ..... 55 percent

Yield strength (0.2% offset from tangent) ..... 80 percent

Elongation at rupture shall be not less than 4 percent in 10 inches. Diameter tolerance of wires, ±0.002 inch.

909.08 ANCHORAGES FOR POST-TENSIONED TENDONS.

(a) For Bars: Wedge type anchorages shall be used for bars. The wedge device shall develop the minimum ultimate stress specified for the nominal bar area. Wedge anchorages shall bear against anchorage plates fabricated of hot-rolled steel having physical characteristics not less than as specified for No. 1040 of the American Iron and Steel Institute Specifications.

(b) For Parallel Wire Assemblies: Wedge type anchorages of the sandwich plate or conical type shall generally be used. The anchorage device shall be capable of developing the utlimate strength of the total number of wires anchored. Conical type anchorages shall be embedded within the ends of the concrete members, unless otherwise specified. Anchorages shall generally bear against embedded grids of reinforcing steel of approved type.

(c) Alternate Anchorage Types: Alternate anchorage types conforming to the general physical requirements specified above for wedge type anchorages will be considered. All anchorage types either will be required to develop the specified ultimate strength of the reinforcing tendons, or the allowable stress on the tendon will be based on anchorage strength.

Any alternate type anchorage considered will be required to show evidence of being capable of withstanding

at least 3,000,000 cycles of twice the maximum live load stress variation.

909.09 REQUIRED TESTS FOR PRESTRESSING REINFORCEMENT. The following tests shall be made to determine the physical characteristics of prestressing reinforcement. Where tests are specified to be made by the manufacturer, 7 certified copies of all test results shall be submitted to the Department's Materials Section in Baton Rouge. It shall be the Department's privilege to have all tests witnessed by its inspectors.

(a) Strand for Pretensioning: The contractor shall make all tests as stipulated in ASTM Designation: A 416. The Department reserves the right to sample in accordance with the LDH Materials Sampling Manual and test for tensile strength and elongation.

(1) Proof Test: During manufacture, each bar shall be proof tested to a minimum stress of 130,000 psi.

(2) Static Test: From each mill heat received, one static test shall be made by the manufacturer on an assembled bar and anchorage to determine the physical properties of the steel and the assembly and shall conform to the minimum physical properties hereinbefore mentioned. For each 1,000 bars received on the job, one bar will be selected at random for static testing by the Department's Materials Section.

(b) Wires and Wire Anchorages: From each 10 coils of wire or fraction thereof, one sample shall be submitted to the Department's Materials Section for static testing. For each 500 anchorages or fraction thereof, one anchorage assembly shall be tested statically to destruction by the Department.

909.10 WIRE ROPE AND FITTINGS FOR HIGHWAY GUARD RAIL. The wire rope or wire cable and fittings shall conform to the requirements of AASHO Designation: M 30 for the specified diameter and strength class.

Flexible rail elements composed of multiple wires in any arrangement other than rope form shall conform in all respects to the plan details and dimensions and to the strength requirements for the item.

NOTE: This paragraph is intended to cover the less fre-

quently used woven steel wire tape and woven steel wire fabric and perhaps new variants that may be offered.

909.11 WIRE ROPE. Unless otherwise specified all wire rope shall conform in general to Federal Specifications RR-W-410C,* and the following specific requirements:

(a) All wire rope shall be improved plow steel, uncoated.

(b) All wire rope shall be preformed.

(c) All wire rope shall be 6 by 19 filler wire construction with hard fiber core.

(d) All wire rope shall be right regular lay.

(e) All fiber cores shall be prelubricated by the cordage manufacturer. All component parts of the wire rope, fiber cores, wires and strands shall be lubricated during fabrication with an approved lubricant containing a rust inhibitor.

Type and Classification:

Unless otherwise specified, the Type and Classification of wire rope shall conform to one of those shown in Table I.

Breaking Strength and Dimensions:

Unless otherwise specified, the diameter, circumference, pitch and breaking strength shall be as specified in Table II. For other types and classifications refer to Federal Specifications RR-W-410C.*

Should the breaking strength of the wire fall below the values specified in Table II, the entire length from which the test pieces were taken shall be replaced by the manufacturer with a new length, the strength and mechanical properties of which shall meet the specifications.

No splicing of wire rope or its component strands will be permitted. All wires in the wire rope shall be of continuous length.

When wire joints are necessary, they shall be electrically butt-welded; and in the stranding operation, no two joints in any one strand shall be closer than 25 feet apart, except for the filler wires.

Unless otherwise specified, all wire ropes shall be shipped

*Copies may be secured from: General Services Administration, Fort Worth, Texas.

on reels, the minimum diameter of which shall be not less than 25 times the nominal diameter of the wire ropes; if shipped in coils, the inside diameter of the coils shall be not less than 25 times the nominal diameter of the wire rope.

Table I

General Wire Rope Classification and Usage

Type	Classification	Usage
I	1. (6 x 7)	Haulage rope, for use where strength and durability are desirable, but not much bending is required. May be used as single line for pulling load, but not suitable for sheave work.
	2. (6 x 19)	Most widely used for cranes, derricks, dredges, draglines and scrapers. This classification is very rugged, withstands abrasion well and is generally suited for all-around use.
	3. (6 x 37)	For hoisting rope where maximum flexibility is required; for instance, hoisting rope on dragline that runs over small sheave.
II	2. (8 x 19)	High speed elevator rope.
III (Marine)	1. (6 x 6)	Deck lashing ropes.
	2. (6 x 12)	Running ropes.
	3. (6 x 24)	Mooring lines.
	4. (6 x 3 x 7)	Spring lay.
	5. (6 x 3 x 19)	Spring lay.
	6. (6 x 42)	Tiller or hand control rope.
IV (Special)	2. (18 x 7)	Nonrotating (for drill rigs).

Table II

Type I, General Purpose, Class 2, 6 by 19, Improved Plow Steel, Fiber Core

Rope Diameter			Maximum Strand Pitch			Minimum Breaking Strength on Bright (uncoated) Wire Ropes
Nominal (ordered) (Minimum)	Maximum	Approximate Circumference	Regular Lay	Lang Lay	Approximate Weight	
Inches	Inches	Inches	Inches	Inches	Lbs./Ft.	Pounds
1/4	9/32	3/4	1–11/16	1–13/16	0.105	5343
5/16	11/32	1	2–1/8	2–9/32	.164	8307
3/8	13/32	1–1/8	2–17/32	2–23/32	.236	11895
7/16	15/32	1–3/8	2–31/32	3–3/16	.32	16127
1/2	17/32	1–5/8	3–3/8	3–5/8	.42	20865
9/16	19/32	1–3/4	3–13/16	4–3/32	.53	26325
5/8	21/32	2	4–7/32	4–17/32	.66	32565
3/4	25/32	2–3/8	5–1/16	5–7/16	.95	46312
7/8	59/64	2–3/4	5–29/32	6–11/32	1.29	62790
1	1–3/64	3–1/8	6–3/4	7–1/4	1.68	81510
1–1/8	1–11/64	3–1/2	7–19/32	8–5/32	2.13	102570
1–1/4	1–5/16	3–7/8	8–7/16	9–1/16	2.63	125970
1–3/8	1–7/16	4–3/8	9–9/32	9–31/32	3.18	151515
1–1/2	1–9/16	4–3/4	10–1/8	10–7/8	3.78	179400
1–5/8	1–23/32	5–1/8	10–31/32	11–25/32	4.44	208650
1–3/4	1–27/32	5–1/2	11–13/16	12–11/16	5.15	241800
1–7/8	1–31/32	5–7/8	12–21/32	13–19/32	5.91	274950
2	2–3/32	6–1/4	13–1/2	14–1/2	6.72	312000
2–1/8	2–7/32	6–5/8	14–11/32	15–13/32	7.59	349050
2–1/4	2–11/32	7–1/8	15–3/16	16–5/16	8.51	390000
2–1/2	2–5/8	7–7/8	16–7/8	18–1/8	10.5	475800
2–3/4	2–7/8	8–5/8	18–9/16	19–15/16	12.7	569400

909.12 COUNTERWEIGHT ROPES. Every effort shall be made to fabricate wire ropes of uniform physical properties, and counterweight wire ropes operating as a group in one equalizing system shall be cut from one continuous manufactured length.

Wire rope furnished shall be prestressed and measured for length by the manufacturer prior to delivery. The contractor shall notify the engineer at least 10 calendar days in advance of prestressing operations so that the Department may have its inspector present for the said operations.

Counterweight ropes shall be prestressed, and the prestressing load shall be 35 percent of the listed breaking strengths of the wire ropes, and such loading shall be applied 3 times to the wire ropes. The cycle of loading shall be between the limits of 5 percent to 35 percent, and the maximum loadings shall be held on the wire rope for a period of 15 minutes each.

The length of each wire rope from center line of open socket pins or from the bearing of closed sockets shall be measured under a tension of 12 percent of the listed breaking strengths, and a metal tag having the said length stamped thereon shall be securely attached to the wire rope. The length of each rope shall also be stamped on each socket. After the wire rope has been measured as noted herein, it shall have a stripe painted on one side along its entire length to assure the twist of the wire rope during erection of the bridge.

The length of these wire ropes shall not vary from the specified length by more than plus or minus .0002 times the specified length.

All sockets and socket pins used in connection with wire ropes shall be forged, without welds, from solid steel and shall conform to ASTM Designation: A 235, Class C 1, normalized. The socket shall be attached to the wire rope by using zinc of a quality not less than defined for Intermediate Grade in ASTM Designation: B 6, and wire rope must not slip appreciably in its connection.

The movement of the zinc cone in the socket basket when the wire rope is stressed to 80 percent of the listed breaking strength shall not exceed 1/6 of the nominal diameter of the wire rope. If a greater movement should occur, the

method of attachment shall be changed until a satisfactory one is found.

Full sized specimens of rope shall be fitted with sockets, attached not less than 25 rope diameters but not more than 12 feet apart, and shall be tested to destruction. The number of test specimens shall not exceed 10 percent of the total number of finished lengths of rope to be made, nor shall there be less than 2 specimens taken from each original length of rope.

The manufacturer shall provide proper facilities for making the tests and shall make them at his expense. The contractor shall furnish the engineer with certified test reports for all required tests.

If the physical properties of the rope or of its individual wires fail to fullfill the specified requirements, the entire length from which the test pieces were taken shall be rejected and shall be replaced with a new length, the physical properties of which shall conform to those specified.

If a socket should break during the tests of the wire rope, 2 others shall be selected and attached to another piece of rope, and the test shall be repeated. This process shall be continued until the reliability of the sockets is established, in which case the lot shall be accepted. If, however, 10 percent or more of the sockets tested break at a load less than the specified minimum strength of the rope, the entire lot shall be rejected.

The engineer also reserves the right to test each wire rope at his expense after the sockets are attached, by a load equal to one-half the listed breaking strength of the wire rope. If the assembly shows weakness, it shall be rejected and replaced.

Wire ropes shall be suitably marked or tagged for identification for proper erection.

The wire ropes shipped on reels shall be removed by revolving the reels, and wire ropes shipped in coils shall be mounted on a turntable for uncoiling. In uncoiling and in erecting, the wire ropes shall be carefully handled so as to avoid any kinks, sharp bends or twisting of the wire ropes.

909.13 CONTINUOUS REINFORCEMENT. The continuous reinforcement shall consist of deformed steel rein-

forcing bars or prefabricated deformed wire mats meeting these requirements.

(a) Deformed Steel Bars: When deformed steel reinforcing bars conforming to ASTM Designation: A 615 are used for longitudinal or transverse members, the bending test requirements will not be required. Bars which are bent and later straightened to facilitate construction shall conform to the requirements of ASTM Designation: A 615, Grade 40.

(1) Longitudinal Bars: Deformed steel bars for longitudinal reinforcement shall conform to one of the following ASTM Designations:

	ASTM Designation:
Billet-Steel (Grade 60)	A 615
Rail-Steel (Grade 60)	A 616

(2) Transverse Bars: Deformed steel bars for transverse reinforcement shall conform to one of the following ASTM Designations:

	ASTM Designation:
Billet-Steel	A 615
Rail-Steel	A 616
Axle-Steel	A 617

(3) Bar Lengths: When reinforcement consists of loose bars assembled at the site, longitudinal bars shall be not less than 30 feet in length, except where shorter bars are required for starting or ending a specified staggered lap pattern or at a construction joint. The maximum length shall be that which, in the judgment of the engineer, can be handled and installed in a proper manner.

(b) Prefabricated deformed wire mats shall conform to ASTM Designation: A 497, with deformed wire conforming to ASTM Designation: A 496 with 70,000 psi minimum yield strength in the welded form.

Tie bars and load transfer devices that require bending shall conform to ASTM Designation: A 615, Grade 40, or ASTM Designation: A 82 with 70,000 psi minimum yield strength.

Section 910

Fence and Guard Rail

910.01 BARBED WIRE. Barbed wire may be either steel or aluminum alloy.

Steel barbed wire shall conform to the requirements of ASTM Designation: A 121. The coating weight shall be Class 1 unless otherwise specified.

Aluminum alloy barbed wire shall be manufactured of aluminum alloy conforming to ASTM Designation: B 211, Alloy 5052-0 for the line wire and Alloy 5052-H 38 for the barbs.

General Requirements: The gage of the wire shall be as shown on the plans. The average spacing of the barbs shall not exceed the specified nominal spacing, and no individual spacing shall vary from the nominal spacing by more than ¾ inch.

910.02 WOVEN WIRE. Woven wire shall conform to the requirements of ASTM Designation: A 116. The size of the woven wire shall be as shown on the plans, and the spelter coating shall be Class 1 unless otherwise specified.

910.03 CHAIN LINK FENCE AND GATES.

(a) Unless otherwise specified, chain link fence may be fabricated of any one of the following at the option of the contractor:

(1) Zinc coated steel.
(2) Aluminum coated steel.
(3) Aluminum alloy.
(4) Vinyl clad steel.

(b) Height of fence, gage and mesh of fabric, gage of tension wire, type and gage of barb wire, type and dimensions of line post, corner post, pull post, top rail, gate post, gate framing, gate opening and all other miscellaneous items required to make up the fence shall be as shown on the plans.

(c) All material furnished, except as specified herein, shall meet the applicable requirements of AASHO Designation: M 181.

(d) Barbed wire used with chain link fence shall conform to the requirements of Subsection 910.01.

(e) Padlocks supplied by the contractor shall be solid jacket, extruded brass metal with interchangeable cores and 1¾ inch cases. All padlocks furnished shall be keyed alike. Two keys shall be furnished for each padlock.

(f) Vinyl clad steel chain link fencing shall meet the requirements of Federal Specification RR-F-191d, Section 3.0, "Requirements." Subsection 3.1.5 is hereby amended to read as follows:

The vinyl covering shall be microscopically examined to insure that a smooth, void free surface is obtained. The minimum thickness of the vinyl covering shall be .020 inches. The vinyl covered chain link fencing shall withstand 1000 hours of weatherometer exposure at a black panel temperature of 145°F with no adverse effects to the vinyl coating. The color of the vinyl coating shall be a dark green.

910.04 METAL BEAM FOR HIGHWAY GUARD RAIL. The rail elements shall be corrugated sheet metal beams conforming to plan details. The class and thickness of the metal shall be as specified on the plans. All guard rail elements, terminal sections and fittings shall be interchangeable with similar parts, regardless of source of manufacturer.

(a) Steel Guard Rail: The guard rail, terminal sections and appurtenances shall be in accordance with AASHO Designation: M 180, the plans and the following requirements.

Unless otherwise specified the beams shall be Class B with buffer end sections being either Class A or B.

The beams shall be galvanized after fabrication with a Type I coating in accordance with AASHO Designation: M 180.

(b) Aluminum Guard Rail:

(1) Rail Elements: The rail elements shall be formed from aluminum alloy conforming to ASTM Designation B 209-2024-T3. The rail elements shall be of such thickness as required to provide the strength and deflection requirements as given in AASHO Designation M 180-65, except that the thickness shall be not less than that shown in AASHO M 180-65.

(2) Terminal Sections: Terminal section shall be of the same thickness and shall conform to the same material specifications as the rail elements, (No. 1 above).

(3) All fasteners shall conform to the requirements of the plans and shall conform to one of the following:

(a) All bolts shall be aluminum alloy conforming to ASTM Designation B 211-2024-T4, with 30 minutes anodize and 30 minutes seal.

(b) All bolts, nuts and washers shall be aluminized steel.

(c) All bolts, nuts and washers shall be steel, galvanized in accordance with ASTM Designation: A 153.

910.05 TIMBER RAIL. The timber rail shall be cut from the specified grade of dry, well seasoned and dressed timber stock of the species specified, which shall meet the applicable requirements of Subsection 914.01.

Where preservative treatment is specified, this shall conform to the requirements of Subsection 914.04.

910.06 FENCE POSTS. Line posts may be either treated timber posts or steel posts, except as may be provided elsewhere herein. However, the same type of posts furnished for line posts shall be used throughout any particular section of fence. Bracing posts, end posts and corner posts may be either treated timber posts or steel posts, as the contractor elects.

(a) Treated Timber Posts: All treated posts shall be Southern Pine of the dimension shown on the plans. Any of the following treatments will be permitted.

(1) Seasoning: Posts to be treated with creosote or pentachlorophenol-petroleum solution shall be air or artificially seasoned prior to treatment.

(2) Preservative Treatment with Creosote or with Pentachlorophenol-Petroleum Solution: Treatment of posts with either creosote or pentachlorophenol-petroleum solution shall have a minimum net retention of preservative per cubic foot of wood as specified in Subsection 914.04(b).

(b) Steel Fence Posts: Steel posts furnished for line, end, corner and bracing posts may be one of the suggested types shown on the plans or such other type as the

contractor elects to use, provided that the type furnished shall meet the requirements of these specifications.

All steel posts shall be equipped with corrugations, knobs, notches, holes or studs so placed and constructed as to engage a substantial number of fence line wires in proper position. Posts may be punched with holes in such position and of such size as will not impair the strength of the posts. Posts with punched tabs used for fastening wires are not acceptable because of the risk of injury to fence wires when such tabs are crimped around the wires and of the tendency of tabs to fracture upon removal and refastening of fence. In addition, corner, end and bracing posts shall be supplied with necessary holes and with galvanized bolts of standard commercial quality or other satisfactory substitute, such as castings, for fastening braces to the posts.

Line posts shall have a nominal weight of 1.33 pounds per foot, exclusive of anchor plate. Corner, end and bracing posts shall have a nominal weight of 4.10 pounds per linear foot. Permissible variation in total weight of posts in any one shipment shall be a maximum of 3½ percent over or under the nominal weights.

Steel posts shall be furnished in the lengths shown on the plans. Permissible variation shall be a minimum of one inch under and two inches over the designated lengths.

Posts shall be fabricated of hot-rolled steel sections meeting either of the requirements given in the following tables:

	Tensile Properties	
Grade	Yield Strength Lb/Sq In (Min.)	Ultimate Strength Lb/Sq In (Min.)
Hot-Rolled Carbon Steel-Minimum Carbon Content 0.35 Percent	40,000	70,000
Hot-Rolled Rail Steel	50,000	80,000

Methods of Tests:

Chemical Requirements	ASTM–E 30
Physical Requirements	ASTM–A 370

Note: Rail steel products shall be rolled from standard tee-section steel rails. No other materials, such as those

known by the terms "rerolled," "rail steel equivalent" and "rail steel quality," shall be substituted.

Line posts shall be furnished with anchor plates of the approximate shape and dimensions shown on the plans and so tapered as to facilitate driving. The anchor plates shall weigh a minimum of 0.67 pound each. The plates shall be clamped, welded or riveted to the posts in a substantial manner to prevent displacement of the plates when the posts are driven.

Steel posts, including anchor plates on line posts and braces, shall be galvanized. Galvanizing of steel posts shall conform to the requirements of ASTM Designation: A 123.

Excessive bow, camber, twist or other injurious defects in posts shall be considered cause for rejection of such posts.

910.07 BRACES.

(a) Timber Braces: All timber braces shall be of the dimensions shown on the plans and shall be treated timber meeting the applicable requirements of Section 914.

(b) Steel Braces: Steel braces shall be of the approximate type and dimensions shown on the plans. Bracing members shall have nominal weight of 3.19 pounds per linear foot. Braces shall be furnished with holes placed in proper position and of proper size for fastening braces to the posts. Fabrication and grade of steel, finish, permissible tolerances and cause for rejection shall be the same as provided for steel posts.

910.08 STAPLES. Staples shall be made of galvanized steel wire and shall be of the size shown on the plans. The minimum spelter coating when tested by ASTM Designation: A 90 shall be 0.2 ounce per square foot.

910.09 METAL FASTENERS FOR STEEL POSTS. Metal fasteners for steel posts shall be galvanized steel wire fasteners or clamps and shall be satisfactory for use with the type of steel post furnished. Wire shall not be less than 0.120 inch in diameter. The spelter coating, when tested in accordance with ASTM Designation: A 90, shall not be less than 0.2 ounce per square foot.

910.10 GUARD RAIL POSTS AND SPACER BLOCKS. Railing posts shall be of either wood, steel or concrete as

may be specified. When the choice of post is at the option of the contractor, there shall be only one kind furnished on the project. Spacer blocks shall be of the same material as the post.

(a) Wood posts shall be treated timber of Southern Pine No. 1 S.R. or Douglas Fir Dense Construction quality and shall be of the section and length as specified or as shown on the plans. The posts shall be fabricated or framed before treatment. Timber, preservatives and preservative treatment shall conform to the requirements of Section 914.

(b) Steel posts shall be of the section and length as specified or as shown on the plans. They shall be of copper bearing steel when so specified. Steel shall conform to the requirements of ASTM Designation: A 36.

The posts shall be galvanized in accordance with ASTM Designation: A 123.

(c) Precast reinforced concrete posts shall be of a section and length as specified or as shown on the plans.

The acceptance of concrete shall be based upon the compressive strength of cylinders made according to Subsection 901.07(f) and cured in the same manner as the posts. The minimum compressive strength of cylinders shall be 3,000 psi at 28 days.

Reinforcing steel shall be deformed bars conforming to the applicable requirements of Section 909.

Aggregate used in concrete shall meet all the applicable requirements of Section 903, except that the gradation shall be optional with the contractor.

Forms may be removed as soon as the concrete has hardened sufficiently to prevent damage to posts. Posts shall be given a Class 1, Ordinary Surface Finish in accordance with Subsection 805.14 and shall present a neat and uniform appearance.

Posts shall be cured by an approved method for a period of not less than 3 days.

(d) Ground end anchorages and bridge end anchorage connections shall be as specified or as shown on the plans. Concrete and reinforcement shall conform to the requirements herein for precast reinforced concrete posts.

(e) Spacer blocks shall be of the dimensions shown on plans. Wood spacer blocks shall be of the same material and shall be treated with the same type preservatives as provided for posts. Concrete spacer blocks shall conform to the requirements herein for precast reinforced concrete posts.

910.11 GATES (Roadside Fence).

(a) Gates: Design of metal gates shown on standard plans is a type acceptable to the Department.

If the contractor proposes to furnish gates of a design other than that shown on the standard plan, he shall submit to the Department for approval specifications covering the design and fabrication of the type gates he contemplates furnishing.

Gates shall be of the dimension and weight specified on the plan.

Steel sheets used in fabricating gates shall have a galvanized coating of 1.25 ounces (commercial per square foot when coated in accordance with ASTM Designation: A 446).

(b) Posts:

(1) Treated Timber Posts: Treated timber posts shall conform to the requirements of Subsection 910.06.

(2) Metal Posts: Metal posts shall be made of galvanized steel pipe, standard weight, conforming to the applicable requirements of ASTM Designation: A 120.

(c) Hardware: Hinges, washers, nails, staples, well chains and latches shall be of standard quality satisfactory for use with the type of gate and posts selected for use and acceptable to the engineer.

(d) Gate Stops:

(1) Treated Timber Posts: The gate stop of the dimensions shown on the plans shall be treated timber conforming to the applicable requirements of Subsection 910.06. Gate stops shall be treated in the same manner as specified for treated timber posts.

(2) Metal Posts: The gate stop shall be galvanized steel, suitable for welding to the post and acceptable to the engineer.

(e) Stop Posts: Stop posts furnished for double swinging driveway gates shall be of the dimensions shown on

the plans and shall be treated timber conforming to the applicable requirements of Subsection 910.06.

910.12 GUARD RAIL HARDWARE. Offset brackets of the resilient and nonresilient types shall be of the type specified or as shown on the plans, and shall meet the strength requirements specified.

Splices and end connections shall be of the type and design specified or shown on the plans and shall be of such strength as to develop the full design strength of the rail elements.

End spring assemblies, when specified, shall be positive and of a type and design coinciding with the intent, design and strength of the railing structure and shall be as specified or as shown on the plans.

End anchor rods and accessories shall be as specified or as shown on the plans and shall be of such size and strength as to develop the full design strength of the rail elements.

Unless otherwise specified, all fittings, bolts, washers and other accessories for steel guard rail shall be galvanized in accordance with the requirements of AASHO Designation: M 111 or ASTM Designation: A 153, whichever may apply. All galvanizing shall be done after fabrication.

Hardware for aluminum guard rail shall be of aluminum alloy conforming to ASTM Designation: B 211. Bolts shall be of Alloy 2024, Temper T4, and nuts of Alloy 6061, Temper T6. Washers shall conform to ASTM Designation: B 209, Alloy 2024, Temper T4.

Section 911

Concrete Curing Materials, Special Finishes and Admixtures

911.01 CURING MATERIALS. Curing materials shall conform to the following requirements as specified.

(a) Cotton Mats for Curing Concrete: AASHO Designation: M 73-49.

(b) Burlap Cloth Made from Jute or Kenaf: AASHO Designation: M 182, Class 3.

(c) Waterproof Paper for Curing Concrete: AASHO Designation: M 171.

(d) White Polyethylene Sheeting (Film) for Curing Concrete: AASHO Designation: M 171.

(e) Combined Burlap and White Polyethylene Plastic Materials: AASHO Designation: M 171.

(f) Liquid Membrane-Forming Compounds for Curing Concrete: This material shall conform to the requirements of AASHO Designation: M 148, with the exception that the specimens tested for drying time shall be maintained at a temperature of 100°F ±2°F and a relative humidity of 32 ±2 percent. When so tested, the membrane-forming compound shall dry to touch in not more than 2 hours.

911.02 SUBGRADE PAPER. The subgrade paper shall conform to the requirements of AASHO Designation: M 74.

911.03 ADMIXTURES. Admixtures, air-entraining and water-reducing (normal set or set retarding), shall meet the requirements of these specifications.

(a) Water-Reducing Admixtures: Water-reducing admixtures, either normal set or set retarding, shall conform to the following requirements.

(1) The water-reducing admixture shall be a product of a company with not less than 5 years experience in the manufacture and successful field use of this type admixture. The manufacturer shall process and package the material in its own factory.

(2) All water-reducing admixtures (normal set or set

retarding) submitted for preliminary approval, when tested in accordance with LDH Designation: TR 224, shall conform to the applicable requirements given in Table VIII, Physical Requirements.

(3) Water-reducing admixtures containing chlorides shall not be used in prestressed concrete.

(b) Air-Entraining Admixtures: All air-entraining admixtures submitted for preliminary approval, when tested in accordance with LDH Designation: TR 224 shall conform to the applicable requirements given in Table VIII, Physical Requirements.

(c) Approved List: A list of approved water-reducing admixtures, either normal set or set retarding, and air-entraining admixtures is maintained by the Department, Materials Section. Companies desiring to have admixtures placed on this list will be required to submit samples for testing at least 60 days prior to anticipated use.

(d) Requirements for Job Control Samples: Samples of admixtures from each lot or shipment made to a job shall be submitted to the Testing Laboratory for testing purposes. These samples must be submitted by the project engineer at least 10 days prior to use of the material. Furthermore, tests to determine the rate of hardening and compressive strength or other properties may be made at any time during the progress of the work to insure continued compliance with the requirements of these specifications.

Samples submitted from the job shall be tested in accordance with LDH Designation: TR 224 and shall conform to the applicable requirements given in Table VIII, Physical Requirements.

Table VIII

Physical Requirements For Admixtures

	Air-Entraining Admixture	Water-Reducing Admixtures	
		Normal Set	Set Retarding
Unit Water Content, Max. Percent of Control	90	95	95
Air Content, Percent	5 ± 2	0 to 3	0 to 3
Time of Setting, Deviation from Control in Hours (Note 1)			
Initial Set – Max.		±1	+3
Min.			+1
Final Set – Max.		±1	+3
Min.		.....	.....
Compressive Strength, Min. Percent of Control			
7 Days	85	105	105
28 Days	85	105	105

NOTE 1: The time of setting requirements in the table provide that concrete containing:
1. A water-reducing, normal set admixture must reach both initial set and final set not more than 1 hour sooner or 1 hour later than the reference concrete.
2. A water-reducing, set retarding admixture must reach initial set at least 1 hour later but not more than 3 hours later than the reference concrete and must reach final set not more than 3 hours later than the reference concrete.

(e) Infrared Spectrographic Analysis: In lieu of the physical testing requirements for job control samples, samples may be approved for use by means of infrared spectrographic analysis in accordance with LDH Designation: TR 224.

911.04 EPOXY RESIN SYSTEMS. The epoxy resin system shall be of the type specified on the plans or in the special provisions and shall conform to the applicable requirements of AASHO Designation: M 200-65 modified as follows. Bond strength tests on hardened to hardened concrete and plastic to hardened concrete shall be performed by the beam break method only.

911.05 SPECIAL SURFACE FINISH. Special surface finish will be allowed as an alternate to a Class 2 rubbed finished.

A list of approved "Special Concrete Masonry Finishes" will be maintained by the Department's Materials Section in Baton Rouge. The Department reserves the right to discontinue such approval of products that prove unsatisfactory when used in accordance with the manufacturer's directions and the requirements of the specifications.

911.05

Companies desiring to have their materials placed on the approved list must submit samples sufficiently in advance of anticipated use to allow all testing to be accomplished. The manufacturer's specifications, recommended application procedure and typical analysis must accompany the qualification samples.

A part of the qualifying test shall consist of applying the surface finish material on a structure in accordance with the manufacturer's recommended procedure, and observing and evaluating the performance for a period of one year.

Prior to application of the approved special surface finish material, a one quart sample must be submitted to the Central Laboratory for acceptance testing.

In addition to the above, the contractor shall submit to the engineer on the project a concrete panel, approximately 4 inches by 8 inches, coated with mixture of components as proposed for use on the project for color approval.

Section 912

Railings

912.01 GENERAL. Unless otherwise specified, this specification covers all of the material used in the construction of any of the types of railings specified on the plans or in the special provisions.

912.02 CONCRETE. All concrete used in railings and railing posts shall be Class A conforming to the applicable requirements of Section 901.

912.03 REINFORCING STEEL. Reinforcing steel shall consist of deformed bars conforming to the applicable requirements of Subsection 909.01.

912.04 STRUCTURAL STEEL. Structural steel for railings and railing posts shall consist of A36 steel conforming to the requirements of Subsection 913.01.

912.05 ALUMINUM PIPE RAILINGS. Aluminum pipe, castings, fittings and hardware shall be of the type, size and detail shown on the plans.

(a) Aluminum Alloy Pipe: Aluminum alloy pipe shall be standard pipe ANS Schedule 40, and shall conform to ASTM Designation: B 241, Alloy 6063 or 6061, Condition T 6.

(b) Cast Aluminum Railing Posts: Material for cast aluminum bridge railing posts shall conform to the following specifications.

(1) Scope: This specification covers permanent mold types of cast aluminum alloy roadway railing posts as designated in the material section of this specification.

(2) Material: The chemical composition of the castings shall conform to the limits listed in the following table:

Table IX

COMPOSITION LIMITS*

Cu	Fe	Si	Mn	Mg	Zn	Ti	Oth. (each)	Oth. (Total)
0.10	0.20	6.5–7.5	0.10	0.05	0.10	0.20	0.05	0.15

*All values maximum, unless shown as a range.

Minimum mechanical properties of test bars machined either vertically or horizontally from the high stressed area of the post tension flange (lower 14 inches), but not at the junction of the rib and tension flange, shall be as shown in the following table:

Table X

MECHANICAL PROPERTIES—CASTING

	Tension Flange
Ultimate Tensile Strength (psi)	20,000
Elongation (% in 2 inches or 4D) (Min.)	20

(3) Test Specimens: The tension test specimens shall be machined from integrally cast test coupons extending from one side of the base of the posts sufficiently large to permit obtaining a 0.350-inch diameter test specimen as defined in ASTM Designation: E 8.

(4) Number of Tests: A minimum of one percent of the posts in any lot, but not less than one, shall be sampled for tensile testing. For the purpose of sampling, a lot shall consist of not more than 1,000 pounds of clean castings when produced from a batch-type furnace charged with one heat of ingot of known analysis or not more than 2,000 pounds of clean castings when produced from one continuous furnace in not more than 8 consecutive hours.

(c) Aluminum Alloy Swedge Bolts and Nuts: Aluminum alloy swedge bolts and nuts shall be made from rods conforming to ASTM Designation: B 211, Alloy 6061-T6 or 2024-T4. Nuts shall conform to American Standard finished hexagon, ANS Designation: B 18.2. Threads shall conform to the standard of Class 2, 2A or 2B. The finished bolts and nuts shall be supplied in either the T 6 or T 4 temper and shall be given an anodic coating at least 0.0002 inch in thickness and chromate sealed.

(d) Aluminum Alloy Washer: Aluminum alloy washers shall be made of sheet conforming to ASTM Designation: B 209, Alloy clad 2024, Condition T 4.

(e) Aluminum Alloy Shim Material (1100-0): Aluminum alloy shims shall be made of sheet or plate conforming to ASTM Designation: B 209, Alloy 1100, Temper O.

Access door cover and rail caps shall conform to either ASTM Designation: B 221, Alloy 6061-T6 or permanent mold castings ASTM Designation: B 108, Alloy S7A-T4 conforming to the chemical and physical requirements of Tables IX and X herein.

(f) Set Screws: Machine screws for fastening access door covers to railing posts and socket head cup point set screws for fastening pipe rail to railing posts and pipe caps to railing shall be stainless steel, and they shall be furnished by the supplier.

912.06 GALVANIZED STEEL PIPE RAILINGS. The standard weight galvanized steel pipe, castings, fittings and hardware shall be of the type, size and detail shown on the plans. Galvanizing surfaces to be placed in contact with concrete shall be given a heavy coat of an approved alkali-resistant bituminous paint and allowed to dry before placing on the concerte. However, a pad of clear, opaque polyethylene film of not less than 6 mils thickness may be placed between the galvanized and concrete surfaces in lieu of the paint and trimmed to the perimeter of the casting base after casting has been bolted down.

The galvanized steel pipe shall be of standard weight conforming to the requirements of ASTM Designation: A 120. From each 1,000 feet or less of galvanized pipe, a sample not less than one foot in length shall be submitted direct to the Materials Engineer for examination and approval as to wall thickness and zinc spelter thickness before shipment.

Fittings and castings for steel pipe shall be of malleable iron or cast steel and shall comply with ASTM Designation: A 47, Grade 35018 or ASTM Designation: A 27, Grade 70-36. All fittings and castings shall be galvanized, and the galvanizing shall comply with ASTM Designation: A 153.

The castings shall be produced under radiographic control. This shall consist of radiographic examination of castings until proper foundry techniques are established for each mold which will produce castings of a satisfactory quality free from harmful internal defects. Seven copies of certified chemical and physical test reports shall be forwarded for approval to the Materials Engineer for each heat or foundry pour of iron or steel post castings with a

certification as to ounces per square foot of the zinc spelter coating applied to these castings.

All bolts, nuts, washers and screws required in handrail construction shall be of the type, size and detail shown on the plans.

Unless otherwise specified, all bolts, nuts and washers shall conform to the ASTM Designation: A 307, Grade A.

When high tensile bolts are required, such bolts shall conform to ASTM Designation: A 325. All bolts, nuts and washers shall be galvanized, and the galvanizing shall comply with ASTM Designation: A 153.

Machine screws for fastening access door covers to railing posts and socket head cup point set screws for fastening pipe rail to railing posts and pipe caps to railing shall be stainless steel and shall be furnished by the supplier.

Section 913

Structural Steel and Structural Metals

913.01 STRUCTURAL STEEL. Unless otherwise specified, the contractor will be required to obtain all applicable physical and chemical tests and furnish the Department's Materials Engineer in Baton Rouge with the required number of copies of the certified test reports.

The type of structural steel to be used shall be as specified and shall meet the following requirements:

(a) Manganese Vanadium Steel (A 441): Manganese vanadium steel shall conform to the requirements of ASTM Designation: A 441.

(b) Manganese Steel (A 440): Manganese steel shall conform to the requirements of ASTM Designation: A 440.

(c) Structural Carbon Steel (A 36): Structural carbon steel shall conform to the requirements of ASTM Designation: A 36.

(d) High-Strength, Low-Alloy Structural Steel: This steel shall conform to ASTM Designation: A 588 and the following requirements.

Impact Properties: The producer shall make and report to the Department for heat qualification one impact test from the thickest material and one impact test from the thinnest material for each heat and/or product furnished. The impact test shall be longitudinal Charpy V-notch conforming to the requirements of ASTM Designation: A 370, Paragraph 23. Products are defined as plates, shapes and bars. If less than 50 tons are supplied from a heat, only one impact test from the thickest material is required for that heat.

For a heat to qualify, the average energy absorbed at 40°F on the test specimens shall not be less than 15 foot pounds, except when subsize specimens are required; then the minimum average energy absorption on the test specimens shall be as follows:

Size	Foot Pounds (Min.)
10mm x 7.5mm	12.0
10mm x 5mm	8.0

Each impact test constitutes the average value of three adjacent specimens. The results on a single specimen may be below the above specified minimum values but in no case below two-thirds of the value. If more than one value is below the specified minimum, or if one specimen is below two-thirds of the specified minimum, a retest of three additional specimens shall be made, each of which must equal or exceed the specified minimum. If the thickest or thinnest material tested fails to qualify, that thickness or those thicknesses shall be rejected. However, the next thinner or thicker material to be furnished may be tested and if the test results meet the requirements, the heat will be considered qualified for those thicknesses represented by the retest.

The governing thickness for beams, tees and channels shall be the average flange thickness. The governing thickness for angles shall be the specified leg thickness. Test specimens for these sections shall be taken at a point one-third the distance from the outer edge of the flange or leg to the web or heel of the section.

913.02 RIVET STEEL.

(a) Structural rivet steel shall conform to the requirements of ASTM Designation: A 502, Grade 1.

(b) High strength rivet steel shall conform to the requirements of ASTM Designation: A 502, Grade 2.

913.03 COPPER BEARING STEEL. When copper bearing steel is specified, the steel shall contain not less than 0.2 percent copper.

913.04 STEEL FORGINGS.

(a) **Carbon Steel Forgings:** Carbon steel forgings shall conform to the requirements of ASTM Designation: A 235, Class C-1.

(b) **Heat-Treated Forgings:** Heat-treated forgings, where specified, shall conform to the requirements of ASTM Designation: A 235, Class G.

(c) **Alloy Steel Forgings:** Alloy steel forgings shall conform to the requirements of ASTM Designation: A 237, Class A.

913.05 WROUGHT IRON.

(a) Wrought Iron Plates: Wrought iron plates shall conform to the requirements of ASTM Designation: A 42.

(b) Rolled Wrought Iron Shapes and Bars: Rolled wrought iron shapes and bars shall conform to the requirements of ASTM Designation: A 207.

(c) Welded Wrought Iron Pipe: Welded wrought iron pipe shall conform to the requirements of ASTM Designation: A 72. The pipe shall be standard galvanized unless otherwise shown on the plans.

913.06 STEEL CASTINGS.

(a) Carbon Steel Castings: Carbon steel castings shall conform to the requirements of ASTM Designation: A 27. Grade to be as specified.

(b) Chromium Alloy Steel Castings: Chromium alloy steel castings shall conform to the requirements of ASTM Designation: A 296, Grade CA-15.

913.07 GRAY IRON CASTINGS. Gray iron castings shall conform to the requirements of ASTM Designation: A 48, Class 30, unless otherwise specified.

Iron castings shall be true to pattern in form and dimensions and free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. The castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

All castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

913.08 MALLEABLE CASTINGS. Malleable castings shall conform to the requirements of ASTM Designation: A 47, Grade 35018, unless otherwise specified.

Malleable castings shall be true to pattern in form and dimensions and free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

The castings shall be boldly filleted at angles, and the arrises shall be sharp and perfect. The surfaces shall have a workmanlike finish.

All castings must be sandblasted or otherwise effectively

cleaned of scale and sand so as to present a smooth, clean and uniform surface.

913.09 BRONZE OR COPPER ALLOY BEARING AND EXPANSION PLATES.

(a) Bronze Bearing and Expansion Plates: Bronze bearing and expansion plates shall conform to the requirements of ASTM Designation: B 22, Alloy B.

(b) Rolled Copper-Alloy Bearing and Expansion Plates: Rolled copper-alloy bearing and expansion plates shall conform to the requirements of ASTM Designation: B 100, Alloy 510.

913.10 BOLTS, NUTS AND WASHERS.

General: Bolts and nuts from different manufacturers shall not be mixed.

(a) All bolts and nuts, except high tensile bolts, unless otherwise specified, shall conform to ASTM Designation: A 307, Grade A.

(b) High tensile bolts, nuts and washers shall conform to ASTM Designation: A 325.

(c) Subject to the approval of the engineer, high strength steel lock-pin and collar fasteners may be used as an alternate for high strength bolts or rivets as shown on the plans. The shank and head of the high strength steel lock-pin and collar fasteners shall meet the chemical composition and mechanical property requirements of ASTM Designation: A 325. Each fastener shall provide a solid shank body of sufficient diameter to provide tensile and shear strength equivalent to or greater than the bolt or rivet specified and shall have a cold forged head on one end of type and dimensions approved by the engineer, a shank length suitable for material thickness fastened and locking grooves, breakneck groove and pull grooves (all annular grooves) on the opposite end. Each fastener shall provide a steel locking collar of proper size for shank diameter used, which, by means of suitable installation tools, is cold swaged into the locking grooves forming a head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collar shall be a standard product of an established manufacturer of lock-pin and collar fasteners, as approved by the engineer.

913.11 STEEL BEARING PILES. Steel bearing piles shall be as specified on the plans and in the special provisions; the steel shall conform to Subsection 913.01 (c).

913.12 STEEL SHEET PILES. Steel sheet piling shall be of the type and weight specified on the plans and in the special provisions and shall conform to the requirements of ASTM Designation: A 328.

913.13 CORRUGATED METAL UNITS. Corrugated metal units shall conform to plan dimensions and the metal to AASHO Designation: M 36. Bituminous coating, when specified, shall conform to AASHO Designation: M 190, Type A.

913.14 SHEET COPPER. Sheet copper shall be of the type and dimensions specified and shall conform to the applicable requirements of AASHO Designation: M 138.

913.15 COLD ROLLED STEEL. Cold rolled steel shall conform to the requirements of ASTM Designation: A 108.

913.16 BRONZE.

(a) Bronze for center discs (for movable bridges) shall conform to the requirements of ASTM Designation: B 22, Alloy A.

(b) Bronze for trunnion and similar bearings (for movable bridges) shall conform to the requirements of ASTM Designation: B 22, Alloy B.

(c) Bronze for shafts and ordinary bearings shall conform to the requirements of ASTM Designation: B 22, Alloy C.

(d) Bronze for gears, nuts transmitting motion and other parts involving stresses other than compression shall conform to the requirements of ASTM Designation: B 22, Alloy D.

913.17 BABBITT METAL. Babbitt metal shall conform to the requirements of ASTM Designation: B 23, Grade 3.

913.18 STEEL FOR CENTER DISCS (Movable Bridges). Steel for center discs shall conform to the requirements of ASTM Designation: A 235, Class G.

913.19 STEEL FOR KEYS (Movable Bridges). Steel for keys shall conform to the requirements of ASTM Designation: A 235, Class E.

913.20 SEAMLESS CARBON-STEEL PIPE FOR HY-

913.20

DRAULIC LINES. Pipe for hydraulic lines shall conform to the requirements of ASTM Designation: A 106, Grade B.

913.21 STEEL FOR OPEN GRID BRIDGE FLOORING. All steel, except rivet steel, shall conform to the requirements of Subsection 913.01 (c), except that copper bearing steel meeting the requirements of Subsection 913.03 will be permitted.

Rivet steel shall meet the requirements of Subsection 913.02 (a).

Unless otherwise specified, the contractor or his fabricator will be required to perform all applicable ASTM tests and submit 7 copies of the certified tests to the Materials Engineer of the Department of Highways, Baton Rouge, Louisiana.

913.22 DUCTILE CAST IRON BEARINGS. Nodular cast iron bearings shall conform to the requirements of ASTM Designation: A 536. The grade shall be as specified on the plans or in the special provisions.

913.23 SHEAR CONNECTORS.

(a) General:

(1) Shear connector studs shall be of a design suitable for endwelding to steel beams and girders with automatically timed stud welding equipment. The type, size or diameter and length of stud shall be as specified by the plans, specifications or special provisions and approved by the engineer. (See Figure 1 for allowable tolerances on dimensions.)

(2) An arc shield (ferrule) of heat-resistant ceramic or other suitable material shall be furnished with each stud. The material shall not be detrimental to the welds or cause excessive slag and shall have sufficient strength so as not to crumble or break due to thermal or structural shock before the weld is completed.

(3) Flux for welding shall be furnished with each stud, either attached to the end of the stud or combined with the arc shield for automatic application in the welding operation.

(4) Studs shall not be painted or galvanized.

(5) Only qualified studs shall be used. A stud, to be qualified, shall have passed the tests prescribed in LDH Designation: TR 601. The arc shield used in pro-

duction shall be the same as used in the qualification tests.

(6) Before placing orders for studs, the contractor shall submit to the engineer for approval the following information on the studs to be purchased:

a. The name of the manufacturer.

b. A detailed description of the stud and arc shield to be furnished.

c. A certification from the manufacturer that the stud is qualified as specified herein.

d. A copy of the qualification test report as certified by the testing laboratory.

(7) The studs, after welding, shall be free from any defect or substance which would interfere with their function as shear connectors.

(b) Material Requirements:

(1) Shear connector studs shall conform to the requirements of ASTM Designation: A 108, cold-drawn bar, Grades 1015, 1017 or 1020, either semi- or fully-killed. If flux-retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall comply with ASTM Designation: A 109.

(2) Tensile properties as determined by tests of bar stock after drawing or of finished studs shall conform to the following requirements:

Tensile Strength (Min.)	60,000 psi
Yield Strength* (Min.)	50,000 psi
Elongation (Min.)	20% in 2 in.
Reduction of area (Min.)	50%

(3) Tensile properties shall be determined in accordance with the applicable sections of ASTM Designation: A 370. Tensile tests of finished studs shall be made on studs welded to test plates using a test fixture similar to that given in LDH Designation: TR 601. If fracture occurs outside of the middle half of the gage length, the test shall be repeated.

(4) Finished studs shall be of uniform quality and condition and free from injurious laps, fins, seams, cracks, twists, bends or other injurious defects. Finish

*As determined by a 0.2 percent offset method.

shall be as produced by cold drawing, cold rolling or machining.

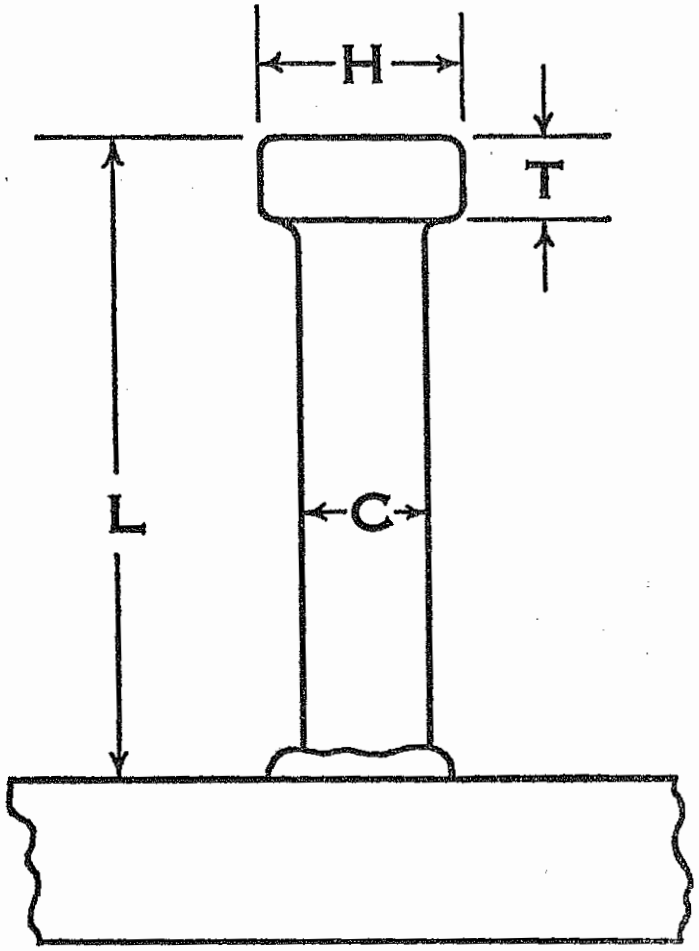
(5) The manufacturer shall certify that the studs as delivered are in accordance with the material requirements of this section. Certified copies of in-plant quality control test reports shall be furnished to the engineer upon request.

913.24 WIDE FLANGE BEAM. Wide flange beams for use in wide flange beam construction for approach slabs conform to the requirements of ASTM Designation: A 242. Reinforcing bars in sleeper blocks that require bending shall conform to ASTM Designations: A 615 or A 617, Grade 40. All other reinforcing bars in the sleeper block shall conform to either ASTM Designation: A 615, A 616 or A 617, Grades 40, 50 or 60.

Reinforcing straps shall conform to ASTM Designation: A 36.

Figure 1

DIMENSIONS AND TOLERANCES



Standard Dimensions—Inches

C	L*	H	T
3/4–.015	$4\ ^{+.062}_{-.125}$	1 1/4 ± 1/64	3/8 Min.
7/8–.015	$4\ ^{+.062}_{-.125}$	1 3/8 ± 1/64	3/8 Min.

* 4 inches length is standard. Other lengths may be obtained by special order.

Section 914

Timber and Timber Preservatives

914.01 STRUCTURAL TIMBER AND LUMBER. The species, grade and treating requirements of structural timber and lumber shall be as specified and shall conform to the applicable requirements of AASHO Designation: M 168 and the following requirements.

(a) Southern Pine Timber: Referring to Standard Grading Rules for Southern Pine Lumber, as published by the Southern Pine Inspection Bureau, effective September 1, 1970, Southern Pine lumber shall be furnished in grades with definite unit working stresses assigned as indicated for grade of lumber required.

(1) For caps, stringers and decking, the material shall conform to the following:

Grade: No. 1 Dense SR Timbers; Paragraph 268.

(2) For items other than caps, stringers, decking and sheet piling, the material shall conform to the following:

Grade: No. 1 SR Timbers; Paragraph 267.

(3) For sheet piling, the material shall conform to the following:

Grade: No. 1 Utility Timbers; Paragraph 263.

(b) Douglas Fir Timber: Referring to the 1970 Standard Grading Rules for Western Lumber, Douglas Fir lumber shall be furnished in accordance with the following:

(1) Caps, stringers and decking shall conform to the requirements of Section 70.10 "Select Structural." Unless otherwise specified, design values shall be in accordance with Table 4, page 176, "Recommended Design Values in Pounds Per Square Inch."

(2) Items other than caps, stringers and decking shall conform to the requirements of Section 70.11, Grade 1. Unless otherwise specified, design values shall be in accordance with Table 4, page 176, "Recommended Design Values in Pounds Per Square Inch."

914.02 TIMBER PILING. Timber piles shall be Southern

Yellow Pine or Douglas Fir and shall conform to the latest applicable requirements of ASTM Designation: D 25; except that unless otherwise specified, Table I herein shall be used in lieu of Tables I and II as specified in ASTM Designation: D 25.

Table I

CIRCUMFERENCES AND DIAMETERS OF TIMBER PILES

Length, Feet	3 Feet from Butt				At Tip, Min.	
	Min.		Max.			
	Circumference, Inches	Diameter (Approx.) Inches	Circumference, Inches	Diameter (Approx.) Inches	Circumference, Inches	Diameter (Approx.) Inches
DOUGLAS FIR OR PINE						
Under 40	38*	12*	63	20	25	8
40 to 54 Incl.	38	12	63	20	22	7
55 to 74 Incl.	41	13	63	20	22	7
75 to 90 Incl.	41	13	63	20	19	6
Over 90	41	13	63	20	16	5

* A minimum circumference of 34 inches or diameter of 11 inches at a point 3 feet from the butt may be specified for lengths of 25 feet and under.

NOTE: All of the above measurements shall be taken under the bark. The diameter of any pile at 3 feet from the butt shall not exceed 20 inches.

914.03 TIMBER PRESERVATIVES. Unless otherwise specified, the type preservatives to be used are as follows:

Creosote Oil—AWPA P-1 for regular treatment; AWPA P-13 for marine treatment.

Creosote Coal-Tar Solution—AWPA P-2, Grade A, for regular treatment; AWPA P-12 for marine treatment.

Pentachlorophenol-Petroleum Solution—AWPA P-8 and P-9.

Chromated Copper Arsenate—Type B, AWPA P-5.

When the preservative treatment specified is Creosote Coal-Tar Solution, unless otherwise specified, the ratio shall be 80 percent creosote oil and 20 percent coal-tar.

914.04 TREATMENT.

(a) General: Unless otherwise provided on the plans or in the special provisions, all materials shall be treated according to current AWPA Standard Specifications for Preservative Treatment by Pressure Processes, except as modified or supplemented by these specifications, as follows:

Timber and Lumber	C1 and C2
Piles	C1, C3 and C12
Poles	C1 and C4
Posts, Round or Half-Round	C1 and C5
Posts, Square Sawn	C1 and C2
Lumber, Fire Retardent	C1 and C20

All air-dried timber shall be steamed prior to treatment for a minimum of 6 hours.

All kiln-dried timber shall be steamed prior to treatment for a minimum of 2 hours.

(b) Amount of Preservative: The net retention in any charge by assay shall be not less than 90 percent of the quantity of preservative that may be specified, but the average retention of the material treated under the contract and the average retention of any 5 consecutive charges shall be at least 100 percent of the quantity specified. Unless otherwise specifically provided on the plans or in the special provisions, the minimum amount of preservative retained shall be as follows:

(1) Creosote, Creosote Coal-Tar Solution or Pentachlorophenol-Petroleum Solution Treatment shall be as follows:

Material	Min. Net Retention of Preservative Per Cu. Ft. of Wood
Southern Pine Timber	16 lbs. full cell
Douglas Fir Timber	16 lbs. full cell
Douglas Fir Piles	20 lbs. full cell
Southern Yellow Pine Piles	16 lbs. full cell

Material	Min. Net Retention of Preservative Per Cu. Ft. of Wood
Southern Yellow Pine Foundation Piles	12 lbs. full cell
Douglas Fir Foundation Piles	17 lbs. full cell
Southern Yellow Pine Piles for Use in Coastal Water (to be specified on plans or in special provisions)	20 lbs. full cell
Douglas Fir Piles for Use in Coastal Water (to be specified on plans or in special provisions)	15 lbs. full cell
Fence and Gate Posts	6 lbs. empty cell
Guard Rail Posts and Spacer Blocks	10 lbs. empty cell

(2) Timber and lumber used in the construction of bridges shall be treated with either creosote oil or creosote coal-tar solution.

(3) Timber piles shall be treated with creosote coal-tar solution.

(4) Timber guard rail posts including spacer blocks shall be treated with creosote oil and steam flushed after treatment.

(c) Painting: When painting of treated material is required by the plans, one of the following preservatives shall be used:

Ammonical Copper Arsenate (ACA)—conforming to AWPA P-5.

Chromated Copper Arsenate (CCA) Type A, B or C—conforming to AWPA P-5.

Pentachlorophenol—conforming to AWPA P-8.

Hydrocarbon solvents for oil borne preservatives shall conform to AWPA P-9, Section 2 or Section 3.

(1) The minimum retention shall be as follows:

Ammonical Copper Arsenate	0.4 lbs. cu. ft.—full cell.
Chromated Copper Arsenate Types A, B or C	0.4 lbs. cu. ft.—full cell.
Pentachlorophenol	0.4 lbs. cu. ft.—empty cell.

(2) When treating with pentachlorophenol, in order to insure paintability and eliminate "bleeding," the ma-

terial shall be given a final steam bath for a minimum of 2 hours to insure cleanliness. This will not be necessary if the solvent used is volatile petroleum solvent.

(3) After giving the treated timber a steam bath for a minimum of 2 hours, it shall be allowed to cure under atmospheric conditions for a sufficient length of time to insure paintability and avoid discolorations.

(4) Any timber showing discoloration or bleeding due to treatment shall be repainted by the contractor at no cost to the Department.

914.05 INSPECTION. All inspection shall be in accordance with AWPA Designation: M 2 and quality control shall be in accordance with AWPA Designation: M 3.

Section 915

Miscellaneous

915.01 WATER FOR USE WITH CONCRETE, MORTAR AND SOIL-CEMENT. Water for use with cement in mortar, concrete or soil-cement that is obtained from an approved city water supply or is suitable for human consumption will not require testing. However, the source shall be noted by the engineer. Water which is obtained from other sources shall meet the following requirements, with the exception that the salt (NaCl) requirements may be waived when used for soil-cement.

Sugar	None
Oil	None
Acid	None
Alkali, Not Over	0.1%
Solids (Organic), Not Over	0.1%
Solids (Inorganic), Not Over	0.4%
Salt (NaCl), Not Over	0.5%

Water of questionable quality shall be subjected to the soundness test as specified in AASHO Designation: T 26.

The sample being tested shall show a strength of 90 percent of the comparative at 7 or 28 days of age.

915.02 CALCIUM CHLORIDE. Calcium chloride shall conform to the requirements of AASHO Designation: M 144.

915.03 HYDRATED LIME. Hydrated lime for use in soil stabilization and conditioning shall conform to the requirements of ASTM Designation: C 207, Type N, except the hydrated lime shall have a maximum free moisture content of 1½ percent.

Sampling and Testing: All sampling shall be in accordance with the Materials Sampling Manual. Testing shall be in accordance with ASTM Designations: C 25 and C 110.

915.04 FRAMES, GRATES AND COVERS, AND LADDER RUNGS. Metal units shall conform to the plan dimensions and to the following specification requirements for the designated materials:

(a) Gray iron casting shall conform to the requirements of Subsection 913.07.

(b) Carbon-steel castings shall conform to the requirements of Subsection 913.06.

(c) Wrought iron items shall conform to the requirements of ASTM Designation: A 42 for plates, ASTM Designation: A 207 for shapes and bars and ASTM Designation: A 152 for rivets.

(d) Malleable iron castings shall conform to the requirements of ASTM Designation: A 47. The grade shall be as specified on the plans or in the special provisions.

(e) Galvanizing, where specified for these units, shall conform to the requirements of AASHO Designation: M 111. The weight of the spelter coat shall be as specified on the plans or in the special provisions.

915.05 COTTON DUCK (Canvas). Cotton duck (canvas) shall be the weight specified and shall conform to the applicable requirements of AASHO Designation: M 166.

915.06 PREFABRICATED MASONRY PADS.

(a) **Type A Pads:** These pads shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high quality rubber compound, or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness after compression and vulcanizing.

The pads shall withstand compressive loads perpendicular to the plane of laminations of not less than 10,000 psi before breakdown. Load deflection properties in accordance with procedures of MIL-C-882 shall be the following maximum percentages of total pad thickness: 10 percent at 1000 psi, 15 percent at 2000 psi. When loaded to 1500 psi, permanent set as load is removed in accordance with procedures of MIL-C-882 shall be a maximum of 2.5 percent of the original "zero point" thickness. Shore "A" Durometer shall be 90 ± 5. The ratio of lateral expansion to vertical deflection shall not exceed 0.25 when loaded to 1500 psi. The material shall not lose effectiveness throughout a temperature range of $-65°F$ to $+150°F$. There shall be no visual evidence of damage or deterioration by environmental effects of sunshine,

humidity, salt spray, fungus and dust in accordance with MIL-D-5272. Thickness shall be as shown on the plans and shall not vary from that specified by more than ±5 percent.

(b) Type B Pads: These pads shall consist of fabric and rubber body made from new unvulcanized rubber and new fabric fibers in proper proportion to maintain strength and stability.

The vulcanized and cured pad shall have a surface hardness of 80 Shore "A" Durometer ±10 and shall be able to withstand a compressive strength of 10,000 psi without excessive extrusion or detrimental reduction in thickness.

The thickness shall be as shown on the plans and shall not vary from that specified by more than ±1/32 inch.

(c) Certification of Type A and Type B Pads: The contractor shall furnish the engineer, for his submittal to the Central Laboratory, 7 certified copies of typical test results with the statement that pads furnished to the project conform in all respects to the applicable specifications.

915.07 FERTILIZER.

(a) Commercial Fertilizer: All fertilizers shall be commercial type, granulated or pelletized and furnished in suitable containers. All fertilizers shall conform to the conditions of the commercial fertilizer law of 1948 (Act Number 93) issued by the Louisiana Department of Agriculture.

Fertilizers shall be analyzed for the minimum percentage by weight of Nitrogen (N), available Phosphoric Acid (P_2O_5) and Soluble Potash (K_2O). Fertilizer samples sent to laboratory shall be clearly marked to identify the analysis type.

8–8–8 Fertilizer shall contain the following:
8 percent Nitrogen (N); 8 percent available Phosphoric Acid (P_2O_5); 8 percent Soluble Potash (K_2O).

9–9–9 Fertilizer shall contain the following:
9 percent Nitrogen (N); 9 percent available Phosphoric Acid (P_2O_5); 9 percent Soluble Potash (K_2O).

10–10–10 Fertilizer shall contain the following: 10 percent Nitrogen (N); 10 percent available Phosphoric Acid (P_2O_5); 10 percent Soluble Potash (K_2O).

12–12–12 Fertilizer shall contain the following: 12 percent Nitrogen (N); 12 percent available Phosphoric Acid (P_2O_5); 12 percent Soluble Potash (K_2O).

13–13–13 Fertilizer shall contain the following: 13 percent Nitrogen (N); 13 percent available Phosphoric Acid (P_2O_5); 13 percent Soluble Potash (K_2O).

14–14–14 Fertilizer shall contain the following: 14 percent Nitrogen (N); 14 percent available Phosphoric Acid (P_2O_5); 14 percent Soluble Potash (K_2O).

15–15–15 Fertilizer shall contain the following: 15 percent Nitrogen (N); 15 percent available Phosphoric Acid (P_2O_5); 15 percent Soluble Potash (K_2O).

16–16–16 Fertilizer shall contain the following: 16 percent Nitrogen (N); 16 percent available Phosphoric Acid (P_2O_5); 16 percent Soluble Potash (K_2O).

(b) Agricultural Lime: Agricultural lime shall consist of ground limestone or seashells containing at least 90 percent calcium carbonate equivalent ($CaCO_3$) and not more than 10 percent magnesium carbonate ($MgCO_3$). The material shall be ground so that not more than 10 percent shall be retained on a No. 10 sieve and 30 percent or more shall pass a No. 100 sieve.

915.08 SEEDING. All seed furnished shall conform to all requirements, rules and regulations of Chapter II, Title 3 of Louisiana Revised Statutes of 1950. The minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with Table XI herein.

Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which shall conform to the applicable requirements of the Rules and Regulations as promul-

gated by the Louisiana Seed Commission for the enforcement of the Louisiana Seed Law (Acts 372 of 1946 and 1952).

The analysis tag shall be a No. 6 standard shipping tag, minimum size, and shall carry the information required by the Louisiana Seed Law, arranged as shown in Illustration No. 1 and in addition, shall carry the Laboratory number of the Louisiana Department of Agriculture for that particular lot number shown on tag.

All seed furnished shall be the previous season's crop and the date of analysis shown on each tag shall be within 6 months of the time of delivery to the project.

Table XI

Variety of Seed	Min. Percentage of Pure Live Seed (Purity Times Germination Including Hard Seed)	Max. Percentage of Weed Seed Permitted
Hulled Bermuda	86	1
Carpet Grass	76	2
Pensacola Bahia	81	2
Louisiana White Dutch Clover	86	1
Dixie Crimson Clover	82	1
Common Lespedeza	76	2.5
Kobe Lespedeza	80	2.5
Alta Fescue	82	1
Kentucky 31 Fescue	82	1

(a) Noxious Weeds: Noxious weeds shall be interpreted to mean that list of weeds, except bermuda, which has been approved and adopted by the Louisiana Seed Commission as being noxious in Louisiana. The sum total of all noxious weed seed shall not exceed 500 per pound.

Analysis tags shall be removed from each bag or container only by the project engineer or his authorized representative. After removal, the tags shall be filed with other test reports and forwarded by the engineer to the Construction Section upon completion of the project.

(b) Test Report: A copy of the laboratory test report for each lot of seed furnished as prepared by the State

Illustration No. 1

La. Dept. of Agriculture

Kind & Variety_____ Laboratory No._____

Where Grown_____ Net Wt._____ Lot No._____

Pure Seed	%	Germination	%
Inert Matter	%	Hard Seed	%
Crop Seed	%	Total Germ. & Hard Seed	%
Weed Seed	%	Date of Test	

Name & No. of Noxious Weed Seed per lb._____

Name_____

Address_____

Seed Analyst of the Louisiana Department of Agriculture and Industry shall be submitted to the project engineer by the contractor. The Department will accept test reports from other states provided the minimum requirements of these specifications are conformed to.

915.09 TIMBER CONNECTORS. Connectors for treated timber structures, except those of malleable iron, shall be galvanized in accordance with the requirements of ASTM Designation: A 123, and shall be one of the following types as specified on the plans:

(a) Split Ring Connectors: Split rings of 2½ inch inside diameter, 4 inch inside diameter and 6 inch inside diameter shall be manufactured from hot rolled, low-carbon steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015. Each ring shall form a closed true circle with an outside cylindrical surface parallel to the axis of the ring. The inside surface, except for the 6 inch ring, shall be beveled from the median line toward the edges. It shall be cut through in one place in its circumference to form a tongue and slot.

Connector grooves in timber shall be cut concentric with the bolt hole and shall be of the following dimensions:

(1) For 2½ inch split rings: Inside diameter, 2.56 inches; width of groove, 0.18 inch; depth of groove, 0.37 inch.

(2) For 4 inch split rings: Inside diameter 4.08 inches; width of groove, 0.21 inch; depth of groove, 0.50 inch.

(3) For 6 inch split rings: Inside diameter, 6.12 inches; width of groove, 0.27 inch; depth of groove, 0.62 inch.

(b) Toothed-ring Connectors: Toothed-ring connectors shall be stamped cold from U.S. Standard 16 gage hot rolled sheet steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015, and shall be bent cold to form a circular, corrugated, sharp-toothed band and circle and shall be parallel to the axis of the ring. The central band shall be welded to fully develop the strength of the band. All sizes (2 inch, 2⅝ inch, 3⅜ inch and 4 inch diameters) shall have an over-all depth of 0.94 inch and depth of fillet of 0.25 inch.

(c) Shear Plate Connectors: Shear plate connectors shall be of the following types:

(1) Pressed Steel Type: Pressed steel shear plates of 2 5/8 inch diameter shall be manufactured from mild steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015. Each plate shall be a true circle with a flange around the edge, extending at right angles to the face of the plate and extending from one face only, the plate portion having a central bolt hole and 2 small perforations on opposite sides of the hole and midway from the center and circumference.

(2) Malleable Iron Type: Malleable iron shear plates of 4 inch diameter shall be manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only, the plate portion having a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

(d) Claw-Plate Connectors: Claw-plate connectors of 2 5/8 inch, 3 1/8 inch and 4 inch diameter shall be of malleable iron, manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. Each claw-plate shall consist of a perforated circular flanged plate with 3 sided teeth arranged about the perimeter of one face. The male plate shall have integral cylindrical hubs on both faces concentric to a bolt hole through the center of the plate. The female plate shall be flat on the side opposite the teeth but shall have an integral cylindrical hub concentric to the central bolt hole and on the face with the teeth.

(e) Spike-Grid Connectors: Spike-grid connectors shall be manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. They shall consist of 4 rows of opposing spikes forming a 4 1/8 inch square grid with 16 teeth which are held in place by fillets. Fillets for the flat grid in cross section shall be diamond shaped. Fillets for the single and double curve grids shall be increased in depth to allow for curvature and shall maintain a thickness between the sloping faces of the fillets equal to the width of the fillet.

915.10 HARDWARE AND STRUCTURAL SHAPES.

(a) **Hardware:** Machine bolts, drift bolts and dowels may be either wrought iron or medium steel. Washers shall be cast ogee gray iron or malleable castings, unless washers cut from medium steel or wrought iron plate are called for on the plans. A standard circular washer shall be used under the heads of all lag screws.

Machine bolts shall have square heads and nuts unless otherwise called for. Nails shall be cut or round wire of standard form. Spikes shall be cut wire or boat spikes. All bridge hardware shall be galvanized in accordance with ASTM Designation: A 153.

(b) **Structural Shapes:** All structural shapes, rods and plates shall be of structural steel or wrought iron, as specified or called for on the plans, meeting the respective requirements prescribed under "Structural Steel," Section 913. All castings shall conform to the requirements prescribed under the aforementioned section for "Structural Steel."

(c) **Electrical Apparatus:** All hardware for electrical apparatus shall conform to the requirements of ASTM Designation: A 193, Class B 8 (bolts and studs) and ASTM Designation: A 194, Class 8 B (nuts).

915.11 RIGID METAL CONDUIT (Electrical). Rigid metal conduit shall be of the type and size specified on the plans or in the special provisions and shall conform to the applicable requirements of A.N.S. Designation: C 80.1 or C 80.5.

915.12 ELECTRICAL CONDUCTORS. Electrical conductors shall be of the type and size as specified on the plans and in the special provisions and shall conform to the latest applicable requirements of IPCEA Pub. No. S-19-81, S-66-524 and S-61-402.

915.13 ALUMINUM PLATE. Aluminum plate for use in construction of such items as junction boxes shall conform to the requirements of ASTM Designation: B 209, Alloy 6061-T6.

915.14 JUTE MATTING. Jute matting shall be of uniform open weave, new, unbleached, single jute yarn. Yarn shall be of loosely twisted construction and shall not vary in thickness by more than one half its normal diameter.

Jute matting shall be furnished in roll strips and shall conform to the following specifications:

Length—approximately 75 yards.
Width—48 inches ±1 inch.
78 warp ends per width.
41 weft ends per linear yard.
Weight to average 1.22 pounds per linear yard, ±5 percent.

915.15 STAPLES USED WITH JUTE MATTING. Staples shall be "U" shaped number 11 gage or heavier wire. They shall be 6 inches long and 1 to 1¼ inches wide.

Handmade staples shall be made from 12 inch long number 8 gage or heavier wire.

915.16 BARRICADE WARNING LIGHTS.

(a) General: As used herein, barricade warning lights are portable, lens directed, enclosed lights. The color of the light emitted shall be yellow. They may be operated by either AC or DC power sources.

Barricade warning lights shall be classified as Type A Low Intensity Flashing Warning Lights, Type B High Intensity Flashing Warning Lights, or Type C Steady Burn Lights.

(b) Type A: The Type A Low Intensity Flashing Barricade Warning Light shall be a bi-directional or uni-directional unit. The lens shall be self-illuminated by means of an electric lamp behind the lens and also externally illuminated by reflex-reflective elements built into the lens to enable it to be seen by reflection from the headlights of oncoming automotive traffic.

(1) Optical Requirements:

a. Flash rate: The light shall have a flash rate of 65 ±10 pulsations per minute from minus 20°F to plus 150°F exclusive of battery source.

b. Flash Duration: The flash duration shall not be less than 150 milliseconds. Flash duration is defined for this measurement as the time that elapses from the point at which the applied voltage reaches 90 percent of peak voltage and that point when the voltage drops below 10 percent of peak voltage. This measurement is to be made at the lamp socket.

c. Effective Intensity: During the initial 336 hours

of continuous flashing, the effective intensity at any point within the solid angle bounded by the two vertical planes 9 degrees from the vertical plane through the axis of the optical system and the two planes 5 degrees above and below the horizontal plane through the axis of the optical system shall be at least 4 candelas.

(2) Lens, Head and Case: The lens shall not be less than 7 inches in diameter including a reflex-reflector ring ½ inch minimum width around the periphery. The lens shall be of one-piece construction.

The lens may be mounted on the case either with or without a frame. If a frame is used it shall be of metal or rigid durable plastic so constructed that it will not break or crack with reasonable usage while still permitting the removal of the lens from the head. Unframed lens shall be constructed and properly fastened to the case in a manner that will preclude breaking or cracking under normal use.

The specific intensity of the lens shall not be less than the following when acting as a reflex-reflector at an observation angle of 0.2 degrees.

Entrance Angle	Specific Intensity Candles Per Foot Candle
0 degrees	18
10 degrees	14
20 degrees	10

If the device uses an incandescent lamp the lens chromaticity shall fall on the C.I.E. equations within the limits defined by the following coordinates:

X	Y	Z
0.543	0.452	0.005
0.548	0.452	0.000
0.584	0.411	0.005
0.589	0.411	0.000

Tested in a range of 2854 degrees Kelvin to 2365 degrees Kelvin, the minimum relative luminous transmittance of the yellow lenses with illuminant at 2854 degrees Kelvin shall be 0.440.

The head or the entire light unit shall permit the swiveling of the light through a 90 degree arc on a

horizontal plane. A stop or some other means shall be provided to prevent twisting and fouling of the light wires.

The housing shall be constructed of steel, not lighter than No. 18 U.S. Standard gage, or from durable, dimensionally stable plastic which by testing is shown capable of withstanding considerable abuse.

The case shall be so constructed and closed as to exclude such moisture as would affect the proper operation of the light. A weep hole shall be present in the case to allow the escape of moisture from condensation.

(c) Type B: The Type B High Intensity Flashing Barricade Warning Light shall have a uni-directional lens and a reflector. The lens shall be self-illuminated by means of an electric lamp behind the lens and also may be externally illuminated by reflex-reflective elements built into the lens to enable it to be seen by reflection from the headlights of oncoming automotive traffic.

(1) Optical Requirements:

a. Flash Rate: The light shall have a flash rate of 65 ±10 pulsations per minute from minus 20°F to plus 150°F exclusive of battery source.

b. Flash Duration: The flash duration shall not be less than 120 milliseconds. Flash duration is defined for this measurement as that time that elapses from the point at which the applied voltage reaches 90 percent of peak voltage and that point when the voltage drops below 10 percent of peak voltage. This measurement is to be made at the lamp socket.

c. Effective Intensity: During the initial 168 hours of continuous flashing, the effective intensity at any point within the solid angle bounded by the two vertical planes 9 degrees from the vertical plane through the axis of the optical system and the two planes 5 degrees above and below the horizontal plane through the axis of the optical system shall be at least 35 candelas.

(2) Lens, Head and Case: The lens shall not be less than 7 inches in diameter. If it includes a reflex-reflector ring, it shall be ½ inch minimum width

around the periphery. The lens shall be of one-piece construction. If the device uses an incandescent lamp the lens chromaticity shall conform to the requirements for a Type A light.

The housing shall conform to the requirements for Type A lights.

(d) Type C: The Type C Steady Burn Light shall be a bi-directional or uni-directional unit. The lens shall be self-illuminated by means of an electric lamp behind the lens and also externally illuminated by reflex-reflective elements built into the lens to enable it to be seen by reflection from the headlights of oncoming automotive traffic.

(1) Optical Requirements-Candle Power: During the initial 336 hours of continuous operation, the candle power at any point within the solid angle bounded by the two vertical planes 9 degrees from the vertical plane through the axis of the optical system and the two planes 5 degrees above and below the horizontal plane through the axis of the optical system shall be at least 2 candles.

(2) Lens, Head and Case: All requirements shall be the same as for Type A lights.

(e) Approval, Testing and Markings: All barricade warning lights used on construction projects must be from an approved source. In order for a supplier to be certified as an approved source, a sample of each type of light must be submitted along with a certified test report from an independent testing laboratory listing test results for each requirement of the specification. The sample light submitted will become the property of the Department to be used as a control sample.

Each light submitted for approval, and each light placed on a construction project shall have permanently attached an identification plate giving the following information:

1. Manufacturer's name
2. Model number
3. Type
4. Lens manufacturer and identification number
5. Circuit manufacturer and identification number
6. Bulb number

7. Minimum operating voltage to conform to minimum intensity requirements
8. Year manufactured

Periodic spot checks of lights in use on projects will be made, and failure of the samples to conform to specification requirements will be cause for removing the supplier from the approved list.

915.17 VEGETABLE MATERIAL FOR MULCH. Vegetable material for mulch shall be applied as indicated on the plans for erosion prevention and shall meet the following requirements:

Mulch shall be vegetative in character and shall consist of either stems or stalks of oats, rye, rice, wheat or other approved straws. The contractor may also use hay obtained from various legumes and grasses such as lespedezas, clover, vetches, soybeans, bermuda, dallas, carpet sedge, fescue or other approved legumes of grasses of any combination thereof. Straw or hay shall be dry and reasonably free from mold, Johnson grass or other noxious weeds.

915.18 ROOFING PITCH. Roofing pitch shall conform to the requirements of AASHO Designation: M 118.

915.19 NEOPRENE BRIDGE BEARING PADS (Elastomeric Bearings).

(a) General: The elastomer portion of the compound used for bearings shall be 100 percent virgin neoprene stock. Natural rubber, vulcanized rubber (natural or synthetic) or other synthetic rubber-like materials will not be acceptable.

Nonelastic laminates, unless otherwise shown on the plans, shall be 1/16 inch (−0, +1/16 inch) thick rolled mild steel plates or sheets which conform to ASTM Designation: A 245.

(b) Physical Properties of Elastomer: The elastomer compound for plain and laminated bearings shall meet the requirements shown in Table A. Tests of the materials shall be made in accordance with the test methods stipulated. Insofar as possible, all tests shall be made on the finished product. A deviation of minus 10 percent from the values shown in Table A will be allowed on the original tensile, original elongation and tear properties where tests are performed on samples taken from the

finished product. Special molded and/or prepared specimens where required shall conform to the specimen preparation requirements of the particular test involved.

Table A

PHYSICAL PROPERTIES

Grade (Durometer)	50	60	70
Original Physical Properties			
Hardness ASTM Designation: D2240	50±5	60±5	70±5
Tensile Strength, Minimum psi ASTM Designation: D 412	2,500	2,500	2,500
Elongation at Break, Minimum Percent	400	350	300
Accelerated Test to Determine Long-Term Aging Characteristics Over-aged – 70 Hours/212°F, ASTM Designation: D 573			
Hardness, Points Change, Maximum	0 to +15	0 to +15	0 to +15
Tensile Strength, % Change, Maximum	±15	±15	±15
Elongation at Break, % Change, Maximum	−40	−40	−40
Ozone – 100±5 PPHM in Air by Volume – 20% Strain or Bent Loop – 100±2°F – ASTM Designation: D 1149*			
100 Hours	No Cracks	No Cracks	No Cracks
Compression Set – 22 Hours/158°F, ASTM Designation: D 395– Method B			
Percent Maximum	25	25	25
Low Temperature Stiffness – ASTM Designation: D 797**			
At −40°F, Young's Modulus, Maximum psi	10,000	10,000	10,000
Tear Test – ASTM Designation: D 624– Die "C"***			
Pounds/Lin. In., Minimum	225	225	225

*Samples to be solvent wiped before test to remove any traces of surface impurities.
**This test required for the manufacturer's certification only.
***This test for information only, not for basis of acceptance.

Adhesion (for laminated bearings only): The adhesion requirements shall be performed by the Department's Materials Laboratory in accordance with LDH Testing

Procedures. All bond failures shall occur within the elastomer itself, rather than at an interface.

(c) Formulation, Prequalification and Certification: All bearings furnished by the contractor shall be produced by a bearing manufacturer who has previously submitted the required prequalification test samples and certifications and whose elastomer formulation has been initially approved for use by the engineer. Each hardness of elastomer formulation produced by a manufacturer must be approved by the engineer prior to its first use on Department projects.

In order to obtain initial prequalification approval of a particular formulation, the bearing manufacturer shall submit to the engineer well in advance of anticipated use certified test results indicating actual test values obtained on the physical properties of the elastomer for compliance with the specifications.

In addition, the manufacturer shall forward prequalification test samples to the Louisiana Department of Highways Materials Laboratory for testing, evaluation and possible subsequent written approval indicating compliance with prequalification requirements. These prequalification samples shall consist of at least two sets of cut samples as required by the ASTM specifications stipulated in Table A. In addition to the required ASTM samples, at least one finished bearing, typical of the size and type intended to be furnished on Department projects, shall be submitted for prequalification testing. All samples will be produced from factory mixed stock.

In the case of laminated bearings, one finished laminated bearing, typical of the size and type to be subsequently furnished on Department projects, shall be submitted for prequalification testing. In addition, a nonlaminated bearing of the approximate size of one layer of elastomer in the laminated bearing shall be furnished.

The bearing manufacturer shall certify that all of the samples submitted are of the same basic elastomer formulation and of equivalent cure to that to be used subsequently in the finished products to be furnished on Department projects.

The engineer may require that the complete testing procedure for prequalification purposes be performed again

by the producer during later production should the engineer feel such action appropriate.

(d) Manufacturing Requirements: All components of a laminated bearing shall be molded together into an integral unit. All edges of the nonelastic laminations shall be covered by a minimum of ⅛ inch of elastomer. Unless otherwise shown on the plans, all laminates shall be parallel with the bottom surface of the bearing, subject to the tolerances that follow.

The preparation of elastomer compound prior to placement in the mold shall be such as to result in a homogeneous finished bearing pad free of voids, blisters, cracks, folds, cuts, nonfills and any appearance of layers or ply separation on the surface or within the pad. Plain bearing pads may be molded individually or cut to length from previously molded strips or slabs. No pads shall be formed from the lamination of previously cured sheets or slabs. The finish of cut surfaces shall be at least as smooth as A.N.S. No. 250 finish.

The batch or lot number shall be marked on each bearing in such a manner as to remain legible until the bearing is placed in the structure. A batch is defined as the quantity of compound produced from each separate mixture of ingredients. A lot is defined as the quantity of compound resulting from the mixture of two or more batches.

(e) Appearance and Dimensions: Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Association, Inc.; RMA-F3-T.063 for molded bearings.

For both plain and laminated bearings the permissible variation from the dimensions and configuration required by the plans and these specifications shall be as follows:

1. Overall Vertical Dimensions
   Average Total Thickness
   1¼ in. or Less ..... −0, +1/8″
   Average Total Thickness
   over 1¼ in. ..... −0, +1/4″
2. Overall Horizontal Dimensions ..... −0, +1/4″

3. Thickness of Individual Layers of Elastomer (Laminated Bearings Only)	±1/8"
4. Variation from a Plane Parallel to the Theoretical Surface	
Top	1/8"
Sides	1/4"
Individual Nonelastic Laminates (As determined by measurements at the edges of the bearing)	1/8"
5. Position of Exposed Connection Members	1/8"
6. Edge Cover of Embedded Laminates or Connection Members	−0, +1/8"
7. Size of Holes, Slots or Inserts	−0, +1/8"
8. Position of Holes, Slots or Inserts	1/8"
9. Thickness of Nonelastic Laminates	−0, +1/16"

(f) After prequalification approval, one plain bearing and/or one laminated bearing will be taken by the engineer, at random, from each project or from each batch or lot of elastomer; however, not less than one sample per 100 bearings will be furnished. These bearings will not be returned for use on the project, and no direct payment will be made for the bearing samples.

Also, the actual certified test results that are used in quality control by the manufacturer shall be furnished to the engineer. These quality control tests shall be taken per batch or lot from factory mixed stock used to produce the finished bearing.

For laminated bearings only, each bearing shall be subjected, by the manufacturer, to an average compression of 1,000 pounds per square inch of bearing area. The performance of each bearing will be considered satisfactory provided there is no visible evidence of bond failure or other damage to the bearing because of this loading.

(g) All cost of elastomeric bearings, either plain or laminated shall be included in the price bid on the precast-prestressed bridge member.

915.20 FIBER GLASS ROVING.

(a) Description: This specification covers a continuous fiber glass roving used in combination with asphalt or

other cementitous materials to control erosion on newly seeded slopes and drainage channels.

(b) **General Requirements:** The material shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving without the use of clay, starch or like deleterious substances. The roving shall be wound into a cylindrical package approximately 1 foot high in such a manner that the roving can be continuously fed from the center of the package through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

(c) **Detailed Requirements:** The fiber glass roving shall conform to these detailed requirements:

Property	Limits	Test Method
Strands/Rove	56-64	End Count
Fibers/Strand	184-234	
Fiber Diameter, in. (Trade Designation-G)	0.00035-0.0004	ASTM D 578
Yards/lb. of Strand	13,000-14,000	ASTM D 578
Yards/lb. of Rove	210-230	ASTM D 578
Organic Content, percent max	0.75	ASTM D 578
Package Weight, lbs	30-35	ASTM D 578

915.21 CELLULAR POLYSTYRENE PLASTIC. Cellular polystyrene plastic material shall conform to ASTM Designation: D 2125-62T with the following specific requirements. Density of the material shall be approximately 2 pounds per cubic foot (range of 1.8 to 2.2) and shall be extruded type of homogeneous foam with 30 psi compressive strength.

Section 916

Welding

916.01 DESCRIPTION. Welding of structural steel, steel pipe and aluminum alloys, and qualification of procedures, welders and welding operators shall be in accordance with the requirements of these specifications and the LDH Welding Procedures Manual.

916.02 QUALIFICATION OF PROCEDURES, WELDERS AND WELDING OPERATORS.

(a) General:

(1) The Materials Section of the Department shall be the sole qualifying agency.

(2) Qualifying tests may be made at locations selected by the contractor, but advance notice of not less than one week shall be given to the Department's Materials Engineer so that the Department can arrange for the presence of the inspector.

(3) Seven copies of the required reports will be furnished to the Materials Engineer. If requested, the Department will furnish the necessary forms.

(4) Each welder and welding operator's work shall be identified with a steel stencil.

(5) The social security number of each qualifying welder and welding operator shall be furnished and recorded on the required reports, and the qualified welder shall have his social security card in his possession when working.

(6) All costs incidental to welding qualifications shall be the responsibility of the contractor.

(b) Steel:

(1) Welding procedures conforming to the requirements of Section 5, Article 501(a) of the LDH Welding Procedures Manual shall be deemed prequalified and are exempt from tests or qualifications. Other procedures shall conform to the requirements of Section 5, Article 502(a).

(2) Welders and welding operators shall be qualified

in accordance with the requirements of Section 5, Article 503 of the LDH Welding Procedures Manual except that welders and welding operators previously qualified by the Department need not be requalified subject to the requirements of Section 6, Article 604.

(c) Aluminum: Welding qualifications for aluminum alloys shall conform to the applicable requirements of Section 8 of the LDH Welding Procedures Manual.

(d) Steel Pipe: Welding qualifications for steel pipe shall conform to the requirements of the American Society of Mechanical Engineers Code, Section IX.

(e) Electrodes: All electrodes shall be qualified in accordance with the LDH Welding Procedures Manual, and these requirements.

The contractor may, at his option, perform the required usability tests, or he may furnish the Department's Materials Section with certified test reports from the manufacturer covering these requirements. If certified test reports are furnished, the contractor shall also furnish a certification from the manufacturer that the process and material requirements were the same for manufacturing the tested electrodes and the furnished electrodes.

The Department will maintain a list of approved brands of electrodes for a period of one year after which time the type and brand of electrode must be retested or certified.

916.03 WELDING OF STRUCTURAL STEEL. Welding of structural steel shall conform to the requirements of the LDH Welding Procedures Manual.

916.04 WELDING OF ALUMINUM ALLOYS. Welding of aluminum alloys shall conform to the requirements of the LDH Welding Procedures Manual.

916.05 MEASUREMENT AND PAYMENT. There will be no direct payment for radiographic inspection, magnetic particle inspection, dye penetrant inspection or other tests as specified. All costs therefor are to be included in the unit price bid on pay items.

The size, type and length of the welds shall be as shown on the plans.

There will be no measurement or payment made for any weld metal deposited; however, there will be no deduction made for the metal to be welded due to edge preparation.

Section 917

Signs and Markers

917.01 DESCRIPTION. This section covers sign face materials and the fabrication of traffic signs, route markers and delineators consisting of sign panels complete with legend, route markers and legend components as individual items. These specifications shall be used in conjunction with Section 729.

For the purpose of these specifications the term "legend" shall be understood to mean the border strip and all letters, numerals and symbols which convey the message on signs.

917.02 GENERAL REQUIREMENTS. Traffic signs and markers shall conform to the requirements of the "Louisiana Uniform Traffic Control Devices Manual," current on the date of receipt of bids, and the AASHO "Manual of Signing and Pavement Markings of the National System of Interstate and Defense Highways," current on the date of receipt of bids, except as modified by these specifications or as shown on the plans.

The manufacturer shall certify that all signs furnished conform to these specifications and will replace or repair all signs that fail to meet these requirements at no additional cost to the Department.

All signs shall be subject to inspection at the time of manufacture, except that the engineer may, at his option, elect to inspect the signs at the destination only. In either case, final acceptance of signs will be made at the destination. Sampling frequency shall be in accordance with the LDH Sampling Manual, and when directed it shall be the responsibility of the contractor or manufacturer to furnish and prepare all samples for testing in accordance with Department instructions.

917.03 REFLECTIVE AND NONREFLECTIVE SHEETING.

(a) Reflex-Reflective Sheeting:

(1) Description: The reflex-reflective sheeting is identified as that material which has the property of reflecting the incident light from a single source in a

relatively narrow cone back toward that source. The reflex-reflective material used shall be of two types.

a. The Enclosed Lens type consisting of spherical lens elements embedded within a flexible transparent plastic which forms a smooth, flat, outer surface as exposed in use.

b. The Encapsulated Lens type consisting of spherical lens elements adhered to a synthetic resin and encapsulated by a flexible transparent waterproof plastic having a smooth outer surface, all in accordance with these requirements. Both types of sheeting shall have a protected precoated adhesive backing and be weather resistant.

(2) Requirements:

a. Adhesive:

1. The Enclosed Lens type reflective sheeting shall include a precoated pressure sensitive adhesive or a tack-free, heat activated adhesive. The Encapsulated Lens type shall include a precoated pressure sensitive adhesive. Either of the adhesive types may be applied without necessity of additional adhesive coats on the reflective sheeting or application surface.

2. The protective liner attached to the adhesive shall be easily removed by peeling without soaking in water or other solvents.

3. The adhesive shall form a durable bond to smooth corrosion and weather resistant surfaces and shall be tough enough to resist scuffing and marring during handling and elastic enough to resist shocking off when struck at low temperatures or sliding off at high temperatures. The adhesive shall be strong enough to resist peeling the reflective sheeting from the application surface when a 5 lb./in. width force is applied as outlined in ASTM Designation: D 903. The adhesive shall be sufficiently moisture-resistant to withstand 8 hours of water-soaking at room temperature without appreciable decrease in adhesion.

b. Photometric:

1. The reflective sheeting shall have the following minimum brightness values at .2° and .5° diver-

gence expressed as average candle power per foot-candle per square foot of material. Measurements shall be conducted in accordance with standard testing procedures for reflex reflectors of Federal Specification L-S-300A, "Sheeting and Tape, Reflective; Nonexposed Lens Adhesive Backing."

Table I

ENCLOSED LENS REFLECTIVE SHEETING

	Silver–White #1		Silver–White #2		Yellow		Red	
Div. Angle	.2	.5	.2	.5	.2	.5	.2	.5
Inc. Angle								
—4	70	30	80	41	50	25	14.5	7.5
40	14.5	8.5	16.5	9.5	11.5	7.0	3.0	1.5

	Blue		Green		Orange		Brown	
Div. Angle	.2	.5	.2	.5	.2	.5	.2	.5
Inc. Angle								
—4	4.0	2.0	9.0	4.5	25	13.5	1.0	0.35
40	0.4	0.4	1.8	1.5	1.0	0.8	0.2	0.1

Table II

ENCAPSULATED LENS REFLECTIVE SHEETING

	Silver		Green		Yellow	
Div. Angle	.2	.5	.2	.5	.2	.5
Inc. Angle						
—4	180	65	30	10	95.0	40.0
40	25	15	4	2	9.5	7.5

2. Applied or Demountable Copy: Reflective sheeting for all sign copy including letters, numerals, symbols, borders and route markers shall be sheeting which has been carefully selected by the manufacturer for uniformity of day and night appearance. Reflective sheeting for copy, etc. shall be Enclosed Lens Silver-White #2 or Encapsulated Lens Silver. No further matching shall be necessary.

3. Rainfall Performance: The brightness of the reflective sheetings totally wet by rain shall not be less than 90 percent of the above values. Wet performance measurements shall be conducted in conformance with Standard Rainfall Test specified in Federal Specification L-S-300A, "Sheeting

and Tape, Reflective, Nonexposed Lens Adhesive Backing."

c. Color: The colors shall be matched visually and be within the limits shown on the Color Tolerance Charts issued by the Office of Traffic Operations, Federal Highway Administration.

d. Film:

1. General: The reflective sheeting shall have sufficient strength and flexibility so that it can be handled, processed, and applied according to the recommendations of the sheeting manufacturer without appreciable stretching, tearing, or other damage. It shall permit application over and conformance to moderate, shallow embossing characteristic of certain sign borders and symbols.

2. Surface: The sheeting surface shall be smooth and flat, facilitate cleaning and wet performance, and exhibit 85° gloss meter rating of not less than 40 (ASTM Designation: D 523). The sheeting surface shall be compatible with recommended transparent and opaque process colors and show no appreciable physical or handling changes with normal processing, cutting and application and shall permit cutting and color processing at temperatures of 60-100°F and RH of 20-80 percent.

3. Lens Elements: The reflective sheeting shall possess stable and durable spherical lens elements which, following extraction and testing for acid resistance in accordance with LDH Designation: TR 605, shall show no deterioration.

4. Cleanability: The sheeting surface shall be solvent resistant such that it may be cleaned with VM&P Naptha, mineral spirits, turpentine, or water and shall show no appreciable loss of reflective intensity or change in appearance when tested in accordance with LDH Designation: TR 606.

5. Impact Resistance: The sheeting, applied according to manufacturers' recommendations to cleaned and etched 0.040 x 3" x 5" aluminum and conditioned for a minimum of 24 hours at room temperature shall show no cracking when face of

panel is subjected to impact of a two pound weight with 5/8 inch rounded tip at a 10 inch pound setting on a Gardner Variable Impact Tester.

e. Durability:

1. Processed, applied and cleaned in accordance with recommended procedures, the reflective sheetings used on traffic control signs shall be considered as performing satisfactorily, for the number of years specified herein, which have not deteriorated due to natural causes to the extent that the resulting defects when viewed from a vehicle make the sign ineffective for the intended purpose or the average nighttime reflective brightness is less than that specified below:

The reflective sheeting shall perform satisfactorily for a minimum period of at least 7 years outdoors and shall retain a minimum brightness as specified in Table IV.

Table IV

Sheeting Type and Color	Average Min. Candlepower Per Ft. Candle Per Sq. Ft. at 0.2° Divergence and −4° Incidence.
Silver-White #1–Enclosed Lens	30
Silver-White #2–Enclosed Lens	36
Yellow–Enclosed Lens	20
Red–Enclosed Lens	5
Blue–Enclosed Lens	2
Green–Enclosed Lens	3
Orange–Enclosed Lens	10
Brown–Enclosed Lens	0.4
Silver–Encapsulated Lens	120
Green–Encapsulated Lens	20
Yellow–Encapsulated Lens	60

The bidder shall supply a statement of performance life for the minimum retained brightness specified above.

2. The reflective material exposed at an approved test facility for 24 months in Florida or Louisiana at 45 degrees south facing shall not support fungus growth and accumulate dirt to the extent

that the reflective brightness before cleaning is less than 75 percent of the reflective brightness after cleaning, when measured at 0.2 divergence and —4 degrees incidence. The precoated adhesive shall have no staining effect on the reflective sheeting.

3. The sheeting surface must be readily refurbishable by cleaning and clear overcoating in accordance with the manufacturer's recommendations.

f. General Characteristics and Packaging: The reflective sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials, and shall be furnished in both rolls and sheets. There shall be no more than four splices per 50 yard length and splices shall be suitable for continuous application as supplied.

Rolls shall be packed snugly in corrugated fiberboard boxes in such manner that no damage or defacement shall occur to the reflective sheeting during shipment or storage.

Rolls 3 inches in width to 12 inches in width shall be packed in corrugated fiberboard cartons of minimum 200# test. Rolls 13 inches in width to 24 inches in width shall be packed in corrugated fiberboard cartons of minimum 275# test. Rolls 25 inches in width and above shall be packed in corrugated cartons of minimum 350# test. Rolls wider than 6 inches and 10 yards in length or longer shall be supported and suspended by the roll core within carton by means of plugs adhered to and within built-up and reinforced corrugated pads.

Cut sheets shall be packaged flat between pressed composition board or corrugated pads of the same dimensions to prevent damage or defacement during shipment or storage.

(b) Nonreflective Sheeting:

(1) General Requirements: The nonreflective sheeting film shall consist of an extensible, pigmented, weather-resistant plastic film. The face side of film shall be supported and protected by a paper liner which is readily removable, after application, without the necessity of soaking in water or other solvents.

(2) Adhesive Requirements: The film shall include a precoated adhesive on the back, eliminating necessity for additional adhesive coats on film or application surface.

The precoated adhesive shall be activated by means of heat and shall be suitable for use with the hand roller, squeeze roller and vacuum process application techniques to form a durable bond to any clean, weatherproof surfaces.

The adhesive shall form a durable bond to smooth corrosion and weather resistant surfaces and shall be tough enough to resist scuffing and marring during handling and elastic enough to resist shocking off when struck at low temperatures or sliding off at high temperatures. The adhesive shall be strong enough to resist peeling the reflective sheeting from the application surface when a 5 lb./in. width force is applied as outlined in ASTM Designation: D 903. The adhesive shall be sufficiently moisture-resistant to withstand 8 hours of water-soaking at room temperature without appreciable decrease in adhesion.

(3) Physical Characteristics: The film shall be readily cut by normal fabricating methods without cracking, checking or flaking.

The applied film shall be free from ragged edges, cracks and blisters, and the material selected shall have demonstrated its ability to withstand normal weathering without checking, cracking or excessive color loss. It shall be resistant to gasoline (Heptane), mild acids, salts and alkali when tested in accordance with LDH Designation: TR 607.

(4) Packaging: The sheeting shall be supplied in rolls 150 feet long of a specified width. Rolls shall be individually packaged in snug-fitting containers in such a manner that no damage or defacement may occur during transportation to destination.

917.04 DEMOUNTABLE REFLECTORIZED LEGEND.

(a) Description: The legend shall be adhesive coated reflective sheeting as specified. The sheeting shall be permanently adhered to a flat aluminum backing.

(b) Fabrication: The reflective sheeting shall be applied

to the properly prepared aluminum with the equipment and in a manner prescribed by the sheeting manufacturer.

Letters, numerals, symbols and borders shall be a minimum of .032 inch thick sheet aluminum conforming to ASTM Designation: B 209-3003 H14. Aluminum shall be properly degreased and etched or treated with a light, tight amorphous chromate type coating. Each letter, numeral, symbol and border shall be supplied with mounting holes and shall be secured to the sign surface with non-twist corrosion resistant approved fasteners. Suitable spacers shall also be provided as necessary.

(c) General Requirements and Packaging: The copy shall show careful workmanship and be clean cut, sharp and have essentially a plane surface.

The manufacturer shall certify that all letters, numerals, symbols and borders furnished conform to this specification and will replace or repair without cost all which fail to meet these requirements.

The copy shall be packaged in such a manner as to assure arrival in an undamaged condition, and shall not become wet in storage or shipment.

917.05 GUIDE DELINEATORS. The contractor may, at his option, furnish delineators using reflective sheeting or acrylic plastic reflectors, meeting the requirements of the plans and these specifications.

(a) Reflective Sheeting Reflectors:

(1) Description: The delineators shall be of adhesive coated reflective sheeting permanently adhered to a sheet aluminum backing. The reflective sheeting shall be "Encapsulated Lens Reflective Sheeting." The delineators shall be 4 inch by 4 inch diamonds or 4 inch by 8 inch rectangles as specified.

The reflective sheeting shall be silver or yellow amber as specified.

(2) Requirements: The adhesive, photometric, film and durability requirements shall meet the specifications of Subsection 917.03, "Encapsulated Lens Reflective Sheeting."

(3) Fabrication: The aluminum sheeting shall be .080 inch minimum thickness conforming to ASTM Designa-

tion: B 209-6061-T6, properly degreased and etched, or treated with a light, tight amorphous chromate type coating.

The reflective sheeting shall be applied to properly treated base panels with mechanical equipment in a manner specified by the sheeting manufacturer.

Delineators shall be punched or sheared to size with ¾ inch radius corners. Mounting holes shall be centered and spaced on 6 inch centers for the 4 inch by 8 inch delineators. The mounting hole shall be centered for the 4 inch by 4 inch delineators so as to present a diamond shape when installed.

(4) General Requirements: The finished delineators shall show careful workmanship, be free of burrs, scratches, or damaged reflective sheeting and have essentially a plane surface.

The manufacturer shall certify that all delineators furnished conform to this specification and will replace or repair without cost all delineators which fail to meet these requirements.

Delineators shall be packaged in such a manner as to insure their arrival at destination in undamaged condition. Delineators shall not be permitted to become wet in storage or shipment.

(b) Acrylic Plastic Reflectors:

(1) Description: The reflector shall consist of hermetically sealed acrylic plastic prismatic reflex-reflectors housed in embossed aluminum and provided with an approved single grommeted mounting hole.

(2) Requirements:

a. Design and Fabrication of Parts: Housing shall be 0.20 inch minimum thickness aluminum and shall conform to ASTM Designation: B 209-5052-0 formed to approximately 3.25 inch in diameter and .235 inch to .325 inch in depth to retain the acrylic reflector. Housing shall be provided with 4 embossed circular reinforcement ribs and marked with name and part number of manufacturer.

An aluminum grommet shall be expanded within the reflector mounting hole.

The reflector shall be acrylic plastic, and the bidder

will specify the manufacturer of the raw material and the identification number of the particular molding compound to be furnished. Acceptable formulations shall be as follows, or an approved equal.

Manufacturer	Trade Name	Type of Molding Compound
E.I. duPont de Nemours & Co., Inc.	Lucite	HM-140
Rohm and Haas Company	Plexiglass	V

The reflector shall consist of a clear and transparent plastic face, with a minimum of 7 square inches of reflective area, herein referred to as the lens, with a heat sealable plastic coated metallic foil or molded acrylic transparent back fused to the lens under heat and pressure around the entire perimeter of the lens and the central mounting hole to form a unit permanently sealed against dust, water and water vapor. The reflector shall be colorless, yellow or red, as specified.

The lens shall consist of a smooth front surface, free from projection or indentations other than a central mounting hole and identification, with a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light. The manufacturer's trade mark shall be molded legibly into the face of the lens.

b. Optical:

1. Definitions:

Entrance Angle shall mean the angle at reflector between direction of light incident on it and direction of reflector axis.

Observation Angle shall mean the angle at reflector between observer's line of sight and direction of light incident on reflector.

Specific Intensity shall mean candlepower returned at the chosen observation angle by a reflector for each foot-candle of illumination at the reflector.

2. Specific Intensity: The specific intensity of each reflex reflector intended for use in delineators or markers shall be equal to or exceed the following minimum values when tested using the procedure described in Federal Specification L-S-300A. Fail-

ure of any one of the samples subjected to test shall constitute failure of the lot.

Observation Angle	Entrance Angle	Specific Intensity Candlepower per Foot-Candle		
Degrees	Degrees	Clear	Yellow	Red
0.2	0	40	25	15
0.2	20	30	18	10

c. Durability:

1. Seal Test: Failure of any one of the samples tested in accordance with LDH Designation: TR 608 shall be cause for rejection.

2. Heat Resistance Test: Three reflectors shall be tested for 4 hours in a circulating air oven at 140°F ±5 degrees. The test specimens shall be placed in a horizontal position on a grid or perforated shelf permitting free air circulation. At the conclusion of the test, the samples shall be removed from the oven and permitted to cool in air to room temperature.

The samples, after exposure to heat, shall show no significant change in shape and general appearance when compared with unexposed control standards. No failures will be permitted.

(3) Sampling Procedure: For qualification purposes, 50 samples will be required for all of the tests set forth in this specification and must be submitted by the manufacturer. For acceptance purposes, the samples will be selected at random at the rate of 10/1000 but not less than 10 nor more than 50 by the purchaser from each shipment.

(4) Packaging: Reflectors shall be supplied in cardboard tube containers with contents marked thereon.

917.06 SIGN ENAMELS AND PAINTS.

(a) Sign enamels or paints for use under this material specification shall be applied in accordance with the manufacturer's recommendations, and the final appearance as well as materials used shall meet with the approval of the engineer.

(b) Silk Screen Paste: Constituents used in manufacture of silk screen paste, and not otherwise specified, shall meet the approval of the engineer. Silk screen paste shall be mixed at the factory, well ground to a uniform con-

sistency and smooth texture, and shall be free from water and other foreign matter. It shall dry within 18 hours to a good film without running, streaking, or sagging. Any paste which has livered or in any way hardened or thickened in the container, or in which the pigment has settled out so that it cannot be readily broken up with a paddle to a uniform usable consistency, will be rejected. The paste and thinner shall be used in accordance with the manufacturer's recommendations.

The paste shall have proper pigmentation and consistency for use on silk screen equipment. The material shall produce the desired color when applied on reflective sheeting background. The paste shall meet the quality and test requirements for appearance, coarse particles, and moisture and water resistance as specified for sign paints.

917.07 FABRICATION.

(a) General: Signs and markers shall be fabricated so as to comply with the detailed plans and alphabets available from the Department.

It is the intent of these specifications that, in addition to compliance with the details of fabrication, plans and specifications, the completed signs shall show careful, finished workmanship in all particulars. They shall be free from cracks, wrinkles, blisters and other blemishes. Signs showing poor workmanship will be rejected.

(b) Special Requirements:

(1) Unless otherwise permitted by the engineer, metal fabrication including shearing, cutting and punching holes shall be completed prior to surface treatment of metal and application of reflective or nonreflective sheeting. Metal panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication. The surface of all sign panels shall be flat.

(2) Sign faces for all overhead and cantilever truss structures shall be fabricated using aluminum alloy sheeting.

(3) Splice plates joining two sign panel sections shall be omitted behind horizontal sills to insure a plane surface on the sign face.

(4) The aluminum sheeting shall be 0.08 inch minimum

thickness conforming to ASTM Designation: B 209-6061-T6, unless otherwise specified.

(5) The galvanized steel sheeting shall be 12 gauge thickness conforming to requirements of Subsection 729.03, unless otherwise specified.

(c) Surface Treatment of Metal:

(1) Aluminum Signs:

a. Degreasing: Required on sheet aluminum and extrusions:

1. Vapor Degreasing by total immersion of the sign in a saturated vapor of trichlorethylene or perchlorethylene. Trademark printing should be removed with lacquer thinner or controlled alkaline cleaning system.

2. Alkaline Degreasing: Signs shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications.

Immersion time shall depend upon the amount of contaminants present and the gage of the metal.

b. Etching: Required only on sheet aluminum.

1. Acid Etch: Etch well in a 6-8 percent phosphoric acid solution at 100°F, rinse thoroughly with running cold water and may be followed by hot water tank rinse.

2. Alkaline Etch: Etch well the precleaned aluminum surface in an alkaline etching material that is controlled by titration; use time, temperature and concentration specified by the solution manufacturer. Rinse thoroughly. Remove smut with an acidic, chrominum compound type solution as specified by the solution manufacturer and then thoroughly rinse.

c. Drying: Dry panels by use of a forced hot air drier. Metal shall not be handled except by an approved method or clean canvas gloves between all cleaning and etching operations and the application of reflective sheeting or nonreflective sheeting. There shall be no opportunity for metal to come in contact with greases, oils, or other contaminants prior

to the application of reflective sheeting or nonreflective sheeting.

(2) Steel Signs: The sign blank or panel shall be given a preliminary cleaning by immersing in a tank containing a buffered alkaline cleaning solution, controlled and titrated according to the manufacturer's specifications. Immersion time shall depend upon the amount of contaminants and the gage of the metal. This shall be followed by a thorough rinse with clean, running cold water. After preliminary cleaning, the sign blank or panel shall be dipped in a mild chromic acid solution as recommended for the final rinse after phosphating zinc. The panels shall then be dried by the use of warm forced air.

Metal shall not be handled except by an approved method or clean canvas gloves between all cleaning and surface preparation and the application of reflective sheeting. There shall be no opportunity for metal to come in contact with greases, oils or other contaminants prior to the application of reflective sheeting.

(d) Painting and Screening Process: Painting and screening of sign faces shall be in accordance with Subsection 917.06 and these requirements.

Signs which are to be painted, with or without legend, shall be painted on the face side only.

No painting will be required on metal surfaces which are to be covered with reflective sheeting.

When specified, legend shall be applied to the sign panel by direct or reverse silk screen method. Screening shall be accomplished in the manner specified by the sheeting manufacturer. Processing may be accomplished either before or after application of the sheeting to the flat, smooth base panels.

(e) Applying Sign Face and Legend Sheeting: Application of reflective and nonreflective sheeting sign face and legend material shall be in accordance with Subsections 917.03 and 917.04, the recommendations of the manufacturer of the materials and subject to the approval of the engineer.

(1) Sign Face-Background: Reflective sheeting shall be applied to properly treated base panels with mechan-

ical equipment in a manner specified for the manufacture of traffic control signs by the sheeting manufacturer.

Sign faces comprising two or more pieces or panels of reflective sheeting must be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night. Alternate, successive width sections of either sheeting or panels must be reversed and consecutive to insure that corresponding edges of reflective sheeting lay adjacent on finished sign. Non-conformance may result in non-uniform shading and undesirable contrast between adjacent widths of applied sheeting which will not be acceptable.

At splices, adhesive coated sheeting shall be overlapped not less than 3/16 inch; or butted, gap not to exceed 1/32 inch.

Sheeting applied to extruded sections shall extend over top edges and down side legs a minimum of 1/16 inch. Reflective sheeting splices and sign edges shall be sealed in accordance with the manufacturer's recommendation.

(2) Legend:

a. Demountable Flat: Legend shall conform to Subsection 917.03 and be .032 inch thick sheet aluminum or when shown on the plans, galvanized sheet steel of 21 gage.

All legend shall be securely fastened to the sign background from the front with approved aluminum or stainless steel bolts or rivets. Spacing of fasteners shall be determined by character size and shape, but in no case shall be greater than 8 inches on center. Suitable spacers shall also be provided as necessary.

b. Applied Legend: This legend shall be reflective sheeting applied directly to clean, dust-free reflective sheeting background panels and shall be applied in a manner specified by sheeting manufacturer and shall meet the requirements of Subsection 917.03.

Legend shall be cut neatly at intersecting panel edges and edge sealed. Prior to application, legend

shall be edge sealed in accordance with the manufacturer's recommendation.

(f) Delineators, Hazard Markers and Milepost Markers:

(1) Delineators shall be fabricated in accordance with Subsection 917.05.

(2) Hazard Markers shall be reflectorized silver white and low gloss black reflex-reflective material in accordance with Subsection 917.03, mounted on aluminum sheeting of 0.08 inch minimum thickness or galvanized steel sheeting of 12 gage minimum thickness.

(3) Milepost Markers shall be reflectorized green background sheeting and reflectorized silver white numerals in accordance with Subsection 917.03, mounted on aluminum sheeting of 0.08 inch minimum thickness or galvanized steel sheeting of 12 gage minimum thickness.

(g) Packaging: Before being packed, signs shall be allowed to stand for at least 12 hours. Signs shall be slip sheeted and packed in such a manner as to insure their arrival at destination in an undamaged condition. Packaged signs shall not become wet in storage or shipment.

PART X

DESIGN OF STRUCTURES

(Current AASHO Standard Specifications for Highway Bridges unless otherwise indicated on plans).

PART XI

DESIGN OF MOVABLE BRIDGES

(Current AASHO Standard Specifications for Movable Highway Bridges unless otherwise indicated on plans.)

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