CHAPTER 6 – DESIGN POLICY FOR BRIDGE REHABILITATION/REPAIR PROJECTS

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6.1—DEFINITION AND MINIMUM REQUIREMENTS

A Bridge Rehabilitation/Repair project shall be defined as any bridge project in which the scope of work is to address deficiencies in an existing structure and/or to add functional capacity to an existing structure, such as bridge widening.

For rehabilitation/repair projects, an in-depth investigation of the condition of the existing structure shall be performed in accordance with the "Guidelines for Existing Structure Evaluation" established in this policy to identify all deficiencies and determine the scope of possible rehabilitation/repair. Design criteria for a rehabilitation/repair project shall be developed on a project-by-project basis depending on the given scope of work. Bridge widening design shall additionally follow the "Guidelines for Bridge Widening Design" established in this policy.

For repair-only projects, whose clearly defined scope of work is to restore damaged elements to a serviceable condition, the requirements of this policy may be waived with the approval of the Bridge Design Engineer Administrator.

The minimum requirements of a Bridge Rehabilitation/Repair project are as follows:

1. All deficiencies in the existing structure shall be identified and documented.
2. The existing structure shall be rehabilitated to improve the overall condition of the bridge to extend its service life and/or improve its bridge load rating as appropriate.

The minimum requirements for Bridge Widening projects shall include the following:

1. All deficiencies in the existing structure shall be identified and documented.
2. The existing structure shall be rehabilitated to improve the overall condition of the bridge to extend its service life and/or improve its bridge load rating as appropriate.
3. The widened portion of the structure shall be designed in accordance with the latest *AASHTO LRFD Bridge Design Specifications* and LADOTD Bridge Design Manuals including Bridge Design Technical Memoranda.
4. Existing bridge components, such as exterior girders, bent caps, columns, piles etc., that are subject to new loadings from the widening sections shall be evaluated based on the current specifications to determine their adequacy. Bridge components with insufficient capacity shall be replaced or rehabilitated as appropriate.

6.2—GUIDELINES FOR EXISTING STRUCTURE EVALUATION

For all bridge rehabilitation/repair projects, including bridge widening projects, an in-depth evaluation of the existing structure(s) shall be included in the scope of work. The evaluation shall be conducted in accordance with the guidelines listed below prior to proceeding with the design of the project.

6.2.1—Review of All Existing Project Documents

Review all relevant project information including as-built plans, shop drawings, rehabilitation work previously done to the structure, inspection reports, bridge load rating reports, accident records, maintenance records, geotechnical and test pile information, hydraulic analysis, scour information, and any other information pertaining to the structure(s).

6.2.2—Field Investigation of the Existing Bridge

Conduct an in-depth field investigation of the existing condition of the structure and obtain a clear understanding of the structure health and its serviceability. The investigation shall encompass all bridge elements and related site conditions including, but not limited to, the following:

- Decks, slabs, railings, and guardrails
- Girders and diaphragms
- Connections, joints, and bearings
- Approach slabs
- Abutments, wingwalls, bents, and exposed footings and piles
- Columns, column protection, and fender systems
- Revetments
- Mechanical and electrical systems
- Bridge drainage systems
- Scour, debris, and other hydraulic issues
- Roadway pavement growth and pavement relief joints
- Protective coatings
- Signs, ITS signage, and other items supported by the bridge
- Lighting
- Utilities
- All other miscellaneous items at the bridge site that may affect the rehabilitation/repair /widening, such as geometric issues, safety concerns, access restrictions, etc.

At a minimum, this field survey shall include the following actions:

a. Confirm that the available existing bridge plans (final plans, shop drawings, and as-built) agree with the actual field conditions for items such as:
    - Bridge location, bent location, skew angle, stationing, finished grade elevations, and vertical and horizontal clearances
    - Span lengths and widths, number and type of girders, railing type and deck drainage details
    - Abutment, wingwall, and bent details
    - Utilities, lighting, signs, ITS signage and any other items supported by the bridge
    - Any other features critical to the rehabilitation/repair/widening
    - Notify LADOTD of any discrepancies that are critical to the design.

b. For concrete members, document patches, spalls, exposure and corrosion of rebar and/or strands, delaminations, cracking, and any other damage, deterioration, and/or deficiencies. For prestressed concrete members, inspect and document signs of flexural and shear cracking.

c. For structural steel members, document the location and extent of all corrosion and loss of section, any fatigue prone details and fatigue cracking, the location and condition of cover plates with cutoffs or transitions, the condition of connection details and fasteners, the condition of protective coatings, and the possible presence of lead paint.

d. For substructures, conduct a visual survey of all abutments, pavement growth, joint closures, wing walls, bent caps and columns to determine any displacement and/or any deterioration that may require removal and replacement to reestablish the substructure stability. If substructure

rehabilitations appear necessary, evaluate locations and feasibility of providing temporary supports for the superstructure.

e. Evaluate the conditions of bearings and joints to determine if replacement or modifications are needed.

f. Evaluate the condition of the approach slab, abutment wall and approach slab connection, and relief joints. Inspect for settlement, voids under the slab, and any other structural deficiencies.

g. Note any issues with the existing hydraulics and consider any other issues that may be created by the widening.

6.2.3—Evaluation of the Load-Carrying Capacity of the Existing Structures

Provide LRFR current-condition bridge ratings for superstructures and pile bents (except piles/drilled shafts) in accordance with the latest edition of the AASHTO *Manual for Bridge Evaluation*, LADOTD BDEM Part II Volume 5 - Bridge Evaluation/Rating, and Bridge Design Technical Memoranda.

Substructure elements, such as piles/drilled shafts in pile bents, and caps, columns, footings and piles/drilled shafts in column bents, which do not have an LRFR rating policy in place, shall require a design analysis to determine the following:

- Live load capacity of the member based on existing configurations for each load effect (axial, shear and moment) which is defined as Capacity

  Capacity = Factored Member Resistance (ΦR_n) – γ_{DC} (DC) - γ_{DW} (DW)

- Live load demand for each load effect from HL-93 using Live Load Factor of 1.35 which is defined as HL-93 Operating Demand

  HL-93 Operating Demand = 1.35 (LL_{HL-93})

- Live load demand for each load effect from HL-93 using Live Load Factor of 1.75 which is defined as HL-93 Inventory Demand

  HL-93 Inventory Demand = 1.75 (LL_{HL-93})

- Live load demand for each load effect from LADV-11 using Live Load Factor of 1.75 which is defined as LADV-11 Inventory Demand.

  LADV-11 Inventory Demand = 1.75 ($LL_{LADV-11}$)

6.2.4—Determination of Proposed Scope for Rehabilitation

Based on the evaluation results from 6.2.1 to 6.2.3, determine a proposed scope of the rehabilitation/repair using the evaluation matrix below. This scope of work should also take into account the cost of rehabilitating the deficiencies as well as site-specific conditions such as ease of access and traffic accommodation during construction.

<table>
<tr><th colspan="3">For Superstructures and Pile Bents (Except Piles/Drilled Shafts)</th></tr>
<tr><th colspan="2">Evaluation Criteria</th><th>Minimum Scope</th></tr>
<tr><td colspan="2">Structures with an Inventory rating for HL-93 < 0.9, low remaining service life (based on structure age), major deterioration and/or deficiencies</td><td>First consider replacement by performing a preliminary cost comparison* of rehabilitation vs. replacement. If rehabilitation is selected, strengthen to bring the HL-93 inventory rating ≥ 0.9; address possible rehabilitation of any other identified deficiencies</td></tr>
<tr><td rowspan="3">All other structures with Inventory rating for HL-93 < 0.9</td><td>NHS routes and routes where posting of bridges is not practical</td><td>Perform a preliminary cost comparison* of rehabilitation vs. replacement. If rehabilitation is selected, strengthen the bridge to bring the HL-93 inventory rating ≥ 0.9 and address possible rehabilitation of all other identified deficiencies</td></tr>
<tr><td rowspan="2">Routes where posting of bridges is practical</td><td>Perform a preliminary cost comparison* of rehabilitation vs. replacement. If it is financially feasible, strengthen the bridge to bring the HL-93 inventory rating ≥ 0.9 and address possible rehabilitation of any other identified deficiencies.</td></tr>
<tr><td>If it is not financially feasible (due to a lack of funding) to bring the HL-93 inventory rating ≥ 0.9, request an exemption from the Bridge Design Engineer Administrator for strengthening these elements, post the bridge, and address possible rehabilitation of any other identified deficiencies.</td></tr>
<tr><td colspan="2">Inventory rating for HL-93 ≥ 0.9</td><td>Address possible rehabilitation of any identified deficiencies</td></tr>
</table>

* The preliminary cost comparison shall take into account all costs associated with the rehabilitation or replacement beyond the structure cost alone, e.g., construction phasing, maintenance of traffic, and life-cycle costs. Refer to NCHRP Report 483 or any other pertinent references for general guidance on calculating bridge life-cycle costs.

<table>
<tr><th colspan="3">For Piles/Drilled Shafts in Pile Bents
For Caps, Columns, Footings and Piles/Drilled Shafts in Column Bents</th></tr>
<tr><th colspan="2">Evaluation Criteria</th><th>Minimum Scope</th></tr>
<tr><td colspan="2">Structures with (Capacity/ HL-93 Inventory Demand) < 0.9, low remaining service life (based on structure age), signs of moment or shear cracks, major deterioration and/or deficiencies</td><td>First consider replacement by performing preliminary cost comparison* of rehabilitation vs. replacement. If rehabilitation is selected, strengthen to bring the ratio of Capacity/ HL-93 Inventory Demand ≥ 0.9; address possible rehabilitation of any other identified deficiencies</td></tr>
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* The preliminary cost comparison shall take into account all costs associated with the rehabilitation or replacement beyond the structure cost alone, e.g., construction phasing, maintenance of traffic, and life-cycle costs. Refer to NCHRP Report 483 or any other pertinent references for general guidance on calculating bridge life-cycle costs.

6.2.5—Summary of the Evaluation Results and Recommendations

Prepare a bridge evaluation report that summarizes the results of 6.2.1 to 6.2.4 for each structure and provides recommendations for a scope of work that addresses all identified deficiencies. The report shall include, but is not limited to, the following information:

- A summary of all identified deficiencies, including all supporting documents, such as as-built plans, field inspection notes and photos
- A summary of bridge rating and design analysis results
- Clear recommendations for either rehabilitation/repair or replacement with justifications
- Scope of work and justifications for all identified deficiencies if rehabilitation/repair is recommended

The bridge evaluation report shall be stamped by an Engineer of Record who possesses a professional engineering license in Civil Engineering in the State of Louisiana. For consultant projects, the report shall be submitted to DOTD for review and final decision regarding the recommended scope.

6.3—GUIDELINES FOR BRIDGE WIDENING DESIGN

For the design of widened bridge sections, adhere to the following criteria:

1. Design all new bridge components in accordance with the latest *AASHTO LRFD Bridge Design Specifications* and LADOTD Bridge Design Manuals including all Bridge Design Technical Memoranda.
2. Existing bridge components that are subject to new loadings from the widening sections shall be evaluated based on the aforementioned specifications to determine their adequacy and shall be replaced or rehabilitated as required and appropriate.
3. The new sections of the structure shall use similar superstructure type and depth as the existing structure. Avoid mixing concrete and steel girders in the same span. The new main load carrying members shall be proportioned and/or positioned to provide similar longitudinal and transverse load distribution characteristics as the existing structure. To ensure uniform stiffness over the entire cross section of the final widened section, the difference in live load deflection between a new girder and an existing girder should be within 10% if possible.
4. A closure pour (with a recommended width of 30 inches) should be used between the existing and new decks. This will allow the substructure of the widened portion to settle before connecting the structures. The bridge plans shall include a note indicating the required waiting period between deck and closure concrete placement.
5. The transverse reinforcement in the new deck should be spaced to match the existing transverse spacing when possible. Different bar size or additional intermediate bars may be used if required by design.
6. When designing and detailing connections between the existing and new structure components, take into account the difference in elevation due to camber or other construction tolerances that will be present prior to placing the new deck.
7. New and existing pile bents should typically be tied together; however, tying new column bent to existing column bent is undesirable due to potential differential foundation settlements. It may be allowed provided there is no adverse effect to the existing substructure.
8. If the existing bridge does not satisfy the current vertical clearance requirements and if the economics of increasing the existing vertical clearance is justified, the superstructure shall be elevated and/or the under-passing roadway shall be lowered to meet the new requirement. The vertical clearance under the widened portion of the bridge shall not be less than current clearance requirements or the existing vertical clearance, whichever is lower.
9. All existing columns that are not designed for lateral impact forces shall be protected in accordance with *AASHTO LRFD Bridge Design Specifications*.
10. All new bridge railings shall meet NCHRP 350 or MASH TL-4. Concrete F-shape barriers are preferred, but other bridge railing types may be allowed with the approval of the Bridge Design Engineer Administrator. Existing bridge railings that do not meet NCHRP 350 or MASH TL-4 shall be replaced.
11. All new guardrails shall meet the current standards. All existing guardrails that do not meet current standards shall be replaced.
12. The cross slope of the widened deck shall match the existing cross slope.
13. Open longitudinal joints in the riding surface shall be avoided. If longitudinal joints are unavoidable, submit the justification and proposed joint details to the Bridge Design Engineer Administrator for approval.
14. The new bearings shall match the existing bearings in terms of fixity. When replacing existing bearings, use the same bearing type for all girders.

15. End diaphragms between new and existing girders shall be provided. For widening sections adding only one girder, at least one intermediate diaphragm shall be provided in addition to the end diaphragms, regardless of span length. When adding two or more new girders, intermediate diaphragms are not required between the new and existing sections.
16. Suggested construction sequence details shall be shown on the preliminary bridge plans for all projects utilizing phased construction. The final plans shall include the complete suggested construction sequence.
17. Any existing lighting system shall be evaluated for adequacy for the final widened bridge.
18. The possible impact of nearby utilities, structures, facilities, or other significant obstructions to the widening shall be evaluated.