

Section 20.3 CURVE SPEED STUDY

20.3.1 PURPOSE

The purpose of the CURVE SPEED STUDY is to determine the speed that a vehicle can negotiate a given horizontal curve under ideal conditions and other conditions which may require a recommended advisory speed. The study is also used to determine where turn and curve signs with advisory speed plates are required for horizontal curves. The study shall be sealed by a Louisiana registered professional engineer taking responsibility for the study recommendations and conclusions.

20.3.2 EQUIPMENT AND PERSONNEL

Test vehicle (passenger car/vehicle), driver, observer, ball bank indicator (slope meter safe curve indicator), Distance Measuring Instrument (DMI), and the CURVE SPEED STUDY form to input data.

20.3.3 PROCEDURE FOR USE OF EQUIPMENT

1. The ball bank indicator is used to measure the overturning force (side friction), measured in degrees, on a vehicle negotiating a horizontal curve. The ball bank should be mounted in such a position as to allow the ball to rest freely at the zero degree position when the vehicle is standing level. The movement of a car around a curve to the left, for example, causes the ball to swing to the right of the zero degree position. The faster the car moves around the curve or the sharper the curve, the greater degree indication from the zero degree position.
2. Beginning well in advance of the curve being checked during free flow conditions, the driver should enter the curve at a predetermined speed (mph as stated in the paragraph below), drive the car parallel with the centerline of that travel lane, and *maintain uniform speed throughout the curve*. The curve should be driven a number of times until at least two identical ball bank readings (degrees) for each direction of travel are obtained. Each direction of travel shall be considered separately. See Table 20.3.1 for criteria in determining the curve advisory speed.

Table 20.3.1 Criteria for Curve Advisory Speed Determination

| Speeds (mph) | Ball Bank Reading (degrees) |
|--------------|-----------------------------|
| ≤ 20 | 16 |
| 25-30 | 14 |
| ≥ 35 | 12 |

3. The first trial run is made at a speed below the anticipated maximum speed. Subsequent trial runs are conducted at 5 mph speed increments. Readings of 16 degrees for speeds of 20 mph or less, 14 degrees for speeds of 25 mph through 30 mph and 12 degrees for speeds of 35 mph or greater are the usually accepted limits beyond which riding discomfort will be excessive and loss of vehicle control may occur.
4. The recommended advisory speed should be to the nearest 5 mph less than the maximum negotiable speed determined separately for each direction of travel. Considerations of sight distance, intersections, crash records, and other conditions may result in a recommended speed lower than that derived by the ball bank indicator method.
5. Advisory speed plates (mph) should be used in conjunction with curve and turn signs when the operating speed is below the posted or prevailing speed on the roadway. When plates are used with curve and turn signs, the miles-per-hour value shown on each plate should be determined by the use of the ball-bank indicator. The lowest speed (to the nearest 5 mph) obtained during trial runs that create a reading equal to or more than the degrees stated in Table 20.3.1 with the corresponding mph should be posted. Each direction should be checked independently and may be posted with different speeds.
6. A horizontal alignment sign with advisory speed plates shall be required for speed advisories differing more than 9 mph from the posted speed. A horizontal alignment sign may be installed for alignments differing less than 9 mph. To decide if the horizontal alignment sign should be a turn or a curve sign, the driver should make test runs at 30 mph (or less, for safety). If the ball bank indicator exceeds 12 degrees or more, a turn sign will be required. If the indicator reading is less than 12 degrees at test run speeds of 30 mph, then test runs should be made at greater speeds. If the indicator exceeds 12 degrees at speeds between 31 and 65 mph, then a curve sign is required. See Table 20.3.2 below and Table 2C-5 in the MUTCD for further guidance.

Table 20.3.2 Turn Sign vs. Curve Sign

| Number of Alignment Changes | Advisory Speed Sign | |
|-----------------------------|---------------------|----------------------|
| | ≤ 30 mph | > 30 mph |
| 1 | Turn (W1-1) | Curve (W1-2) |
| 2 | Reverse Turn (W1-3) | Reverse Curve (W1-4) |
| 3 or more | Winding Road (W1-5) | |

20.3.4 PLACEMENT OF WARNING SIGNS

1. Since warning signs are primarily for the benefit of the driver who is unfamiliar with the road, it is very important that care be given to the placement of such signs. Warning signs should provide adequate time for the driver to perceive, identify, decide, and perform any necessary maneuver to safely negotiate the curve. This total time to perceive and complete a reaction to a sign is the sum







of the times necessary for perception, identification/understanding, emotion/decision-making, and execution of decision. This time may vary from approximately 3-seconds for general warning signs to as much as 10-seconds for high driver judgment condition warning signs. The advance distance for the placement of warning signs is determined by the posted speed or the 85th percentile speed as calculated from speed study data and conditions that exist on the section of roadway being studied. Once the type of warning signs has been selected, the proper sign location can be determined. The advance warning sign placement shall be in accordance with Table 2C-4 Guidelines for Advance Placement of Warning Signs in the current adopted edition of the MUTCD.

2. Warning signs and advisory speed plates shall be erected in accordance with the general requirements of the MUTCD.

20.3.5 USE OF CURVE SPEED STUDY FORM (FIGURE 20.3.2)

1. Enter the *Roadway I.D.* and *Location* so that the curve speed study location is thoroughly identified. The street name(s), state road number(s), parish, and control section should be included.
2. Enter the *Posted Speed Limit*, *Pavement Condition*, *Date of Study*, and *Observer(s)* in the appropriate spaces. Include any information that may need to be considered in addition to data being collected in the *Remarks* area.
3. In the *Direction of Travel* column enter *North*, *East*, *South*, or *West* indicating the direction of the study vehicle. In the *Logmile* column enter the logmile for the beginning of the curve or in the *GPS* column enter the gps coordinates of the beginning of the curve. In the *Speed on Curve* column enter the constant speed of the study vehicle as the vehicle travels through the curve. In the *Degree of Deflection* column, enter the degree of deflection as shown on the ball bank indicator for constant speed of the study vehicle as the vehicle passed through the curve.

Figure 20.3.2 Curve Speed Study Example

| State of Louisiana Department of Transportation and Development | | | | | |
|---|---|----------------------|--|--|---|
| CURVE SPEED STUDY | | | | | |
| Traffic Engineering | | | | | |
| Speeds (mph) | Ball Bank Reading (degrees) | | | | |
| ≤ 20 | 16 | | | | |
| 25 - 30 | 14 | | | | |
| ≥ 35 | 12 | | | | |
| LOCATION I.D.: US 190 (Near Cedar Ridge Road) | | | | | |
| PARISH: EBR | CONTROL SECTION: 013-05 | | | | |
| POSTED SPEED (mph): 55 | PAVEMENT CONDITION: Dry | | | | |
| DATE: 01-10-10 | OBSERVERS: Todd Humphreys & Monique Ordogne | | | | |
| REMARKS: None | | | | | |
| LOGMILE/GPS: BEGIN CURVE <u>8.317</u> END CURVE <u>8.428</u> | | | | | |
| DIRECTION OF TRAVEL | SPEED ON CURVE | DEGREE OF DEFLECTION | # of curves | Less than or equal to 30 mph | Greater than or equal to 35 mph |
| North | 40 | 8 | 1 |  W1-1 |  W1-2 |
| South | 40 | 7 | | | |
| North | 45 | 10 | | | |
| South | 45 | 8 | 2 |  W1-3 L or R |  W1-4 L or R |
| North | 50 | 12 | | | |
| South | 50 | 11 | | | |
| North | 45 | 10 | 3 or more |  W1-5 L or R |  W1-5 L or R |
| South | 45 | 9 | | | |
| North | 45 | 10 | | | |
| South | 45 | 8 | Advisory Speed: | | |
| | | | Recommended Signs: | | |
| | | | Approved by District Traffic Oper. Engineer: | | |
| | | | | | |

20.3.6 EQUIPMENT AND PERSONNEL

A reproducible copy of the CURVE SPEED STUDY is in Appendix A. This form is also available on the Departments internet site under Traffic Engineering.