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IOWA DEPARTMENT OF TRANSPORTATION

To Office Bridges and Structures Date June 1, 2008

Attention All Employees Ref No. 521.1

From Gary Novey

Office Bridges and Structures

Subject MM No. 159 (Policy on Bulb Tee Use)

With the release of the two new bulb tee sections, the 36 inch deep BTB and the 63 inch deep BTE, the Office of Bridges and Structures now has 4 bulb tee sections that can be used in bridge projects. The bulb tee beams that are now available are:

1. BTB (36 inches deep, spans 30 ft to 105 ft)
2. BTC (45 inches deep, spans 30 ft to 120 ft)
3. BTD (54 inches deep, spans 50 ft to 135 ft)
4. BTE (63 inches deep, spans 60 ft to 155 ft)

Note the longer beam spans will have limited beam spacing (less than 9'-3). The standard A through D (AASHTO Type) beams are still available and in general are preferred for economic reasons. When considering the use of a bulb tee section, the designer should consider the following:

1. Longer spans

   For span lengths over 110 ft, the BTC, BTD and BTE should be considered along with a steel girder option. The 72 inch BT standards are void and no longer used in standard design.

2. Vertical clearances:

   For structures with vertical clearance problems where AASHTO Type beams cannot be used, the BTB, BTC, and BTD should be considered along with a steel option.

3. Profile Grade Adjustments:

   a. For replacement bridge projects where substantial cost increases are incurred with profile grade adjustments necessary to accommodate the AASHTO type beam, BTB, BTC, and BTD should be considered along with a steel option.

   b. For roadway alignments on relocation, costs associated with profile grade adjustments are generally considered part of the plan development process.

4. High skews:

   The bulb tee standards are set up for skews of 30 degrees or less. Use of the bulb tees will require wider abutment and pier caps to accommodate the wide bottom flange (30 inches). For bridges with skews greater than 30 degrees, the designer should contact the supervising section leader.

5. Estimated Haunch Limitations

   When considering the use of bulb tee beams, take into account the geometrics of the roadway. On roadways with sharp vertical/horizontal curves, the longer bulb tee beams may not be feasible because of the large haunches and offsets that are associated with the longer spans (See Attachment “A” for pending Preliminary guidelines 3.2.6.3).

   Use the estimated haunch equation (See attachment B) to determine if a bulb tee beam can be utilized. In cases where the estimated haunch limitations are exceeded because of vertical or horizontal curve issues noted above, other beam types and span arrangements should be considered.

6. Longer spans for reducing piers:

   For longer bridges, the use of the longer span bulb tee beams can reduce the number of piers and may provide a more economical structure.

If you have any questions, please check with me.

GAN /dgb/bj

3.2.6.3 Horizontal curve / 28 Feb 08

If a bridge is to be placed along a horizontally curved alignment, the designer will need to decide how to configure the superstructure. For relatively insignificant curves, a superstructure may be constructed with straight beams or girders between locations of support, but for significant curves the beams or girders will need to be curved. The decision to require horizontally curved members generally limits the superstructure type and increases both final design and construction cost, so the designer needs to make the decision carefully.

The office has the following policy for horizontal curves. First, the designer shall determine the distance between the chord and arc, defined here as M, at the midpoint of the bridge. If M does not exceed 4 inches (100 mm), the bridge shall be designed on a chord at the designated full shoulder width. If M is larger than 4 inches (100 mm) but not larger than 12 inches (300 mm), before proceeding the designer shall consult with the supervising Section Leader. In most cases, for this intermediate curvature the bridge should be designed on a chord but slightly wider to provide full shoulder width or greater at all locations. If M is greater than 12 inches (300 mm), the bridge deck shall be designed on a horizontal curve.

If the bridge deck is to be constructed on a horizontal curve, the designer needs to consider the use of beams on chords or curved steel girders. When considering straight beams, the designer should check the offset for each span between the arc and chord. If any offset exceeds 9 inches (225 mm) a curved steel beam bridge should be considered.

In all cases, whether the bridge is designed on a chord or on a curve, the designer shall label stationing of bridge details from the centerline of the approach roadway. The stationing should be referenced from the centerline of the construction survey.

3.2.6.3.1 Spiral curve / 28 Feb 08

The use of spiral curves in roadways in Iowa is an accepted practice to improve alignment and safety. In order to minimize the effects of complicated roadway geometryon bridges, spiral curves will either be moved off the bridge or eliminated from use in order to simplify design and construction.

Preliminary haunch for all Prestressed Beam Bridges

Note: The calculations provides a haunch thickness estimate (X) value, which doesn't include the nominal haunch thickness.

$S := 111.5\,ft$	Longest Span (feet)
$e := 0.03$	Superelevation (feet/feet)
$G_1 := -1.68$	Grade 1 vertical curve [+ increasing, - decreasing] (%)
$G_2 := 2.10$	Grade 2 vertical curve [+ increasing, - decreasing] (%)
$A := \frac{G_2 - G_1}{100}$	$A = 0.038$
$L := 984\cdot ft$	Length vertical curve (feet)
$D_c := 1.75\,deg$	Degree of Horizontal Curvature (degree)
$C := 0.337\cdot ft$	Final Beam Camber (feet) - From prestressed concrete beam standards
$D := 0.19\cdot ft$	Dead load deflection - Elastic + 1/2 Plastic(feet) - From prestressed concrete beam standards
$T := 1.667\cdot ft$	Top flange width (feet)

X = Haunch estimate along the centerline of the beam.

$$X := (C - D) + \frac{S\cdot e}{2}\cdot\left(\frac{1}{\sin\left(\frac{D_c}{2}\right)} - \frac{1}{\tan\left(\frac{D_c}{2}\right)}\right) + \left(\frac{S}{L}\right)^2\cdot A\cdot\frac{L}{8}$$

$X = 0.219\,ft$ $\qquad$ $X = 66.894\,mm$

$T\cdot e = 0.6\cdot in$

If T * e < 1 then X < 4 in. If T * e > 1 then X < 3 in.

Also check maximum offset for horizontal curve < or = 9 in.