structures design bulletin 13-08  
(FHWA Approved: June 10, 2013)

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TO: District Directors of Production, District Design Engineers, District Construction Engineers, District Structures Design Engineers

FROM: Robert V. Robertson, P. E., State Structures Design Engineer

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SUBJECT: Top Slab Tendons Across Mid Span Closure Pours in Balanced Cantilever Segmental Bridges

requirements

1. Replace Structures Design Guidelines, Table 4.5.5-3 with the following:

Table 4.5.5-3 Minimum Number of Tendons Required for Critical Post-Tensioned Elements

<table>
<thead>
<tr>
<th>Post-Tensioned Bridge Element</th>
<th>Minimum Number of Tendons</th>
</tr>
</thead>
</table>
| Mid Span Closure Pour CIP and Precast Balanced Cantilever Bridges | Bottom slab – two tendons per web  
Top slab – See SDG 4.5.5.K for tendon number, size and anchorage requirements per cell |
| Span by Span Segmental CIP Multi-Cell Bridges and Post-Tensioned U-Girder Bridges | Four tendons per web  
Three tendons per web |
| Post-Tensioned I-Girder Bridges | Three tendons per girder |
| Unit End Spans CIP and Precast Balanced Cantilever Bridges | Three tendons per web |
| Diaphragms - Vertically Post-Tensioned | Six tendons if strength is provided by PT only;  
Four tendons if strength is provided by combination of PT and mild reinforcing |
| Diaphragms - Vertically Post-Tensioned Segment | Four Bars per face, per cell |
| Diaphragms - Vertically Post-Tensioned Segment | Two Bars per web |

1. Two U-Girders minimum per span.
2. Three girders minimum per span.
2. Add the following new section, table, figure and commentary to *Structures Design Guidelines*, Section 4.5.5 at the end of the section:

K. Provide top slab continuity tendons across mid span closure pours in balanced cantilever bridges as follows.

1. For boxes with wing lengths less than or equal to 0.6 x W (See Figure 4.5.5-1), provide top slab continuity tendons across mid span closure pours as shown in Table 4.5.5-4.

<table>
<thead>
<tr>
<th>Web Spacing per cell - see Figure 4.5.5-1</th>
<th>Number and size of Tendons per cell</th>
<th>Tendon Anchor Locations referenced from adjacent face of Closure Pour</th>
</tr>
</thead>
<tbody>
<tr>
<td>W ≤ 12 ft</td>
<td>Two tendons - 4-0.6” diameter</td>
<td>One adjacent to each web anchored in 2nd Segment back</td>
</tr>
<tr>
<td>12 ft &lt; W ≤ 20 ft</td>
<td>Two tendons - 4-0.6” diameter</td>
<td>One adjacent to each web anchored in 3rd Segment back</td>
</tr>
<tr>
<td>20 ft &lt; W ≤ 25 ft</td>
<td>Two tendons - 7-0.6” diameter</td>
<td>One adjacent to each web anchored in 3rd Segment back</td>
</tr>
<tr>
<td>25 ft &lt; W ≤ 30 ft</td>
<td>Three tendons - 7-0.6” diameter</td>
<td>One adjacent to each web anchored in 2nd Segment back and one at middle of cell anchored in 3rd Segment back</td>
</tr>
<tr>
<td>W &gt; 30 ft</td>
<td>Four tendons - 7-0.6” diameter</td>
<td>One adjacent to each web anchored in 3rd Segment back and two evenly spaced across cell anchored in 4th Segment back</td>
</tr>
</tbody>
</table>

1. Alternate strand or PT bar tendon configurations which provide an equivalent force may be substituted for tendon configurations shown.

2. The resulting distance from tendon anchor location to adjacent face of closure pour is the minimum. Locate top slab tendon anchors longitudinally so that the tendons overlap a minimum of one pair of cantilever tendons.

2. For boxes with wing lengths greater than 0.6 x W (See Figure 4.5.5-1), use the following methodology to determine top slab continuity tendon configurations:

   a. Determine lateral distribution of tendon force across the top slab using *LRFD* [C4.6.2.6.2] (the *LRFD* 30-degree model).

   b. Locate top slab tendon anchors sufficient distances back from the closure pour to ensure full distribution of tendon forces across the closure pour and so that the tendons overlap a minimum of one pair of cantilever tendons. Do not anchor top slab tendons in the segments adjacent to the closure pour.

   c. Provide a minimum of 75 psi compression across the top slab assuming a uniform stress of P/A on the top slab area only (See Figure 4.5.5-1). Neglect the effects of the bottom slab continuity post-tensioning for this calculation.

   d. Locate top slab tendon anchors adjacent to the webs as shown in Figure 4.5.5-1. Provide additional tendons evenly spaced across each cell and within the wings as required to provide the required uniform minimum compression.
Figure 4.5.5-1 Top Slab Tendon Layout versus Web Spacing At Mid Span Closure Pours

Commentary: This is a minimum requirement and is not to be added to those required by the longitudinal analysis, i.e. if the number and size of top slab tendons across closure pours required by the longitudinal analysis exceeds these minimums, no additional tendons are required.

BACKGROUND

The absence of a sufficient number of tendons across the top slab closure pour and the resulting lack of compression has been identified as contributing to in-service performance issues with closure pours in balanced cantilever spans.

IMPLEMENTATION

These requirements are effective immediately on all design-bid-build projects in Phase I design development (less than 30% complete). These requirements may be implemented immediately on all design-bid-build projects in Phase II, III or IV at the discretion of the District.

These requirements are effective immediately on all design build projects that have yet to release the final RFP. Design build projects that have had the final RFP released are exempt from these requirements unless otherwise directed by the District.
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