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IOWA DEPARTMENT OF TRANSPORTATION

To Office Bridges and Structures Date July 24, 2003

Attention All Employees Ref No. 521.1

From Gary Novey

Office Bridges and Structures

Subject Methods Memo No. 79 (Integral Abutment Piles)

Information from representatives of the companies supplying steel H-piles, from the American Institute of Steel Construction (AISC), and from mill reports on Iowa DOT projects all indicate that the yield stress for H-piles is consistently 50 ksi (345 MPa) or greater. Iowa DOT Standard Specifications require A36 (250 MPa) steel, but the ASTM A36 (250 MPa) specification has no upper limit on yield. Present pile manufacturing processes depend on scrap steel, which includes strength-enhancing elements that are not easily removed, and therefore it is difficult for manufacturers to produce steel with a yield stress below 50 ksi (345 MPa).

Although the higher yield stress improves the stability and yield checks recommended by HR-273 and Methods Memo No. 23 (the current basis for integral abutment pile design), the higher yield stress worsens the ductility check for partially compact shapes. As the yield stress for shapes increases from 36 to 50 ksi, (250 to 345 MPa) the allowable or limiting $b_f/2t_f$ ratio for compact flanges reduces from 10.83 to 9.19, and the ratio for noncompact flanges reduces from 15.83 to 13.44. Therefore piles with a 50 ksi (345 MPa) yield are less likely to be able to meet the ductility demand for integral abutments.

Because piles that are noncompact at 50 ksi (345 MPa) yield have no allowable plastic rotation capacity, the following pile sections are prohibited for use in integral abutments:

- HP 12x53 (HP 310x79)
- HP 14x73 (HP 360x108)

These pile sections, however, may be used for stub abutments and pier footings.

The preferred pile section for integral abutments for pretensioned prestressed concrete beam and continuous welded plate girder shall be HP 10x57 (HP 250x85), a compact shape at 50 ksi (345 MPa) yield. In addition to providing ample ductility, use of the HP 10x57 (HP 250x85) section at 36 ksi (250 MPa) will increase the allowable pile capacity for friction piles to 50 tons (6 ksi * 16.8 in^2) or 443 kN (41000 kN/m^2 * 0.0108 m^2) and the resulting pile spacing, which often has been at the minimum for the HP 10x42 (HP 250x62) section. However, the friction bearing capacity per foot of pile for the HP 10x57 (HP 250x85) section is the same as for the HP 10x42 (HP 250x62), and on some sites HP 10x57 (HP 250x85) piles will need to be longer to achieve full bearing. HP 10x42 (HP 250x62) piles may continue to be used for continuous concrete slab bridges within the limits set in the updated Bridge Design Manual (Table 6.5.1.1.1).

In addition, exceeding the limits for integral abutments in article 6.5.1.1.1 of the Design Manual (Methods Memo No. 23) is discouraged. Special cases brought to the attention of the Chief Structural Engineer will be checked for ductility assuming a pile yield stress of 50 ksi (345 MPa) (but all other checks will be on the basis of 36 ksi (250 MPa)).

In addition to the new office policy of using HP 10x57 (HP 250x85) piles in integral abutments, the office is recommending that on projects where the HP 10x57 (HP 250x85) is used that no other 10 inch (250 mm) pile size be used. This policy is to prevent similar 10-inch pile (250 mm) sizes from being used in the wrong location.

This policy should be applied to bridge projects currently under design that have not been detailed.

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