Bridges and Structures ~~???? ??,~~ March 23, 2001

All Employees 521.1

Bridges and Structures

Gary Novey

Bridge Substructure Design-MM No. 1 (Footing Elevation for Scour and Allowable Unsupported Pile Lengths).

When calculating the T-pier footing elevations, the following guidelines should be used in the design.

1. Set the bottom of the footing elevation to 6 ft (1800 mm) below the channel elevation.
2. Check the unsupported pile length for the piling assuming the pile length is from the bottom of the footing to 4 ft (1200 mm) below the scour elevation. Based on the unsupported length, select the following steel pile size.

Pile Size	Unsupported Length
HP10x42 (HP 250x62)	14 ft. (4200 mm)
HP 12x53(HP 310x79)	17 ft. (5100 mm)
HP 14x89(HP 360x132)	20 ft. (6000 mm)

Note: The preferred pile size to use is HP10x42 (HP 250x62) piles if possible. Consider lowering the bottom of the footing if only an additional 1 or 2 ft. (300-600 mm) is required to meet the 14-ft. (4200-mm) limit for HP10x42 piles (HP 250x62).

~~3.~~3. To provide additional stability for the pile group the piles on the outside rows should be battered at 4:1 slopes. ~~If the piles are not battered in the pier due to the site conditions, then a refined analysis for stability is required using the AASHTO LRFD Spec. 10.7.4.1.~~

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If other conditions are encountered where these guidelines cannot be followed, then check with your section leader ~~or consultant coordinator~~ for additional details.

Commentary:

These lengths were based on the following office policies:

a. For the HP10x42 (HP 250x62) pile, the unsupported pile length is 10 ft (3000 mm) of exposed pile plus 4 ft (1200 mm) below the scour line for a total length of 14-ft (4200-mm).
b. Pin connections for the piling are assumed at the bottom of the footing and at the point 4 ft. (1200-mm) below the scour line. Using a K of 1.0, the KL/r of a HP10x42 (HP 250x62) is approximately 70.
c. Using the KL/r of 70 the unsupported lengths for the HP 12x53(HP 310x79) and HP 14x89(HP 360x132) were calculated.

d. No impact on the footing piles was assumed in the calculations for the scour condition.

e. These lengths give a factor of safety of 3.38 for a 55-ton (490 kN) bearing pile (9 ksi, 60 MPa) and 5.08 for a 37-ton (330 kN) friction pile (6 ksi, 40 MPa).

The office practice of using 6 ft for the depth of the footing below streambed is based on a past AASHTO Specification (1983 spec 4.4.2) that is still followed by the office. The guidelines for the KL/r are conservative when compared with the AASHTO Specification Table 10.32.1.A for concentrically loaded columns. The office is conservative on this issue because:

1. Pile loads will not be perfectly concentric in a footing.
2. Lateral loads will be applied to the piles during scour conditions.
3. Any damage that may happen to the piles during scour conditions or loss of section because of corrosion cannot be inspected later.

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