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IOWA DEPARTMENT OF TRANSPORTATION

To Office Bridges and Structures Date January 12, 2004

Attention All Employees Ref No. 521.1

From Gary Novey

Office Bridges and Structures

Subject Methods Memo No. 82 (Internal River Pier Ice Loads)

Since the present office policy was established, the Cold Regions Research and Engineering Laboratory (CRREL) has determined additional river pier ice loading information. Also, the AASHTO LRFD specifications make use of the latest information and differ somewhat from the AASHTO standard specifications. Consequently the office is updating policy as follows for Iowa internal river pier ice loads (excluding Mississippi River, Missouri River, and lakes).

Iowa internal river pier ice loads shall be determined from the following modified AASHTO standard specifications formula [3.18.2.2.1]:

$F = C_n C_b C_w p t w$

Where:

C_n = coefficient for nose inclination taken from the table in the AASHTO standard specifications [3.18.2.2.1].

C_b = coefficient for b/t (Pier Width/Ice Thickness) interpolated from the table in the AASHTO specifications [3.18.2.2.4].

C_w = reduction coefficient for bridges less than 300 feet (91 400 mm) long, from the AASHTO LRFD specifications commentary [C3.9.2.3]. The bridge length is a conservative assumption that was adopted by the office, so the designer would not have to estimate the stream width. C_w (K_1 in the LRFD specifications) shall be interpolated from the AASHTO LRFD specifications commentary [Table C3.9.2.3-1] based on A/r^2 (A = area of ice floe, r = radius of pier nose). Area of ice floe may be estimated as a circular area with diameter equal to the larger of two-thirds of the opening between the pier and abutment or between piers.

p = effective ice strength = 200 psi (1.38 MPa)

t = thickness of ice in contact with pier, inches (mm). Thickness shall be selected from the following table. These thicknesses were determined from the formula in AASHTO LRFD specifications commentary [C3.9.2.2]. The coefficient α was taken as an intermediate value for average and small rivers, 0.4, and the freezing index was taken as the 50-year (98%) value for a central location in the District, usually the District Office. Note the AASHTO LRFD coefficient of 0.4 is the same for both English and Metric units.

District	Thickness, inches (mm)
5	15 (380)
1, 4, 6	17 (430)
2, 3	19 (480)

w = width of pier stem or diameter of circular pier shaft at level of ice action, inches (mm). In cases where the pier is skewed to the flow, the projected width shall be used. The projected width will increase the ice load considerably, and if the load seems excessive the designer should investigate a circular pier shaft or other pier alternatives.

The following table compares the ice loads for a typical 3-foot-thick (910 mm) T-pier shaft with a vertical nose, at the center of the river, and aligned with the flow. The present load in the table includes the reduction effect of the coefficient associated with b/t in the AASHTO standard specifications [3.18.2.2.4].

District	Updated Load, Bridge Length >300 Feet (91 400 mm), kips (kN)	Updated Load, Bridge Length 100 feet (30 500 mm), kips (kN)	Present Load, River Any Width, kips (kN)
5	103.68 (460)	83.98 (370)	116.64 (520)
1, 4, 6	121.68 (540)	98.16 (440)	116.64 (520)
2, 3	139.54 (620)	113.03 (500)	116.64 (520)

Reference

Haynes, F.D. “Bridge Pier Design for Ice Forces,” *Ice Engineering Information Exchange Bulletin (Cold Regions Research and Engineering Laboratory)*, No. 12, December 1995

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