Illinois Department of Transportation

Memorandum

To:	ALL BRIDGE DESIGNERS
From:	D. Carl Puzey
Subject:	New Permanent Sheet Piling Design Policy
Date:	November 30, 2011

The Department has revised its policy for the design and specification of permanent sheet pile retaining walls covered in Article 3.11.4 of the Bridge Manual. In the past, the contract plans only provided the "Minimum Effective Section Modulus" necessary for design while corrosion and the "Hartman cold formed" reductions were accounted for in the special provision (GBSP11) based on the specific sheet selected by the contractor. However, this required the Department to maintain the specification's list of reduced sections and hindered contractors from quickly shopping for the most cost effective section. To address these concerns, we are making the following changes to the design and specification procedure:

1) The designer shall select the appropriate design life for the sheet pile application. Walls shall be designed with a 50 year design life unless they are traffic bearing or considered critical in which case a 75 year design life shall be used.

2) Consideration shall still be given to select a minimum required section modulus that is large enough to withstand driving stresses and limit excessive deflection.

3) An initial minimum design section modulus shall be computed according to the LRFD Design Specifications using a minimum 50 ksi yield strength.

4) Local buckling effects related to transverse stresses shall only be accounted for when the applied lateral pressure at point of maximum moment is more than 1000 psf. In such cases a reduction factor ρ_p, determined from Table 1, shall be used to reduce the yield strength (F_y) used to determine the required section modulus.

$$F_{yr} = \rho_p F_y$$

Where:
F_{yr} = reduced yield strength of steel (ksi)
ρ_p = reduction factor for local buckling effects related to transverse stresses, found in Table 1. Note: if the interlocks of the sheet piles are welded, ρ_p may be taken as 1.0.
F_y = yield strength of steel (ksi)

Table 1 **Reduction Factor ρ_p for Local Buckling Effects Due to Transverse Stresses** (See Notes A and B)

D_P	$(b/t_{min})\varepsilon =$ 20.0	$(b/t_{min})\varepsilon =$ 30.0	$(b/t_{min})\varepsilon =$ 40.0	$(b/t_{min})\varepsilon =$ 50.0
1000	1.00	1.00	1.00	1.00
2000	0.99	0.97	0.95	0.87
3000	0.98	0.96	0.92	0.76
4000	0.98	0.94	0.88	0.60

Where:

D_P = applied lateral pressure at the point of maximum moment (psf)

b = flange width (in.), but not less than 0.707c

c = slant height of web (in.)

t_{min} = minimum of t_f and t_w (in.)

t_f = flange thickness (in.)

t_w = web thickness (in.)

ε = $\sqrt{\dfrac{34}{F_y}}$

F_y = yield strength of steel (ksi)

Note A Since using Table 1 requires information based on the specific sheet pile section to be used, and that would not be determined until the contractor selects a section, the designer shall assume the largest (b/tmin) available based on a pile section that meets the minimum section modulus determined from item #3 listed on the previous page. For the designers convenience a spread sheet of available sheet pile section data can be found at the following link http://www.dot.il.gov/bridges/dcspreadsheets.html.

Note B Intermediate values may be interpolated linearly.

5) Corrosion shall be accounted for by the designer using the minimum design section modulus (S_x) and the desired design life. Since each sheet has a slightly different corrosion reduction, the Department developed the following formulas to estimate the extra section modulus required to account for corrosion.

    a) For a 50 yr. design life, S_{req} (ksi)= $S_x(1.10) + 2.2$

    b) For a 75 yr. design life, S_{req} (ksi)= $S_x(1.12) + 4.0$

S_{req} is the minimum required section modulus to be shown on the plans.

A New Guide Bridge Special Provision (GBSP74) Permanent Steel Sheet Piling (LRFD) has been written to address these changes and will be available on the IDOT internet site in the near future.

This new permanent sheet piling wall design procedure shall be effective beginning with TS&L's approved December 15, 2011. If there are any questions concerning these new policies please contact Gary Kowalski at 217-785-2914 or Bill Kramer at 217-782-7773.