February 2021

Errata to Page 4-30.

Design of a reinforced beam ledge for a double tee leg

Pages 4-29 to 4-31 in the CPCI Design Manual provide a solved example (Example 4.7) of beam ledges supporting a concentrated load from a double tee leg. On page 4-30, the example provides guidance on how to calculate the punching shear capacity of the ledge using the shear friction method. However, based on recent in-depth research CPCI believes a new example should be developed to take into account the global flexural and shear stresses and to ensure the shear friction reinforcement is in tension. As such, the punching shear calculations using the shear friction method on page 4-30 have been removed from the CPCI Design Manual – 5th Edition, see excerpt below.
An advisory with further information will be issued by CPCI.

The reinforcement can be distributed along the length of the beam if the shear along the assumed inclined cracks is checked using shear friction. See Figure 4.10.4.

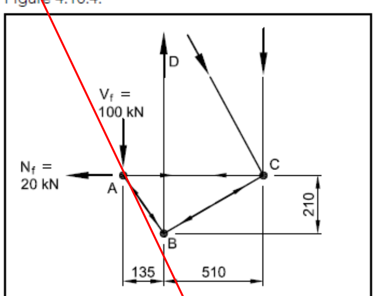

Figure 4.10.3 Force diagram for beam ledge example

$V' = (100)\cos 20° = 94$ kN

$N' = (100)\sin 20° = 34$ kN

A_{cr} = Area of 2 sides + Area of back

$$A_{cr} = 2 \times \left[\left(\frac{300}{\cos 20°}\right)\left(\frac{200 + 200 + 300\tan 20°}{2}\right)\right] + \left[\left(\frac{300}{\cos 20°}\right)\left(\frac{125 + 125 + (2)300\tan 20°}{2}\right)\right]$$

$= 162{,}371 + 74707$

$= 237{,}077$ mm^2

The worst case stirrup location is assumed. The horizontal tension force is also resisted by shear friction.

The shear friction reinforcement consists of 1 – 15M longitudinal bar in the top of the ledge.

This example neglects any ledge stirrups and also assumes the longitudinal bar is not stressed due to flexure and has full yield capacity available for shear friction. This needs careful consideration by the designer as recent ledge tests [10] indicate failure loads much lower than would predicted by this approach, and further research is required.

Note: the bottom longitudinal reinforcement in the ledge may be resisting bending moment so it is ignored.

$$v_f = \frac{94{,}000}{237{,}077} + \frac{20{,}000}{162{,}371}$$

$= 0.4 + 0.12$

$= 0.52$ MPa

$A_{vf} = (2)(200) = 400$ mm² (1 – 15M times 2)

$$\sigma = \rho_v f_y \cos 20° - \frac{N'}{A_g}$$

$$= \frac{400}{237{,}077}(400)\cos 20° - \frac{(34)(10^3)}{237{,}077}$$

$= 0.63 - 0.14 = 0.49$ MPa

$v_r = \phi_c (c + \mu\sigma)$

$= (0.70)(1 + (1.4)(0.49))$

$= 1.18 \text{ MPa} > 0.52$ MPa

Check $v_r \le 0.25\phi_c f'_c = 6.13$ MPa OK

Therefore, the load cannot punch through the ledge and the reinforcement can be distributed along the length of the beam

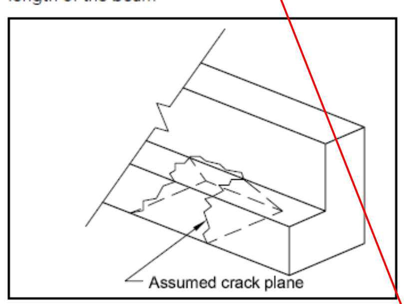

Figure 4.10.4 Punching through ledge

4-30 CPCI Design Manual 5