Composite Steel Beam Design

Composite steel beam design incorporating Hollow Core or solid slabs provides a structural and cost efficient solution for steel frames. It reduces total tonnage of steel beams by up to 40% and also reduces the number of components to be erected.

Definition

Composite steel beam design is the use of Hollow Core or solid slabs together with in-situ infill in conjunction with welded studs onto steel beams. This enables the slabs and beams to act compositely together, enhancing the load capacity of the steel beams.

Design considerations

1. Shear stud capacity

$P_{RD} = 0.8 f_u (\pi d^2/4) / \gamma v$

or

$P_{RD} = 0.29 \alpha \beta \varepsilon d^2 \sqrt{\omega f_{cp} E_{cp}} / \gamma v$

Whichever is the lesser.

α = 0.2 (h/d+1) h = height of the stud.

d = is the diameter of the shank of the stud.

f_u = is the specified ultimate tensile strength of the material of the stud but not greater than 500 N/mm^2.

β = a factor which takes into account the gap width g (mm) and is given as 0.5 (g/70+1) ^{2} 1.0 and g ^{3} 30mm.

ε = a factor which takes into account the diameter ø of transverse high tensile tie steel (grade 460) and is given by 0.5 ($ø$ / 20+1) ^{2} 1.0 and $ø$ ^{3} 8mm.

ω = transverse joint factor = 0.5 (w / 600+1), w = width of hollow core unit.

fcp = average concrete cylinder strength = 0.8 x average cube strength of the in-situ and precast concrete.

Ecp = average value of elastic modulus of the insitu and precast concrete.

γv = partial safety factor for shear stud.

2. Effective width of compression area

$$Beff = \left[\left(\frac{ø}{16}\right)\left(\frac{f_y}{460}\right)\left(\frac{300}{s}\right)\left(\frac{40}{f_{cu}}\right)\right]^{-0.33} *1000+2.5g$$

$ø$ = transverse reinforcement diameter

f_{cu} = concrete strength

s = bar spacing

f_y = reinforcement strength

g = gap

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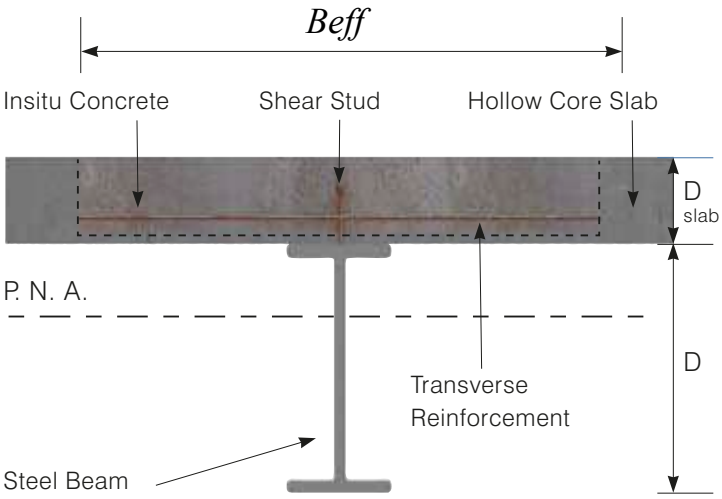
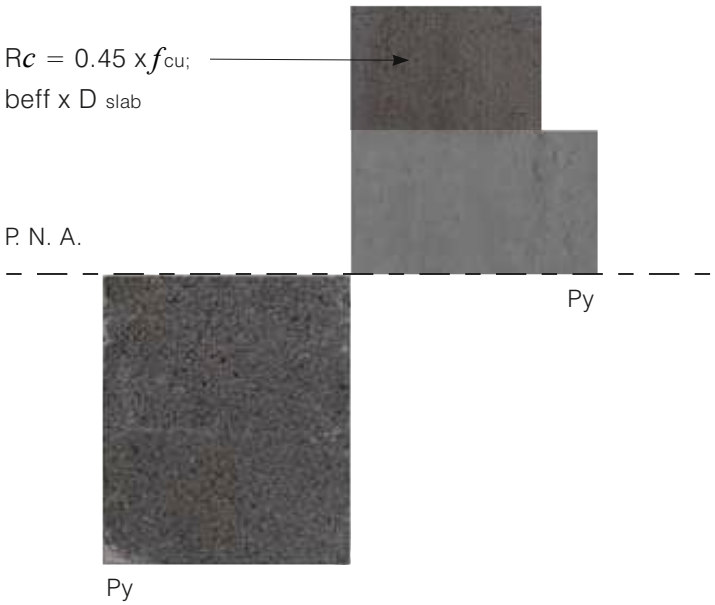
Design considerations





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