

Shear at composite beam interface

$$b_f := 20 \cdot \text{cm} \quad t_f := 1.5 \cdot \text{cm} \quad d := 60 \cdot \text{cm} \quad t_w := 1 \cdot \text{cm}$$

$$b_c := 2.8 \cdot \text{m} \quad t_c := 15 \cdot \text{cm} \quad w_c := 150 \cdot \text{pcf}$$

$$F_y := 355 \cdot \text{MPa}$$

$$E_s := 200000 \cdot \text{MPa}$$

$$f_c := 35 \cdot \text{MPa} \quad E_c := 33 \cdot \text{psi} \cdot \left(\frac{w_c}{\text{pcf}} \right)^{1.5} \cdot \sqrt{\frac{f_c}{\text{psi}}} \quad E_c = 29781.35 \cdot \text{MPa}$$

$$n := \frac{E_s}{E_c} \quad n = 6.72 \quad b_{eq} := \frac{b_c}{n} \quad b_{eq} = 41.69 \cdot \text{cm}$$

$$B(y) := \begin{cases} b_f & \text{if } y \leq t_f \\ t_w & \text{if } t_f < y \leq d - t_f \\ b_f & \text{if } d - t_f < y \leq d \\ b_{eq} & \text{otherwise} \end{cases} \quad y_G := \frac{\int_{0 \cdot \text{m}}^{d+t_c} y \cdot B(y) \, dy}{\int_{0 \cdot \text{m}}^{d+t_c} B(y) \, dy} \quad y_G = 61.62 \cdot \text{cm}$$

$$b(y) := B(y + y_G) \quad I_x := \int_{-y_G}^{d+t_c-y_G} y^2 \cdot b(y) \, dy \quad I_x = 213315.19 \cdot \text{cm}^4$$

Interface is at d from bottom

$$S_{x_at_interface} := \int_{-y_G}^{d-y_G} |y| \cdot b(y) \, dy \quad \text{from bottom to interface}$$

$$S_{x_at_interface} = 3722.91 \cdot \text{cm}^3$$

$$V_d := 15000 \cdot \text{kgf} \quad \text{worse factored shear in the segment allocated to the typical stud or group of studs (at beam station)}$$

$$\text{separation}_{\text{studs_or_sets_of_studs}} := 30 \cdot \text{cm} \quad \text{along the beam}$$

$$\text{Shear_at_the_interface} := \frac{V_d \cdot S_{x_at_interface}}{I_x \cdot b_f}$$

$$\text{Shear_at_the_interface} = 13.09 \frac{\text{kgf}}{\text{cm}^2}$$

$$\text{Shear_in_the_segment} := \text{Shear_at_the_interface} \cdot b_f \cdot \text{separation}_{\text{studs_or_sets_of_studs}}$$

$$\text{Shear_in_the_segment} = 7853.68 \text{ kgf}$$

$$\text{Additional_shear_per_connector} := 2000 \cdot \text{kgf}$$

$$\text{Total_shear_per_connector} := \text{Shear_in_the_segment} + \text{Additional_shear_per_connector}$$

$$d_{\text{conn}} := \frac{3}{4} \cdot \text{in} \quad \text{equal or less than } 3/4 \text{ in, otherwise you may be wasting steel and getting a worst weld (bigger central unwelded area) for fatigue}$$

$$S_u := 0.4 \cdot d_{\text{conn}}^2 \cdot \sqrt{f_c \cdot E_c}$$

$$\frac{\text{Total_shear_per_connector}}{0.85 \cdot S_u} = 0.77 \quad \text{should be less than 1}$$