TALAT Lecture 2301

Design of Members

Axial Force

Example 5.1 : Axial force resistance of square hollow section

2 pages

Advanced Level

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Example 5.1. Axial force resistance of square hollow section

Width	$b := 70 \cdot mm$	$MPa \equiv 10^6 \cdot Pa$	$kN \equiv 1000 \cdot newton$
Thickness	$t := 1.9 \cdot mm$	$f_o := 200 \cdot MPa$	
Column length	$L := 1000 \cdot mm$	$E := 70000 \cdot MPa$	
		$\gamma_{M1} := 1.0$	

5.4.3   **Slenderness parameter**

$b_f := b - 2 \cdot t$ $b_f = 66.2 \circ mm$

$\beta := \dfrac{b_f}{t}$ $\beta = 34.8$
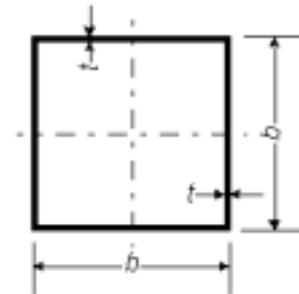
5.4.4   **Element classification**

$\varepsilon := \sqrt{\dfrac{250 \cdot MPa}{f_o}}$ $\varepsilon = 1.118$

Tab. 5.1

$\beta_1 := 11 \cdot \varepsilon$ $\beta_1 = 12.3$

$\beta_2 := 16 \cdot \varepsilon$ $\beta_2 = 17.9$

$\beta_3 := 22 \cdot \varepsilon$ $\beta_3 = 24.6$

$class := if\left(\beta > \beta_1, if\left(\beta > \beta_2, if\left(\beta > \beta_3, 4, 3\right), 2\right), 1\right)$ $class = 4$

5.4.5   **Local buckling**

5.4.5 (3) c)
heat-treated
unwelded

$\rho_c := if\left[\dfrac{\beta}{\varepsilon} \le 22, 1.0, \dfrac{32}{\left(\dfrac{\beta}{\varepsilon}\right)} - \dfrac{220}{\left(\dfrac{\beta}{\varepsilon}\right)^2}\right]$ $\rho_c = 0.8$

$t_{eff} := if\left(class \ge 4, t \cdot \rho_c, t\right)$ $t_{eff} = 1.52 \circ mm$

$A_{eff} := 4 \cdot (b - t) \cdot t_{eff}$ $A_{eff} = 414.2 \circ mm^2$

$I := \dfrac{b^4}{12} - \dfrac{(b - 2 \cdot t)^4}{12}$ $I = 4.004 \cdot 10^5 \circ mm^4$

$r := \sqrt{\dfrac{I}{A_{eff}}}$ $r = 31.1 \circ mm$

> **According to 5.8.4.1 (1)**
>
> $\lambda = \sqrt{\dfrac{A \cdot \eta \; f_o}{N_{cr}}}$
>
> Substitute
>
> $N_{cr} = \dfrac{\pi^2 \cdot E \cdot I}{l^2}$ $\eta = \dfrac{A_{ef}}{A}$ $r = \sqrt{\dfrac{I}{A_{ef}}}$
>
> Result
>
> $\lambda = \dfrac{l}{r} \cdot \dfrac{1}{\pi} \cdot \sqrt{\dfrac{f_o}{E}}$
>
> Note: λ with a bar cannot be written

5.8.4   **Flexural buckling**

Table 5.7 $K := 1$ $l := K \cdot L$

Table 5.5
and 5.6 $\alpha := 0.2$ $\lambda_o := 0.1$ $k_1 := 1$ $k_2 := 1$

See to the
right $\lambda := \dfrac{l}{r} \cdot \dfrac{1}{\pi} \cdot \sqrt{\dfrac{f_o}{E}}$ $\lambda = 0.547$

(5.33) $\phi := 0.5 \cdot \left[1 + \alpha \cdot \left(\lambda - \lambda_o\right) + \lambda^2\right]$ $\chi := \dfrac{1}{\phi + \sqrt{\phi^2 - \lambda^2}}$

$\phi = 0.694$ $\chi = 0.891$

5.8.3 (1) $N_{b.Rd} := \chi \cdot k_1 \cdot k_2 \cdot \dfrac{f_o}{\gamma_{M1}} \cdot A_{eff}$ $N_{b.Rd} = 73.8 \circ kN$