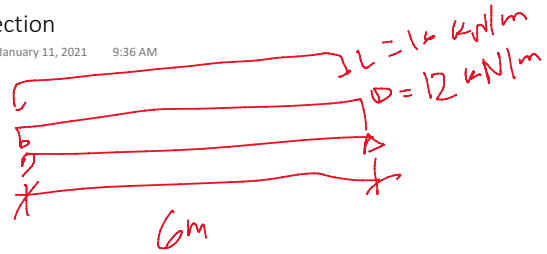
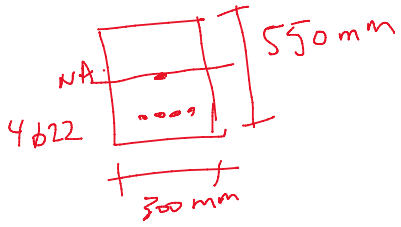
Deflection

Monday, January 11, 2021 9:36 AM





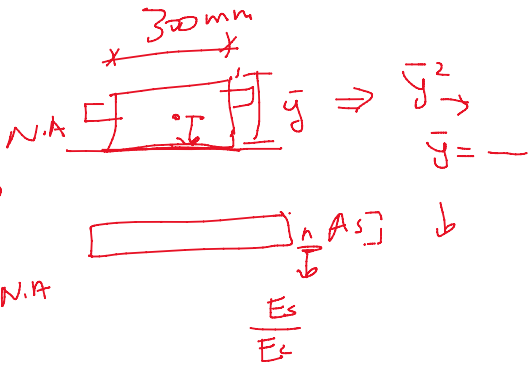
$\Delta = \frac{5wl^4}{384EI_e}$ →

$E = 4700\sqrt{f'_c} = 24870$ MPa

ignore reinforcement

$I_g = \frac{BH^3}{12} = 4.16 \times 10^9$ mm^4

$I_{cr} = 4.3 \times 10^8$ mm^4 →



M_{cr} → $\sigma = \frac{My}{I}$

$f_r = 0.62\sqrt{f'_c} = 3.28$ MPa

$y = H/2$ $I = I_g$

$M_{cr} = 49.7$ kN·m

Not supporting elements → Δ_L

Supporting → Δ_{Long}

Service moment	Effective moment of inertia, I_e, mm^4
$M_a \le (2/3)M_{cr}$	I_g
$M_a > (2/3)M_{cr}$	$\frac{I_{cr}}{1-\left(\frac{(2/3)M_{cr}}{M_a}\right)^2\left(1-\frac{I_{cr}}{I_g}\right)}$

① Calc. Δ_D

$M_D = \frac{wl^2}{8} = \frac{12 \times 6^2}{8} = 54$ kN·m $> \frac{2}{3}M_{cr}$ → I_e

$I_e = 6.4 \times 10^8$ mm^4

12 kN/m → N/mm

E, w, l

$\Delta_D = \frac{5wl^4}{384EI} = \frac{5 \times 12 \times 1 \times (6000)^4}{384 \times 24870 \times 6.4 \times 10^8} = 12.72$ mm

(N/mm)

② Calc. Δ_{D+L}

$M_{D+L} = \frac{(12+16)(6)^2}{8} = 126$ kN·m $> \frac{2}{3}M_{cr}$

$I_e = 4.58 \times 10^8$ mm^4

$\Delta_{D+L} = \frac{5(w_D+w_L)l^4}{384EI} = 41.5$ mm

③ Calc. Δ_L

$\Delta_L = \Delta_{D+L} - \Delta_D = 28.9$ mm

elements

(3)

$\Delta_L = \Delta_{D+L} - \Delta_D -$

Not supporting Non struct elements

roof	floor
$\rightarrow \frac{l}{180}$	$\frac{l}{360}$
333 mm	16.67 mm
	Not satisfied

Supporting Non-st. elements

sustained loads → 25% live load residential
8% warehouses

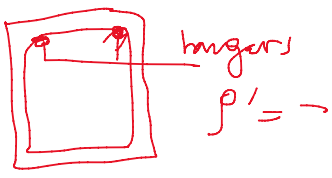
(4) Δ_{D+SL}

$M_{D+SL} = \frac{(12+0.25\times16)(6)^2}{8} = 72$ kN.m → $\frac{2}{3}M_{cr}$

$I_e = 5.27\times10^8$ mm⁴

$\Delta_{D+SL} = 20.6$ mm

(5) $\Delta_{SL} = \Delta_{D+SL} - \Delta_D = 7.88$ mm



(6) Long term multiplier λ

$\lambda = \frac{\xi}{1+50\rho'} =$

SL ⇒ $\lambda_\infty = 2$

D ⇒ $\lambda_\infty = 2$

(7) $\Delta_{long} = \Delta_L + \lambda_\infty \Delta_D + \lambda_\infty \Delta_{SL}$

mm

(7) $\Delta_{long} = \Delta L \ldots$

$= 70$ mm

↓

likely to damaged

$\frac{l}{480}$

12.5 mm

Not likely to be damaged

$\frac{l}{240}$

25 mm