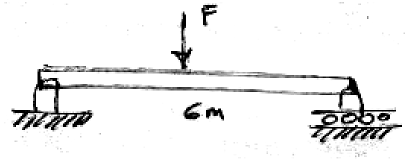
Answer Key

Beams and Machine Shop

1



$$M = \frac{FL}{4}$$

$$M = \frac{F(6m)}{4}$$

$$M = 1.5F$$

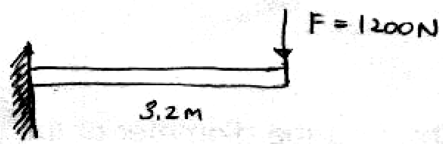
for rectangular cross-section

$$S_f = \frac{6M}{bh^2} = \frac{6(1.5F)}{bh^2} = \frac{9F}{bh^2}$$

$$8500\text{ kPa} = \frac{9F}{(0.060\text{m})(0.180\text{m})^2}$$

$$\boxed{F = 1.836\text{ kN}}$$

2



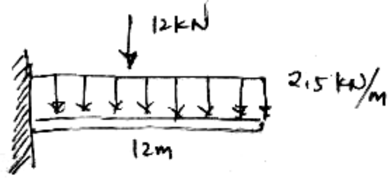
$$M = (1.2\ kN)(3.2\ m) = 3.84\ kN\text{-}m$$

from;
$$S_f = \frac{6M}{bh^2}$$

$$120000\ kPa = \frac{6(3.84\ kN\text{-}m)}{(0.028\ m)\,h^2}$$

$$h = 0.08281\ m$$

$$\boxed{h = 82.81\ mm}$$



Find: maximum slope of the beam

$$\theta_1 = \frac{FL^2}{8EI} = \frac{(12\,kN)(12\,m)^2}{8(13\,000\,kN\text{-}m^2)} = 0.01662 \text{ rad}$$

$$\theta_2 = \frac{WL^3}{6EI} = \frac{(2.5\,kN/m)(12\,m)^3}{6(13\,000\,kN\text{-}m^2)} = 0.05538 \text{ rad}$$

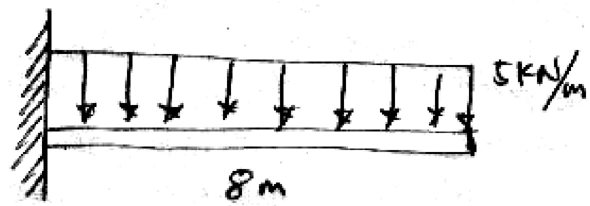
Total slope

$$\theta_T = \theta_1 + \theta_2$$

$$\theta_T = (0.072 \text{ rad})\left(\frac{180^\circ}{\pi}\right)$$

$$\boxed{\theta_T = 4.1253^\circ}$$

4

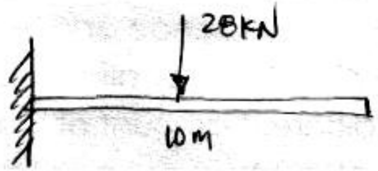


$$\theta = \frac{WL^3}{6EI} = \frac{(5\,kN/m)(8\,m)^3}{6(12500\,kN\text{-}m^2)}$$

$$\theta = (0.03413\,rad)\left(\frac{180°}{\pi}\right)$$

$$\boxed{\theta = 1.9557°}$$

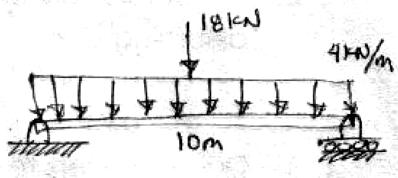
5



$$\theta = \frac{FL^2}{8EI} = \frac{28\,\text{kN}\,(10\text{m})^2}{8(12000\,\text{kN-m}^2)}$$

$$\theta = (0.02917\text{ rad})\left(\frac{180^\circ}{\pi}\right)$$

$$\boxed{\theta = 1.6711^\circ}$$



$$\delta_1 = \frac{FL^3}{48EI} = \frac{18\,kN\,(10\,m)^3}{48\,(10000\ kN\text{-}m^2)} = 0.0375\,m$$

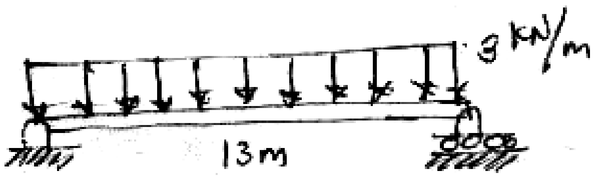
$$\delta_2 = \frac{5WL^4}{384(EI)} = \frac{5\,(4\,kN/m)(10\,m)^4}{384\,(10000\ kN\text{-}m^2)} = 0.05208\,m$$

Hence;

$$\delta_T = \delta_1 + \delta_2$$

$$\delta_T = 0.08958\,m$$

$$\boxed{\delta_T = 89.58\,mm}$$

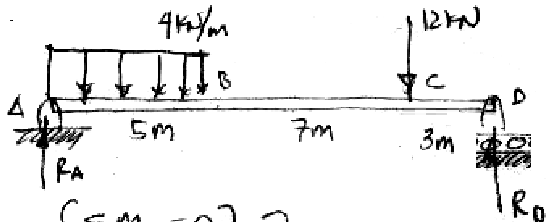


$$\delta = \frac{5wL^4}{384EI} = \frac{5(3\ kN/m)(13\ m)^4}{384(11000\ kN\text{-}m^2)}$$

$$\delta = 0.1014\ m$$

$$\boxed{\delta = 101.4\ mm}$$

8



$[\Sigma M_A = 0]$ +↻

$$-R_D(15\,m) + 12\,kN(12\,m) + (4\,kN/m)(5\,m)(2.5\,m) = 0$$

$$R_D = 12.9333\,kN$$

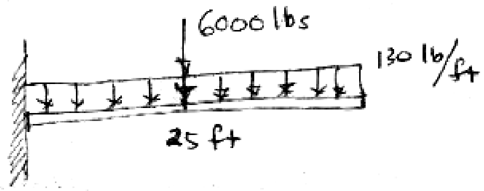
Hence;

$$M_C = R_D(3\,m)$$

$$= 12.9333\,kN(3\,m)$$

$$\boxed{M_C = 38.8\,kN\text{-}m}$$

9



$$M = \frac{FL}{2} = \frac{\left[6000\,\text{lbs} + (130\,\text{lb/ft})(25\,\text{ft})\right](25\,\text{ft})\left(\frac{12\,\text{in}}{1\,\text{ft}}\right)}{2}$$

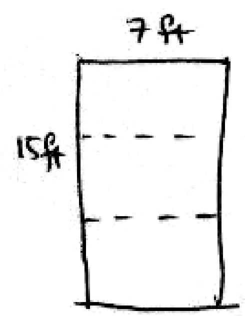
$$M = 1387500\ \text{lb-in}$$

and;

$$S_f = \frac{6M}{bh^2} = \frac{6(1387500\ \text{lb-in})}{(8\,\text{in})(15\,\text{in})^2}$$

$$\boxed{S_f = 3854.1667\ \text{psi}}$$

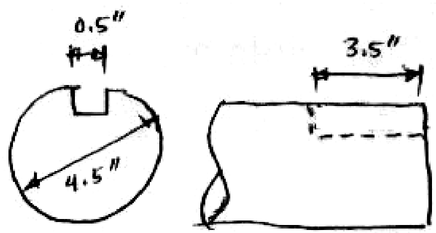
10



$$t = \left[\frac{(7\text{ ft})\left(\frac{12\text{ in}}{1\text{ ft}}\right)}{0.5\text{ in/min}} \right] 2$$

$$\boxed{t = 336\text{ min}}$$

11



$$t = \left[\frac{3.5\ \text{in}}{(26\ \text{tooth})\left(100\ \frac{\text{rev}}{\text{min}}\right)(0.006\ \text{in})}\right]$$

$$t = (0.22435\ \text{min})\left(\frac{60\ \text{sec}}{1\ \text{min}}\right)$$

$$\boxed{t = 13.4615\ \text{sec}}$$

$$t = \left[\frac{4\ ft}{\left(4.5\ \frac{mm}{s}\right)\left(\frac{1\ in}{25.4\ mm}\right)\left(\frac{1\ ft}{12\ in}\right)} \right]$$

$$t = (270.9333\ sec)\left(\frac{1\ min}{60\ sec}\right)$$

$$\boxed{t = 4.5156\ min}$$

Total GAS consumption

$$V_T = (V_1 + V_2) L$$

$$= (12 + 10)\frac{ft^3}{ft}(6ft)$$

$$\boxed{V_T = 132\ ft^3}$$

$$\text{Drill Penetration} = \left(1200\,\frac{\text{rev}}{\text{min}}\right)\left(0.005\,\frac{\text{in}}{\text{rev}}\right)$$

$$\boxed{\text{Drill Penetration} = 6\,\frac{\text{in}}{\text{min}}}$$

15

$$t = \left[\frac{8\ in}{\left(130\ \frac{strokes}{min}\right)\left(0.155\ \frac{mm}{stroke}\right)\left(\frac{1\ in}{25.4\ mm}\right)}\right]$$

$$t = (10.0844\ min)\left(\frac{60\ sec}{1\ min}\right)$$

$$\boxed{t = 605.0620\ sec}$$

exponential LEAP
ONLINE REVIEW

$$v = \pi D N$$

$$= \pi (6\,in)\left(\frac{1\,ft}{12\,in}\right)\left(120\,\frac{rev}{min}\right)$$

$$\boxed{v = 188.4956\ ft/min}$$