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Program:- M.S (CEM)

Subject:- Advanced Mechanics of Materials.

paper:- Final Term

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Q No (02) ①

Ans :-

① Given data :- Al E = ~~200~~ 70 GPa

(ii) Cross Sectional Area of AB = 50 mm²

(iii) link CD = steel made. $E = 200$ GPa

Cross Sectional Area of link CD = 60 mm²

F = Roll No = 15367

F = Ist two digits of R = 15 kN.

Required :-

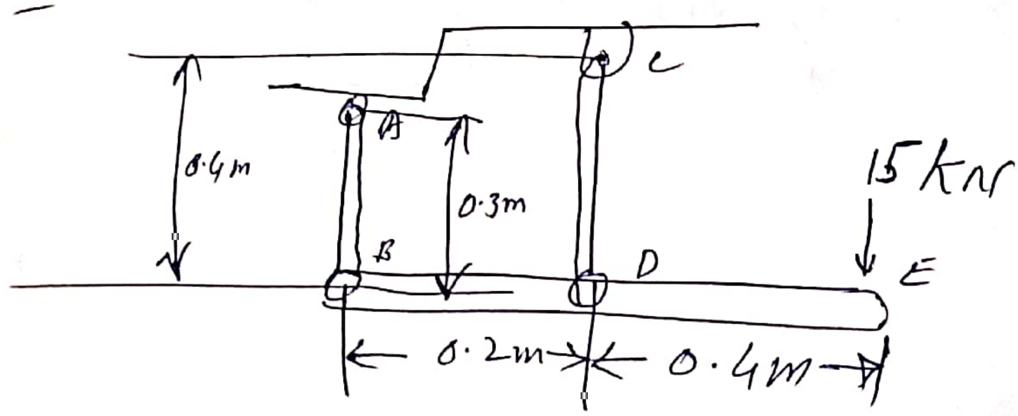
deflection at

(i) (a) of B

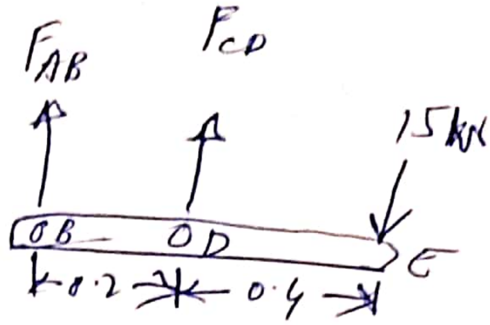
(b) of D

(c) of E

Diagram :-



bar BDE as F.B. Diagram



$\Sigma M_B = 0$

$F_{CD} \times (0.2) - 15 \times (0.6) = 0$

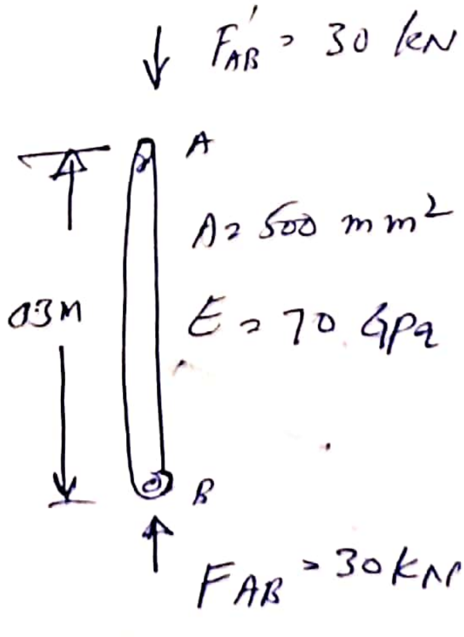
$F_{CD} = \dfrac{15 \times 0.6}{0.2}$ kN

$F_{CD} = \dfrac{9.00}{0.2} = +45$ kN.

$\uparrow \Sigma F_y = 0 \rightarrow F_{AB} + F_{CD} - 15 = 0$

$F_{AB} = 15 - 45 = -30$ (comp)

(a) Deflection of B :-



p.T.O

$$\delta_B = \frac{PL}{AE} = \frac{(-30 \times 10^3)(0.3)}{(70 \times 10^9)(5 \times 10^{-6})}$$

$$\delta_B = \frac{-9000}{350000}$$

$$\delta_B = -0.02571 \text{ m.}$$

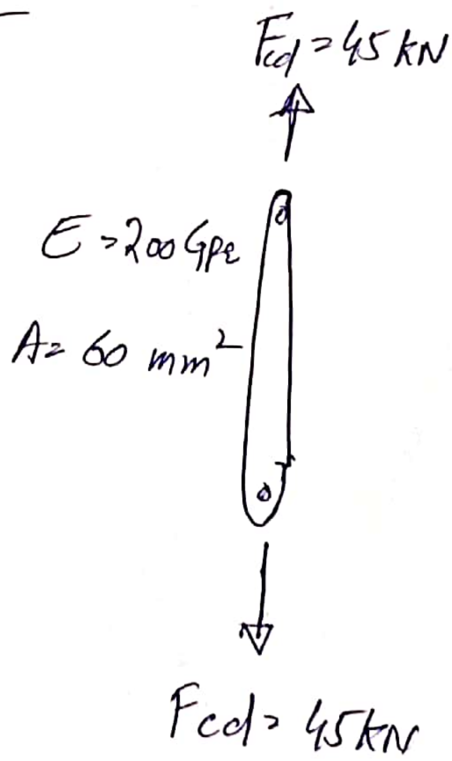
$$\boxed{\text{or } \delta_B = -25.71428 \text{ mm}} \text{ Ans}$$

(B) Deflection of D

$$\delta_D = \frac{PL}{AE} =$$

$$= \frac{(45 \times 10^3)(0.4)}{(200 \times 10^9)(60 \times 10^{-6})}$$

$$\Rightarrow \frac{18000}{12000000}$$



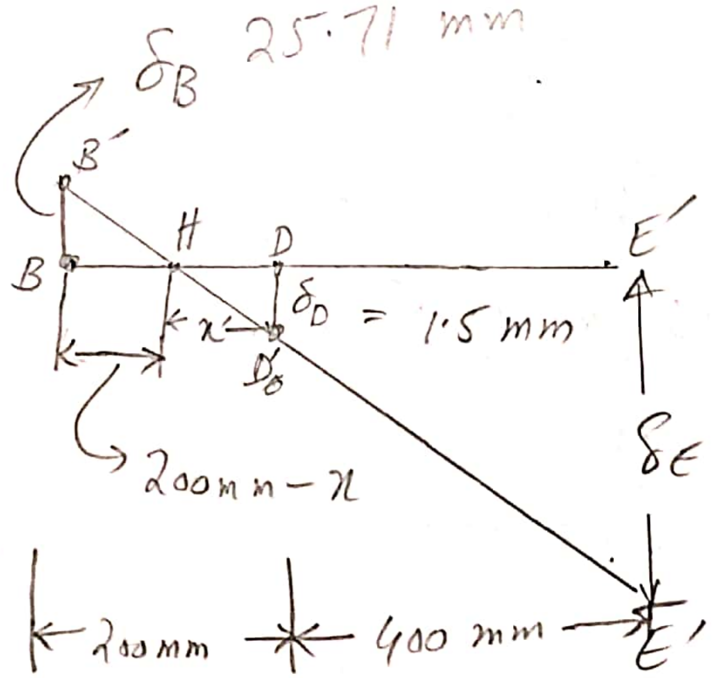
$$\delta_D = \frac{18000}{12000000} = 0.0015 \text{ m}$$

$\delta_D = 0.0015$ m

OR $\delta_D = 1.5$ mm — Ans-

(c) Deflection of E :-

Diagram



we denote by B′ & D′ the displaced positions of points B & D.
Since the bar BDE is rigid, points B′, D′ and E′ lie in a straight line and we write

$$\frac{BB'}{DD'} = \frac{BH}{HD} = \frac{25}{1.5} = \frac{200-x}{x}.$$

$$x = 11.32 \text{ mm}$$

$$\frac{EE'}{DD'} = \frac{HE}{HD}$$

$$\frac{\delta E}{1.5} = \frac{400 + 11.32}{11.32}$$

$$\delta_E = \frac{411.32 \times 1.5}{11.32} = 54.5 \text{ mm}$$

$$\boxed{\delta_E = 54.5 \text{ mm} \downarrow}$$ Ans.

Q. No 04

Given Data:-

$b = 4\,in$ $h = 6\,in$

$t = 0.15\,in$

V = 1st two digits of R + 3 kips

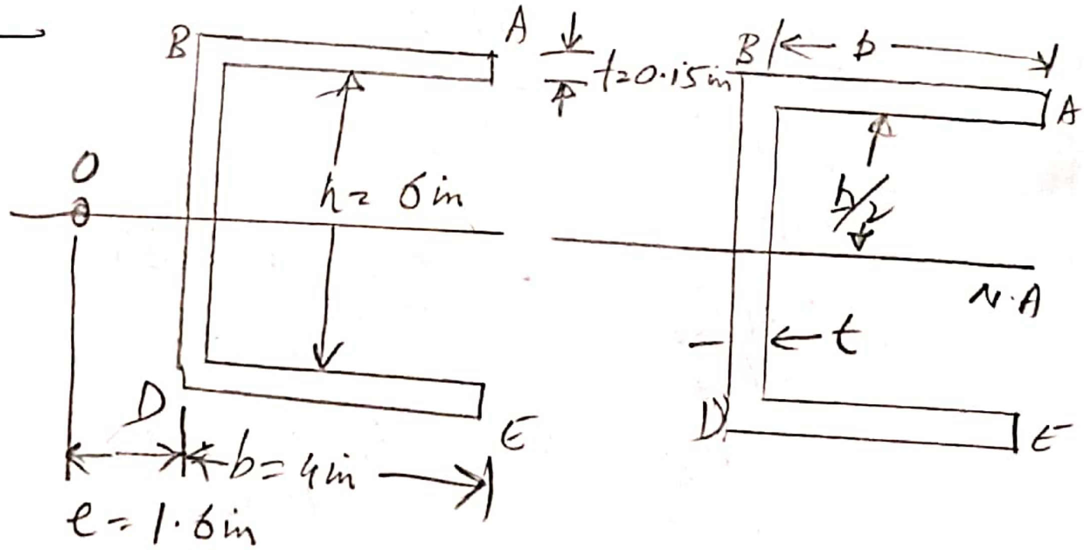
R = 15367

So $V = 15 + 3 = 18$ kips.

Required:-

Determine shear stress Distribution for V

Diagram:-



(i) shear stress Distribution in flange.

$$\tau = \frac{VQ}{It}$$

from Diagram

$$\tau_B = \frac{VQ}{It} = \frac{V}{It}(st)\frac{h}{2} = \frac{Vh}{2I}s$$

$$\tau_B = \frac{Vhb}{2\left(\frac{th^2}{12}\right)(6b+h)}$$

$$\tau_B = \frac{6Vb}{th\,(6b+h)} \quad \text{——— (A)}$$

puting values in eq (A)

$$\tau_B = \frac{6 \times 18 \times 4}{(0.15)(8)(6 \times 4 + 8)} \quad \boxed{= 16\ ksi} \text{ Ans}$$

$$\tau_B =$$

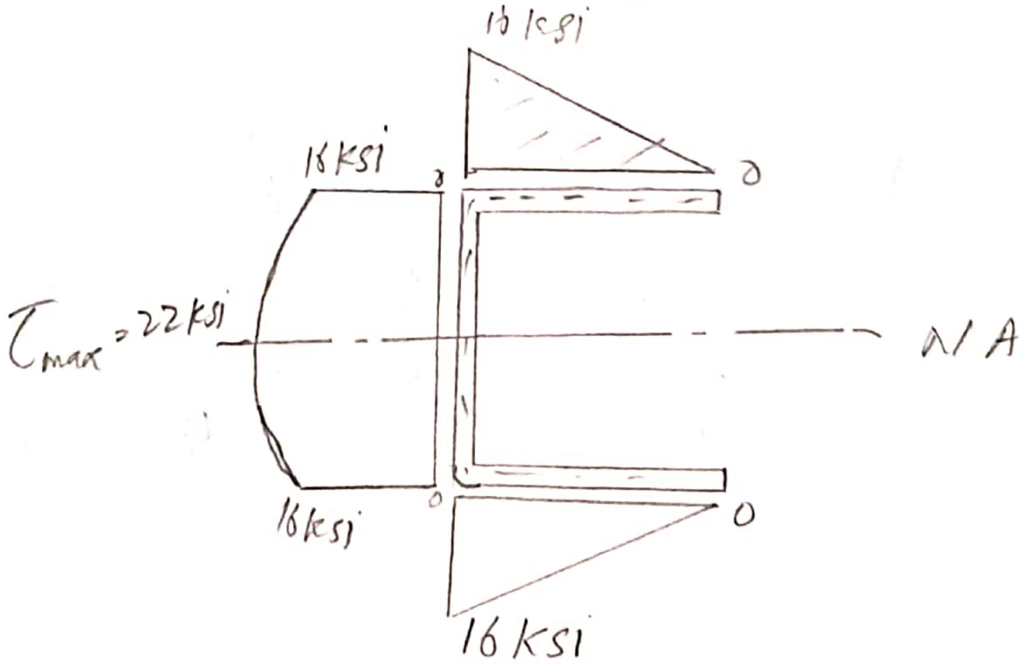
(ii) Shear Stress in web

$$\tau_{max} = \frac{VQ}{IE} = \frac{v\left(\frac{ht}{8}\right)(4b+h)}{\frac{1}{2}+h^2(6b+h)t}$$

$$\tau_{max} = \frac{3v\,(4b+h)}{2th\,(6b+h)}$$

$$\tau_{max} = \frac{3 \times 18\,(4 \times 4+6)}{2(0.15)(6)(4 \times 6+6)}$$

$$\boxed{\tau_{max} = 22\ ksi}$$ Ans



Q NO 03

Ans :- Given Data.

G = Ist two digits of $R \times 10^6$ psi
$R = 15367$
$G = 15 \times 10^6$ psi

Required :- largest torque T_o of shaft AB

Solution :-

Denoting by F the magnitude of tangential force between gear teeth we have

Gear B, $\Sigma M_B = 0$

$= F \times (0.875\ in) - T_o = 0$

Gear C = $\Sigma M_C = 0$

$= F \times (2.45\ in) - T_{CD} = 0$

$T_{CD} = 2.8\ T_o$ ——— (A)

$R_C = 2.45$ in

$R_B = 0.875$ in

$$r_B \phi_B = r_C \phi_C$$

$$\phi_B = \phi_C \frac{r_C}{r_B}$$

$$\Rightarrow \phi_C \times \frac{2.45}{0.875 \text{ in}} = 2.8\phi_C \rightarrow (B)$$

(a) **Torque T_0 of shaft AB** :—

with $T_{AB} = T_0$ and $c = 0.375$ in

with max shearing stress of 8000 psi

$$\tau = \frac{T_{AB}\, c}{J} = 8000 \text{ psi} = \frac{T_0 (0.375 \text{ in})}{\frac{1}{2}\pi (0.375 \text{ in})^4}$$

$$\boxed{T_0 = 663 \text{ lb} \cdot \text{in}}$$

Ans 3

Scanned with CamScanner

Q5)

Ans

Given Data :-

δ_{all} Ist two Digits of Ro:No + 4 ksi

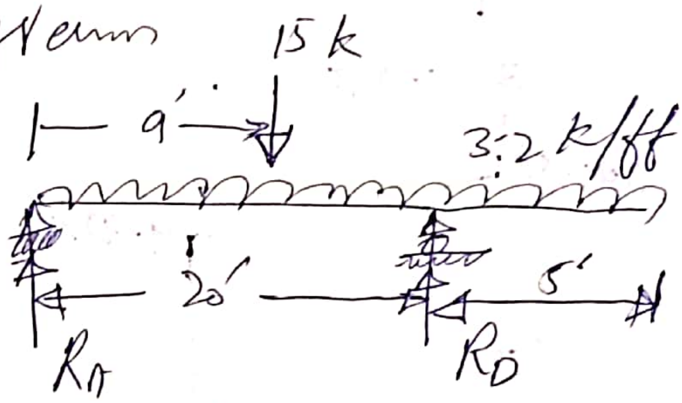
R = 15367

$\delta_{all} = 15 + 4$ ksi $= 18$ ksi

$\tau_{all} = 15 + 1 = 16$ ksi.

Solution :-

Diagram



① Reactions at A & D

$\Sigma M_A = 0$ (+)

$R_D \times 20 = 15 \times 9 + 3.2 \times 25 \times \frac{25}{2}$

$R_D = 56.75$ K

p.t.o

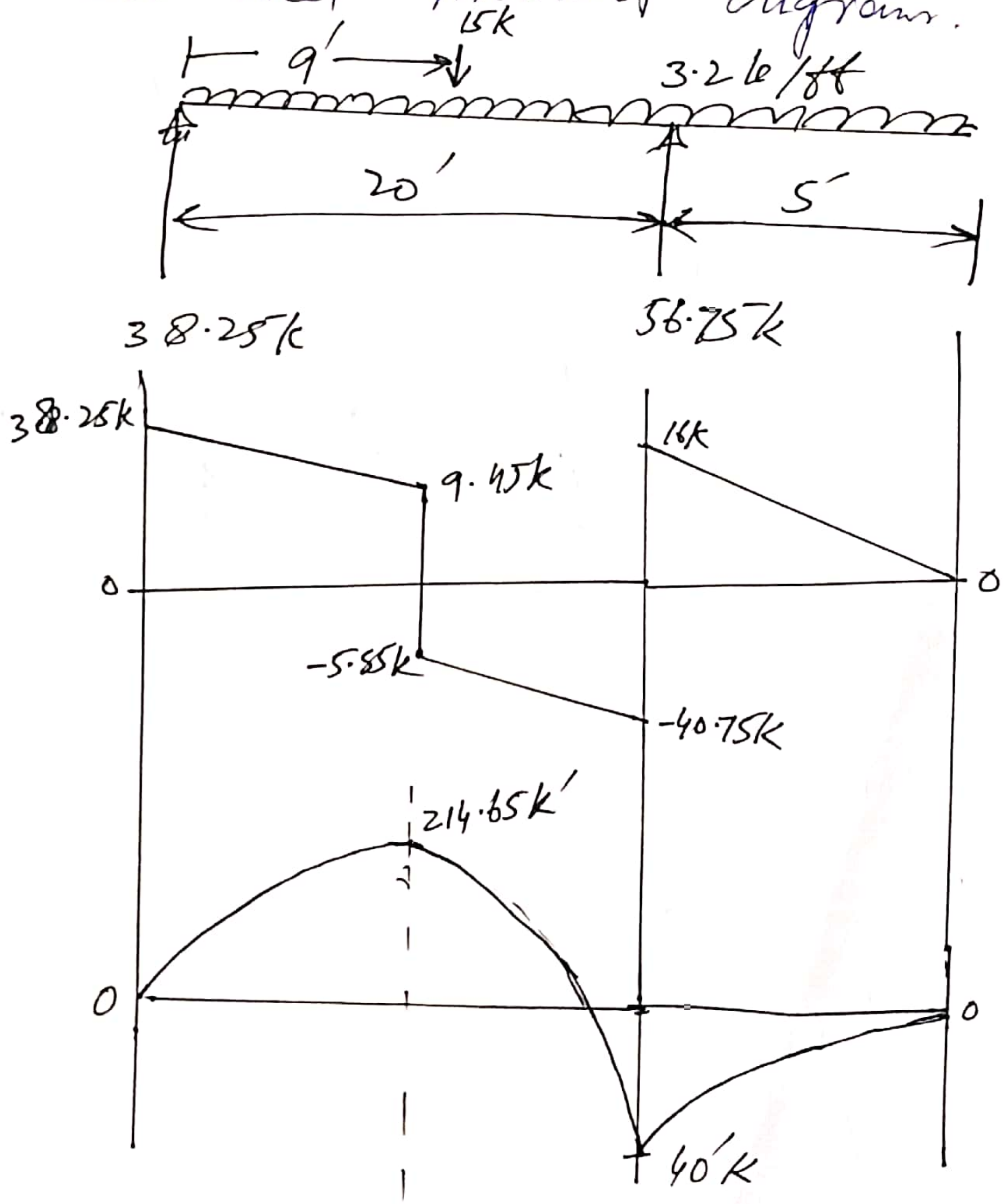
$\Sigma F_y = 0 \quad \uparrow +$

$R_A + R_D = 15 + 3.2 \times 25 = 95$

$R_A = 95 - 56.75 = 38.25\ k$

$$\boxed{R_A = 38.25\ k}$$

② Shear and moment diagram.



③ Section Modulus 13 :-

$$S_{min} = \frac{M_{max}}{\sigma_{all}} = \frac{214.65 \times 12}{19}$$

$$S_{min} = 135.5684 \ in^3$$

referring to Appendix B, selecting W 24 x 68 with $S_x = 154 \ in^3$ as a lightest section for the given beam.

(4) Max. normal stress :-

$$\sigma_{max} = \frac{|M_{max}|}{S} = \frac{214.65 \times 12}{154}$$

$$\sigma_{max} = 16.73 \ ksi$$

p.t.o

(5)

Max shear stress

$$\tau_{max} = \frac{3}{2}\frac{V}{A}$$

$V_{max} = 40.75$ kips & from table

$A = 20.0\ in^2$

$$\tau_{max} = \frac{3}{2} \times \frac{40.76}{20.0} = 3.06\ ks$$

$$\boxed{\tau_{max} = 3.06\ ksi}$$ Ans.

15

Q No 01

Solution:-

Given Data:-

① F = R = 15367 N

E alu = 207000 kpa

E = 223 x 10^6 kpa.

n = 0

factor of safety N = 1

x = 1st two digits of R + 5 cm

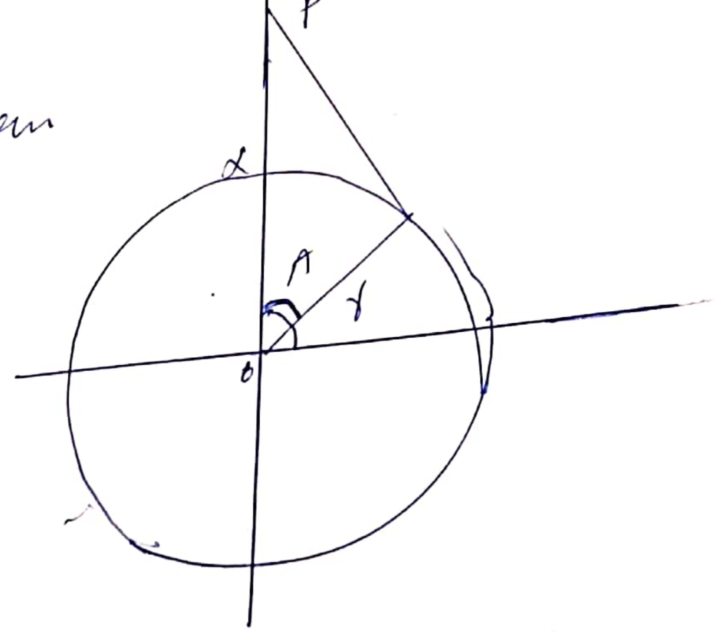
R = 15367

X̄ = 15 + 5 = 20 cm

Ȳ = 15 cm

Required :- Diameter of the shaft

Diagram



$$M_c = \frac{\pi}{32} \times (d_c)^3 \times \delta_b$$

$$d_c = \frac{M_c}{3} \times \frac{32}{\pi} \times \frac{1}{\delta_b}$$

~~D_c~~ = $M_c = A_1 \times b_2 =$

$83.83 \times 69.6 = \underline{5834.53 \text{ kN.mm}}$

$$d_c = \frac{5834.53}{3} \times \frac{32}{3.1415} \times \frac{1}{103}$$

$d_c = 89.46$ mm Say ~~80~~ 90 mm

$D_c = 90$ mm

Ans.