Name :- Shahzeb

Roll No :- 15629.

Subject : Adv Mechanics of Material.

Teacher :- Engr Sir Fawad Ahmed.

Date : 29/9/2020.

IQRA National University Peshawar.

①

Roll = 15629

Q # (4)

Given data:

b = 4in

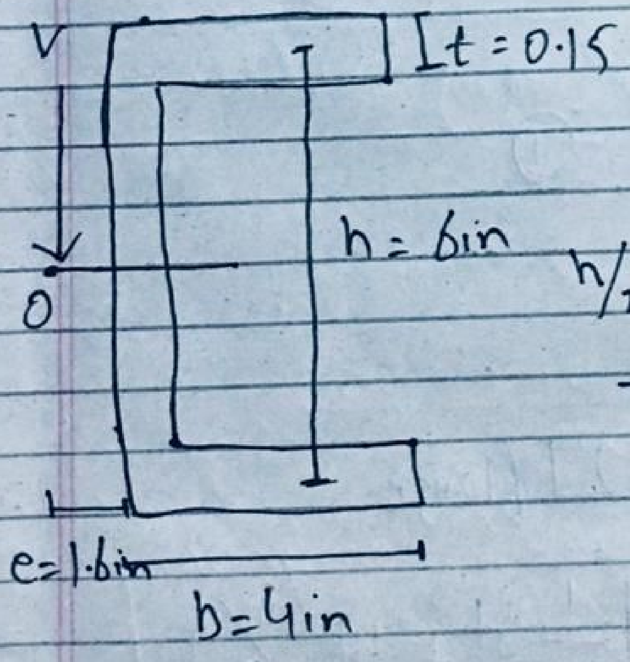
h = 6in

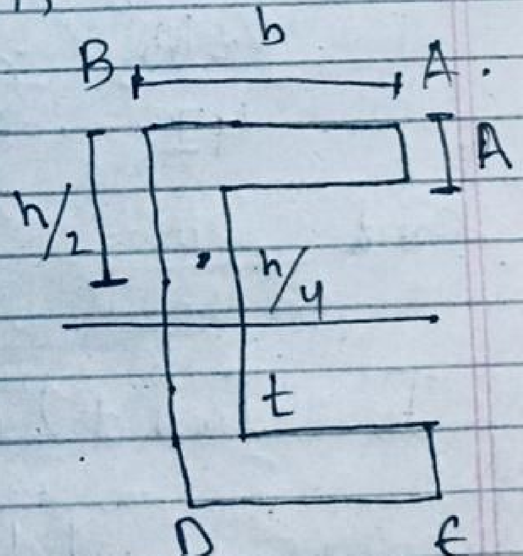
t = 0.15in

Determine the shear stress distribution for V = first two digits of R + 3 kips -

R = 15+3

$\boxed{R = 18 \text{ Kips}}$





Sol:

① Determine the location for the shear center of the channal section:-

(2) (15629)

As I know that

$$e = \frac{Fh}{I} \quad \text{--- (A)}$$

where

$$F = \int_0^b q\,ds = \int_0^b \frac{VQ}{I}\,ds$$

$$F = \frac{V}{I}\int_0^b st\frac{h}{2}\,ds$$

$$F = \frac{Vthb^2}{4I} \quad \text{--- (1)}$$

and

$$I = I_{web} + 2I_{flange}$$

$$= \frac{1}{12}th^3 + 2\left[\frac{1}{12}bt^3 + bt\left(\frac{h}{2}\right)^2\right]$$

$$= \frac{1}{12}th^2(6b+h) \quad \text{--- (2)}$$

Now putting eq ① and ② in (A).

$$e = \frac{\frac{V t h h^2}{4I}}{\frac{1}{12} t h^2 / 6b + h}$$

$$e = \frac{b}{2 + \frac{h}{3b}}$$

b = 4 in
h = 6 in } → given

putting the Value -

$$e = \frac{4}{2 + \frac{6}{3(4)}}$$

$$\boxed{e = 1.6 \, in}$$

(b) Determine the shear stress distribution for V = 18 kips.

$\phi = \phi$

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

Shearing stresses in the flange

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

$$\tau_B = \frac{Vhb}{2\left(\frac{1}{12}th^2\right)(6b+h)} = \frac{6Vb}{th(6b+h}$$

$$\tau_b = \frac{6Vb}{th(6b+h}.$$

$$\left.\begin{array}{l} V = 18\,\text{kips} \\ t = 0.15\,\text{in} \\ b = 4\,\text{in} \\ h = 6\,\text{in} \end{array}\right] \rightarrow \text{given}$$

putting the Value -

$$\tau_b = \frac{6(18)(4)}{(0.15)(6)(6(4)+6)}$$

$$\tau_b = \frac{432}{0.15(6)(30)} = \frac{432}{27}$$

$$\boxed{\tau_b = 16 ksi}$$

shearing stress in the web

$$\tau_{max} = \frac{VQ}{It} = \frac{V(\frac{1}{8}ht)(4b+h)}{\frac{1}{12}th^2(6b+h)t}$$

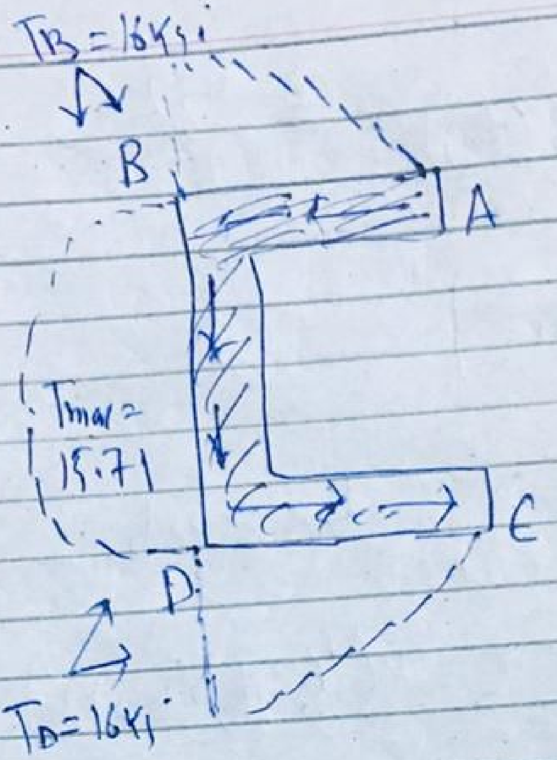
$$= \frac{3V(4b+h}{2th(6b+h}$$

$$= \frac{3(18)(4(4)+6)}{2(0.15)(6)(6(6)+6)}$$

$$\frac{54(22)}{0.3(252)} =$$

$$\boxed{\tau_{max} = 15.714 ksi}$$

6



Roll No= 15629

Q:- 3

Given data.

$$G = 15 \times 10^6 \text{ psi}$$

Allowable shearing stess = 10ksi

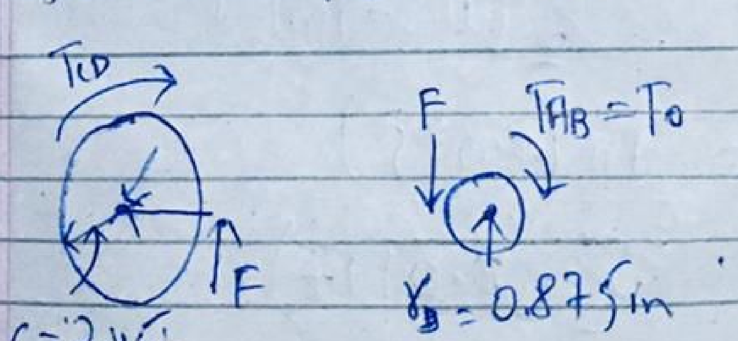
$$X = 15 + 10$$

$$\boxed{X = 25 \text{ in}}$$

Determine = (a) the largest torque To
(b) corresponding angle through which end A of shaft AB rotate.

Sol
(a) The largest torque To.

Applying a static equalibrium Analysis on the two shaft to find a relationship ~~betwe~~ between TcD and To.

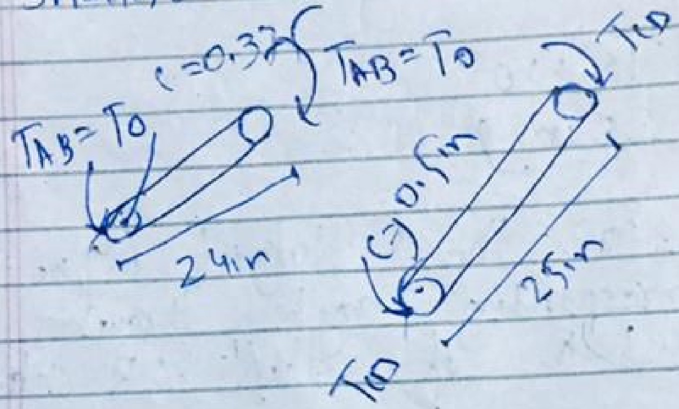


$$\Sigma M_C = 0 = F(2.45\text{in}) - T_{CD}$$

$$\Sigma M_B = 0 = F(0.875\text{in}) - T_0$$

$$\boxed{T_{CD} = 2.8\,T_0}$$

The max allowable torque on each shaft choose the smallest -



$$\tau_{max} = \frac{T_{AB}\,c}{J_{AB}}$$

$$1000\ psi = \frac{T_0\,(0.375\,in)}{\frac{\pi}{2}\,(0.375\,in)^4}$$

$$1000\,psi = \frac{T_0\,(0.375)}{\frac{3.14}{2}\,(0.0197)}$$

$$1000\,psi = \frac{T_0\,(0.375)}{1.57\,(0.0197)}$$

$$1000psi = \frac{T_0(0.375)}{0.0309}$$

$$T_0(0.375) = 10{,}000(0.0309)$$

$$T_0(0.375) = \cancel{30.429}\ 309$$

$$T_0 = \frac{309}{0.375}$$

$$\boxed{T_0 = 824\ lb.in}$$

$$T_{max} = \frac{T c_D}{J_{CD}}$$

$$10{,}000psi = \frac{2.8T_0(0.5)}{\frac{\pi}{2}(0.5in)^4}$$

$$10{,}000psi = \frac{2.8T_0(0.5)}{\frac{3.14}{2}(0.5)^4}$$

(10)

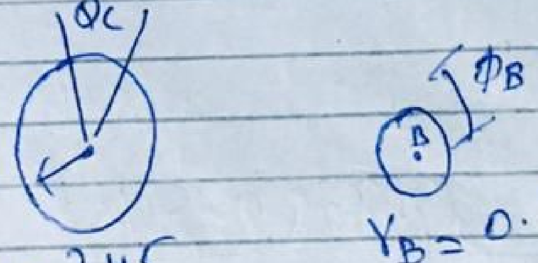
$$1.4\,T_0 = 10000 \times 1.57 \times 0.0625$$

$$T_0 = \frac{981.25}{1.4}$$

$$\boxed{T_0 = 700.89\ \text{lb.in.}}$$

(b) The corresponding Angle through which end A of shaft AB rotates:

Apply a kinematic analysis to relate the angular rotation of the gear.



$r_c = 2.45$ $\qquad r_B = 0.875\text{in}.$

$$r_B \phi_B = r_c \phi_c$$

$$\phi_B = \frac{r_c}{r_B}\phi_c = \frac{2.45\text{in}}{0.875\text{in}}\phi_c$$

$$\boxed{\phi_B = 2.8\phi_C}$$

finding the corresponding angle of twist for each shaft and the net angular rotation of End A.

$$\phi_{A/B} = \frac{T_{AB}L}{J_{AB}G} = \frac{(700.89)(24)}{\frac{\pi}{2}(0.375)^4(15\times10^6)}$$

$$= \frac{16821.36}{1.57\times 0.0197\times 15\times10^6}$$

$$= \frac{16821.36}{463935}$$

$= \cancel{0.387\ rad}$.

$= 0.036\ rad$

$= 0.036 \times 180/\cancel{3.14}\ 57.29$

$$\boxed{2.08^\circ}$$

12

$$\theta_c / D = \frac{T_{CD} L}{J_{CD} G}$$

$$= \frac{2.8\,(700.96)(24)}{\frac{3.14}{2}\,(0.5)^4\,(15 \times 10^6)}$$

$$= \frac{47104.512}{1471875}$$

$$= 0.0320 \text{ rad.}$$

$$= 0.0320 \times 57.29$$

$$= \boxed{1.8^\circ}$$

Now

$$\theta_B = 2.8\,\theta_c$$

$$= 2.8(1.8)^\circ$$

$$= 7.04^\circ$$

$$\Phi A = \Phi_B + \Phi_{A/B}$$

$$\Phi A = 7.04 + 2.06$$

$$\boxed{\Phi A = 9.1}$$

Q # 2

Given data:

$E = 70\,GPa$

$Area = 5mm$

$CD = E = 200\,GPa$

cross section $Area = 60mm^2$

$\boxed{F = force = 15KN}$

To find = Deflection = of = B

of = D

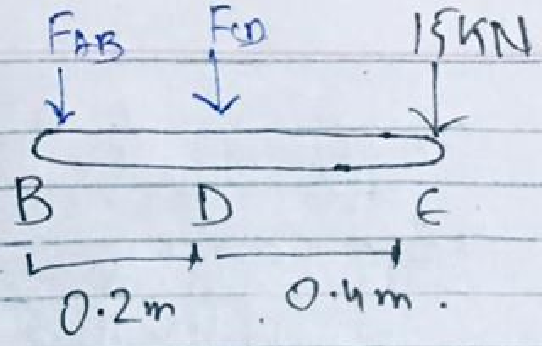
of = E

Sol.

Apply a free body analysis to the bar BDE to find the force exerted by link AB and DC.

free Body diagram-

BDE =



$\Sigma M_B = 0$

$0 = -15 \times 0.6m + F_{CD} \times 0.2m$

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

$\boxed{F_{CD} = 45\ KN\ (tension).}$

$\Sigma M_D = 0$

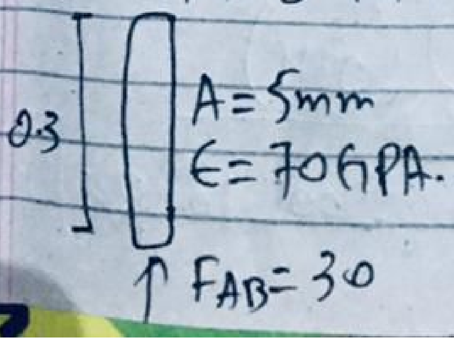
$0 = -(15 \times 0.4) - F_{AB} = 0.2.$

$F_{AB} = -\dfrac{15 \times 0.4}{0.2}$

$\boxed{F_{AB} = -30\ KN.}$ (compression).

Displacement of B2

$F_{AB} = 60 KN.$

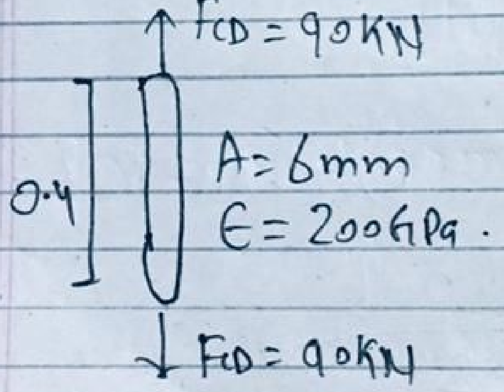


$$\delta_B = \frac{PL}{AE}$$

$$= \frac{(-30\times10^3)(0.3m)}{5\times10^{-6} m\,(70\times10^9 Pa}$$

$$\boxed{\delta_B = 0.0257 mm \uparrow}$$

Displacement of D



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

$$= \frac{(45\times10^3)(0.4)}{6\times10^{-6} mm\,(200\times10^9 Pa)}$$

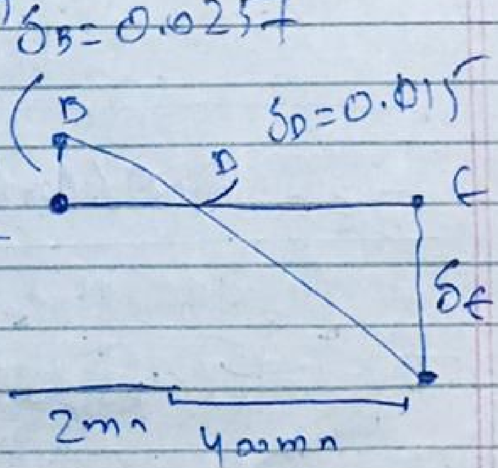
$$\boxed{\delta_D = 0.015\,mm \downarrow}$$

Displacement of E:

$$\frac{BB'}{DD'} = \frac{BH}{HD}.$$

$$\frac{0.0257\,mm}{0.015\,mm} = \frac{200\,mm - x}{x}.$$

$$\cancel{x = 200 \times 0.015}$$



$$x = \frac{200 \times 0.015}{0.0257}$$

$$x = \frac{3 - 0.015}{0.0257}$$

$$\boxed{x = 116.14\,mm}$$

$$\frac{EE}{DD} = \frac{HG}{HD}$$

$$\frac{\delta_E}{0.015} = \frac{(400 + 116.3)\,mm}{116.31}$$

$$\delta_E \times 116.1 = 516.1 \times 0.015$$

$$\delta_E = \frac{7.7415}{116.1}$$

$$\boxed{\delta_E = 0.066\,mm \downarrow}$$

Q # 1

Given data

$F = 15629\,N$

elastic limit $= 207{,}000\,kPa$.

$E = 223 \times 10^6\,kPa$.

$n = 15$

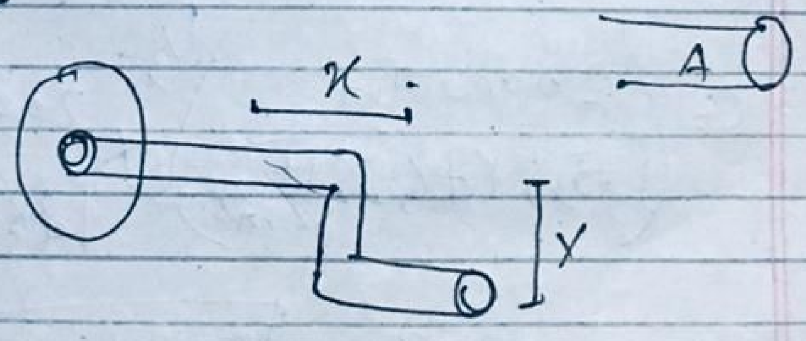
Diameter of shaft $= ?\ D$

$N = 5$

$X = 15 + 5 = \boxed{20\,cm}$

$\boxed{X = 15\,cm}$

Sol



$\tau = \frac{Tc}{J}$ $\quad c = d/2$

$J = \frac{\pi}{2} c^4$

20

$$T_{max} = \frac{Tc}{J} = \frac{Tc}{\frac{\pi}{2} c^4}$$

$T = 15629 \,kN$

$$15629 = \frac{2 \,kN_m \times c}{\frac{\pi}{2} c^4}$$

$$133{,}517{,}688 Pa = \frac{1000 Nm}{c^3}$$

$$\times \frac{Nm}{m^3} = N/m^2$$

$$c = \left(\frac{20000 Nm}{133{,}51768{,}88 N/m^2} \right)^{1/3} \times \frac{2000}{183{,}517688} m^3$$

$c = 0.0247 m = \boxed{24.7 m}$

$d = c \times 2$

$d = 24.7 mm \times 2$

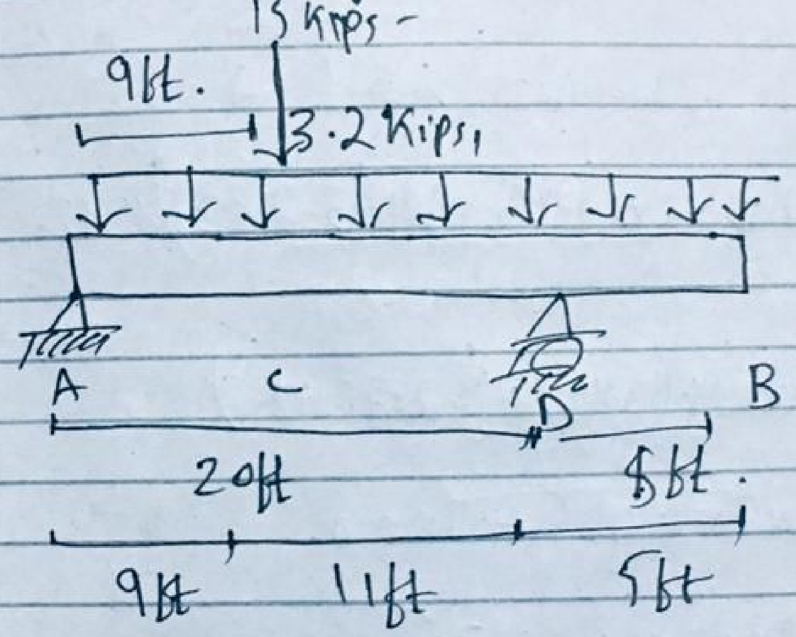
$\boxed{d = 49.4 mm}$

Q # 5,

Given data :

$$\sigma_{all} = 15 + 4 = 19\,ksi$$

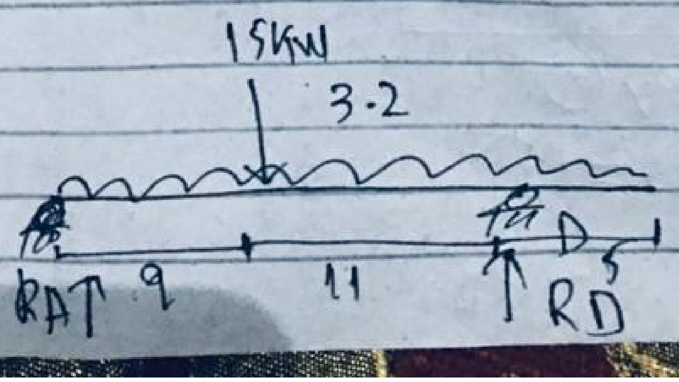
$$\tau_{all} = 15 + 1 = 16\,ksi$$



(1) Determin. reactions at A and D

Applying the condition of equilibrium

$\Sigma F_y = 0$ ↑(+) ↓(−)



$R_A + R_D - 15 - 3.2(25) = 0$

$R_A + R_D - 95 = 0$

$\therefore R_A + R_D = 95\,kN$ (1)

$\Sigma M_A = 0$ (+) (-)

taking moment about A

$-R_D \times 20 + (15 \times 9) + (3.2 \times 25) \times 12.5$

$-R_D \times 20 + (15 \times 9) + (3.2 \times 25 \times 12.5)$

$-R_D \times 20 + 135 + 1000$

$-R_D \times 20 + 1135$

$-R_D \times 20 = -1135$

$R_D = 1135/20$

$\boxed{R_D = 56.75\,kN}$

from eq (1)

$R_A + R_D = 95$

$R_A = 95 - R_D$

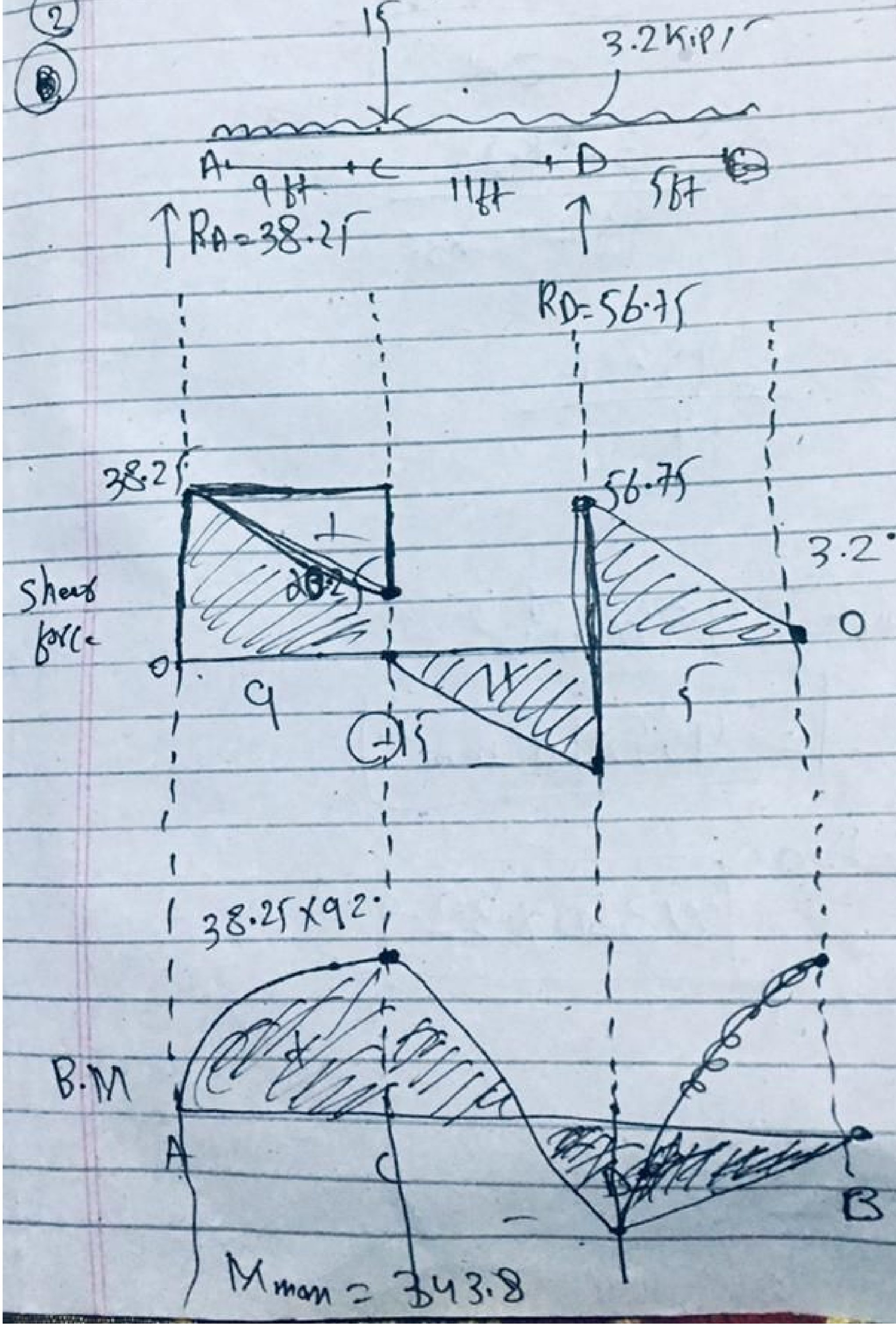
Put $R_D = 56.75$

$R_A = 95 - 56.75$

$\boxed{R_A = 38.25 \text{ K-ft}}$

(2)

(b)



(3) Calculate required Section modulas and select appropriate beam Section.

(4)

$$S_{min} = \frac{|M|_{Max}}{\sigma_{all}}$$

$$= \frac{348 \cdot Kips}{15 + 4 \, Ksi}$$

$$= \frac{348 \, Ksi}{19}$$

$S_{min} = 455 \times 10^{-6} \, m^3.$

$$\boxed{= 455 \times 10^{3} \, mm^{3}.}$$

Section.

$$\boxed{W360 \times 32 \cdot 9.}$$

(4) Max Normal stress:-

$$\sigma_m = \frac{|M|}{S} = \frac{3481 \text{ Kips}}{455 \times 10^3}$$

$$S = 455 \times 10^3$$

$$\boxed{\sigma_m = 7.56 \text{ ksi}}$$

Maximum shearing stress:

$$\sigma_m = \frac{|M|_{max}}{I} = \frac{|M|_{max}}{S}$$

$$\sigma_m = \frac{3481 \text{ Kip}}{455}$$

$$\boxed{\sigma_m = 455 \text{ ksi}}$$