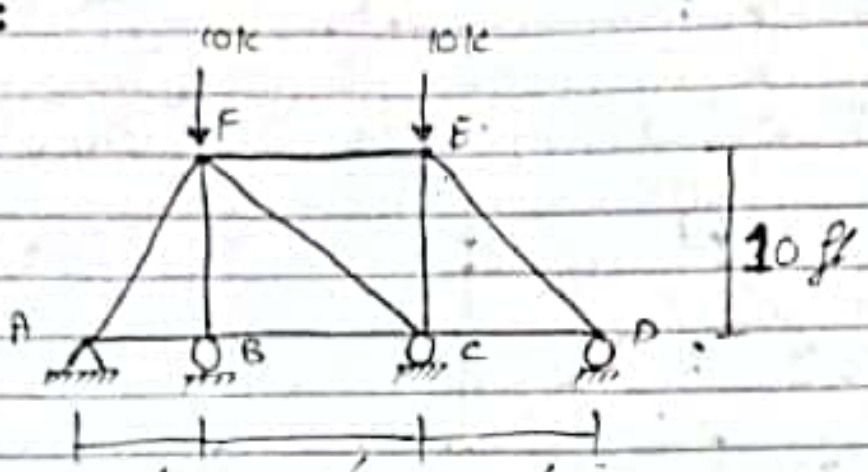
Name : Nauman Khan

ID : 6829

Subject : Theory of Structures II

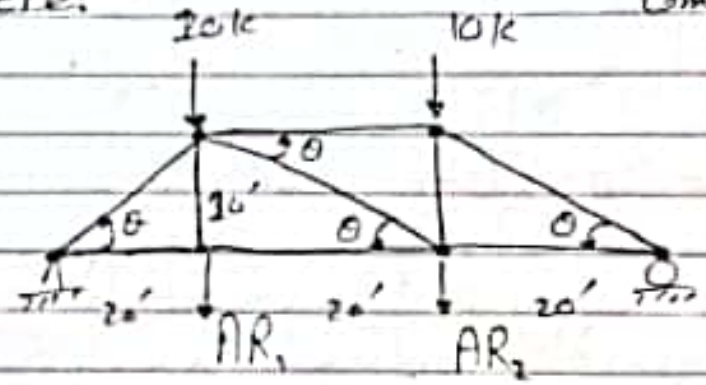
Submitted to : Engr. Humaira Arshad

Q.No 2:



Solution: Identify the redundants and obtain BDS also compute (DRS) value.

Solution:



$$[AR] = \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$[DRS] = \begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} \rightarrow \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$\tan\theta = \frac{16}{20}$$

$$\theta = \tan^{-1}\left(\frac{16}{20}\right)$$

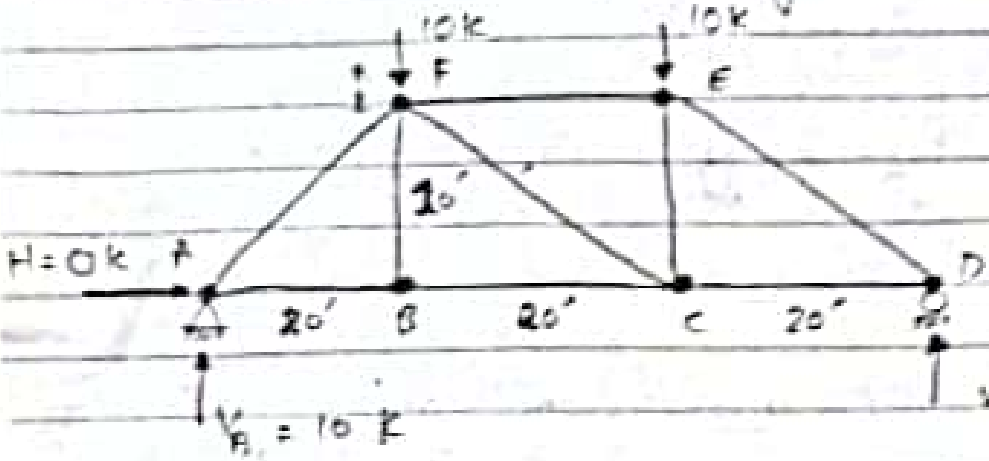
$$\theta = 26.57^\circ$$

$$\sin\theta = 0.45$$

$$\cos\theta = 0.89$$

Step # 02 :

i. BDS acted upon by the actual loads;



$\Sigma M_A = 0$

$10 \times 20 + 10 \times 40 - V_D \cdot 60 = 0$

$V_D = 10$

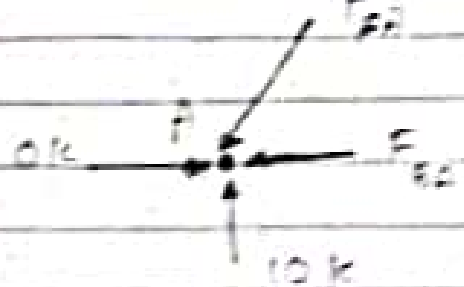
$\Sigma F_y = 0$

$V_A = 20 - 10$

$V_A = 10$ K

Now we find forces using method of joints and we will get;

Joint A :



$\Sigma F_y = 0$

$10 - F_{FA} \sin(26.57) = 0$

$F_{FA} = 22.36$ K

$\Sigma F_x = 0 : \rightarrow$

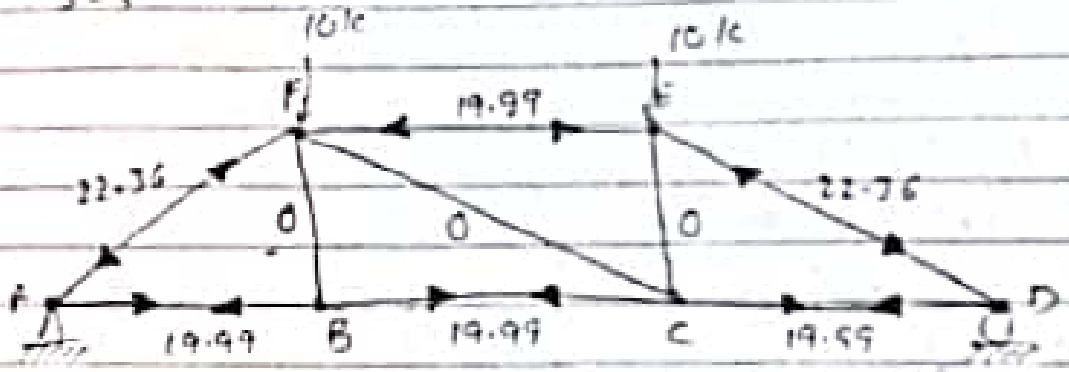
$0 - F_{BD} - F_{BD}\cos\theta = 0$

$F_{BD} = -22.36\cos(26.57)$

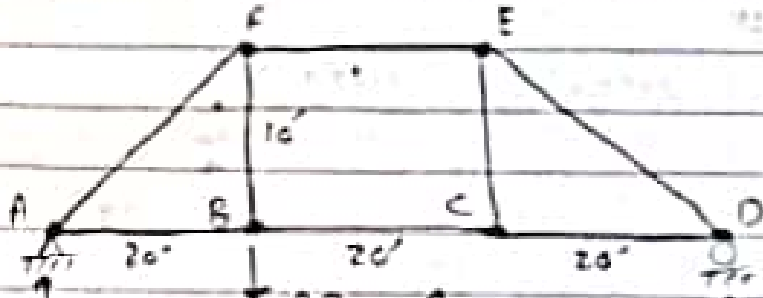
$F_{BD} = -19.99\ k$

$F_{BD} = 19.99\ k\ (\rightarrow)$

As we know our truss is symetric
So;



II. BDS acted upon by Unit load at redundant location 1.



$\Sigma M_A = 0\ \circlearrowleft^+$

$2 \times 20 - V_D \times 60 = 0$

$V_D = \frac{20}{60} = 0.33\ k$

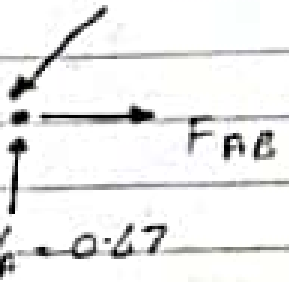
$\Sigma F_y\uparrow^+ = 0$

$V_A = 1 - 0.33$

$V_A = 0.67\ k$

Now we find all member forces using method of joints; and

Joint A:



$\Sigma F_y A = 0$

$-0.67 + F_{FF} \sin(26.57) = 0$

$F_{FA} = 1.4997$ k

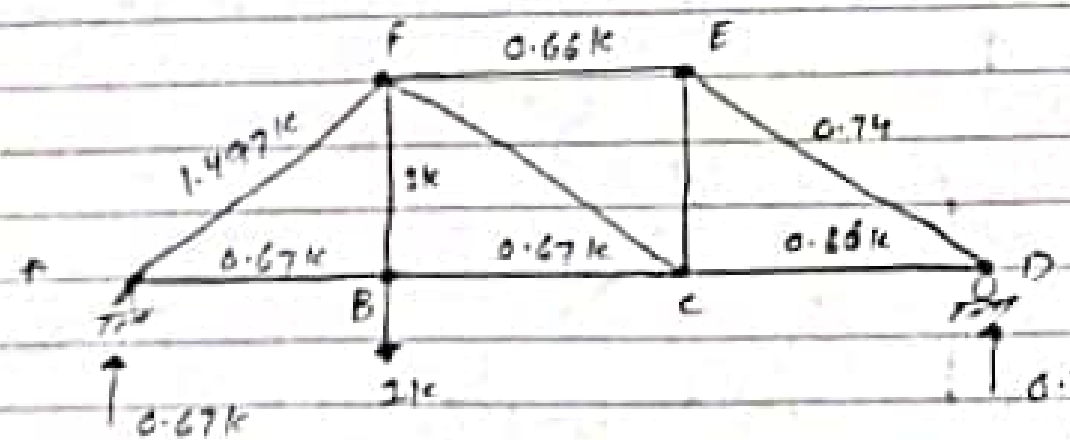
$\Sigma F_x = 0 \rightarrow$

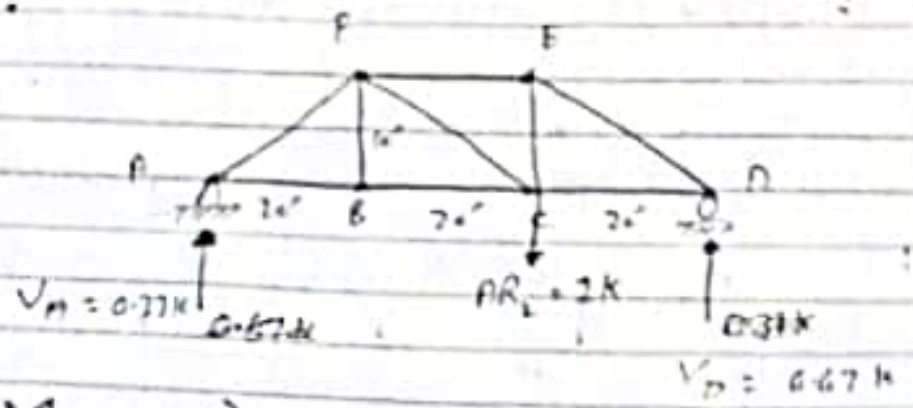
$F_{AB} - F_{FA} \sin\theta = 0$

$F_{AB} = 1.4997 \sin(26.47)$

$= 0.67$ k

Hence;





$\Sigma M_A = 0$ +)

V_D

$2 \times 40 - 0.33 \times 60 = 0$

$V_D = 0.67$

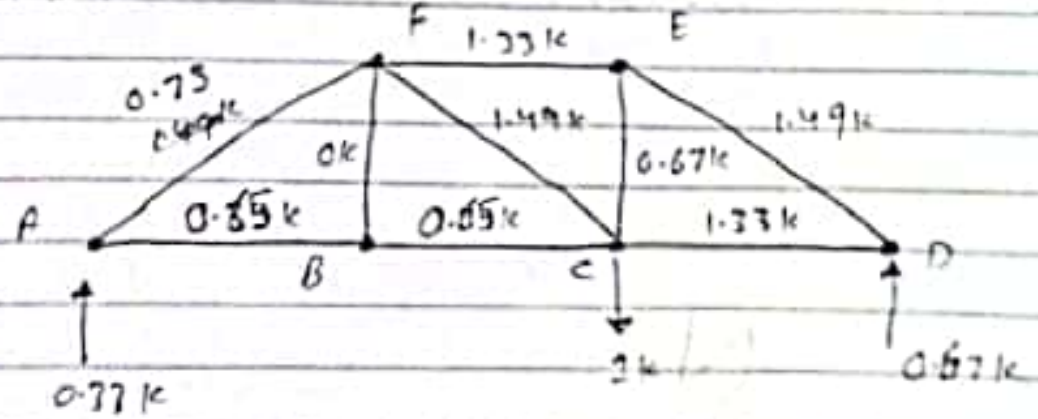
$\Sigma F_y \uparrow + = 0$

$V_A = 2 - 0.67$

$V_A = 0.33$

Now we find the member forces using method of joints as:

Joint A



Step #3: Member forces Table

B

Member	AE	Length L_i (ft)	P_i Values	U_{1i} Values	U_{2i} Values
AB		20	19.99	1.33	0.65
BC		20	19.99	1.33	0.65
CD		20	19.99	0.66	1.33
DE		22.36	22.36	0.74	1.49
EF	Constants	20	19.99	0.66	1.33
AF		22.36	22.36	1.497	0.73
BF		10	0	1	0
CF		22.26	0	0.74	1.49
CF		10	0	0.33	0.67
		22.26			

Step #4:

Q No 1

Given data:

$E = 30000$ ksi

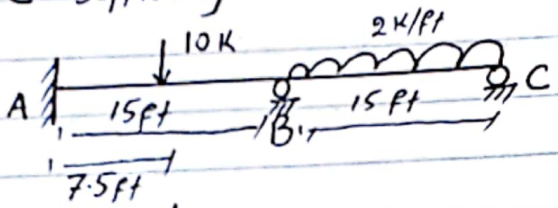
$I = 800\ in^4$

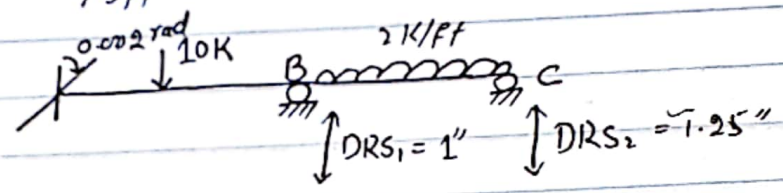
$EI = 166666.6\ K\text{-}ft^2$

S.I = 2 degree So two Redunfant action Should be choosen.

Support B Settles by 1 inch

Support C Settles by 1.25 inch



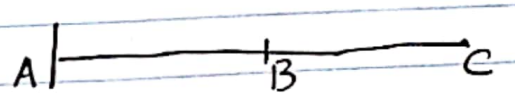


=> Step 1

$$\Rightarrow [AR]_{2\times1} = \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

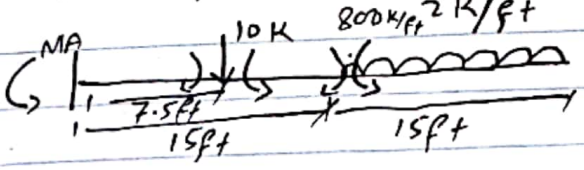
$$\Rightarrow [DRS]_{2\times1} = \begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 1'' \\ 1.25'' \end{bmatrix} = \begin{bmatrix} 0.0833' \\ 0.10416' \end{bmatrix}$$

Now primary structure.



=> Step 2: Compute value of DRL

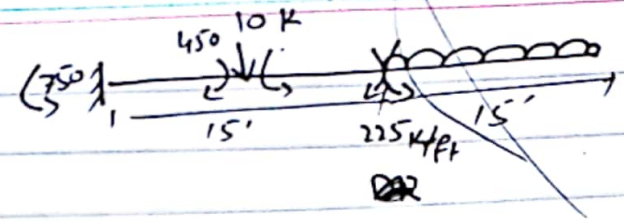
Now Moment



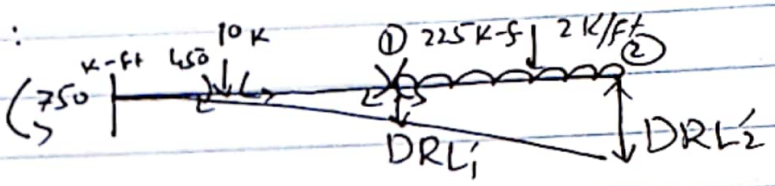
$\zeta \Sigma M_A = 0$

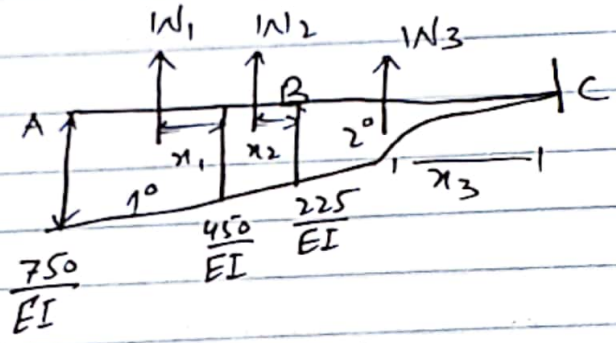
$$M_A - 10\times7.5 - 2\times15\times22.5 = 0$$

$$\Rightarrow \boxed{M_A = 750\ K\text{-}ft}$$



Real Beam:





$$IN_1 = \frac{1}{2}\left(\frac{750+450}{EI}\right)7.5 = \frac{4500}{EI}$$

$$IN_2 = \frac{1}{2}\left(\frac{450+225}{EI}\right)7.5 = \frac{2531.25}{EI}$$

$$IN_3 = \frac{1}{3}\left(\frac{225}{E}\right)15 = \frac{375}{EI}$$

$$x_1 = \frac{7.5}{3}\left(\frac{450+2(750)}{450+750}\right) = 4.0625'$$

$$x_2 = \frac{7.5}{3}\left(\frac{225+2(450)}{225+450}\right) = 4.166'$$

$$x_3 = \frac{3}{4}(15) = 11.25'$$

$$\Rightarrow DRL_1 = IN_1(x_1 + 7.5) + IN_2(x_2)$$

$$= \frac{4500}{EI}(4.0625 + 7.5) + \frac{375}{EI}(4.166)$$

$$= \frac{53593.5}{EI}$$

$$\Rightarrow DRL_2 = \frac{4500}{EI}(4.0625 + 22.5) + \frac{2531.25}{EI}(4.166 + 15)$$

$$+ \frac{375}{EI}(11.25')$$

$$= \frac{172263.93}{EI}$$