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ID No 6264

Section No # B

paper structure analysis II

Date 25/09/2020

University Fata University National peshawar.

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MND (02) problems

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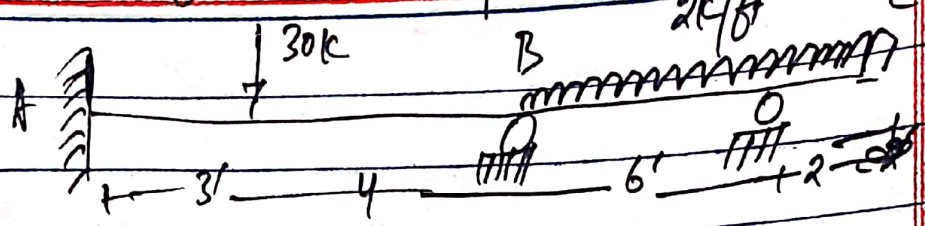


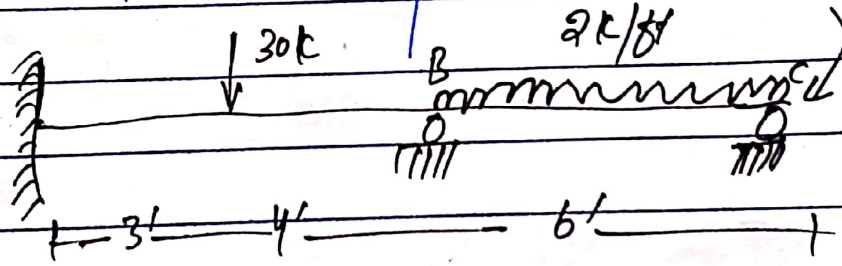
Sol:-

Step (1):-

Determining Kinemati Indeterminancy.

K.I = 5°

So, we have to reduce the Extended portion.



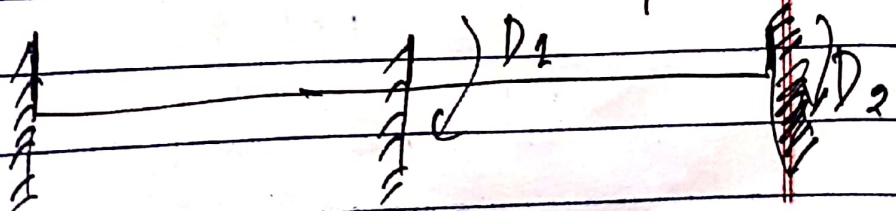
$= \frac{2(2)}{1} = 4\ k\cdot ft.$

Now

K.I = 2°.

Step No #02:-

Determine unknown Joint Displacement.



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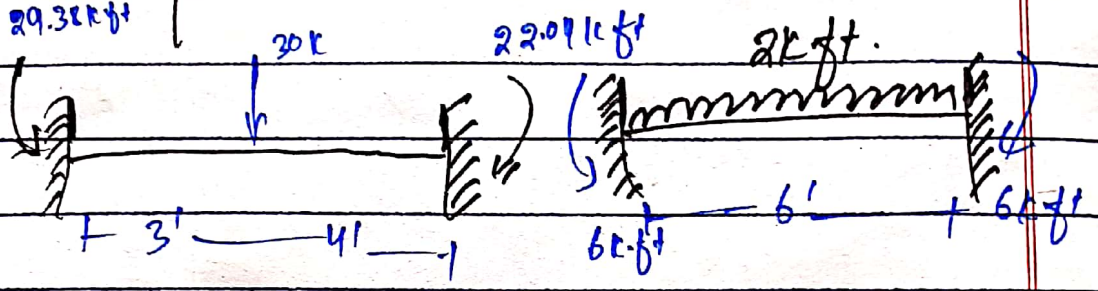
$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \qquad \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$$

① Step No #03 ⑧.

Compute [ADL] Matrix.



⇒ For pointed load (not at mid)

⇒ For left end. ⑧

$$= \frac{Pa^2b}{L^2} = \frac{(30)(3)^2(4)}{(7)^2} = 29.38 \text{k-ft}.$$

⇒ For Right ~~hand~~ End: ⑧.

$$= \frac{Pa^2b}{L^2} = \frac{(30)(3)^2(4)}{(7)^2} = 22.04 \text{k-ft}.$$

⇒ For UDL ⑧.

$$\frac{WL^2}{12} \rightarrow \frac{(2)(6)^2}{12} = 6 \text{k-ft}.$$

$ADL_1 = +22.04 - 6 = 16.04$ k.ft.

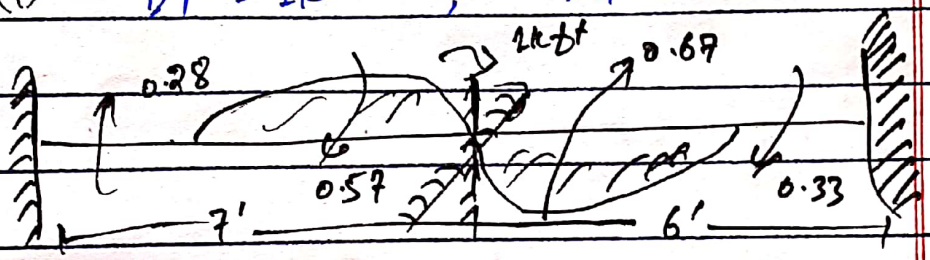
$ADL_2 = 6$ k.ft.

Step No # 04:-

Compute [S] Matrix.

$$S = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$$

(a) $D_1 = 1$k , $D_2 = 0$



$\frac{4EI}{7} = 0.57$

$\frac{4EI}{6} = 0.67$

$\frac{2EI}{6} = 0.33$

$\frac{2EI}{7} = 0.28$

$S_{11} = 0.57 + 0.67$

$= 1.24EA.$

$S_{21} = 0.33EA$

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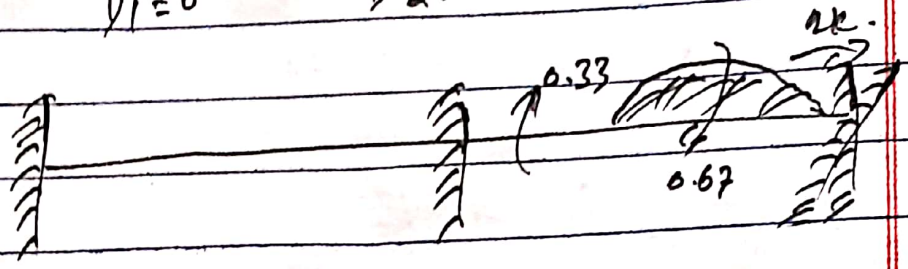
(b) $D_1 = 0$ $D_2 = 1k$.



$$\frac{4EI}{6} = 0.67.$$

$$\frac{2EI}{6} = 0.33$$

$$S_{12} = 0.33$$

$$S_{22} = 0.67.$$

$$S = \begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}$$

Step No #05 ⑤

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}^{-1} \times \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} - \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix}$$

$$\begin{bmatrix} D_2 \\ D_2 \end{bmatrix} = \begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}^{-1} \times \begin{bmatrix} 0-16.04 \\ 4-6 \end{bmatrix}$$

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$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}^{-1} \times \begin{bmatrix} -16.04 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} -13.9 \\ 3.89 \end{bmatrix}$$

$$[AM] = [AML] + [AMD] \times [D]$$

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{bmatrix} = \begin{bmatrix} 15 \\ 15 \\ 6 \\ 6 \\ 29.38 \\ 22.04 \\ 6 \\ 6 \end{bmatrix} + \begin{bmatrix} -0.12 & 0 \\ 0.12 & 0 \\ -0.16 & -0.16 \\ 0.16 & 0.16 \\ -0.28 & 0 \\ 0.57 & 0 \\ -0.67 & -0.33 \\ -0.33 & 0.67 \end{bmatrix} \times \begin{bmatrix} -13.9 \\ 3.89 \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{bmatrix} = \begin{bmatrix} 15 \\ 15 \\ 6 \\ 6 \\ 29.38 \\ 22.04 \\ 6 \\ 6 \end{bmatrix} + \begin{bmatrix} +1.668 \\ -1.668 \\ -11.6016 \\ +13.392 \\ -7.9 \\ +18.0243 \\ -6.0807 \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{bmatrix} = \begin{bmatrix} 16.668 \\ 13.332 \\ 7.6 \\ 4.3984 \\ 33.272 \\ 14.14 \\ 0 \end{bmatrix}$$

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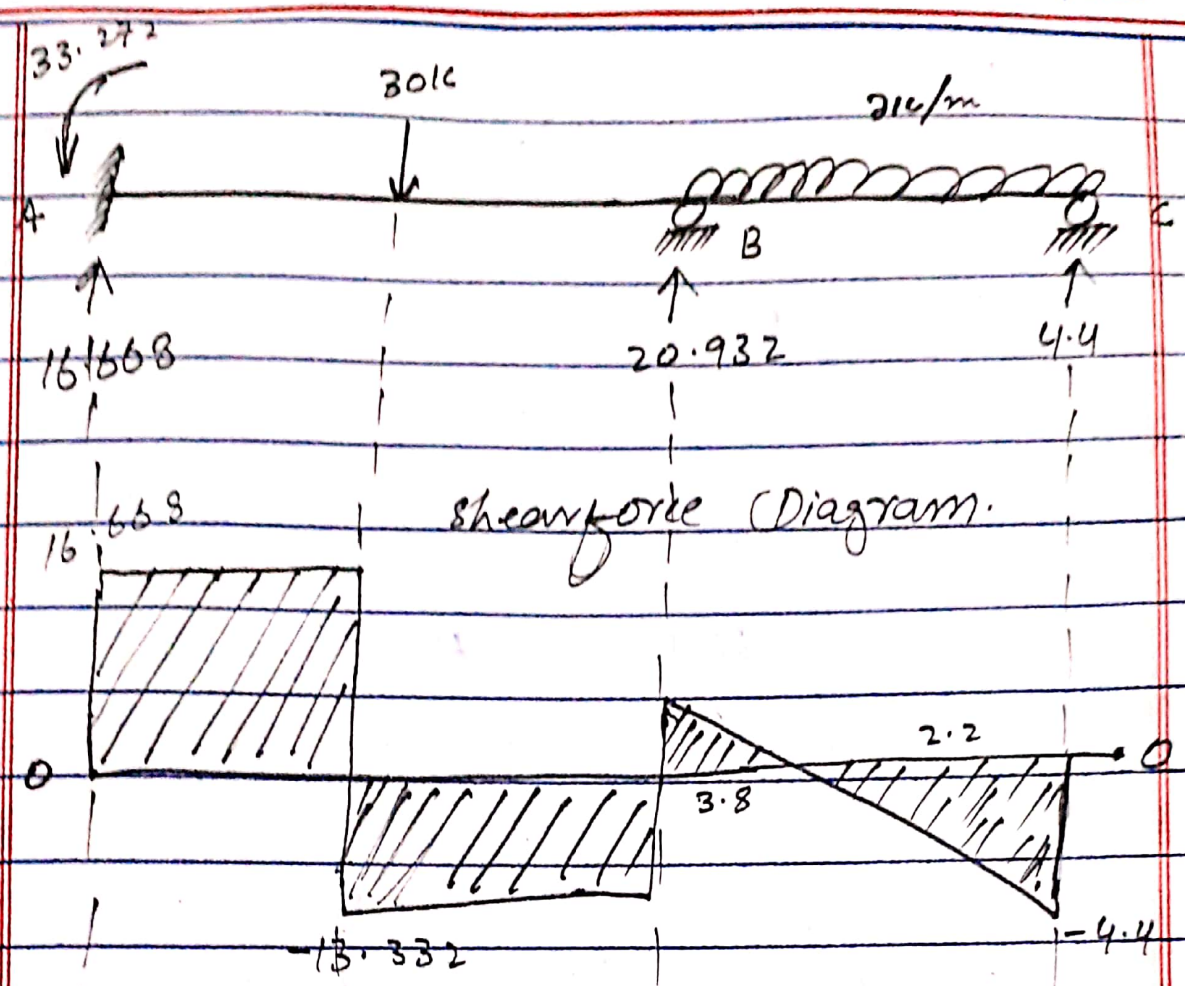
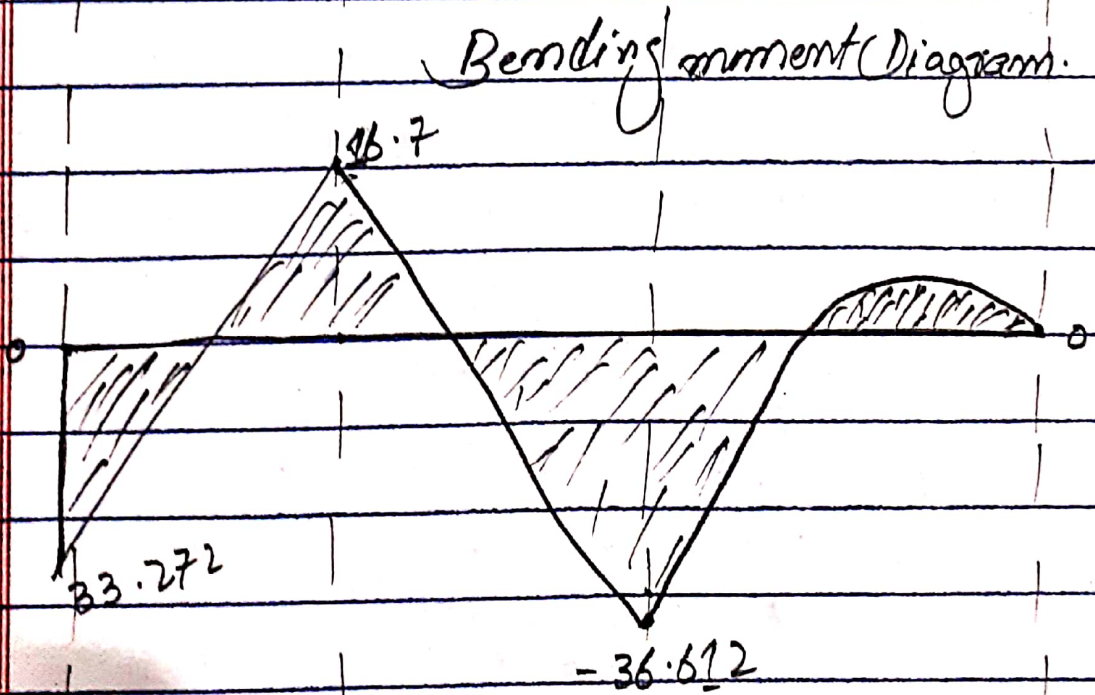
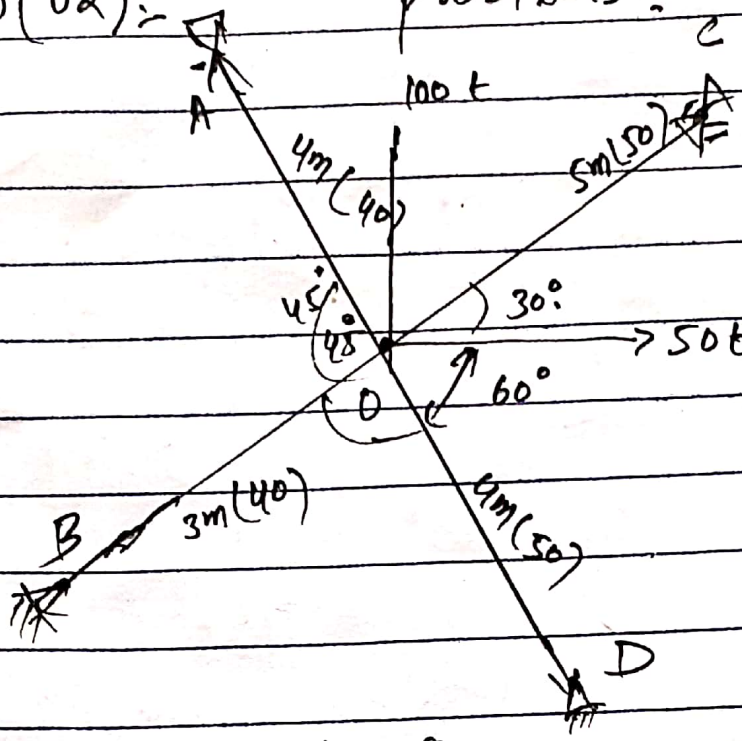




Q NO (02):- Problems.



Sol:- ① For A ①.

$$\sin 45^\circ = \frac{P}{h} = \frac{P}{4}$$

$$\Rightarrow P = 2.828\ m$$

$$\cos 45^\circ = \frac{b}{4}$$

$$\Rightarrow b = 2.828\ m.$$

① For 'B' ①

$$\sin 45^\circ = \frac{P}{3}$$

$$\Rightarrow P = 2.12\ m.$$

$\cos 45° = \frac{b}{h}$

$\Rightarrow b = 2.12\ m$

④ For 'P' ⑧.

$\sin 30° = \frac{P}{h=5}$

$\Rightarrow P = 2.5\ m.$

$\cos 30° = \frac{b}{5}$

$\Rightarrow b = 4.33\ m.$

NOW.

$E_{A(A)} = 2000 \times 40 = 80,000\ t.$

$EA_{(B)} = 2000 \times 40 = 80,000\ t.$

$EA_{(C)} = 2000 \times 50 = 100,000\ t$

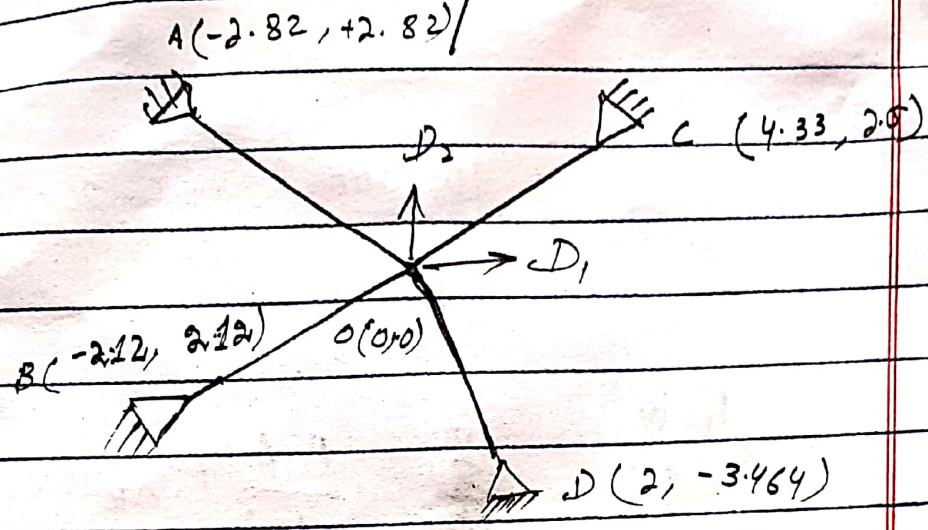
$= 2000 \times 50 = 100,000\ t.$

④ Step #01 ⑧. K I.

$K.I = 2j - r$

$= 2(5) - 8 = 2°$

Step #02 :- Select unknown Joint + displacement.



$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 50 \\ -100 \end{bmatrix}$$

Step NO #03 :- $[AMD]_{4\times2} \{S\}_{2\times2}$

(i) $D_1 = 1$, $D_2 = 0$.

$$AMD = \frac{EA}{L^2}(X_{IC} - X_j)$$

$$AMD_{11} = \frac{80,000}{(400)^2} \times (0+282) = 141$$

$$AMD_{621} = \frac{80,000}{(300)^2} \times (0+212) = 188.44$$

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$$AMD_{31} = \frac{100,000}{(500)^2} \times (0-433) = -173.2$$

$$AMD_{41} = \frac{100,000}{(400)^2} \times (0-200) = -125$$

Now

$$S_{11} = \sum_{i=1}^{m} \frac{EA}{L^3} (x_{ic} - x_j)^2$$

$$= \frac{80,000}{(400)^3} \times (282)^2 + \frac{80,000}{(300)^3} \times (212)^2 +$$

$$\frac{100,000 \times (-433)^2}{(500)^3} + \frac{100,00}{(400)^3} \times (-200)^2$$

$$S_{11} = 99.405 + 133.107 + 149.991 + 82.5$$

$$S_{11} = 445.063.$$

$$S_{12} = S_{21} = \sum_{i=1}^{m} \frac{EA}{L^3} \times (x_{ic} - x_j)$$

$$(y_k - y_j).$$

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$$= \frac{80,000}{(400)^3} \times (282)(-282) + \frac{80,000}{(300)^3} \times (212)(212)$$

$$+ \frac{100,000}{(500)^3} \times (-433)(0-250) + \frac{100,000}{(400)^3} \times (-200)(0+340).$$

$$S_{12} = S_{21} = 12.237.$$

(ii) $D_1 = 0$, $D_1 = 1k'$

$$AMD = \frac{EA}{L^2}(y_k - y_j).$$

$$AMD_{12} = \frac{80,000}{400^2}(-282) = -141.$$

$$AMD_{22} = \frac{80,000}{300^2}(212) = 188.44$$

$$AMD_{32} = \frac{100,000}{500^2}(-250) = -100$$

$$AMD_{42} = \frac{100,000}{400^2}(346) = 216.25$$

NOW , $$S_{22} = \sum_{i=2}^{m} \frac{EA}{L^3}(y_k - y_j)^2.$$

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$$= \frac{80,000}{400^3}(-282)^2 + \frac{80,000}{300^3}(212)^2 + \frac{100,600}{500^3}(-250)^2 + \frac{100,000}{400^3}(346)^2$$

$$S_{22} = 469.628.$$

Step No #04:-

$$[D] = [S]^{-1} \times [AD]$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 445.003 & 12.237 \\ 12.237 & 469.628 \end{bmatrix}^{-1} \begin{Bmatrix} 50 \\ -100 \end{Bmatrix}.$$

$$\begin{Bmatrix} D_1 \\ D_2 \end{Bmatrix} = \begin{Bmatrix} 0.1183 \\ -0.216 \end{Bmatrix}.$$

Step No #6 [AM].

$$\begin{Bmatrix} AM_1 \\ AM_2 \\ AM_3 \\ AM_4 \end{Bmatrix} = \begin{bmatrix} 141 & -141 \\ 188.44 & 188.44 \\ -173.2 & -100 \\ -125 & 216.25 \end{bmatrix} \times \begin{bmatrix} 0.1183 \\ -0.216 \end{bmatrix}$$

$$= \begin{bmatrix} 141 \times 0.1183 + (-141) \times (0.216) \\ 188.44 \times 0.1183 + 188.44 \times (-0.216) \\ -173.2 \times 0.1183 + (-100) \times (-0.216 \\ -125 \times 0.1183 + 216.25 \times [0.216) \end{bmatrix}$$

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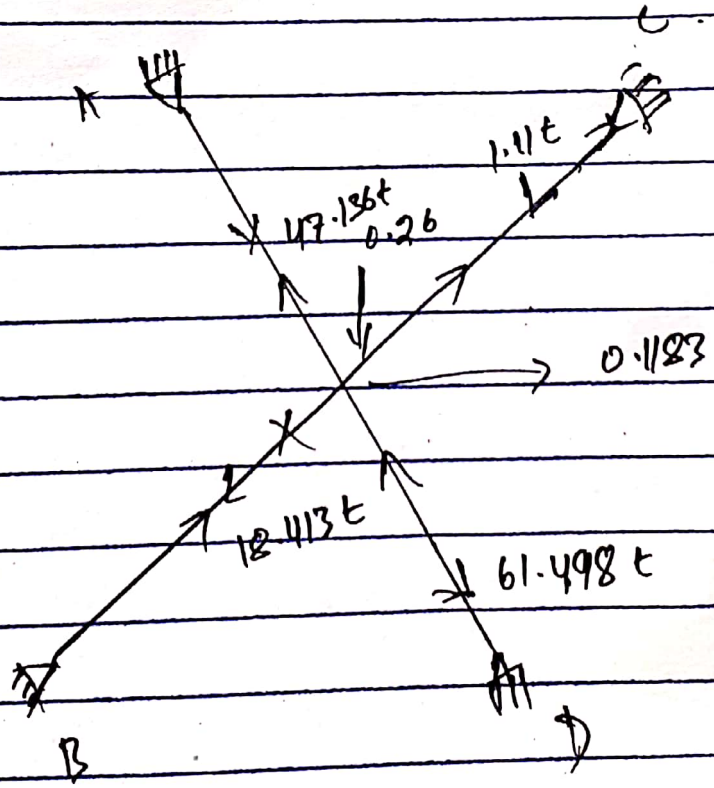
$$\begin{bmatrix} AM_1 \\ AM_2 \\ AM_3 \\ AM_4 \end{bmatrix} = \begin{bmatrix} 16.68 + 30.46 \\ 22.29 - 40.70 \\ -20.49 + 21.6 \\ -14.79 - 46.71 \end{bmatrix}.$$

$$\begin{bmatrix} AM_1 \\ AM_2 \\ AM_3 \\ AM_4 \end{bmatrix} = \begin{bmatrix} 47.136\,t \\ -18.413\,t \\ 1.11\,t \\ -61.498\,t \end{bmatrix}.$$



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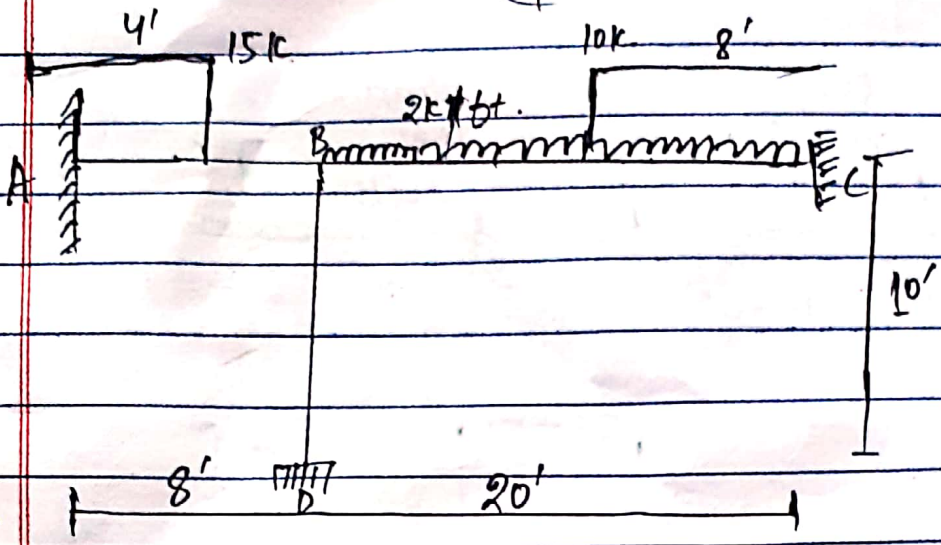
QNo(03):- (problems :-)..



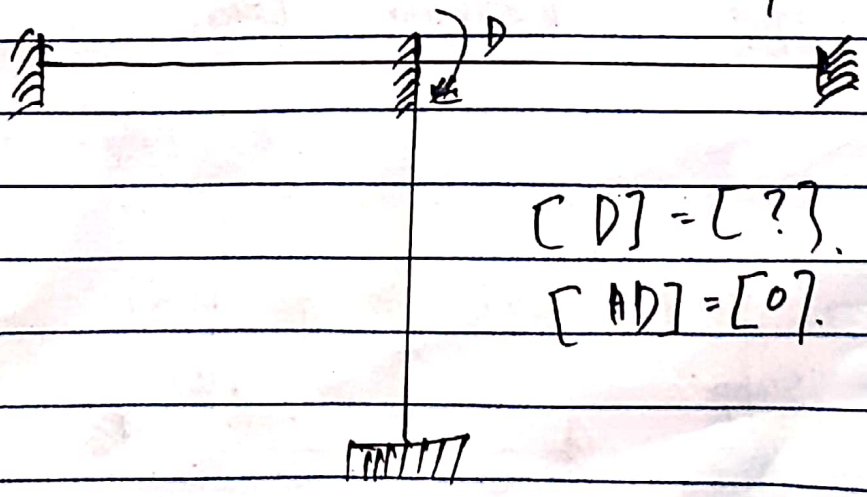
Sol:- ① Step No #01:- ①.

Determine kinematic indeterminancy.

K.I = 1°.

① Step No #02:- ①.

Determine Unknown Joint Displacement.



[D] = [?].

[AD] = [0].

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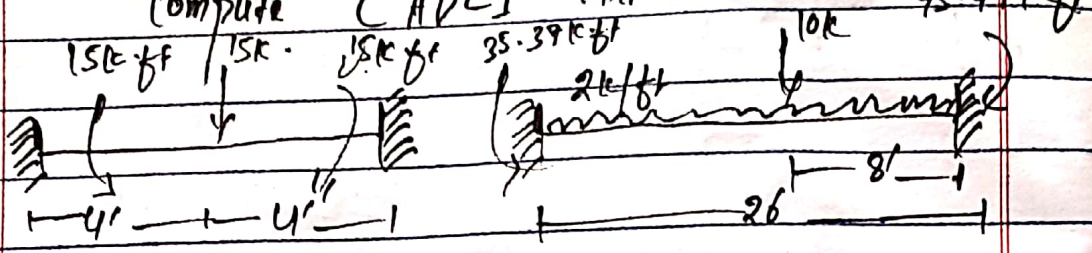
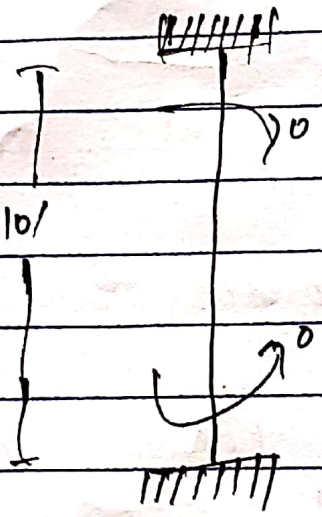
Step No #03:-

Compute [ADL] Matrix.





⇒ Point Load at center.

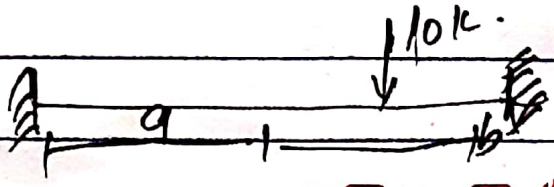
$$\frac{PL}{8} \Rightarrow \frac{(15)(8)}{8} = 15 \text{ k-ft.}$$

⇒ Uniformly Distributed Load.

$$\frac{WL^2}{12} \Rightarrow \frac{(2)(20)^2}{12} = 66.67 \text{ k-ft.}$$

⇒ Point Load (Not at mid).

Suppose



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① For left End. ②

$$\frac{Pab^2}{L^2} \Rightarrow \frac{(10)(12)(8)^2}{(20)^2} = 19.2 \text{ k-ft}$$

② For Right End ①.

$$\frac{Pa^2b}{L^2} = \frac{(10)(12)^2(8)}{(20)^2} = 28.8 \text{ k-ft}$$

So total ~~k-ft~~ Moment at left end:-

$$19.2 + 66.67 = 85.87 \text{ k-ft.}$$

Similarly at right End.

$$28.8 + 66.67 = 95.47 \text{ k-ft.}$$

So $[AD] = -85.87 + 15 = -70.87$ k-ft

Step No # 4:-

Determine [S] Matrix.

Now

D = 1k.

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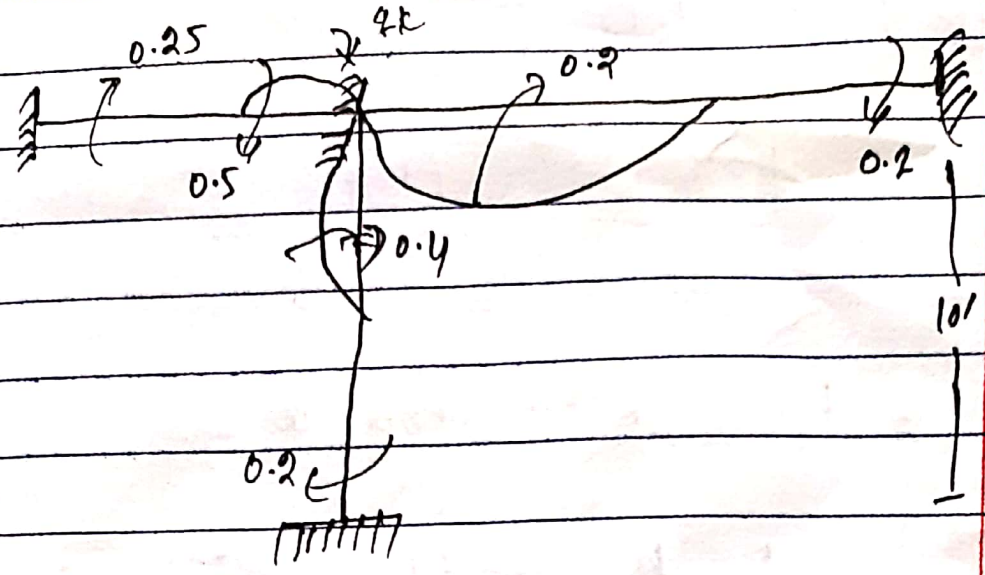

$\Rightarrow \frac{4EI}{8} = 0.5$ $\quad \frac{2EI}{8} = 0.25$

$\Rightarrow \frac{4EI}{20} = 0.2$ $\quad \frac{2EI}{20} = 0.1$

$\Rightarrow \frac{4EI}{10} = 0.4$ $\quad \frac{2EI}{10} = 0.2.$

$[S] = (0.5 + 0.4 + 0.2)\,EI$

$= 1.1\,EI$

$[S] = "\ 1.1\,EI).$

Step No. #5:-

Compute [D] Matrix

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$$[D] = [S]^{-1} \times [AD] - [ADL]$$

~~$[D] = [S]^{-1}$~~

$$[D] = \frac{1}{1.1} \times [0] - [-70.87].$$

$$= \frac{70.87}{1.1}$$

$$D = [64.42] \frac{1}{EI}$$