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I.D 7869

Section B

Subject Structure Analysis II

Submitted To;

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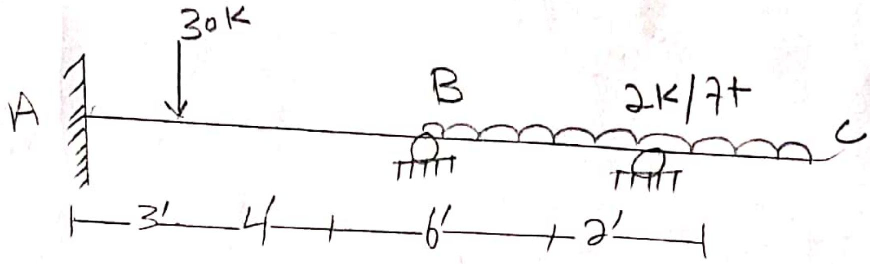
IQRA NATIONAL UNIVERSITY

Q No 1::



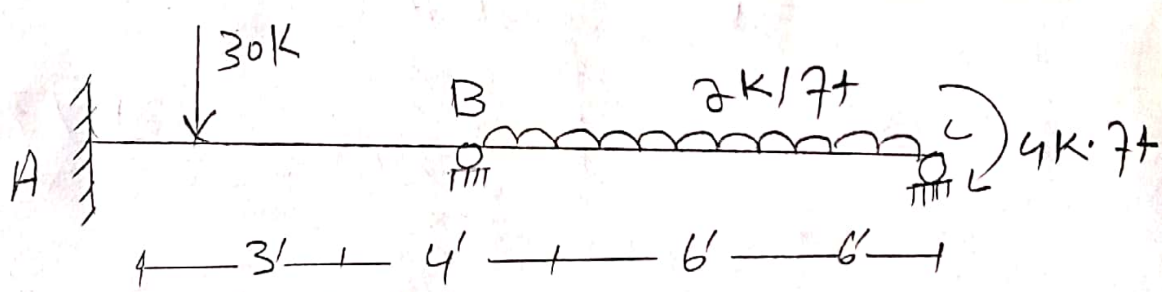
Sol::

Step #1::

Determing kinematic Indeterminacy.

K. I = 5°

So we have to reduce the extended portion.



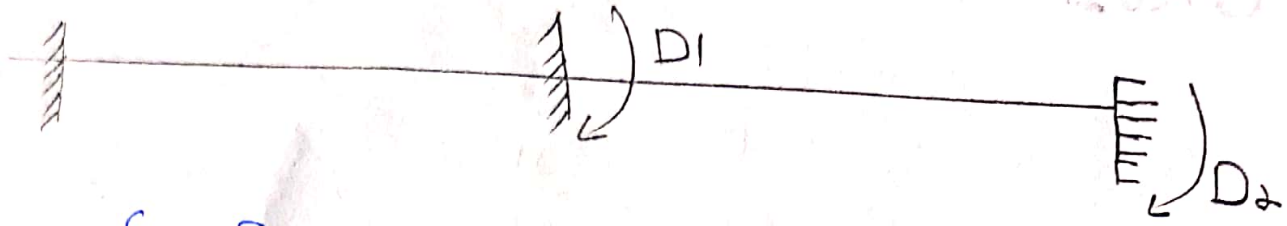
$$\Rightarrow \frac{2(2)}{1} = 4\,K.ft$$

Now

K.I = 2°

Step # 2

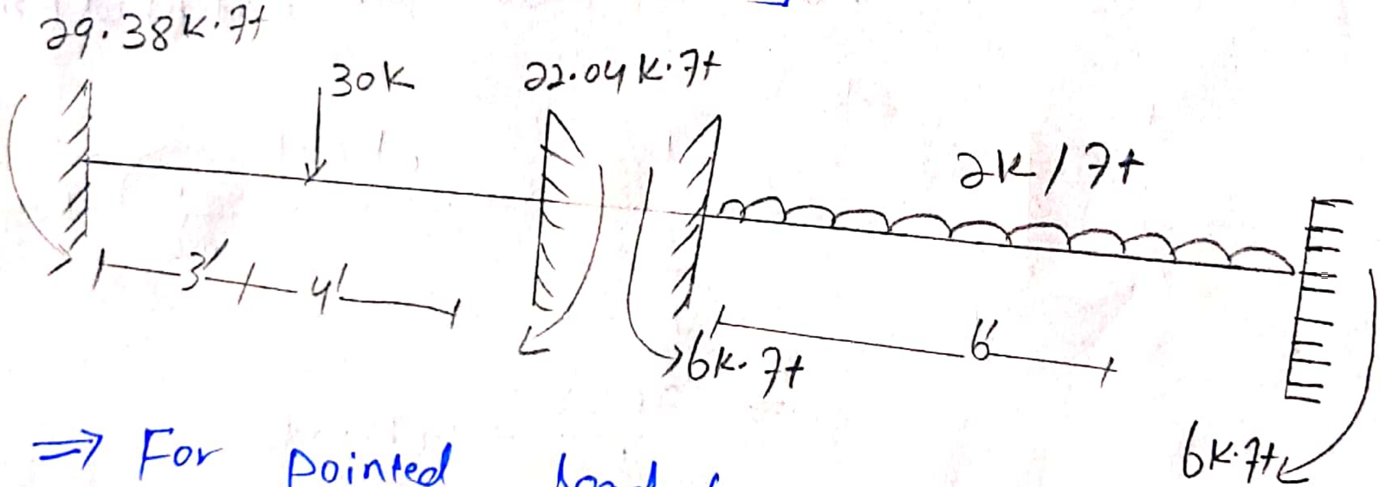
Determine unknown Joint Displacement



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

Step #3
= =

compute $[ADL]$ matrix.



⇒ For pointed load (not at mid)
⇒ For left end:

$$= \frac{Pab^2}{L^2} = \frac{(30)(3)(4)^2}{(7)^2} = 29.38\,K.ft$$

(3)

$\Rightarrow$ For Right end:

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

$\Rightarrow$ For UDL:

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

$AD\,L_1 = +22.04 - 6 = 16.04 k.ft$

$AD\,L_2 = 6 k.ft$

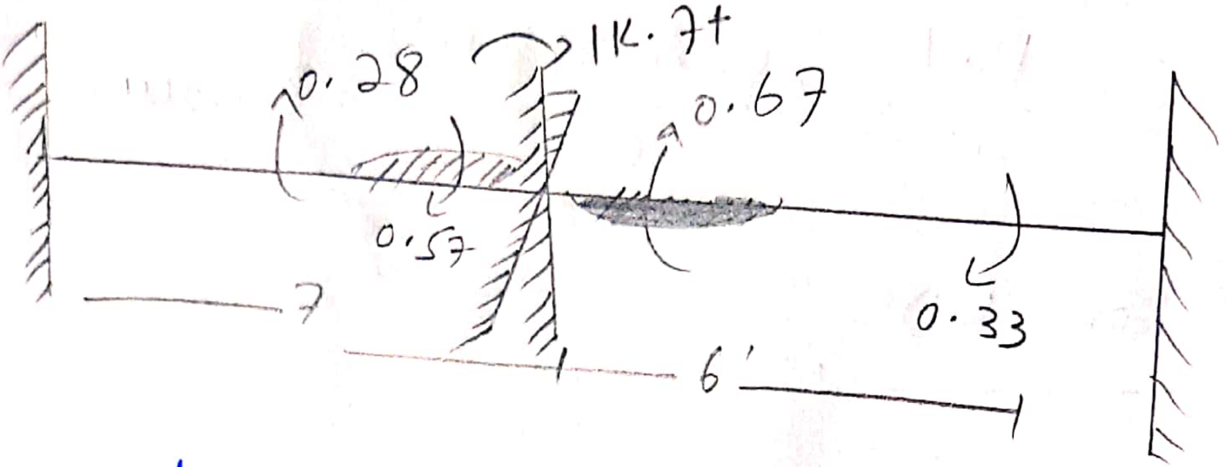
Step #4:

compute [S] Matrix

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

(4)

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



$$\frac{4EI}{7} = 0.57 \qquad \frac{2EI}{6} = 0.33$$

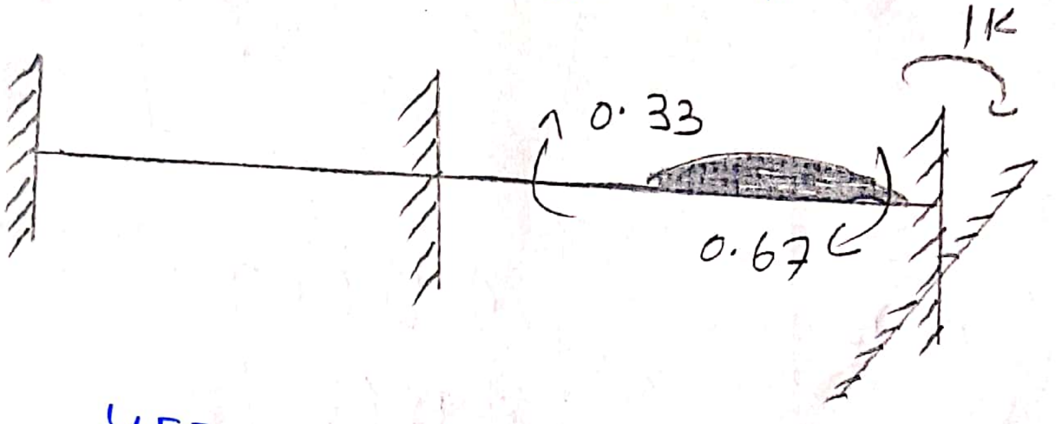
$$\frac{4EI}{6} = 0.67 \qquad \frac{2EI}{7} = 0.28$$

$$S_{11} = 0.57 + 0.67$$
$$= 1.24EA$$

$$S_{21} = 0.33\ EA$$

(5)

(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 # 5:

compute [D] matrix

Scanned with CamScanner

(6)

$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} S11 & S12 \\ S21 & S22 \end{bmatrix}^{-1} x$$

$$\begin{bmatrix} AD1 \\ AD2 \end{bmatrix} - \begin{bmatrix} ADC1 \\ ADC2 \end{bmatrix}$$

$$= \frac{1}{\begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}} \times \text{Adj} A \times \boxed{0\ 4}$$

$$\begin{bmatrix} 16.04 \\ 6 \end{bmatrix}$$

$$|S| = (1.24 \times 0.67) - (0.33 \times 0.33)$$

$$= 0.8308 - 0.1087$$

$$|S| = 0.7219$$

$$\text{Adj } A = \begin{bmatrix} 0.67 & -0.33 \\ -0.33 & 1.24 \end{bmatrix}$$

Scanned with CamScanner

(7)

Now

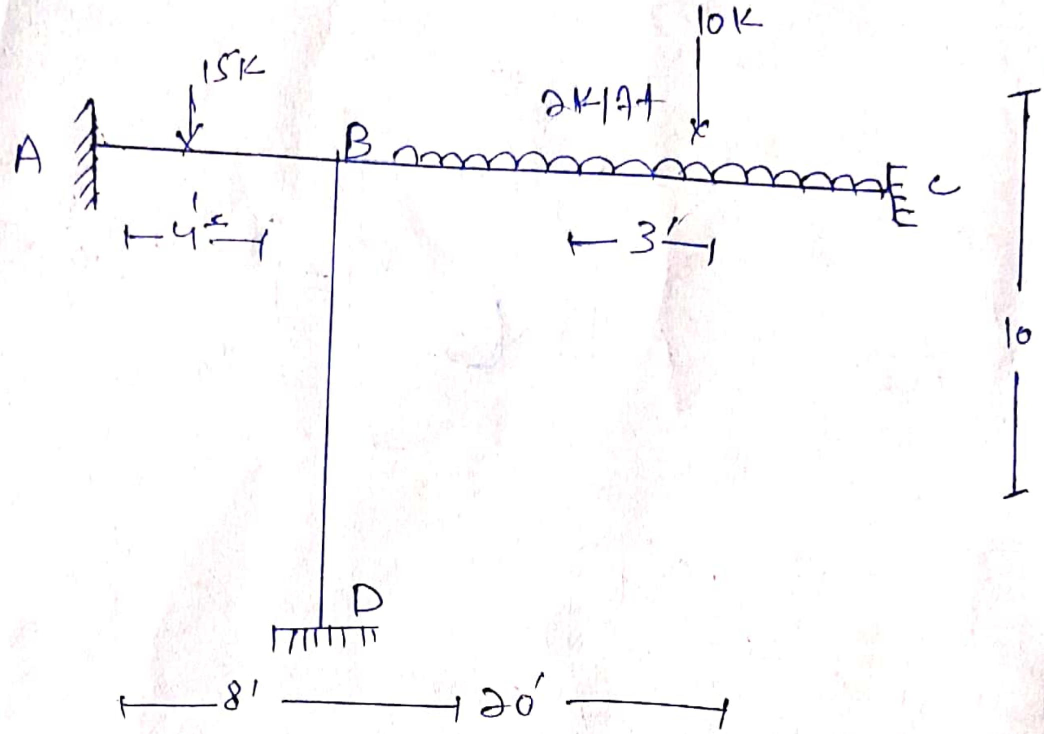
$$\begin{bmatrix} AD_1 & -AD_{L1} \\ AD_2 & AD_{L2} \end{bmatrix} = \begin{bmatrix} 0-16.04 \\ 4-6 \end{bmatrix}$$

$$= \begin{bmatrix} -16.04 \\ -2 \end{bmatrix} E$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \frac{\begin{bmatrix} 0.67 & -0.33 \\ -0.33 & 1.24 \end{bmatrix}}{0.7219} \times \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} -13.915 \\ 3.894 \end{bmatrix}$$

Q No 2.80



Sol::

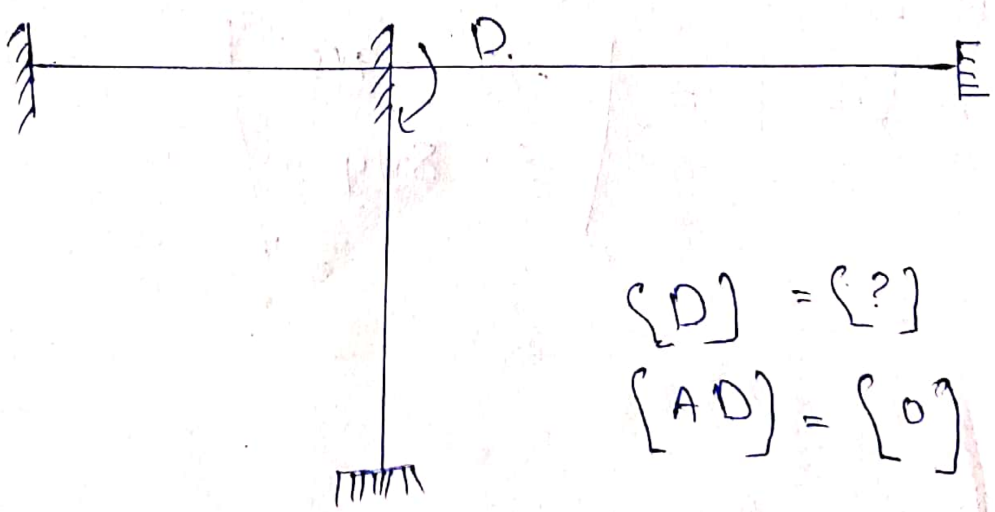
Step #1::

Determine Kinematic Indeterminancy

K. I = 1°

Step # 2::

Determine Unknown Joint Displacement

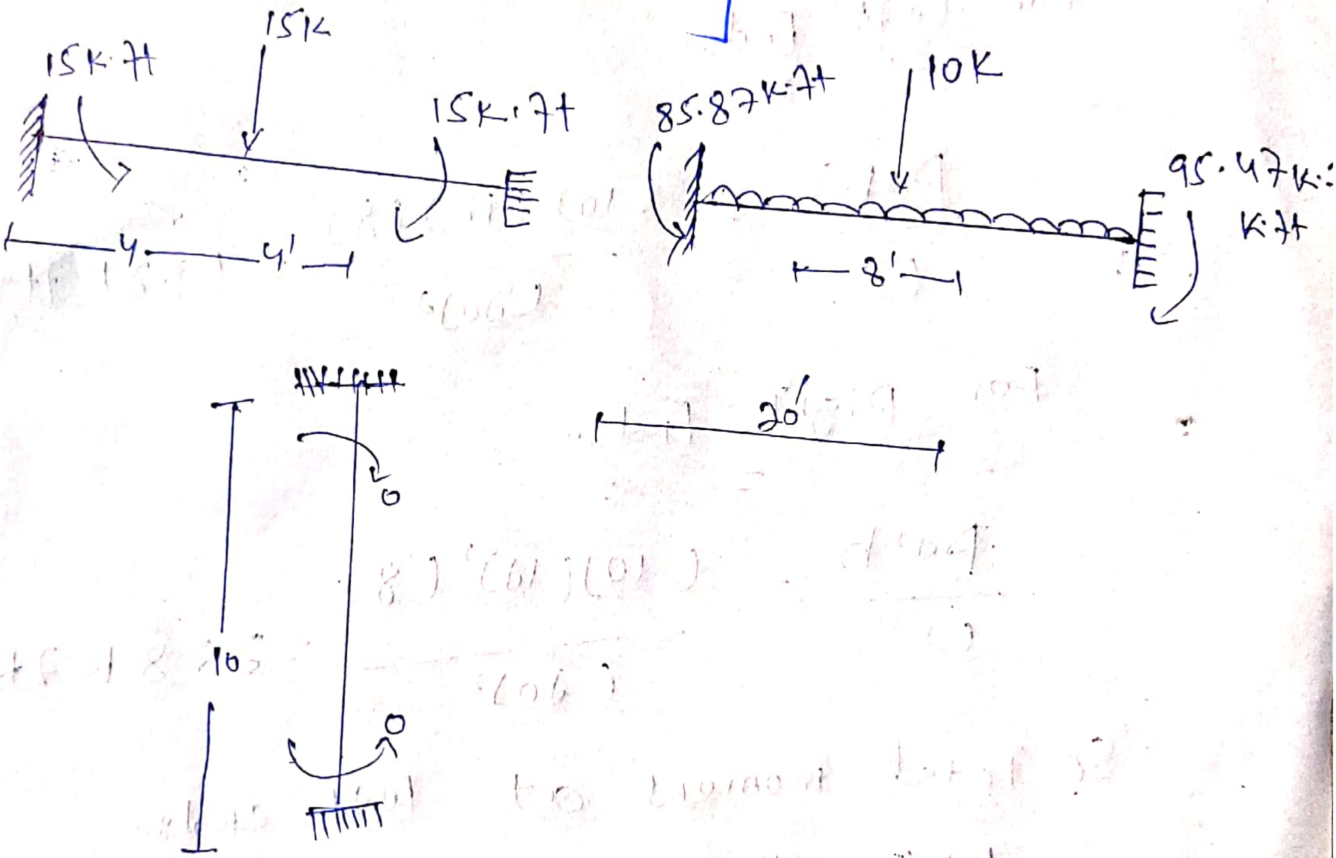


$\{D\} = \{?\}$

$\{AD\} = \{0\}$

Step #3

Compute [ADL] matrix



⇒ Point Load at center:-

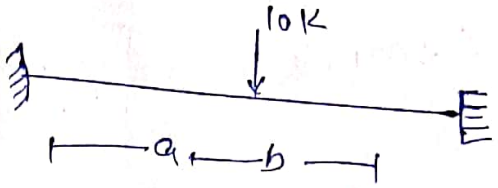
$$\frac{PL}{8} \rightarrow \frac{(15)(8)}{8} = 15 \text{ Kip.ft}$$

⇒ uniformly Distributed Load.

$$\frac{wL^2}{12} \Rightarrow \frac{(2)(20)^2}{12} = 66.67 \text{K.ft}$$

= point Load (Not at mid)

Suppose:



For Left End:

$$\frac{Pab^2}{L^2} = \frac{(10)(12)(8)^2}{(20)^2} = 19.2\ K\cdot ft$$

For Right End:

$$\frac{Pa^2b}{L^2} = \frac{(10)(12)^2(8)}{(20)^2} = 28.8\ K\cdot ft$$

So Total moment at left end:

$19.2 + 66.67 = 85.87\ K\cdot ft$

Simarly at Right End:

$28.8 + 66.67 = 95.47\ K\cdot ft$

So $[ADL] = -85.87 + 15 = -70.87\ K\cdot ft$

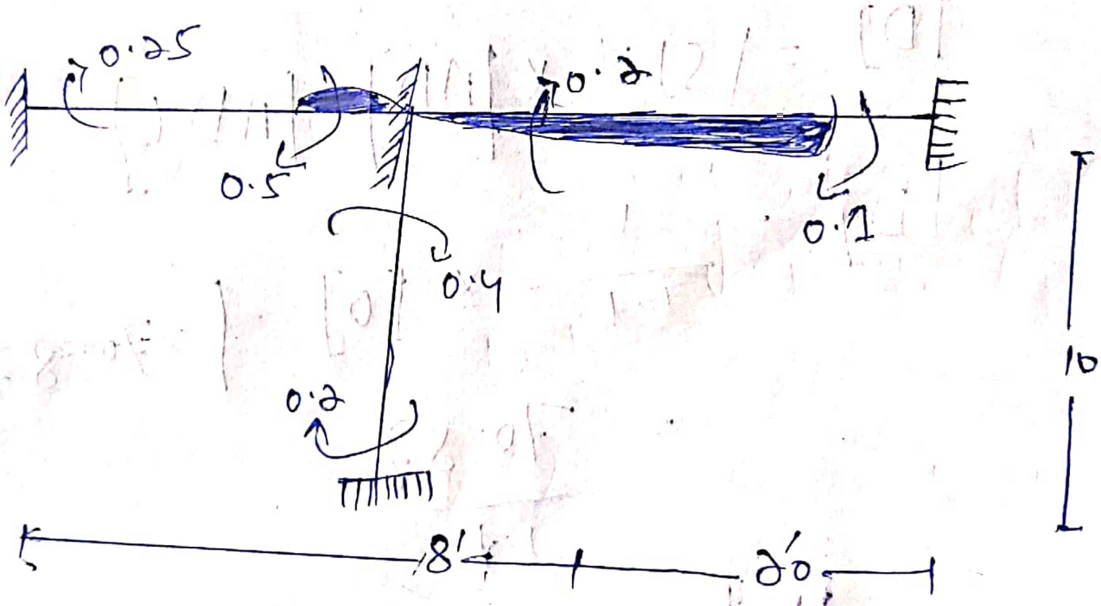
Step #4:-

Determine [s] matrix

$[s] = [s_{11}]$

Now:-

$D = 1k$



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

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

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

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

$$= 1.1EI$$

$$[S] = 1.1EI$$

Step #5:

compute $[D]$ matrix

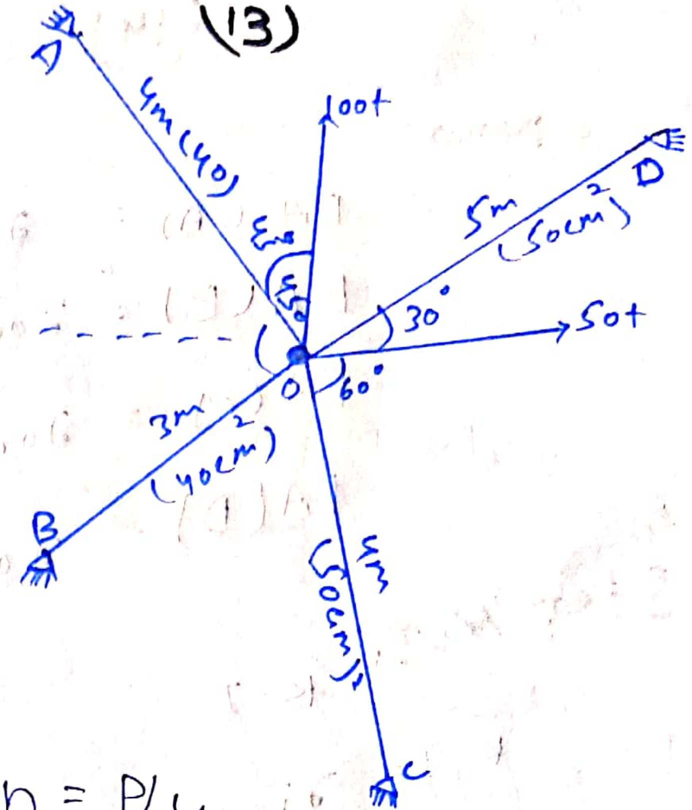
$$[D] = [S]^{-1} \times [AD] - [ADL]$$

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

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

$$[D] = [64.42] \, 1/EI.$$

Q No 3:



Sol: For A

$\sin 45° = P/h = P/4$

$\Rightarrow P = 2.828\,m$

$\cos 45° = b/4$

$\Rightarrow b = 2.828\,m$

For B:

$\sin 45° = P/3$

$P = 2.12\,m$

$\cos 45° = b/h$

$\Rightarrow b = 2.12\,m$

For C:

$\sin 30° = P/h = 5$

$\Rightarrow P \Rightarrow 2.5\,m$

$\cos 30° = b/5$

$\Rightarrow b = 4.33\,m$

Now

$EA(A) = 2000 \times 40 = 80,000t$

$EA(B) = 2000 \times 40 = 80,000t$

$EA(C) = 2000 \times 50 = 100,000t$

$EA(D) = 2000 \times 50 = 100,000t$

Step No1::

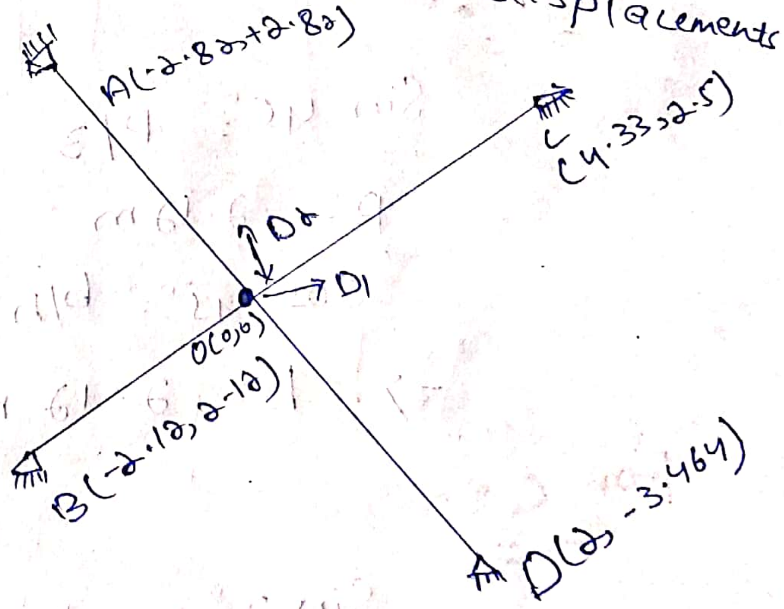
K.I

$K.I = 2j - r$

$= 2(5) - 8 = 2$

Step No2::

select unknown joint displacements



$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} S \\ S \end{bmatrix}, \begin{bmatrix} AD1 \\ AD2 \end{bmatrix}$$

(15)

Step # 03:: $[AMD]_{4\times2}$ & $[S]_{2\times2}$

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

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

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

$$AMD_{21} = \frac{80,000}{(300)^2} \times (0 + 212) = 188.44$$

$$AMD_{31} = \frac{100,000}{(500)^2} \times (0.433) = -173.2$$

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

Now $S_{11} = \sum_{i=1}^{m} \frac{EA}{L^3}(X_k - X_j)^2$

$$= \frac{80,000}{400^3} \times (282)^2 + \frac{80,000}{(300)^3} \times (212)^2 + \frac{100,000}{(500)^2} \times (-433)^2$$

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

$S_{11} = 99.405 + 133.167 + 149.991 + 62.5$

$$\boxed{S_{11} = 445.063}$$

$$S_{12} = S_{21} = \sum_{I=1}^{m} \frac{EA}{L^2} \times (x_k - x_j)(y_k - y_j)$$

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

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

$$(-200)(0+346)$$

$$\boxed{S_{12} = S_{21} = 12.237}$$

(ii) $D_1 = 0$, $D_1 = |K|$

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

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

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

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

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

(17)

Now, $S_{22} = \sum_{i=1}^{m} \frac{EA}{L^3} (y_k - y_i)^2$

$= \frac{80,000}{400^3} (-280)^2 + \frac{80,000}{300^3} (212)^2 + \frac{100,000}{500^3} (-250)^2 + \frac{100,000}{400^3} (346)^2$

$\boxed{S_{22} = 469.628}$

Step # 04:

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

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

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

Step #06 [AM]

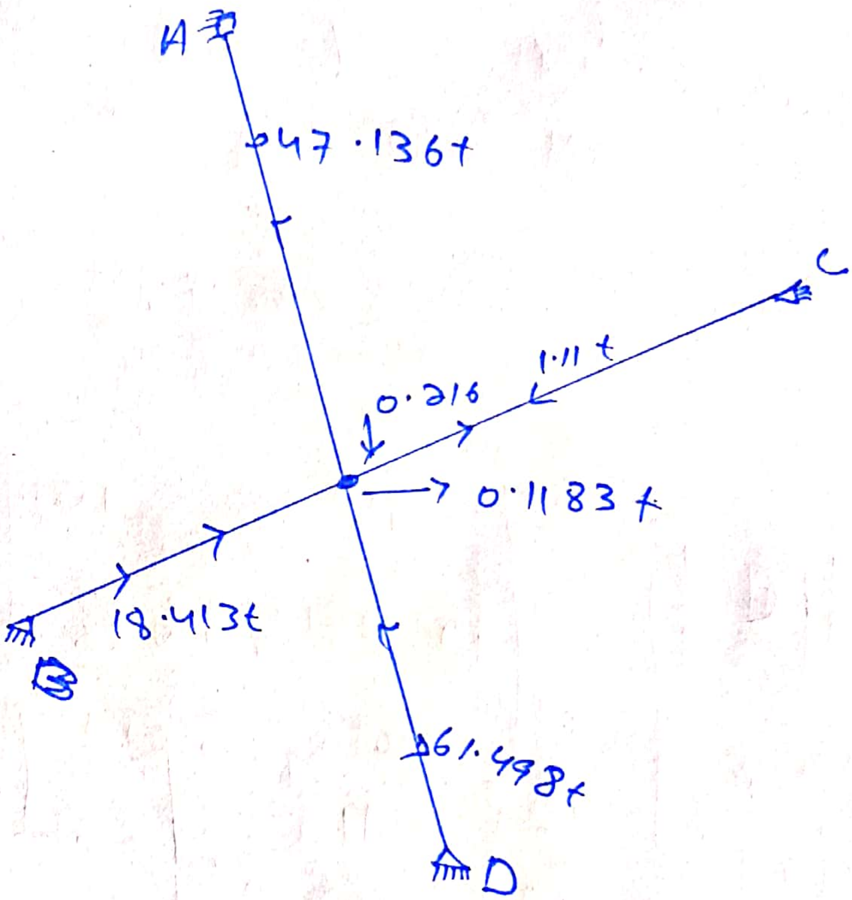
$$\begin{bmatrix} Am1 \\ Am2 \\ Am3 \\ Am4 \end{bmatrix} = \begin{bmatrix} 141 & -141 \\ 188.44 & 188.44 \\ -173.2 & -100 \\ -125 & 216.25 \end{bmatrix} \times \begin{bmatrix} 0.1183 \\ -0.216 \end{bmatrix}$$

$$= \begin{bmatrix} 141 \times 0.1183 + (-141) \times (-0.216) \\ 188.44 \times 0.1183 + 188.44 \times (-0.116) \\ -173.2 \times 0.1183 + (-100) \times (-0.316) \\ -125 \times 0.1183 + 216.25 \times (0.216) \end{bmatrix}$$

$$\begin{bmatrix} Am1 \\ Am2 \\ Am3 \\ Am4 \end{bmatrix} = \begin{bmatrix} 16.68 + 30.46 \\ 22.29 - 40.70 \\ -20.49 + 21.6 \\ -14.79 - 46.71 \end{bmatrix}$$

(219)

$$\begin{bmatrix} A_{m1} \\ A_{m2} \\ A_{m3} \\ A_{m4} \end{bmatrix} = \begin{bmatrix} 47.136t \\ -18.413t \\ 1.11t \\ -61.498t \end{bmatrix}$$



The End.