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Subject :- Structure II

Prog :- BEC

Exam :- Final Summer.

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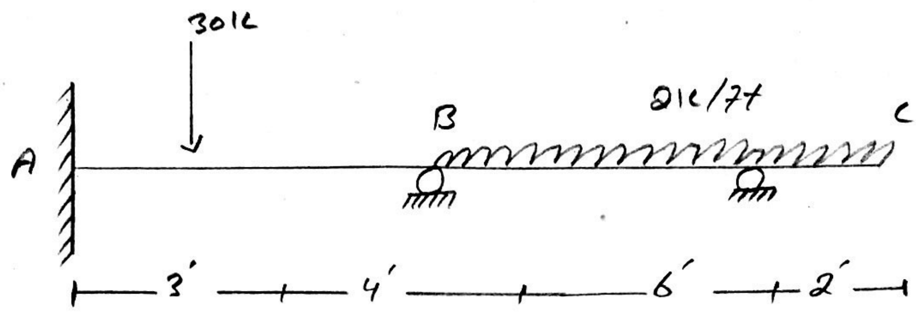
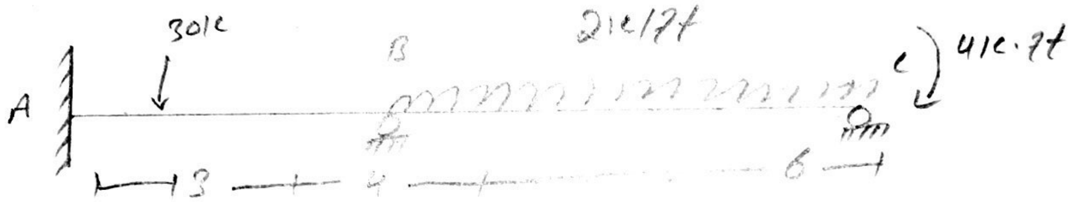
Q#01



Sol:- step#01
Determining kinematic Indeterminancy, / EI = const)

$K.I = 5^{\circ}$

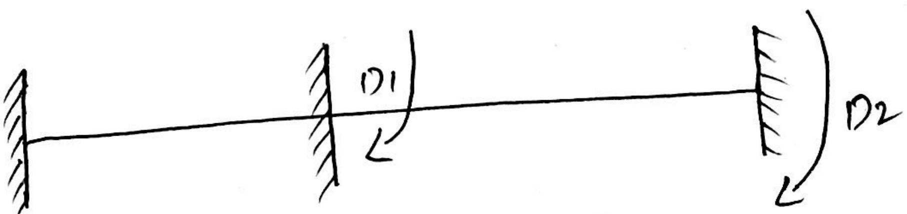
So we have to reduce the extended portion



$$\Rightarrow \frac{2(2)}{1} = 4k/ft$$

Now $K.I = 2^{\circ}$

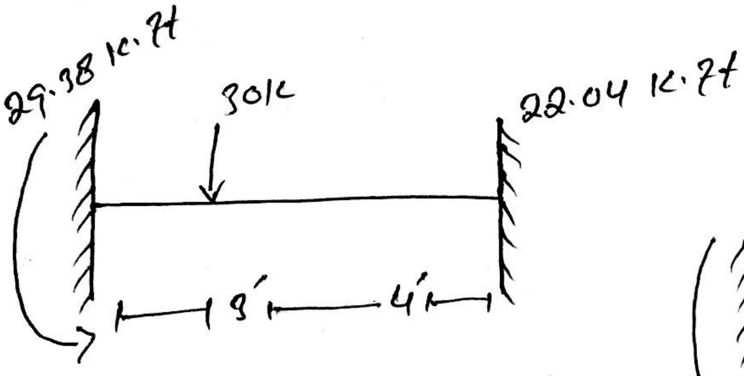
step#02 :- To Determine unknow Joint Displacement

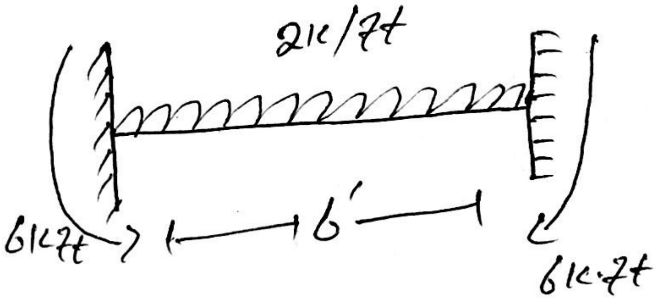


$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \qquad \begin{bmatrix} AD1 \\ AD2 \end{bmatrix} = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$$

Step #03:

Compute [ADL] matrix





=> for point load (not at mid)

For left end:

$$\Rightarrow \frac{pab^2}{l^2} = (30)(3)(4)^2 = 29.38 \text{ k.ft}$$

For Right End

$$\frac{pa^2b}{l^2} = (30)(3)^2(4) = 22.04 \text{ k.ft}$$

For UDL:

$$\frac{wl^2}{12} \Rightarrow \frac{(2)(6)^2}{12} = 6 \text{ k.ft}$$

$$ADL_1 = +22.04 - 6 = 16.04 \text{ k.ft}$$

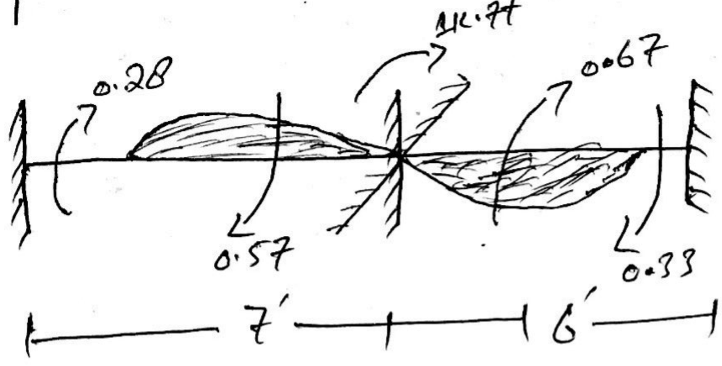
$$ADL_2 = 6 \text{ k.ft}$$

Step #04:

Compute [S] matrix

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

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



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

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

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

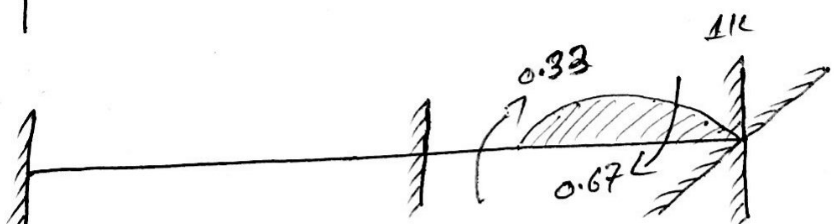
$\frac{2EI}{7} = 0.28$

$S_{11} = 0.57 + 0.67$

$\Rightarrow 1.24\ EA$

$S_{21} = 0.33\ EA$

(b) $D_1 = 0$, $D_2 = 1K$



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

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

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

Step #05

Compute [D] matrix

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

$$= \frac{1}{\begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}} \times \text{Adj } A \times \begin{bmatrix} 0 - 16.04 \\ 4 - 6 \end{bmatrix} - \begin{bmatrix} -16.04 \\ -2 \end{bmatrix} E$$

$$|S| = (1.24 \times 0.67) - (0.33 \times 0.33)$$
$$= 0.8308 - 0.1089$$

$$|S| = 0.7219$$

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

Now

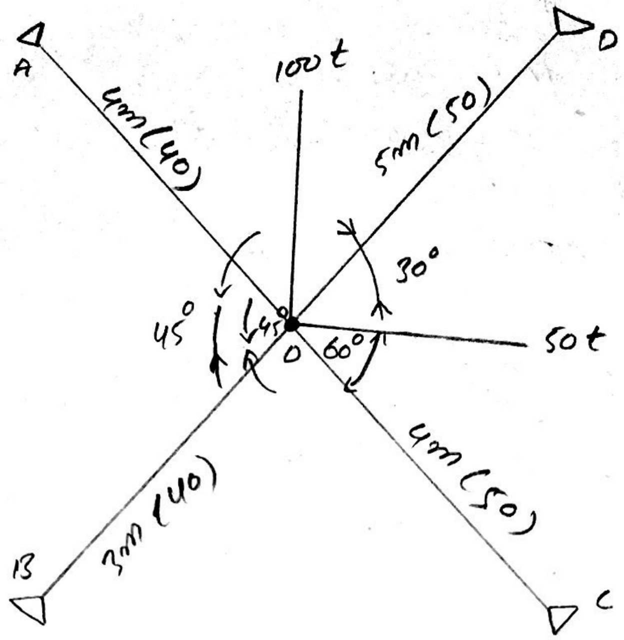
$$\begin{bmatrix} AD_1 - ADL_1 \\ AD_2 - ADL_2 \end{bmatrix} = \begin{bmatrix} 0 - 16.04 \\ 4 - 6 \end{bmatrix} = \begin{bmatrix} -16.04 \\ -2 \end{bmatrix} E$$

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

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} -13.97 \\ 3.8902 \end{bmatrix}$$

Q#02

$E = 2000 t/cm^2$



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):-

$\sin 45° = P/3$

$\Rightarrow P = 2.12 m$

$\cos 45° = b/h$

$\Rightarrow b = 2.12 m$

For (D):- $\sin 30° = \frac{P}{h=5}$

$\Rightarrow P \Rightarrow 2.5 m$

$\cos 30° = b/5$

$\Rightarrow b = 4.33 m$

Now:- $EA(A) = 2000 \times 40 = 80{,}000 t$

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

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

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

step # 01

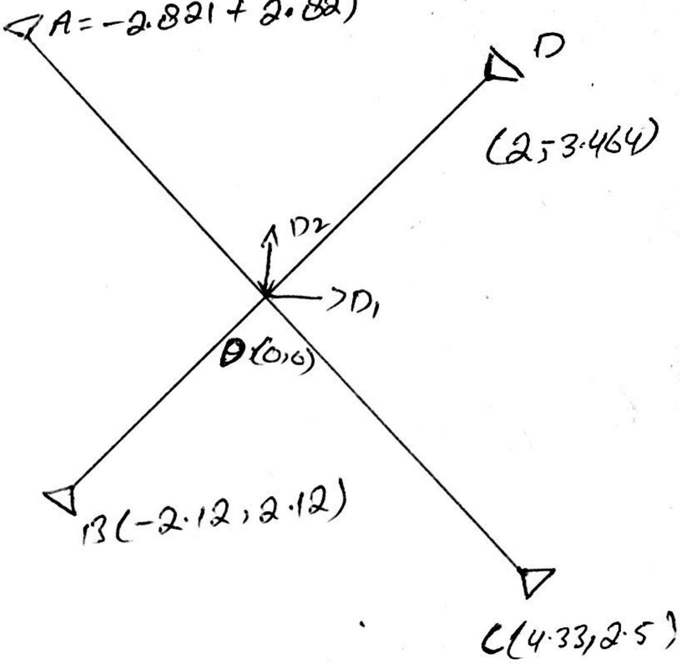
K.I :-

$K.I = 2J - r$

$= 2(5) - 8 = 2^{\circ}$

step # 02 :

Select unknow joint displacement



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

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 $S_{11} = \sum_{n}^{m} \frac{EA}{l^3}(x_k - x_j)^2$

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

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

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$S_{11} = 99.405 + 133.107 + 149.991 + 62.5$

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

$$S_{12} = S_{21} = \sum_{I=1}^{m} \frac{EA}{l^3} \times (X_{1L} - X_j)(Y_{1L} - Y_j)$$

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

$$+ \frac{100{,}000}{(500)^3} \times (-433)(-0.250) + \frac{100{,}000}{(400)^3} \times (-200)(0+346)$$

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

(ii) $D_1 = 0 \quad D_1 = 1k'$

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

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

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

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

Now $S_{22} = \sum_{I=1}^{m} \frac{EA}{l^3} (Y_{1L} - Y_j)$

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

$$+ \frac{100{,}000}{400^3}(346)^2$$

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

Step#04:-

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

$$\begin{Bmatrix} D1 \\ D2 \end{Bmatrix} = \begin{bmatrix} 445.003 & 12.237 \\ 12.237 & 469.628 \end{bmatrix}^{-1} \times \begin{Bmatrix} 50 \\ -100 \end{Bmatrix}$$

$$\begin{Bmatrix} D1 \\ D2 \end{Bmatrix} = \begin{Bmatrix} 0.1183 \\ -0.216 \end{Bmatrix}$$

Step#06:

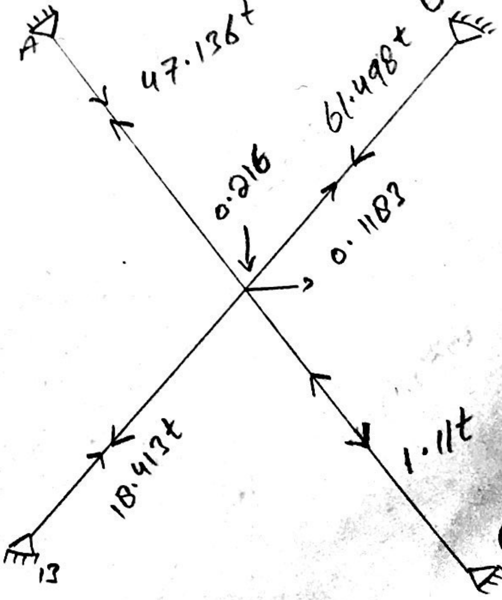
$\{Am\}$

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

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

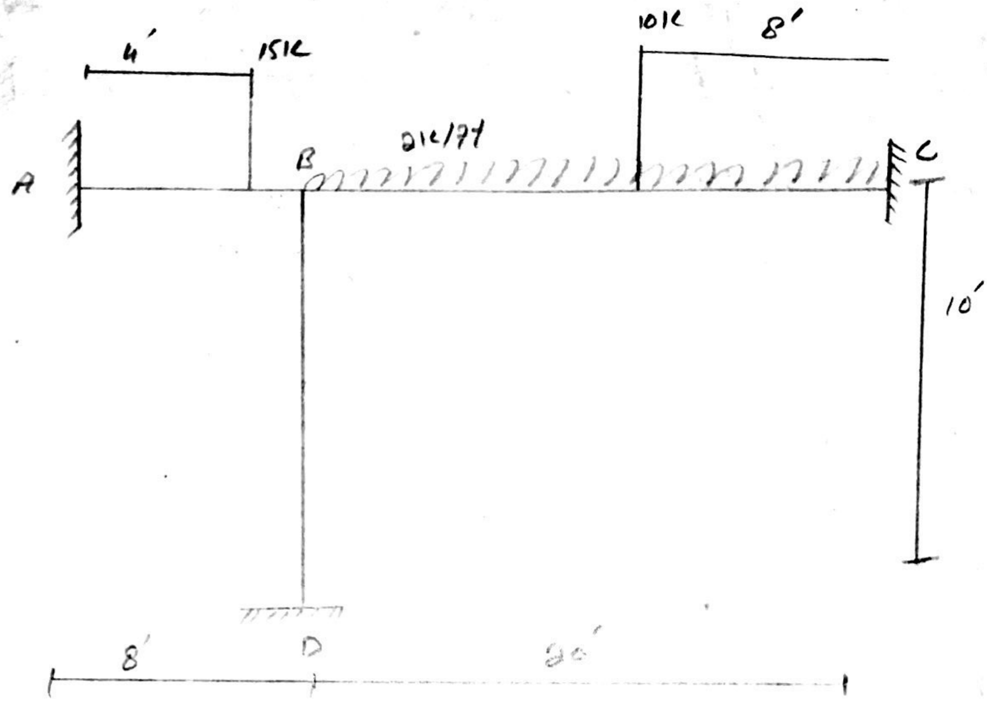
$$\begin{Bmatrix} Am1 \\ Am2 \\ Am3 \\ Am4 \end{Bmatrix} = \begin{bmatrix} 16.68 + 30.46 \\ 22.29 - 40.70 \\ -20.49 + 21.6 \\ -14.79 - 46.71 \end{bmatrix}$$

$$\begin{Bmatrix} Am1 \\ Am2 \\ Am3 \\ Am4 \end{Bmatrix} = \begin{Bmatrix} 47.136t \\ -18.413t \\ 1.11t \\ -61.498t \end{Bmatrix}$$



To Be Solve

Q#03

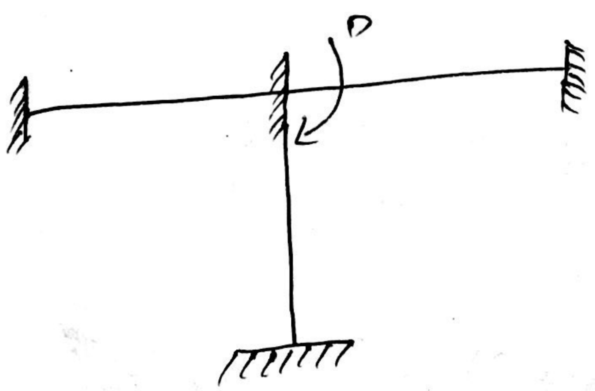


Sol:-

Step#01: Determine kinematic Indeterminancy

$K.I = 1^{\circ}$

Step#02: Determine unknown Joint displacement



$[D] = ?$

$[AD] = [0]$

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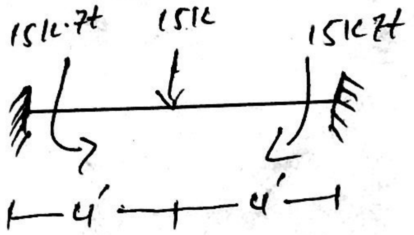
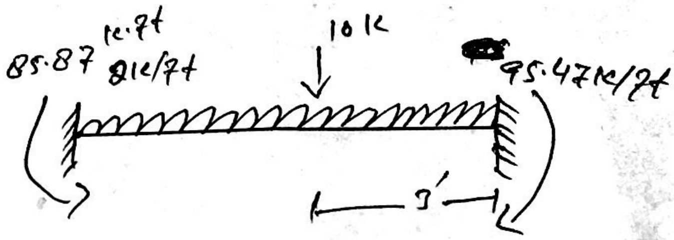
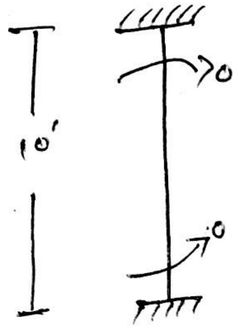
Step #03:

Compute [ADL] matrix.







point load at centre:

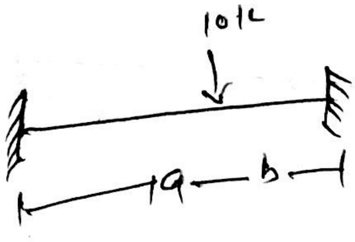
$$\frac{PL}{8} = \frac{(15)(8)}{8} = 15\,\text{kip.ft}$$

uniformly distributed load:

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

=> point load (Not at mid):

suppose



For left end:

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

For Right end:

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

So the total moment at left end

$$19.2 + 66.67 = 85.87 \text{ K·ft}$$

Similarity at right end:

$$28.8 + 66.7 = 95.47 \text{ K·ft}$$

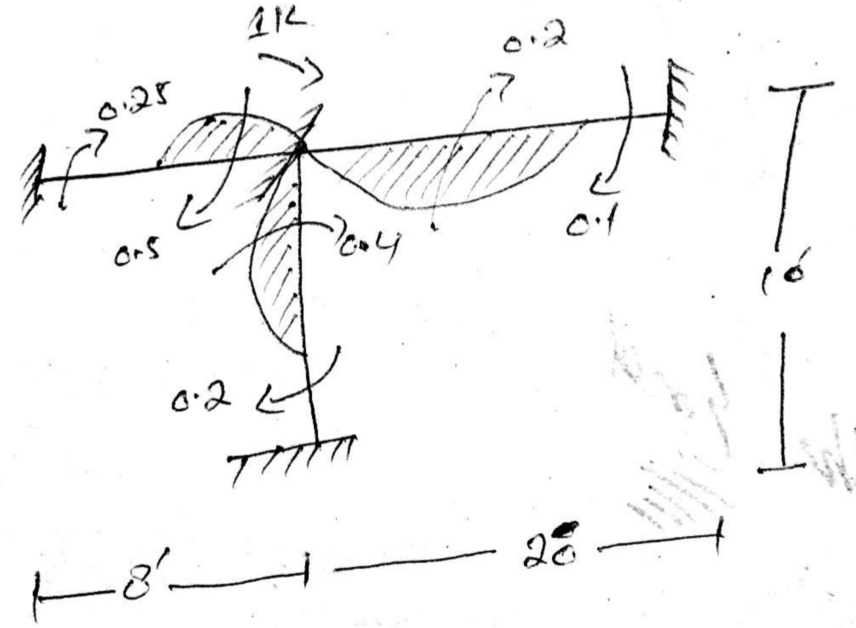
$$\text{So } \{ADL\} = -85.87 + 15 = -70.87 \text{ K·ft}$$

Step #04:

Determine [S] matrix.

Now

D = 1K



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

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

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

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

$= 1.1 EI$

$[S] = 1.1 EI$

step # 5
Compute the [D] matrix

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

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

$\Rightarrow \frac{70.87}{1.1}$

$[D] = [64.42] \; 1/EI$

The End