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Subject	Structure II
Submitted to	Sir. Adeed Khan
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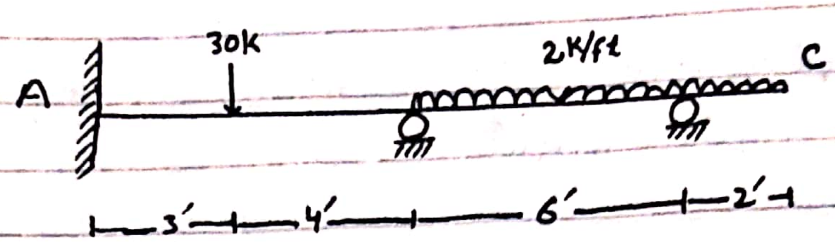
Ans 1:



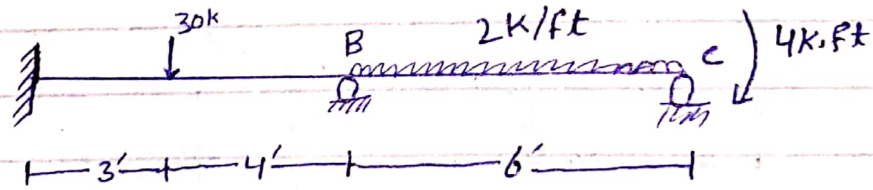
Solution:-

Step # 1

Determining Kinematic Indeterminancy.

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

So we have to reduce the extended portion.



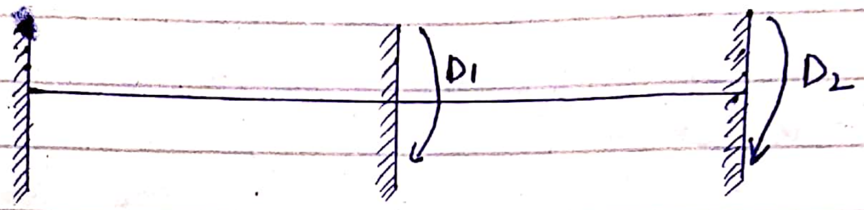
$$= \frac{2(2)}{1} = 4 K.ft.$$

Now

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

Step #2.

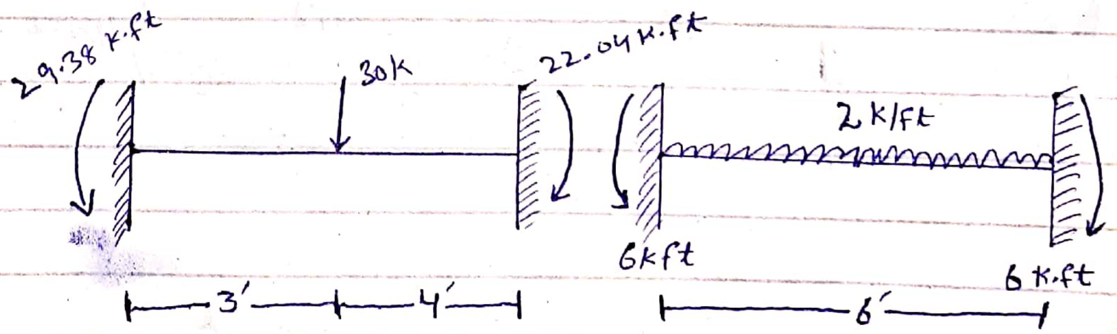
Determine Unknown joints Displacement



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

Step #3

Compute [ADL] Matrix.



⇒ For Pointed Load (not at mid)

⇒ For Left end:-

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

⇒ For Right end:-

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

⇒ For UDL:-

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

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

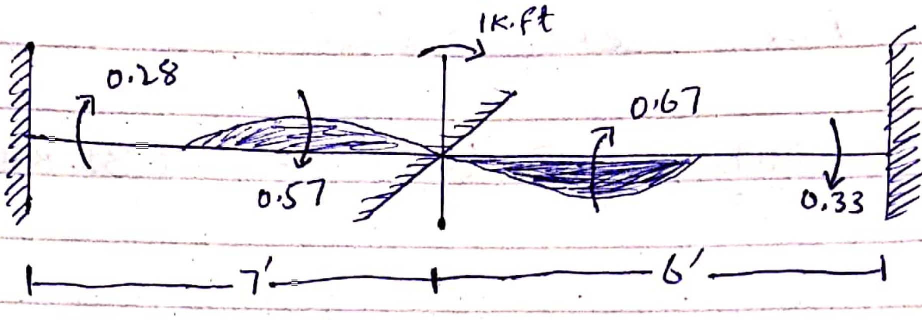
$ADL_2 = 6$ k.ft

Step # 4:-

Compute [S] Matrix

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

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



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

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

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

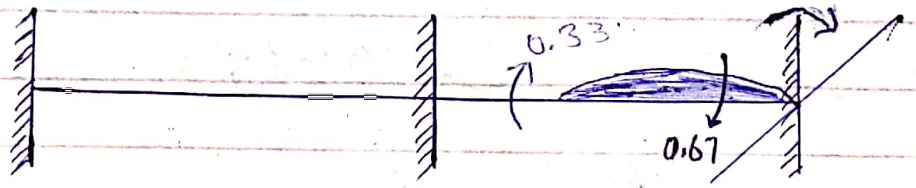
$$\frac{2EI}{7} = 0.28$$

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

$$= 1.24\ EA$$

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

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



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

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

$S_{12} = 0.33$

$S_{22} = 0.67$

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

Step #5

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

$$= \frac{1}{\begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}} \times \text{Adj } A \times \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} - \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix}$$

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

$= 0.8308 - 0.1089$

$|S| = 0.7219$

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

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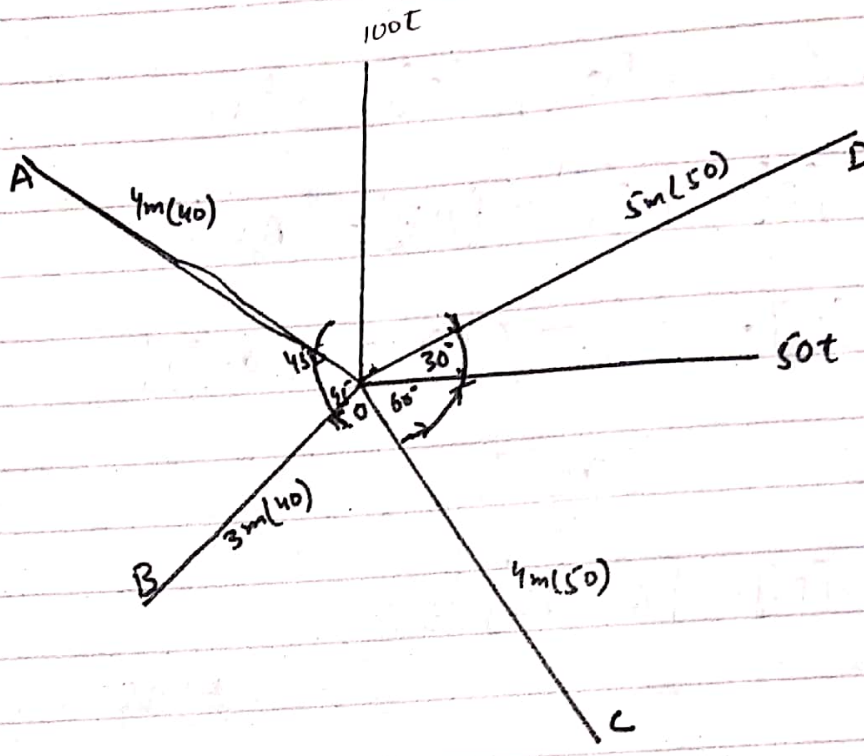
Now

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

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

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} -13.83 \\ 3.85 \end{bmatrix}$$

Q2.



Solution:-

For A

$$\sin 45 = \frac{P}{H} = \frac{P}{4}$$

$$\Rightarrow P = 2.828 \, m$$

$$\cos 45° = \frac{b}{H} = \frac{b}{4}$$

$$b = 2 - 2.828.$$

For B;

$$\sin 45 = \frac{P}{H} = \frac{P}{3}$$

$$\Rightarrow P = 2.12m$$

$$\cos 45 = b/H = b/H = b/3$$

$$\Rightarrow b = 2.12m$$

For C.

$$\sin 60 = P/H = P/4$$

$$(\sin 60)(4) = P$$

$$P = 3.46$$

$$\cos 60 = \frac{b}{H} = \frac{b}{4}$$

$$\cos 60 \times 4 = b$$

$$b = 2$$

For D:-

$\sin 30 = P/5$

$P = 2.5m$

$\cos 30 = b/3$

$b = 4.33m$

Now;

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

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

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

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

Step #1.

K.I

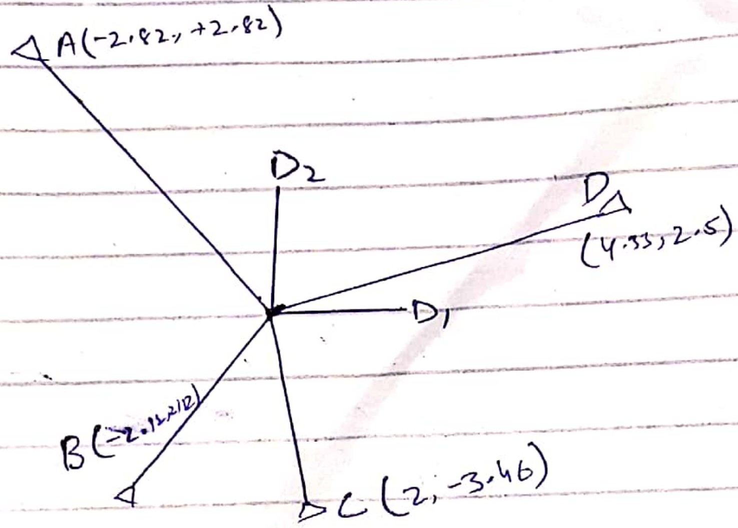
$K.I = 2j - r$

$= 2(5) - 8$

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

Step #2:

Select unknown joint displacement.



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

Step #3

$$[AMD]_{4\times 2} \qquad [S]_{2\times 2}$$

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

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$$AMD_{11} = \frac{80000}{400^2} \times (0+282) = 141$$

$$AMD_{31} = \frac{80000}{500^2} \times (0.433) = -173.2$$

$$AMD_{21} = \frac{100000}{500^2} \times (0+212) = 188.44$$

$$AMD_{41} = \frac{100000}{400^2} \times (0-200) = -125$$

Now

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

$$= \frac{80,000}{400^3} (282)^2 + \frac{80000}{300^3} \times (212)^2 +$$

$$\frac{100000}{500^3} \times (-433)^2 + \frac{100000}{400^3} \times (-200)^2$$

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

$$S_{11} = 445.063$$

$$\Rightarrow S_{12} = S_{21} = \sum_{i=1}^{m} \frac{EA}{L^3} \times (xk - xj)(Yk - Yj)$$

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

$$+ \frac{100,000}{500^3} (-433)(0.250) + \frac{100000}{400^3} (-200)(0+346)$$

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

(ii) $D_1 = 0 \qquad D_2 = 1k$

$$AMD = EA/L^2 \ (y_k - y_i)$$

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

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

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

$$AMD_{42} = \frac{100000}{400^3}(346) = 216.25$$

Now,

$$S_{22} = \sum_{P=1}^{m} \frac{EA}{L^3}(y_k - y_j)^2$$

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

$$+ \frac{100000}{500^3}(-250)^2 + \frac{100000}{400^3}(346)^2$$

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

Step # 4.

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

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 445.003 & 12.237 \\ 12.237 & 469.628 \end{bmatrix}^{-1} \begin{bmatrix} 150 \\ -100 \end{bmatrix}$$

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

Step # 5

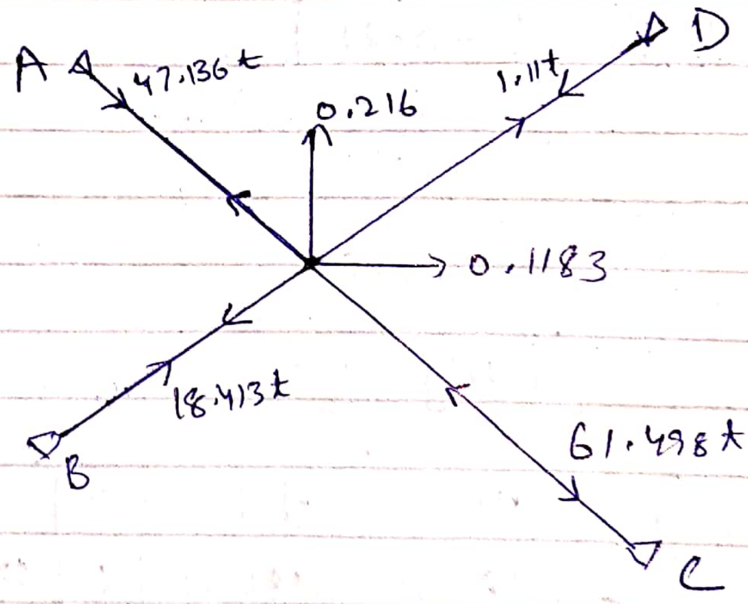
$$[AM].$$

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

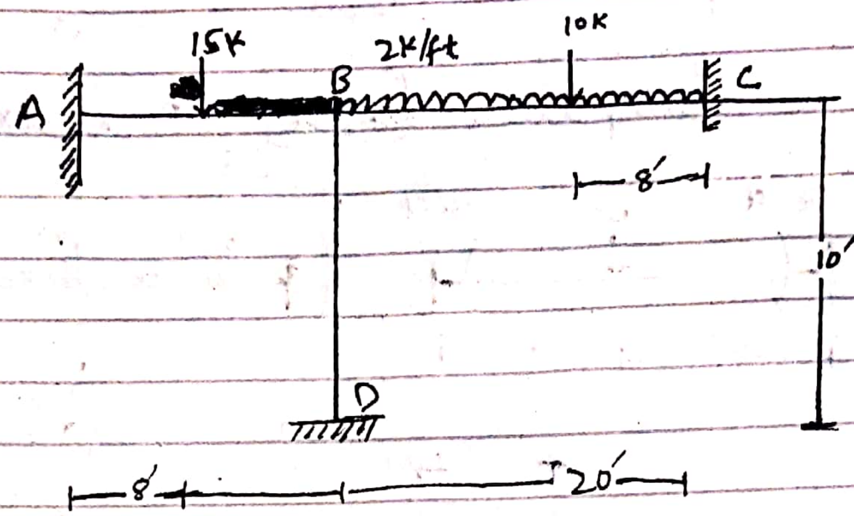
$$= \begin{bmatrix} 141 \times 0.1183 + (-141) \times (-0.216) \\ 188.44 \times 0.1183 + (188.44) \times (-0.216) \\ -173.2 \times 0.1183 + (-100)(-0.216) \\ -125 \times 0.1183 + 216.25(-0.216) \end{bmatrix}$$

$$= \begin{bmatrix} 16.68 & +30.46 \\ 22.29 & -40.70 \\ -20.49 & +21.6 \\ -14.79 & +46.71 \end{bmatrix}$$

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



Q 3.



Solution:-

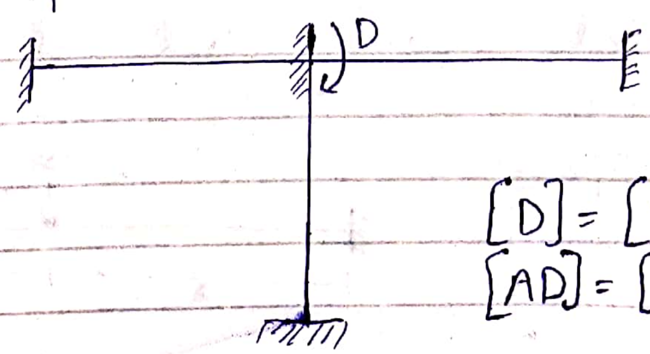
Step#1:-

Determine Kinematic Indeterminancy

K.I = 1°

Step #2.

Determine Unknown joint Displacement

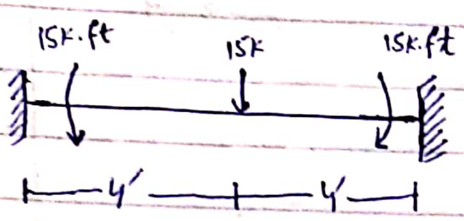


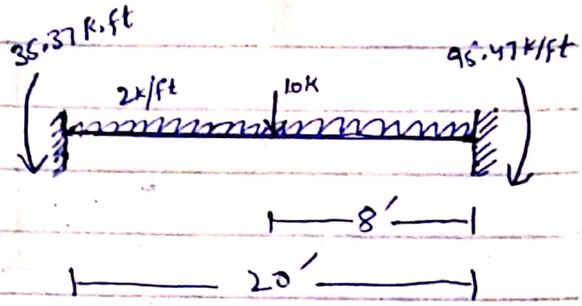
$[D] = [?]$

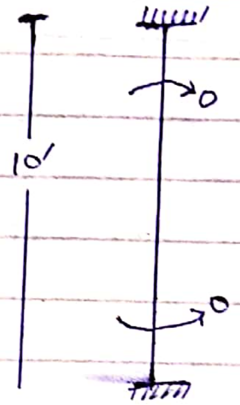
$[AD] = [0]$

Step #3.

Compute [ADL] Matrix







⇒ Point Load at center.

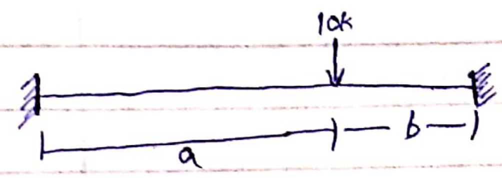
$$\frac{PL}{8} \Rightarrow \frac{(15)(8)}{8} = 15 \text{ Kip.ft}$$

⇒ 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:-

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

For right End:-

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

So Total 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 $[ADL] = -85.87 + 15$
$= -70.87$ K.ft

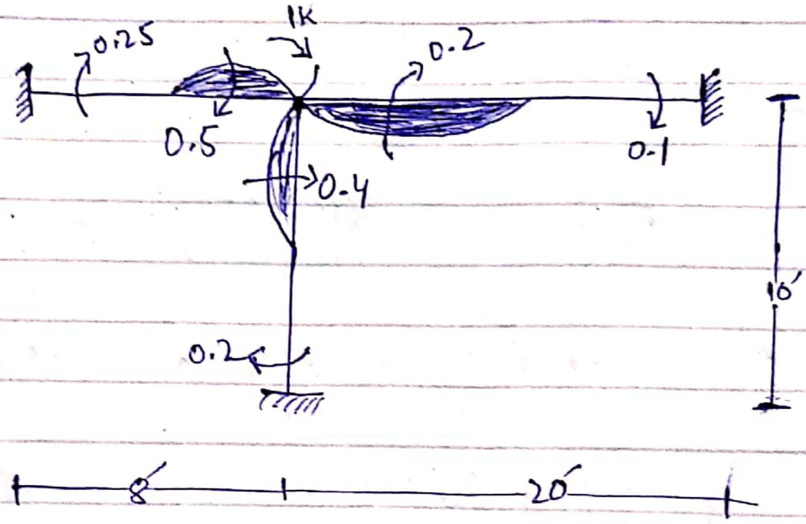
Step # 4:-

Determine [S] Matrix.

$$[S] = [S_{11}]$$

Now:

$D = 1k$



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

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

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

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

$= 1.1\, EI$

$[S] = 1.1\, EI$

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Step # 5

Compute [D] Matrix

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

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

$= \frac{70.87}{1.1}$

$[D] = [64.42]\ ^{1}/_{EI}$

Ans: