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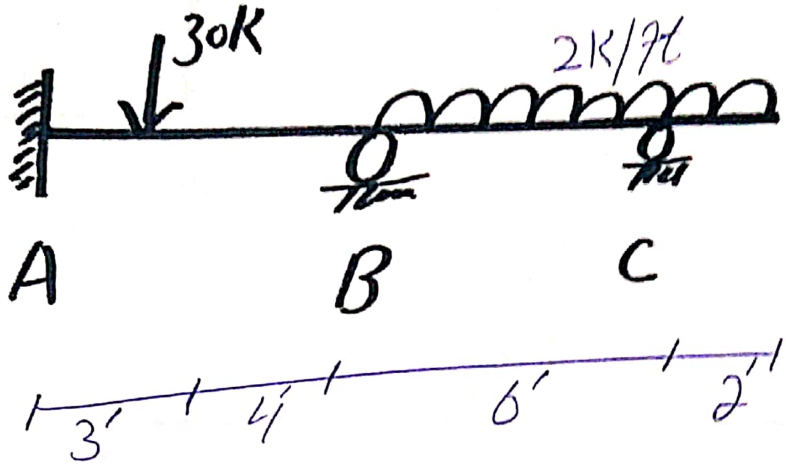
Subject : Structure Anylusis II

Date : 25/9/2020

Ans:01:

Beam



* EI = Constant.

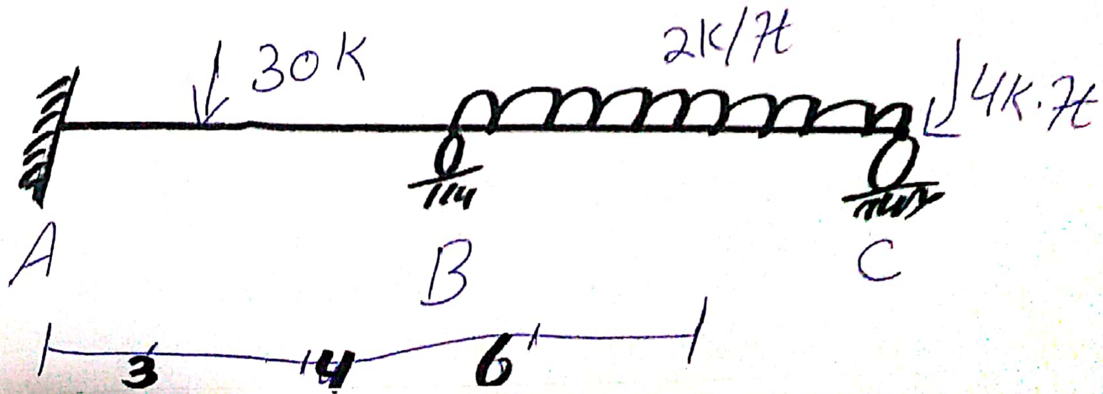
* **Stiffness Method:**

Step#01

Kinematic indeterminancy;

K·I = 5

We have to reduce the extend portion

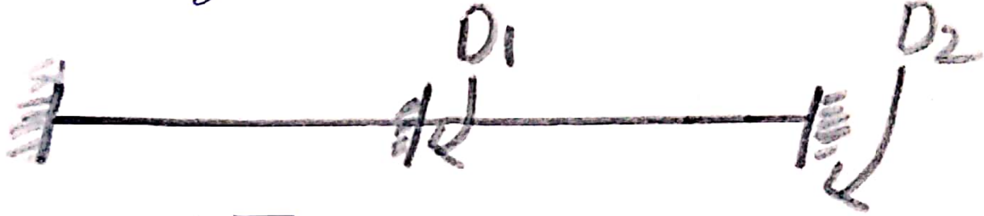


Now,

$K \cdot I = 2^\circ$ $\frac{2(2)}{1} = 4 K \cdot ft$

Step # 02

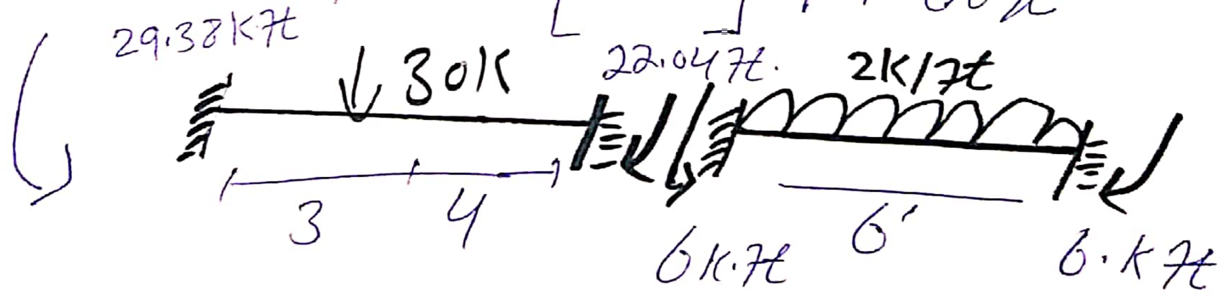
Determining uknown joint displacement



$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \quad \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 4 \end{bmatrix}$$

Step # 03

Compute [ADL] Matrix



- For point load (not at mid point)
  - For left End.

$$Pab^2/L^2 = 30(3)(4)^2/(7)^2 = 22.04 K.ft$$

• For righ End.

$$Pa^2b/L^2 = 30(3)^2(4)/(7)^2 = 22.04\ K\cdot ft$$

↳ For uniformly Distributed load.

• $$WL^2/12 = 2(6)^2/12 = 6\ K\cdot ft$$

• $$ADL_1 = +22.04 - 6 = 16.04\ K\cdot ft$$

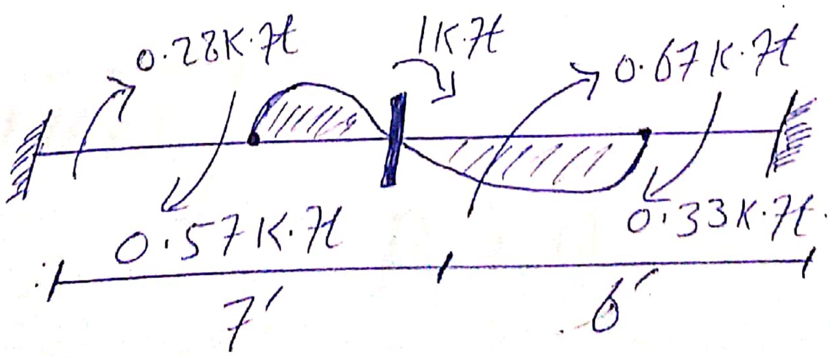
• $$ADL_2 = 6\ K\cdot ft$$

Step #04

Now computing [S] matrix.

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

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



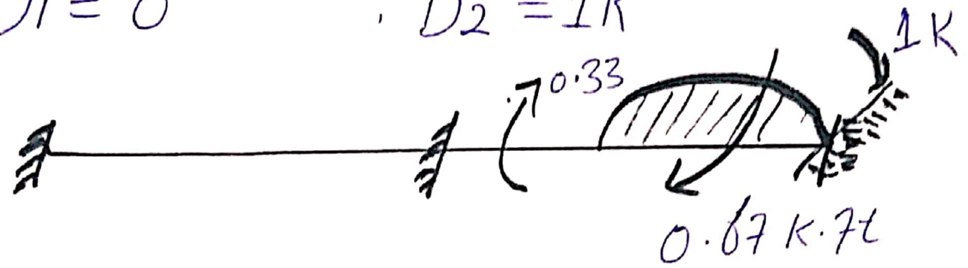
$\frac{4EI}{7} = 0.57$ $\quad \frac{2EI}{6} = 0.33$

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

$S_{11} = 1.24 EA$ $\quad S_{21} = 0.33 EA$

(b);

$D_1 = 0$ $\quad D_2 = 1K$



$4EI/6 = 0.67$

$2EI/6 = 0.33$

$S_{12} = 0.33$

$S_{22} = 0.67$

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

STEPHOS

P.T.O

Step #05

Now Computing [D] Matrix

$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}^{-1} \times \begin{bmatrix} AD1 \\ AD_2 \end{bmatrix} - \begin{bmatrix} ADL_i \\ ADL_2 \end{bmatrix}$$

$$= \frac{1}{\begin{bmatrix} 1.24 & 0.33 \\ 0.33 & 0.67 \end{bmatrix}} \times \text{Adj} A \times \begin{bmatrix} AD1 \\ AD_2 \end{bmatrix} - \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix}$$

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

$$= 0.8308 - 0.1089$$

$$|S| = 0.7214$$

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

Now:

$$\begin{bmatrix} AD1 - ADL_1 \\ AD_2 - ADL_2 \end{bmatrix} = \begin{bmatrix} 0 - 16.04 \\ 4 - 6 \end{bmatrix} = \begin{bmatrix} -16.04 \\ -2 \end{bmatrix} E$$

$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \frac{1}{|S|} \times \text{Adj} A \times \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}$$

$$= \frac{\begin{bmatrix} 0.67 & -0.33 \\ -0.33 & 1.24 \end{bmatrix}}{0.724} \times \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}$$

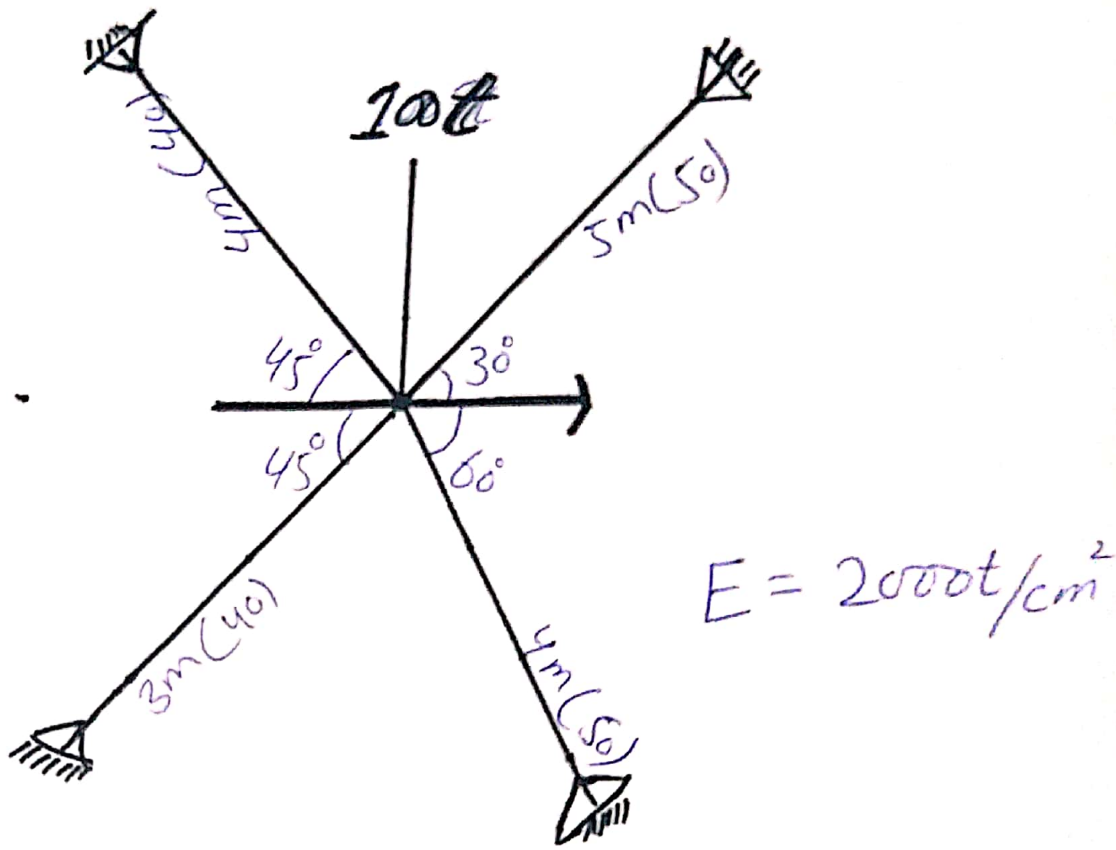
$$\begin{bmatrix} 0.919 & -0.452 \\ -0.452 & 1.70 \end{bmatrix} \times \begin{bmatrix} -16.04 \\ -2 \end{bmatrix}$$

$$\begin{bmatrix} D1 \\ D2 \end{bmatrix} = \begin{bmatrix} -13.83 \\ 3.85 \end{bmatrix}$$

2

Ans# 02;

• "Pin-jointed frame"



: Stiffness Method :→

Sol:-

For A;

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

$P = 2.828m$

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

$b = 2.828m$

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For B;

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

  $P = 2.12m$

- $\cos 45 = \frac{b}{H} = \frac{b}{3}$

  $b = 2.12m$

For C;

- $\sin 60 = \frac{P}{H} = \frac{P}{4}$

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

  $P = 3.46$

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

  $(\cos 60)(4) = b$

  $b = 2$

For D;

- $\sin 30 = \frac{P}{5}$

  $P = 2.5m$

- $\cos 30 = \frac{b}{5}$

  $b = 4.33m$

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#01

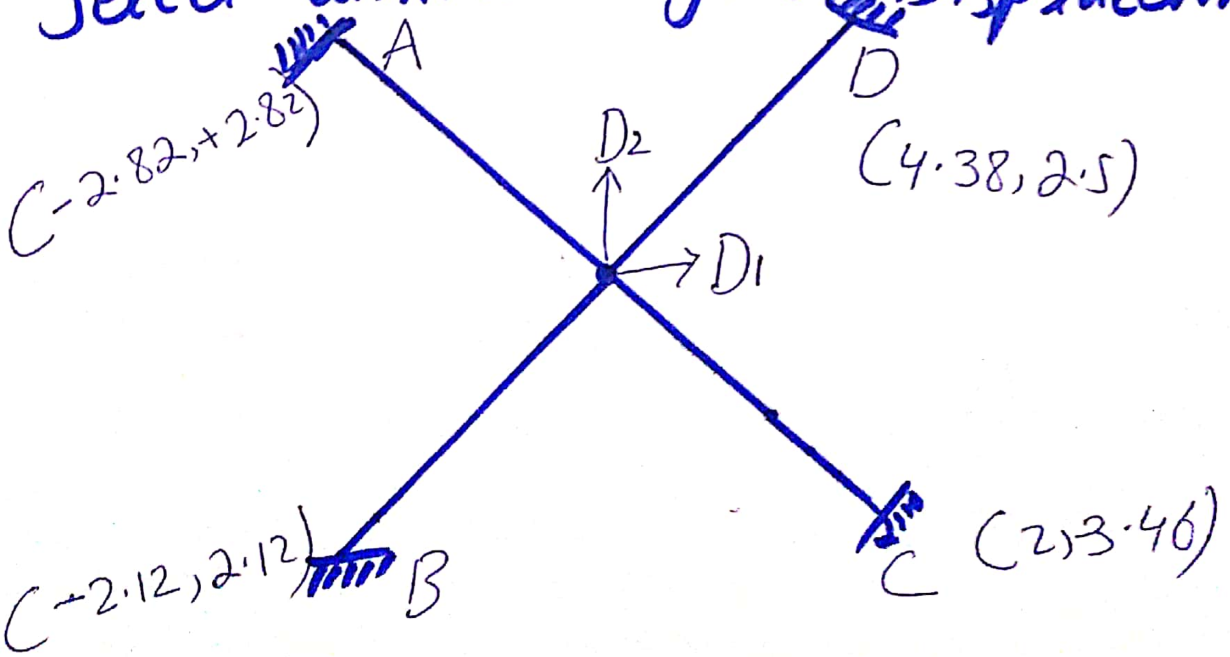
Kinematic indeterminacy

$K \cdot I = 2j - r = 2(5) - 8$

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

Step#02

Select unknown 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

$$[AMD]_{4\times2} \quad [S]_{2\times2}$$

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

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

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

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

$$AMD_{31} = \frac{10,0000}{(400)^2} \times (0-433) = -173.2$$

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

Now:

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

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

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

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

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

$$S_{12} = S_{21} = \sum_{i=1}^{m} \frac{EA}{L^3} (X_K - X_j)(Y_K - Y_j)$$

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

$$+ \frac{100{,}000}{(500)^3}(433)(0-250) + \frac{100{,}000}{(400)^3}(-200)(0346)$$

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

(b);

$D_1 = 0$, $D_2 = 1K$

$$AMD = \frac{EA}{L^2}(Y_2 - Y_1)$$

$$AMD_{12} = \frac{800,000}{(400)^2}(-282) = -1141$$

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

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

$$AMD_{42} = \frac{100,000}{(400)^3}(346) = 216.25$$

Now:

$$S_{22} = \sum_{i=1}^{m} \frac{EA}{L^3}(Y_K - Y_J)^2$$

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

$$+ \frac{100,000}{(500)^3}(-250)^2 + \frac{100,000}{(400)^3}(346)^2$$

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

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Step # 04

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

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

Step # 05

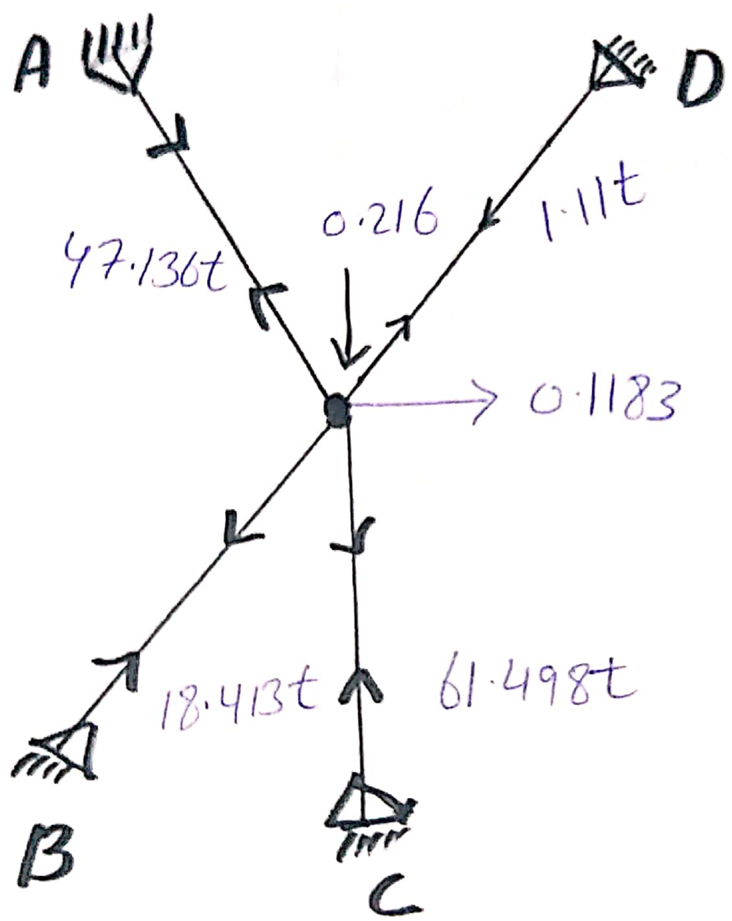
[AM]

$$\begin{bmatrix} AM1 \\ AM2 \\ AM3 \\ AM4 \end{bmatrix} = \begin{bmatrix} 141 & -141 \\ 188.44 & 188.44 \\ -173.2 & -100 \\ -125 & 216.25 \end{bmatrix} \times \begin{bmatrix} 0.1183 \\ -0.216 \end{bmatrix}$$

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

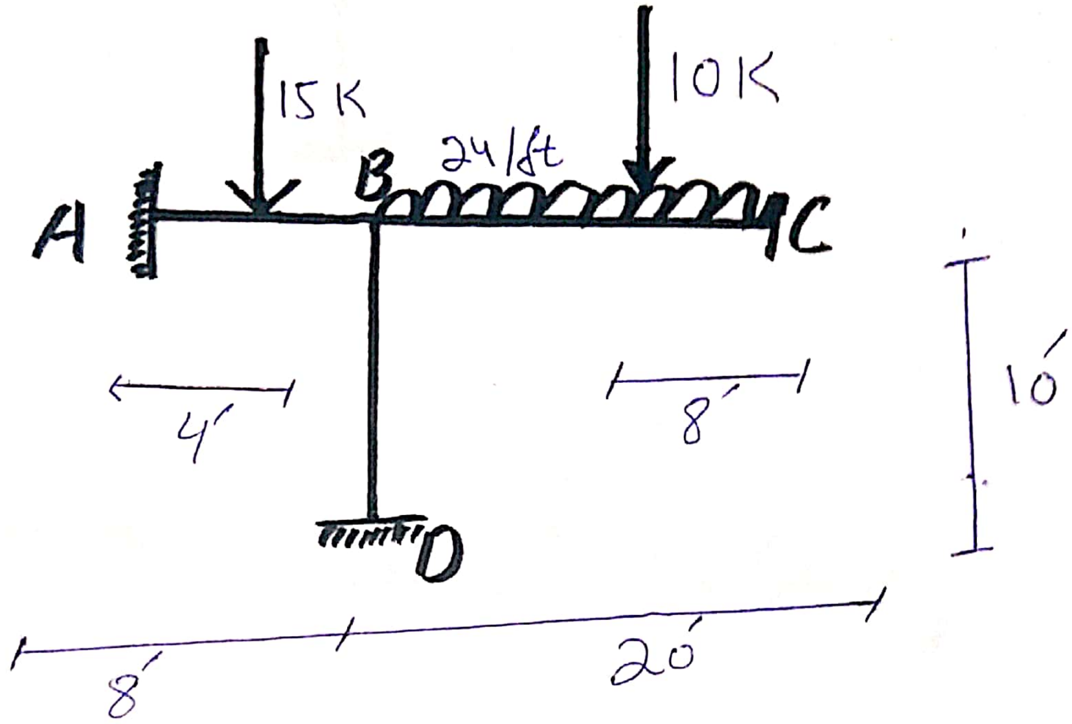
$$\begin{bmatrix} AM1 \\ AM2 \\ AM3 \\ AM4 \end{bmatrix} = \begin{bmatrix} 16.68 + 30.46 \\ 22.29 - 40.70 \\ -20.49 + 21.60 \\ -14.79 + 46.71 \end{bmatrix}$$

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



ANS#03;

Rigid-Joint Frame:



- EI = constant
- using Siffness method;

Step#01

- Kinematic indeterminacy

K·I = 1

Step#02

Determination of unknown Joint Displacement.

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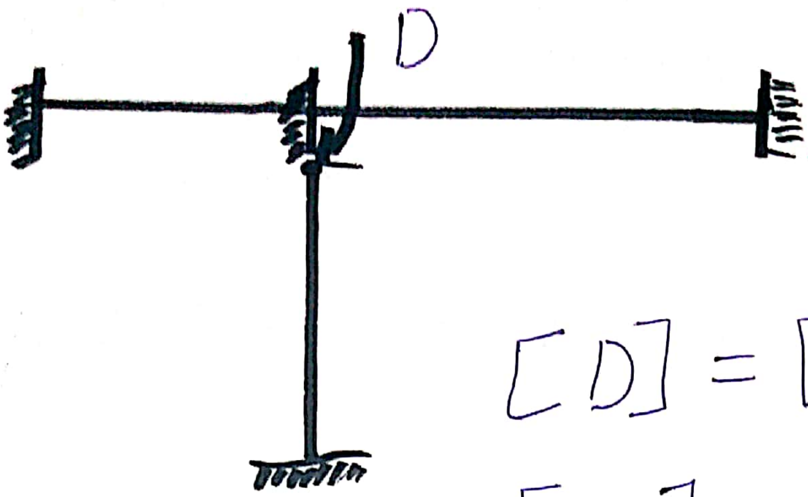
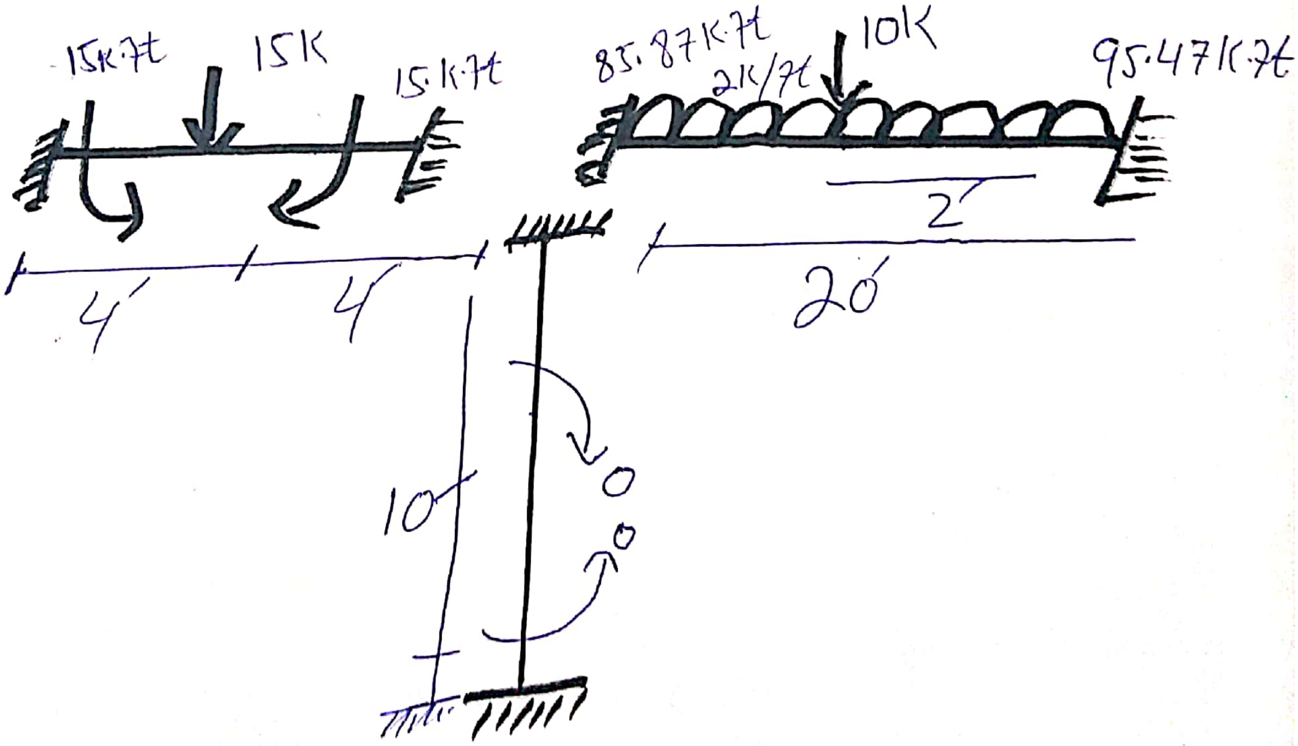


[D] = [?]

[AD] = [0]

Step #03

Compute [ADL] Matrix;



* Point Load at center;

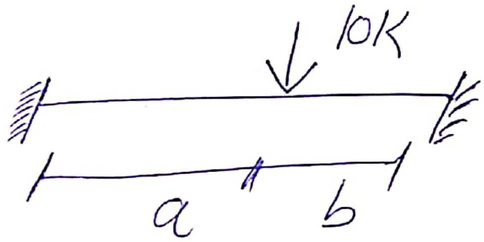
$$PL/8 = 15(8)/8 = 15 \text{ K·ft}$$

* uniformly Distributed Load;

$$WL^2/12 = 2(20)^2/12 = 66.67 \text{ K·ft}$$

* point Load (Not at mid point)

Suppose;



* For left End;

$$Pab^2/L^2 = 10(12)(8)^2/(20)^2 = 19.2 \text{ K·ft}$$

* For Right End;

$$Pa^2b/L^2 = 10(12)^2(8)/(20)^2 = 28.8 \text{ K·ft}$$

★ Total moment at left End;

$19.2 + 66.67 = 85.87$ K.ft

★ Total moment at Rigid End;

$28.8 + 66.67 = 95.47$ K.ft

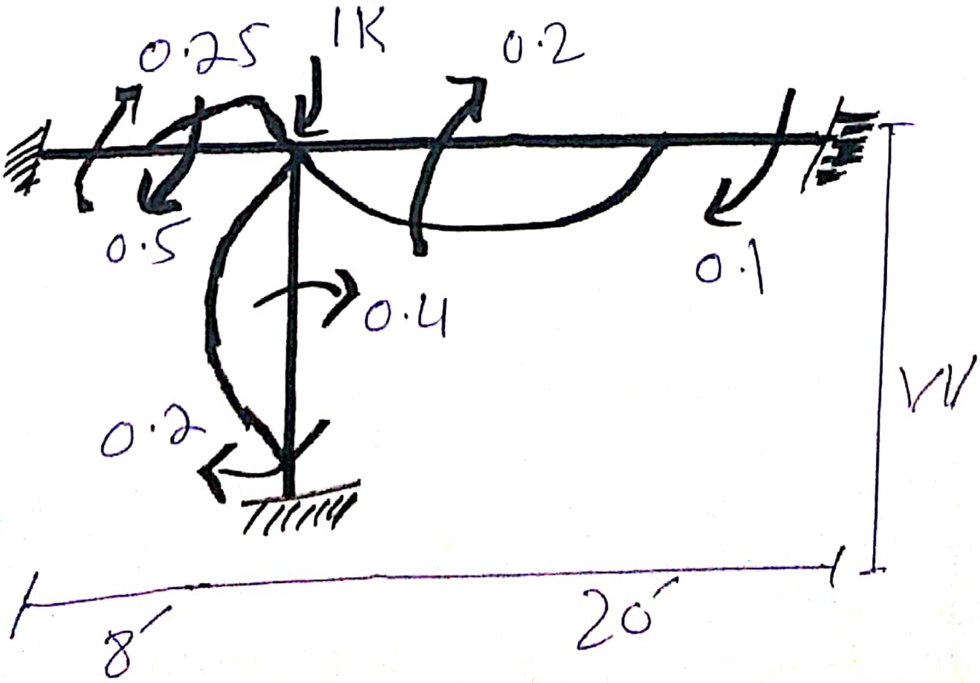
So $[ADL] = -85.87 + 15 = -70.87$ K.ft

Step # 04

Determine [S] matrix;

$[S] = [Sn]$

Now; $D = 1K$



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

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

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

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

$$[S] = 1.1\,EI$$

★ **Step # 05**

Compute [D] matrix;

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

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

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

$$[D] = [64.42]/EI$$