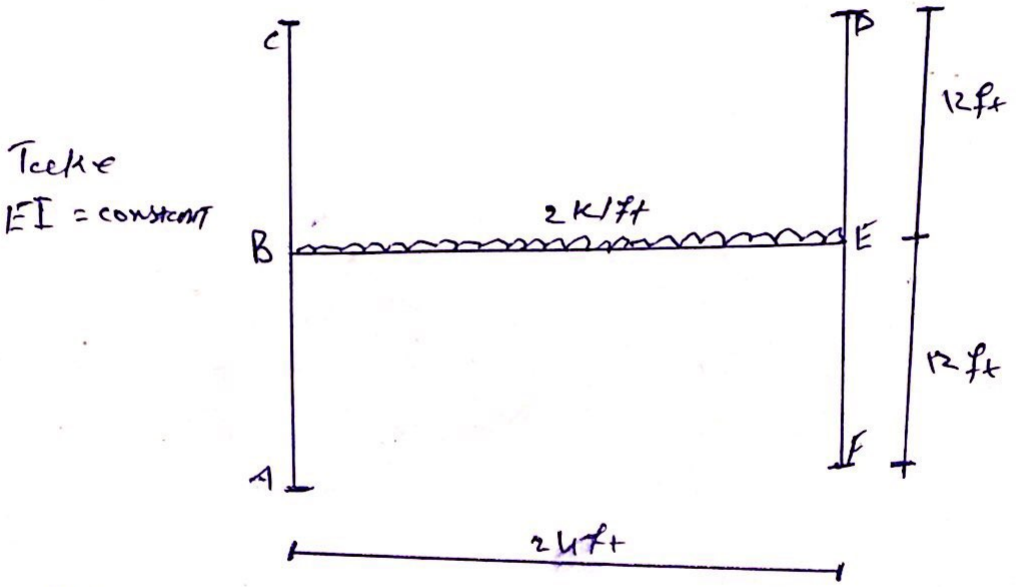
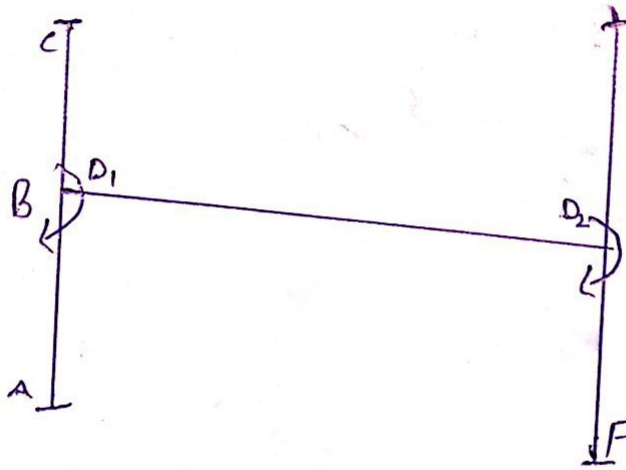
Q: No. 1



DI = 2 degree

STEP #01 selection of redundant ~~action~~ joint displacements and assign cordinates at those locations Also compute AD value.

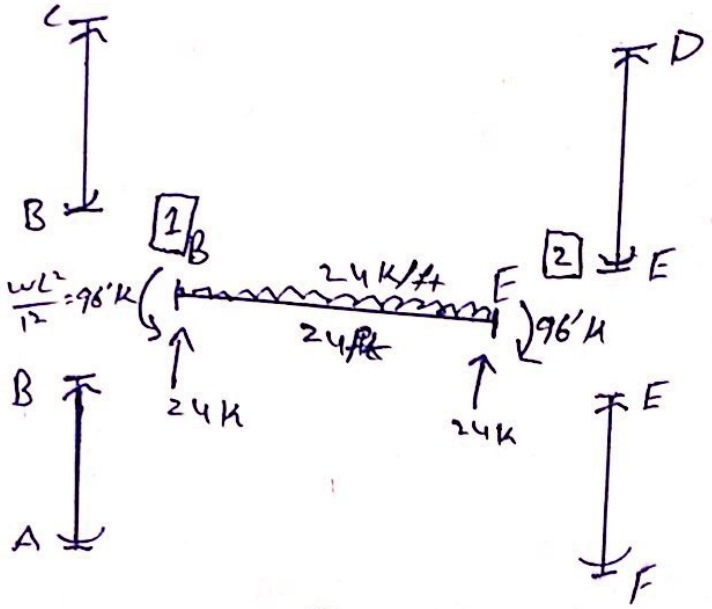


Rotation At B & C is taken as redundant joint displacement

$$[D]_{2*1} = \begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \quad [AD]_{2*1} = \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

STEP #02: (2)

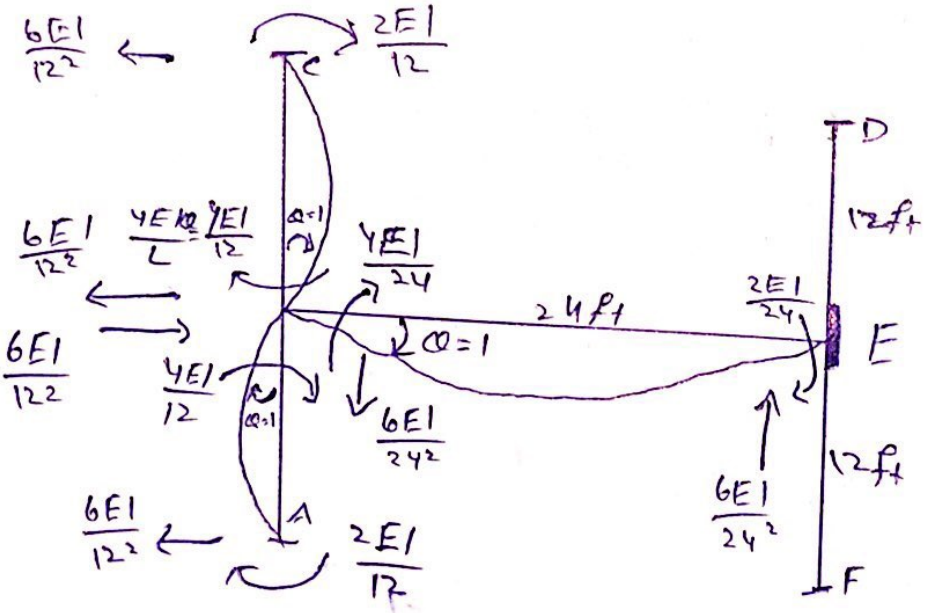
Compute ADL matrix (fixed end act)



$$[ADL] = \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix} = \begin{bmatrix} -96 \\ 96 \end{bmatrix}$$

STEP #03:-

i Ist D_1 & $D_2 = 0$ & compute the values of S_{11} & S_{21}



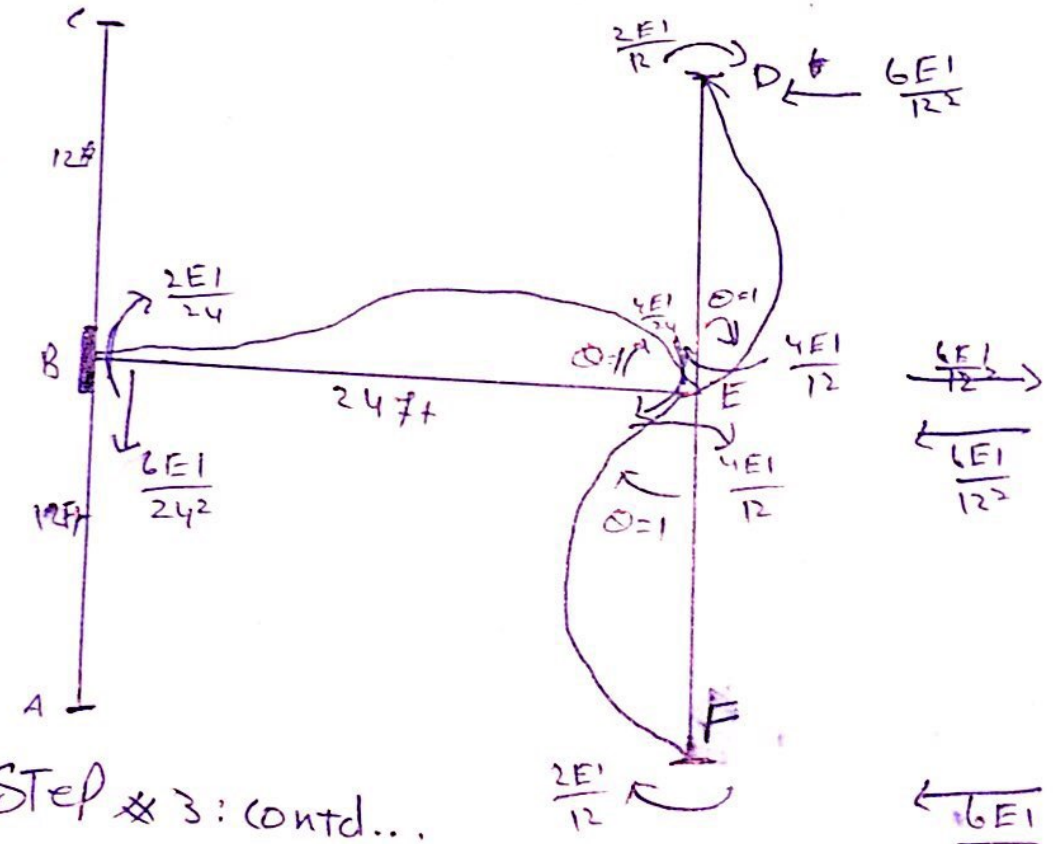
STEP ✱ 03 (i): contd....

$$S_{11} = \frac{4EI}{12} + \frac{4EI}{12} + \frac{4EI}{24} \qquad S_{21} = \frac{2EI}{24}$$

$$S_{11} = 0.833EI \qquad S_{21} = 0.0833EI$$

ii) Now $D_2 = 1$ & $D_1 = 0$ as shown

compute the value of S_{12} & S_{22}



STEP ✱ 3: contd...

$$S_{12} = \frac{2EI}{24} \qquad S_{22} = \frac{4EI}{24} + \frac{4EI}{12} + \frac{4EI}{12}$$

$$S_{12} = 0.083EI \qquad S_{22} = 0.833EI$$

STEP # 3 : contd...

$$S_{11} = 0.833EI \qquad S_{12} = 0.0833EI$$

$$S_{21} = 0.0833EI \qquad S_{22} = 0.833EI$$

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

$$[S] = EI \begin{bmatrix} 0.833 & 0.0833 \\ 0.833 & 0.833 \end{bmatrix}$$

stiffness coefficient matrix

STEP # 04 :-

$$AD_1 = ADL_1 + S_{11}D_1 + S_{12}D_2$$

$$AD_2 = ADL_2 + S_{21}D_1 + S_{22}D_2$$

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

$$[AD]_{2\times1} = [ADL]_{2\times1} + [S]_{2\times2} \cdot [D]_{2\times1}$$

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

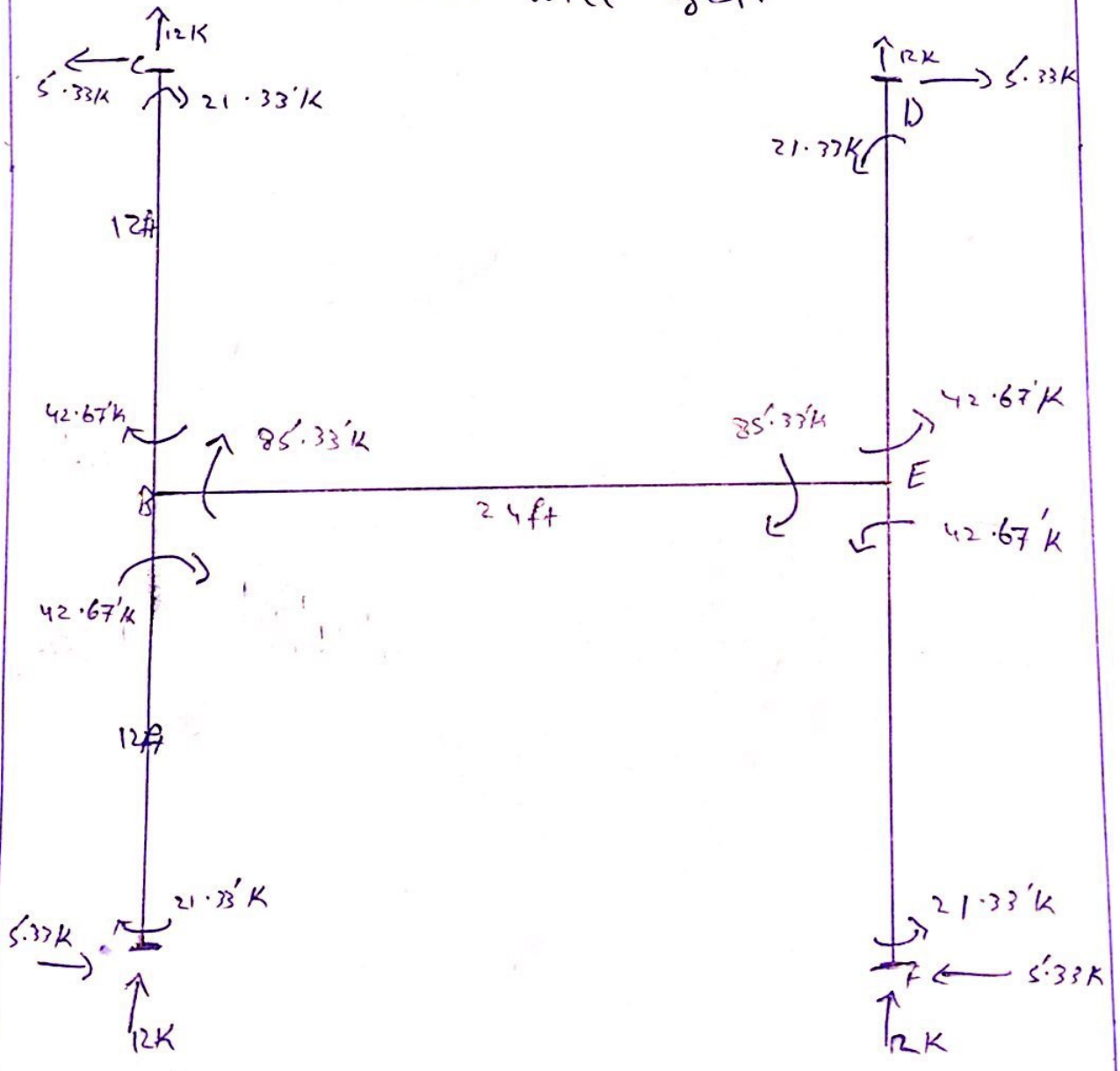
$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}^{-1} \begin{bmatrix} AD_1 - ADL_1 \\ AD_2 - ADL_2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \frac{1}{EI} \begin{bmatrix} 0.833 & 0.0833 \\ 0.0833 & 0.833 \end{bmatrix}^{-1} \begin{bmatrix} 0 - (-96) \\ 0 - 96 \end{bmatrix}$$

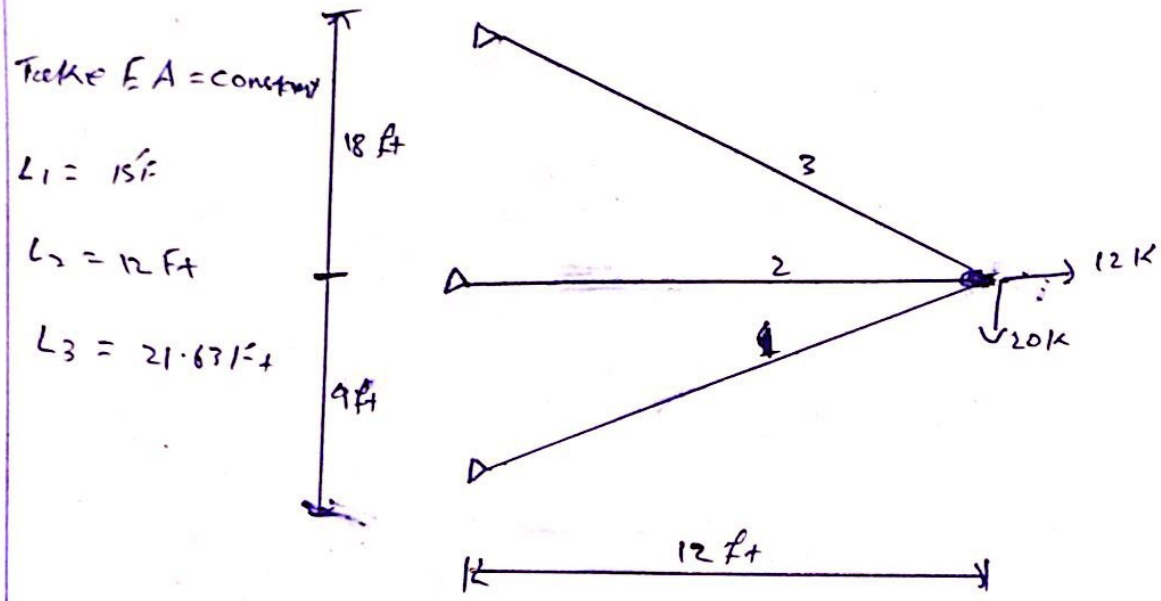
$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 128 \\ -128 \end{bmatrix} \frac{1}{EI}$$

+ve sign shown assume redundant joint displacement direction is wrong.

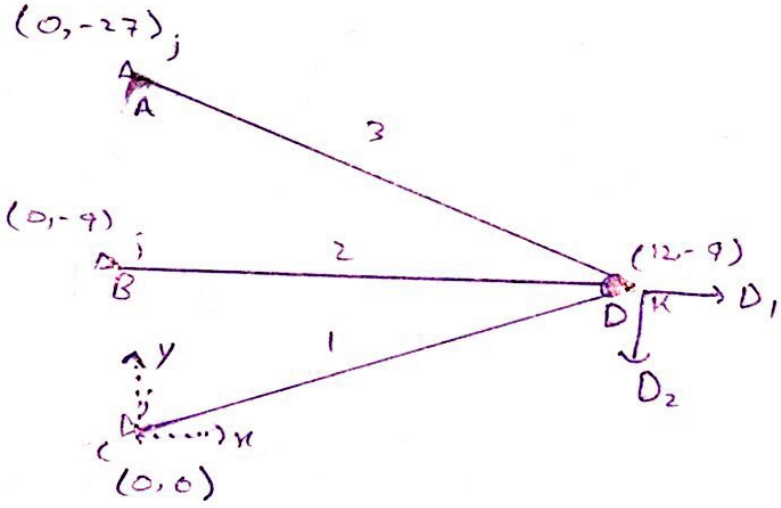
STEP #05: compute the member end actions & you will get.



Q No: 02 :- (1)



STEP ** 01 :



$$[D]_{2\times1} = \begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$[AD]_{2\times1} = \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 20 \end{bmatrix}$$

Step #02: computation of AMD & stiffness matrices.

i. when $D_1 = 1$ & $D_2 = 0$

$$AMD_{11} = \frac{EA}{L^2}(x_K - x_j) = \frac{EA}{15^2}(12 - 0) = 0.0533EA$$

$$AMD_{21} = \frac{EA}{L^2}(x_K - x_j) = \frac{EA}{12^2}(12 - 0) = 0.0833EA$$

$$AMD_{31} = \frac{EA}{L^2}(x_K - x_j) = \frac{EA}{21.63^2}(12 - 0) = 0.0256EA$$

$$S_{11} = \frac{EA}{L^3}(x_K - x_j)^2 = \frac{EA}{15^3}(12-0)^2 + \frac{EA}{12^3}(12-0)^2 + \frac{EA}{21.63^3}(12-0)^2$$

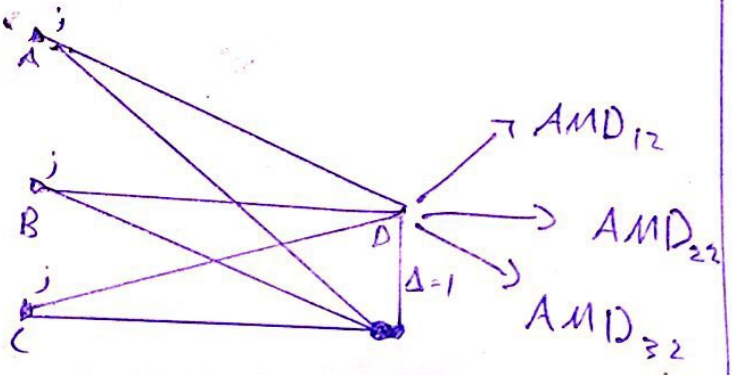
$$= 0.1402\,EA$$

$$S_{21} = \frac{EA}{L^3}(x_K - x_j)(y_K - y_j) = \frac{EA}{15^3}(12-0)(-9-0) + \frac{EA}{12^3}(12-0)(-9-(-27))$$

$$+ \frac{EA}{21.63^3}(12-0)(-9-(-27))$$

$$= -0.0107\,EA$$

STEP #02:



STEP #02:

$$AMD_{12} = \frac{EA}{L^2}(y_k - y_j) = \frac{EA}{15^2}(-9+0) = -0.04EA$$

$$AMD_{22} = \frac{EA}{L^2}(y_k - y_j) = \frac{EA}{12^2}(-9-(-9)) = 0$$

$$AMD_{32} = \frac{EA}{L^2}(y_k - y_j) = \frac{EA}{21.63^2}(-9-(-12) = 0.038EA$$

$$S_{12} = \frac{EA}{L^3}(x_k - x_j)(y_k - y_j) = \frac{EA}{15^3}(12-0)(-9-0) + \frac{EA}{12^3}\cdots$$

$$(12-0)(-9-(-9)) + \frac{EA}{21.63^3}(12-9)(-9-(-27))$$

$$= -0.010\,7EA$$

$$S_{22} = \frac{EA}{L^3}(y_k - y_j)^2 = \frac{EA}{15^3}(-9-0)^2 + \frac{EA}{12^3}(-9+9)^2$$

$$+ \frac{EA}{21.63^3}(-9-27)^2$$

$$= 0.056EA$$

STEP #03: computation of AMD & stiffness matrix

AMD matrix will be

$AMD_{11} = 0.0533EA$ $AMD_{21} = 0.0833EA$ $AMD_{31} = 0.026EA$

$AMD_{12} = -0.04EA$ $\quad AMD_{22} = 0$ $\quad AMD_{32} = 0.0125EA$

$$[AMD] = EA \begin{bmatrix} 0.0532 & -0.04 \\ 0.0833 & 0 \\ 0.0256 & 0.0375 \end{bmatrix}$$

Stiffness matrix will be

$S_{11} = 0.1402EA$ $\quad S_{21} = -0.0107EA$ $\quad S_{12} = -0.0107EA$

$S_{22} = 0.056EA$

$$[S] = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \qquad [S] = EA \begin{bmatrix} 0.1402 & -0.0107 \\ -0.0107 & 0.056 \end{bmatrix}$$

STEP # 03:-

$$AD_1 = S_{11} D_1 + S_{12} D_2$$

$$AD_2 = S_{21} D_1 + S_{22} D_2$$

$$\begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} D_1 \\ D_2 \end{bmatrix}$$

$$[AD]_{2\times 1} = [S]_{2\times 2} \cdot [D]_{2\times 1}$$

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

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

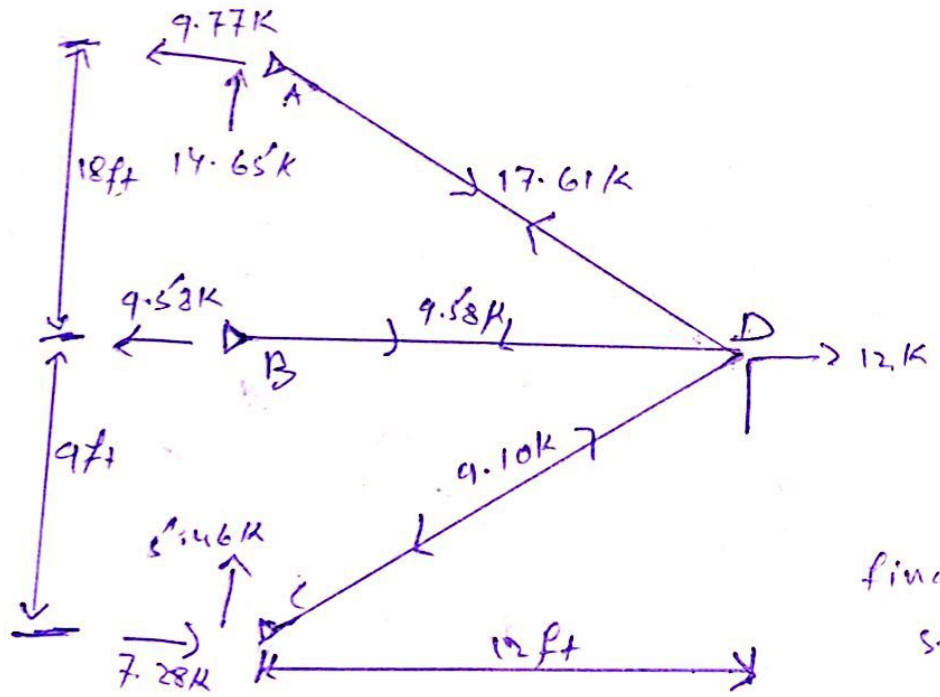
$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \frac{1}{EA} \begin{bmatrix} 0.1402 & -0.0107 \\ -0.0107 & 0.056 \end{bmatrix}^{-1} \begin{bmatrix} 12 \\ 20 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \frac{1}{EA} \begin{bmatrix} 115.065 \\ 380.83 \end{bmatrix}$$

$$\begin{bmatrix} AM_1 \\ AM_2 \\ AM_3 \end{bmatrix} = \begin{bmatrix} AMD_{11} & AMD_{12} \\ AMD_{21} & AMD_{22} \\ AMD_{31} & AMD_{32} \end{bmatrix} \begin{bmatrix} D_1 \\ D_2 \end{bmatrix}$$

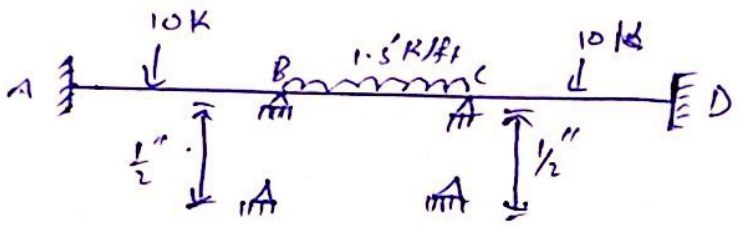
$$\begin{bmatrix} AM_1 \\ AM_2 \\ AM_3 \end{bmatrix} = EA \begin{bmatrix} 0.0537 & -0.04 \\ 0.0833 & 0 \\ 0.0256 & 0.0385 \end{bmatrix} \begin{bmatrix} 115.065 \\ 380.83 \end{bmatrix} \frac{1}{EA}$$

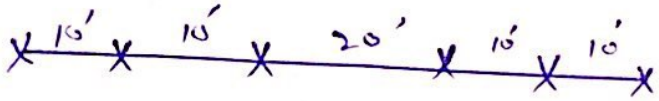
$$= \begin{bmatrix} -9.1\,K \\ 9.58K \\ 17.61K \end{bmatrix}$$



final analyzed structure.

Q NO: 03





Take $EI = 30,000$ KSI & $I = 2000\ in^4$

$EI = 41666.67\ K-ft^2$

$\Delta = \frac{1}{2}" = \frac{1}{24}'$

Sol:-

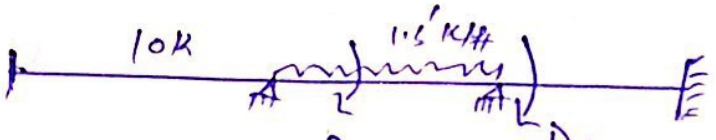
STEP # 01

$K \cdot I = 3j - \gamma + (\quad$

$= 3(4) - 10 + 0$

$= 12 - 10$

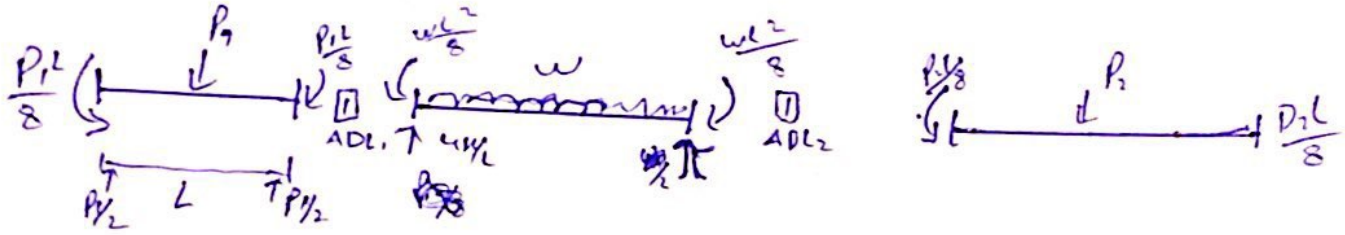
$$\boxed{K \cdot I = 2^0}$$



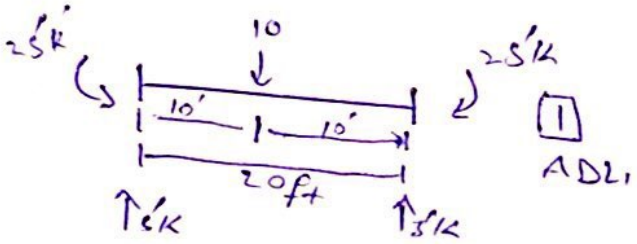
$$\begin{bmatrix} AD \end{bmatrix}_2 = \begin{bmatrix} AD_1 \\ AD_2 \end{bmatrix}$$

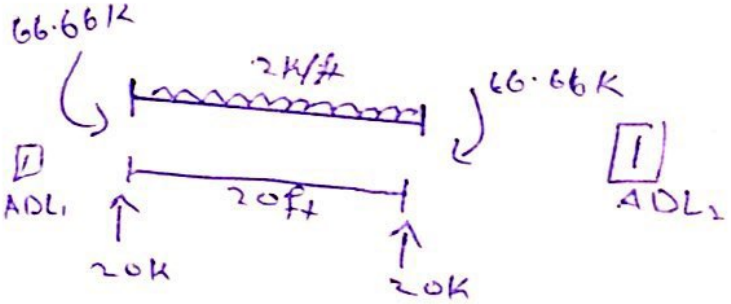
STEP #02

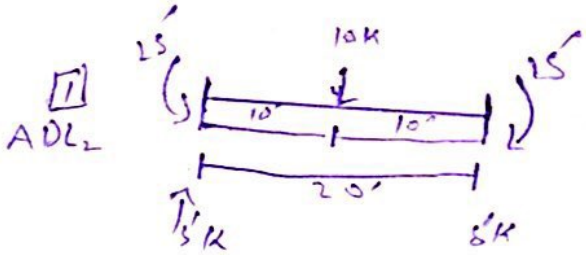
Generate ADL Matrix



1)



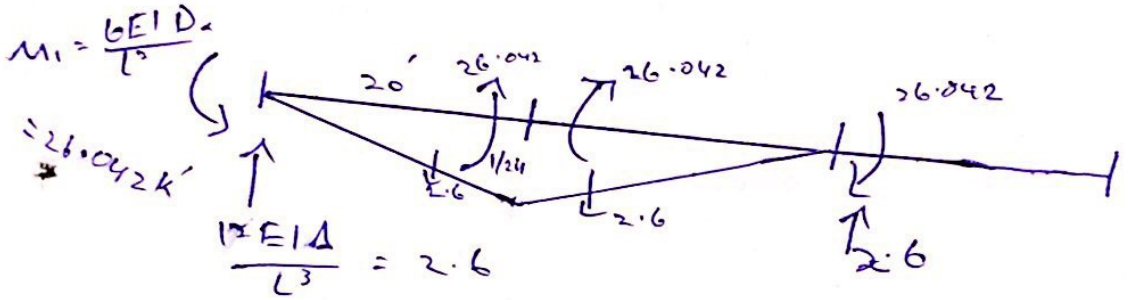




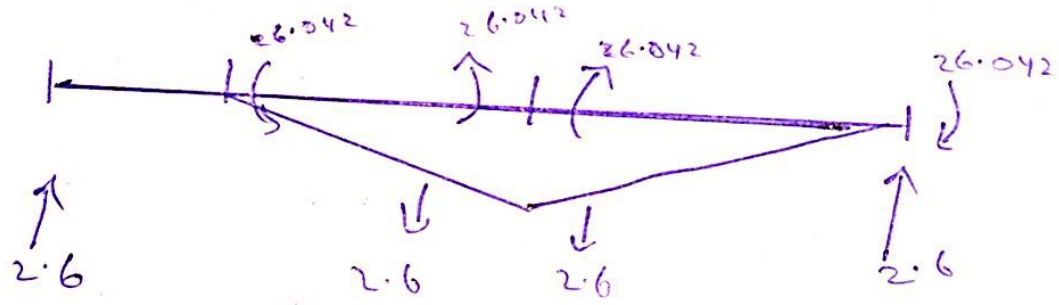
$$\Rightarrow \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix} = \begin{bmatrix} -46.66K' \\ 41.66K' \end{bmatrix}$$

(3)

Compute ADL due to indirect settlement at B



$$\begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix} = \begin{bmatrix} 26.04 \end{bmatrix}$$



$$\begin{bmatrix} ADL_1'' \\ ADL_2'' \end{bmatrix} = \begin{bmatrix} -26.042 \\ 0 \end{bmatrix}$$

$$ADL_1 = ADL_1' + ADL_1'' + ADL_1'''$$

$$= -47.66 + 0 - 26.092$$

$$= 67.702$$

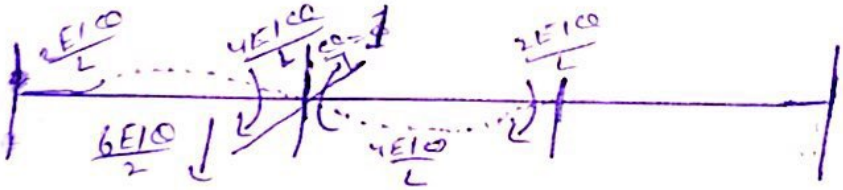
$$ADL_2 = ADL_2' + ADL_2'' + ADL_2'''$$

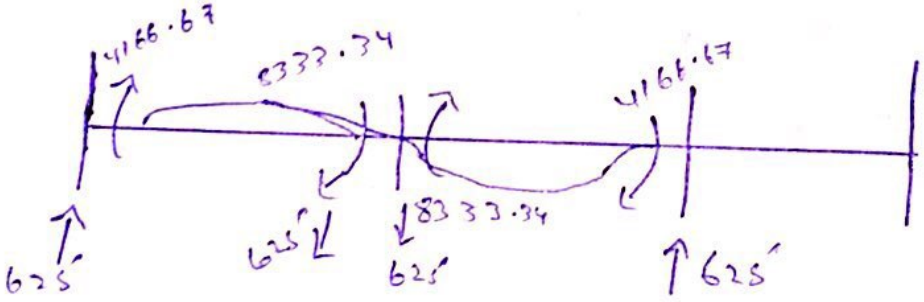
$$= 41.66 + 26.042 + 0$$

$$= 67.702$$

STEP # 3: $\dot{J}$ rotation at 1D.

i)

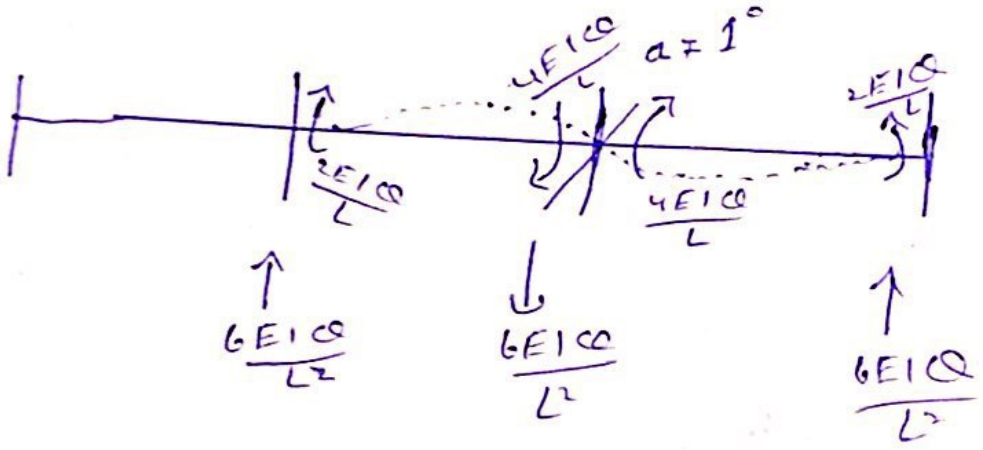


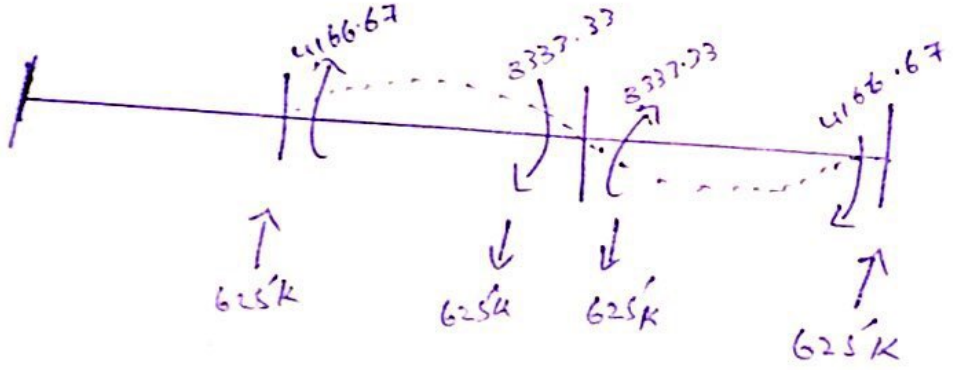


$$S_{11} = 16666.662$$

$$S_{21} = 4166.67$$

ii) Rotation at D_2





$S_{22} = 16666.68$

$S_{21} = 416667$

STEP # 04:-

$$\begin{bmatrix} AD1 \\ AD_2 \end{bmatrix} = \begin{bmatrix} ADL_1 \\ ADL_2 \end{bmatrix} + \begin{bmatrix} S11 & S12 \\ S21 & S22 \end{bmatrix} \begin{bmatrix} D_1 \\ D_2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} S11 & S12 \\ S21 & S22 \end{bmatrix}^{-1} \begin{bmatrix} AD_1 - ADL_1 \\ AD_2 \qquad ADL_2 \end{bmatrix}$$

$$\begin{bmatrix} D_1 \\ D_2 \end{bmatrix} = \begin{bmatrix} 16666.68 & 4166.67 \\ 4166.67 & 16666.68 \end{bmatrix}^{-1} \begin{bmatrix} 67.702 \\ -67.702 \end{bmatrix}$$

$$= \begin{bmatrix} 6.399 \times 10^{-5} & -1 \times 10^{-5} \\ -1 \times 10^{-5} & 6.394 \times 10^{-5} \end{bmatrix} \begin{bmatrix} 67.702 \\ -67.702 \end{bmatrix}$$

$$= \begin{bmatrix} 0.00542 \\ -0.00542 \end{bmatrix}$$

NAME : HILAL AHMAD

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Subject : STRUCTURE II

Subbmitted to : MAM HUMAIRA ARSHAD

Date : 25^: 09: 2020