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Subject Structure II

B.E (C) Section B

Semester 5th

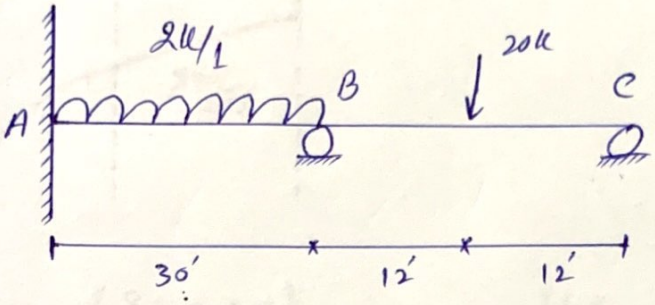
Summer Examination

Instructor Engr Adeed Khan

Date 21st August, 2020.

Question No 01 :-

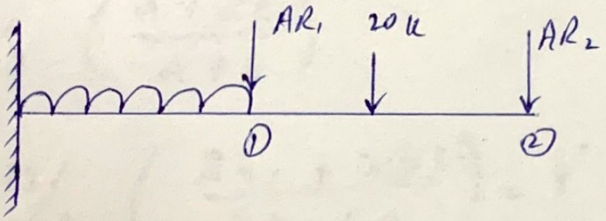
Analyze the given beam shown in Fig-1 by Flexibility method. EI is constant.




E.I constant

S.I = 2°

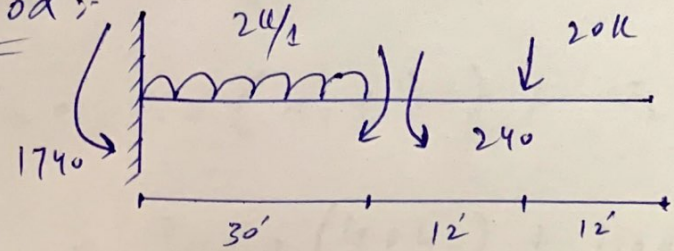
Step 01 :- Select redundant actions




$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}, \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

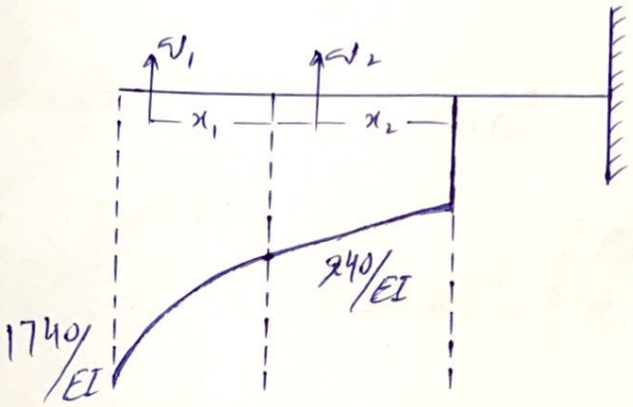
$$[DRS] = [DRL] + F \times AR$$

Step 02 :-



$20 \times 12 = 240$

$(20 \times 42) + 2 \times 30 \times 15 = 1740$




$$A_1 = \left(\frac{240+0}{EI}\right) \times 12 = 1440/EI$$

$$A_2 = \frac{1}{n+1} \times (b \times h) = \frac{1}{2+1}\left(\frac{1100}{EI}\right) \times 30 = 1100/EI$$

$$x_1 = 1/3 \left(\frac{a+2b}{a+b}\right)$$

$$x_1 = 12/3 \left(\frac{240+2(0)}{240+0}\right) = 4'$$

$$x_2 = \frac{3}{n+2} \times b = \frac{3}{2+2}(30) = 22.5'$$

$$DRL_1 = A_1 (x_1 + 30) = 1440 (4+30) = 48960/EI$$

$$DRL_2 = A_1 (x_1 + 40) + A_2 (x_2 + 12)$$

$$= 1440 (4+40) + 11000 (22.5 + 12)$$

$$DRL_2 = 442860$$

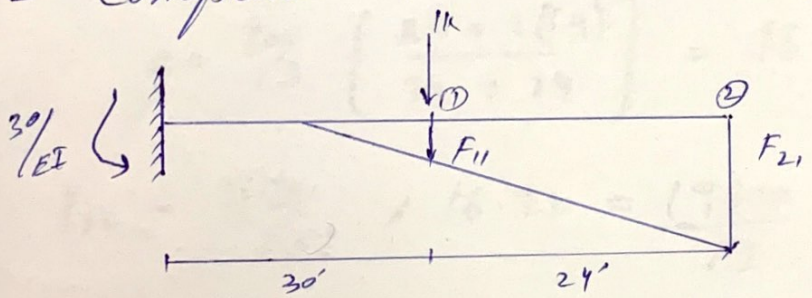
$$[DRL] = \frac{1}{EI}\begin{bmatrix} 48960 \\ 442860 \end{bmatrix}$$

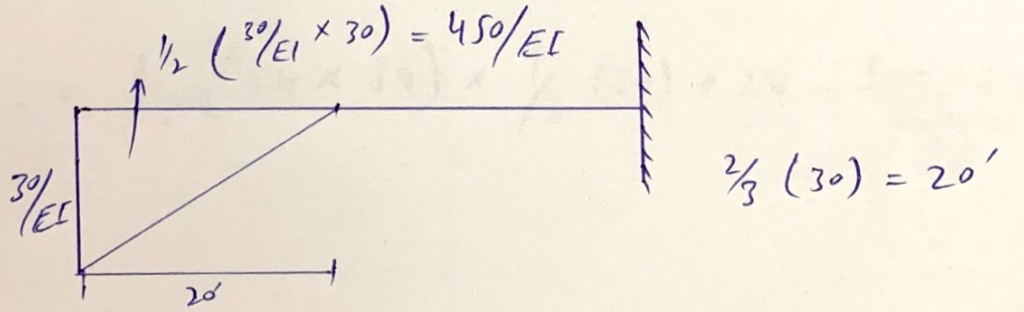
Step 03 :- Construct flexibility co-efficient matrix

$$F_{2\times 2} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}$$

(a) Apply a unit value of $AR_1$ at reference point

i- Compute the value of $F_{11}$ & $F_{21}$



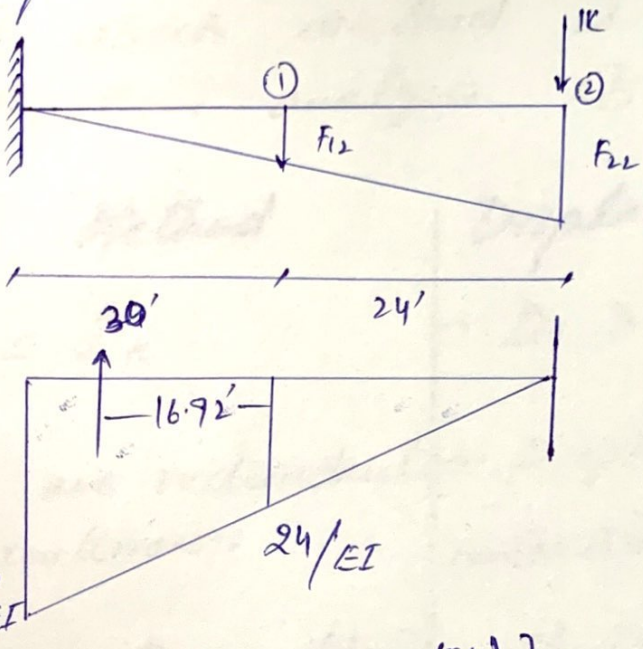




$$F_{11} = \frac{450}{EI}(20) = \frac{9000}{EI}$$

$$F_{21} = \frac{450}{EI}(20+24) = \frac{19800}{EI}$$

(b) Apply a unit of $AR_2$ at reference point (2)

(ii) Compute the value of $F_{12}$ & $F_{22}$




$$\omega = \left(\frac{54+24}{2EI}\right) \times 30 = \frac{1170}{EI}$$

$$\bar{x} = 30/3 \left[\frac{24 + 2(54)}{54 + 24}\right] = 16.92'$$

$$F_{12} = \frac{1170}{EI} \times 16.92 = \frac{19800}{EI}$$

$$F_{22} = 1/2\,(54 \times 54) \times 1/3\,(30) + 24 = \frac{49572}{EI}$$

Question No 2:- Differentiate b/w force method and displacement method and suggest which method is more suitable for structure analysis & matrix approach.

| Force Method | Displacement Method |
|---|---|
| → $D_s < D_k$ | → $D_s > D_k$ |
| → Forces are redundant or unknowns | → Displacement are redundant or unknowns. |
| → Starts with equilibrium of forces. | → Starts with compatible deformations. |
| → Forces found by compatibility eqns of displacements. | → displacements found by equilibrium eqns of forces. |
| → No. of redundants = $D_s$ | → No. of redundants = $D_k$ |
| → Not suitable for Compute. | → Not suitable for truss. |

Force Method :- Strain energy method, Castigliamose theorem, Maxwell's reciprocal theorem, method of virtual work, consistent deformation method, Flexibility matrix method.

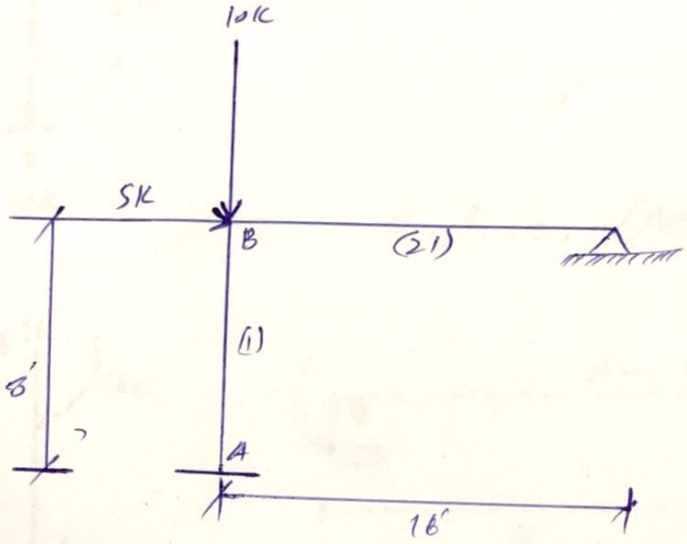
Displacement Method :- Moment distribution method slope deflection moment, Kani's method, stiffness matrix method.

Suggest :- Displacement Method is better or suitable than force method it is globally used.

It is an easy & convenient method.

Question No. 03 :-

Analyze the rigid-joint frame shown in FIG-2 by flexibility method. Assume EI is constant for all members

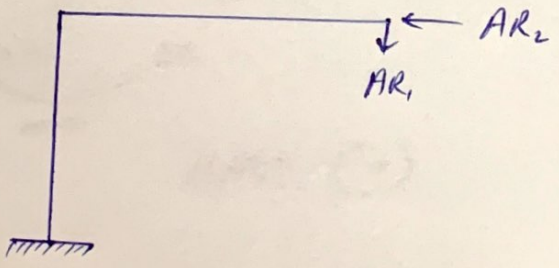



Solution :-

$$S.I = R - 3$$
$$= 5 - 3$$
$$= 2^{\circ}$$

Step I :-

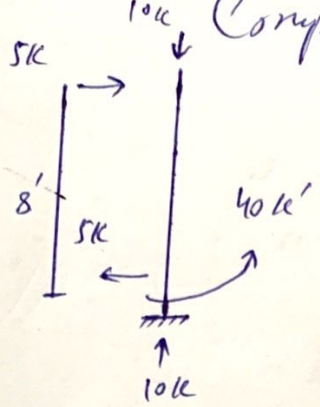
Identify the redundant actions

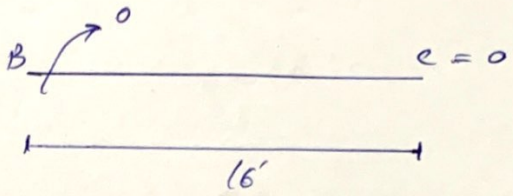



$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

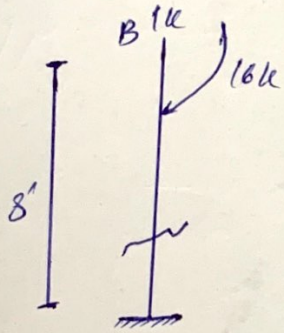
Step :- 02 :-

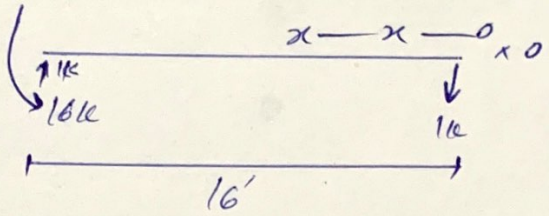
Compute the value of DRL & F



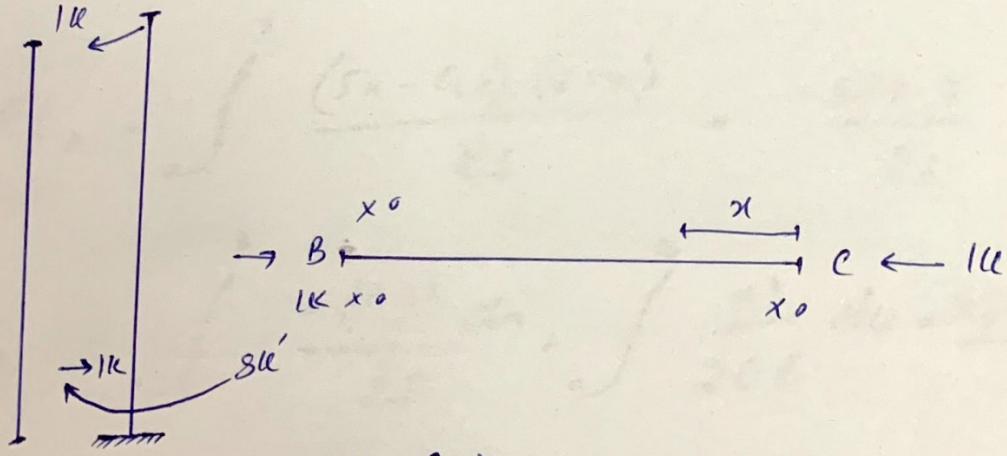




AML – Values (M)




AMR = 01 (m)




AMR₂ (0)

Table .....

| Members | AB | BC |
|---|---|---|
| origin | A | C |
| Limit | 0-8 | 0-16 |
| I | I | 2I |
| M | 5x-40 | 0 |
| $m_1$ | -16 | x |
| $m_2$ | -8-x | 0 |

$$DRL_1 = \int_0^8 \frac{(5x-40)(-16)\,dx}{EI} = 2560/EI$$

$$DRL_2 = \int_0^8 \frac{(5x-40)(8-x)}{EI} = -\frac{853.3}{EI}$$

$$F_{11} = \int_0^8 \frac{-(16)^2\,dx}{EI} + \int_0^{16} \frac{x^2}{2EI}\,dx = \frac{2730.67}{EI}$$

$$F_{12} = \int_0^8 \frac{-(16)(8-x)\,dx}{EI} = -512/EI$$

$$F_{22} = \int_0^8 \frac{(8-x)^2}{EI}\,dx = 170.67/EI$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} F_{11} & F_{12} \\ F_{21} & F_{22} \end{bmatrix}^{-1} \begin{bmatrix} DRS_1 - DRL_1 \\ DRS_2 - DRL_2 \end{bmatrix}$$

$$= \begin{bmatrix} 2730.31 & -512 \\ -512 & 170.0 \end{bmatrix} \begin{bmatrix} 0 - 2560 \\ 0 - 853.33 \end{bmatrix}$$

$$\begin{matrix} AR_1 \\ AR_2 \end{matrix} = \begin{bmatrix} \text{Ans} \end{bmatrix}$$