Mid - term

Name:- Tauseef Ali

I.D :- 7701

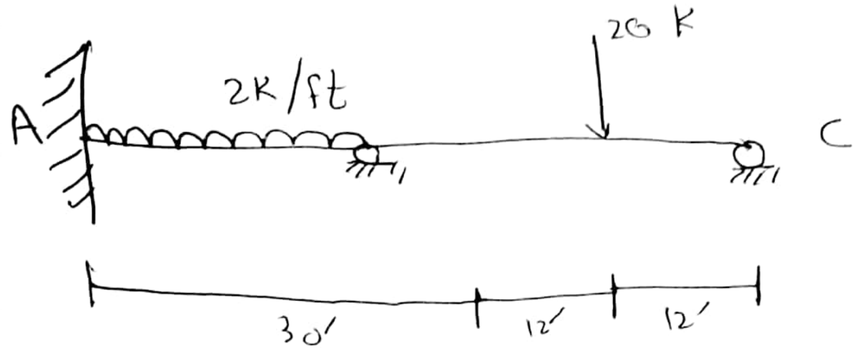
Section:- B

Submitted to:- Eng. Adeed

Date:- 21/8/2020

Subject Structure Analysis II

Question # 1



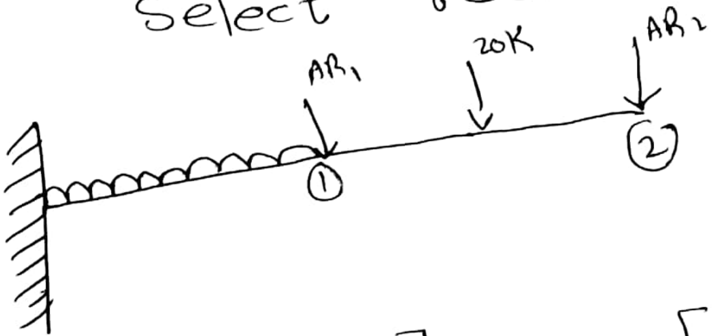
EI = Constant

Solution:

Structural indeterminancy = 2"

Step # 1

Select redundant Aactions

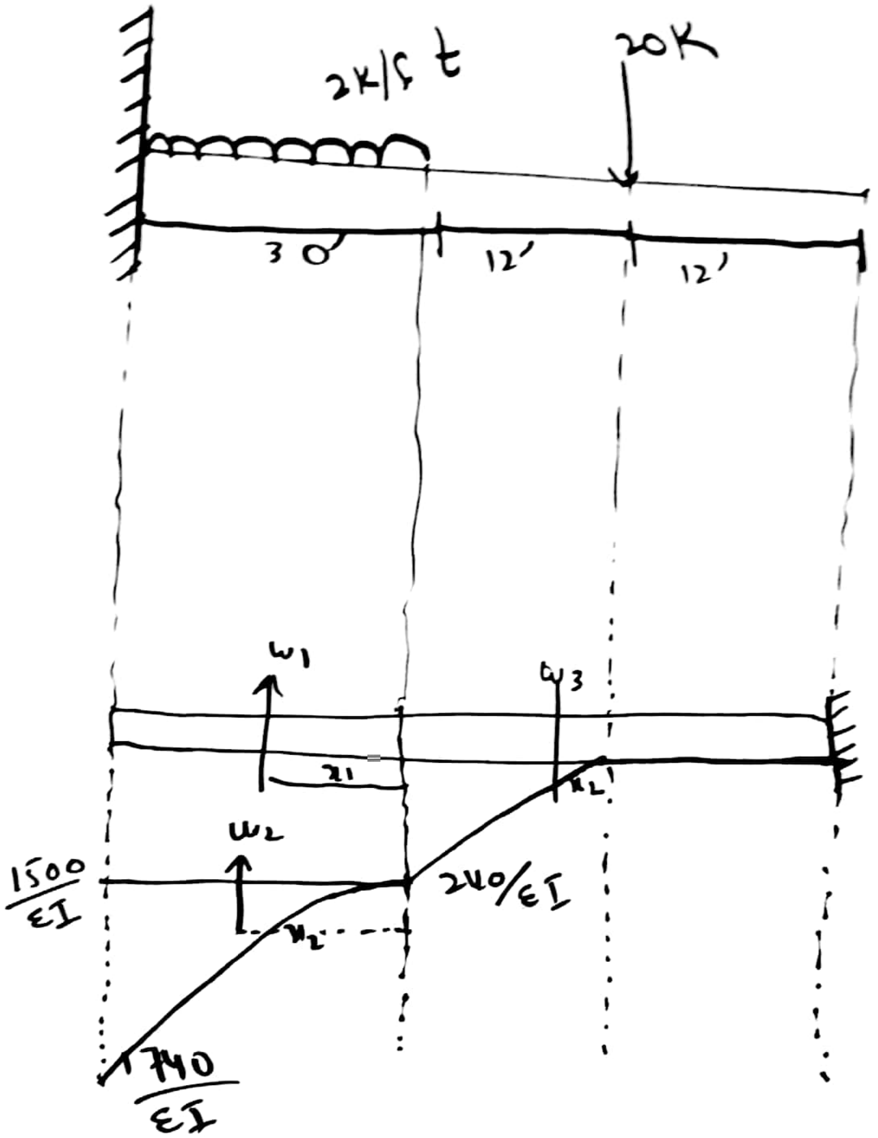


$$\begin{bmatrix} DR_1 \\ DR_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \quad , \quad \begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

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

Step # 2

Compute the value of [DRL] 2



$w_1 = 1500 \times 30 = 4500$

$w_2 = \frac{1}{3} \times 30 \times 2400 = 2400$

$w_3 = \frac{1}{2} \times 12 \times 240 = 1440$

$20 \times 12 = 240$

$20 \times (12+30) +$
$2 \times 30 \times 15$
$= 1740$

$x_1 = b/2 = 30/2 = 15'$

$x_2 = \frac{3}{n+2} \times 1 = \frac{3}{2+2} \times 30 = 22.5'$

$x_3 = \frac{2}{3} \times 12 = \frac{2}{3} \times 12 = 8'$

Now find DRL

$$DRL_2 = w_1 \times (x_1 \times 24) + w_2 (x_2 + 24) + w_3 (x_3 + 12)$$

$$= 45000 (15 + 24) + 2400 (22.5 + 24) + 1440 (8 + 12)$$

$$DRL = \boxed{1895400 EI}$$

$$DRL_1 = 45000 (15) + 2400 (22.5)$$

$$= 675000 + 54000$$

$$= \boxed{729000}$$

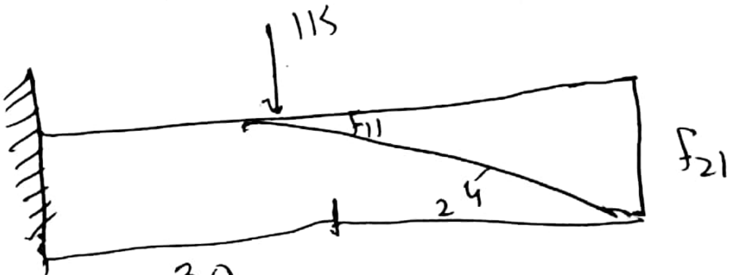
So

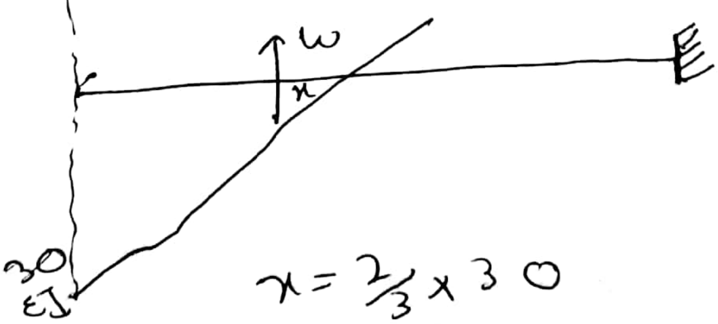
$$DRL = \frac{1}{EI} \begin{bmatrix} 729000 \\ 1895400 \end{bmatrix}$$

Step # 3 flexibility method.

$$F_{2\times2} = \begin{bmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{bmatrix}$$

(a) applying unit load on AR_1





$$w = \frac{1}{2} \left(\frac{30}{EI} \times 30 \right)$$

$$= 450/EI$$

$$x = \frac{2}{3} \times 30$$

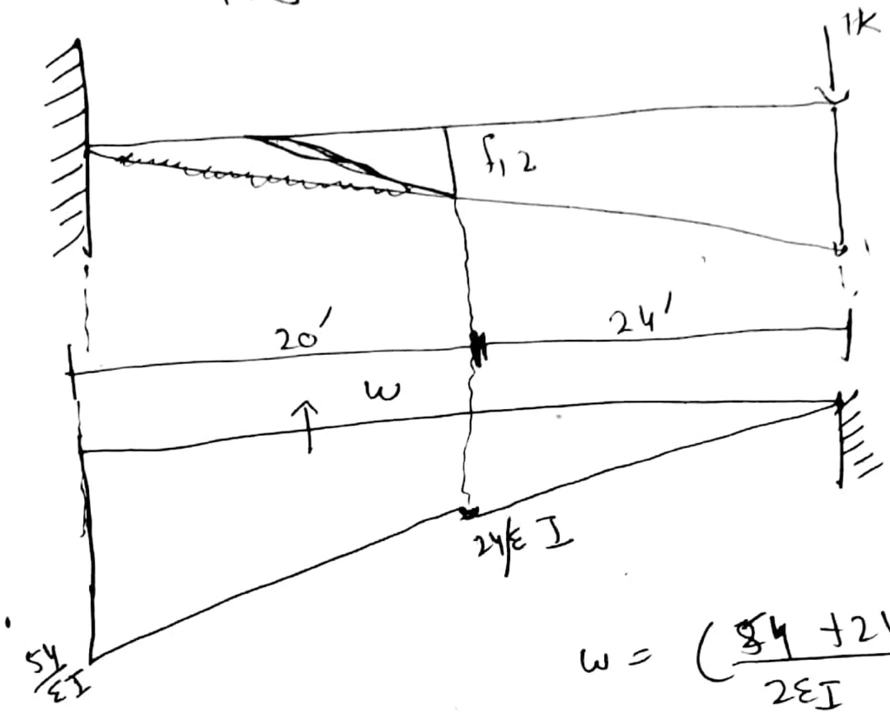
$$= 20'$$

So,

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

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

(B) Now apply unit load on AR_2



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

$$= 1170\,EI$$

Now the distance

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

$$F_{12} = \frac{1170}{EI} \times 16.92 = \frac{19796.4}{EI}$$

$$F_{22} = \frac{1170}{EI} \times (16.92 \times 24) = \frac{47876.4}{EI}$$

Hence

$$F_{2\times 2} = \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix} 1/EI$$

Step # 3 compute the value of AR

$$[AR] = [DRs - DR2] \times [F]^{-1}$$

$$[F]^{-1} = \frac{1}{|F|} \times \text{Adj } F$$

$$= \frac{1}{\begin{vmatrix} 9000 & 19796.4 \\ 198000 & 47876.4 \end{vmatrix}} \times \text{Adj} \begin{bmatrix} 9000 & 19796.4 \\ 19800 & 47876.4 \end{bmatrix}$$

$$|A| = (9000 \times 47876.4 - 1976.4 \times 19800)$$

$$= (430887600 - 39196872\text{0})$$

$$\boxed{|F| = 38918880}$$

$$\text{Adj } A = \begin{bmatrix} 47876.4 & -19796.4 \\ -19800 & 9000 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 - 729000 \\ 0 - 1895400 \end{bmatrix} \frac{1}{EI} \times \frac{1}{38918880} \begin{bmatrix} \; \end{bmatrix}$$

$$= \begin{bmatrix} -729000 \\ -1815400 \end{bmatrix} \frac{1}{EI} \times \frac{\begin{bmatrix} 47876.4 & -19798 \\ -198000 & 9000 \end{bmatrix}}{3891880}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 66.193 \\ -67.505 \end{bmatrix}$$

Q#2

There are two main method of Structural analysis using the matrix approch.

1) force method
2) Displacement method

force Method	Displacement Method
It is also known as flexibility matrix method or compatabiliby method	It is also called equilibrium method or stifness matrix method.
In ~~un~~ force method the unknown are taken as reaction & force	In displacement method the unknown are taken as joint displacement (θ, Δ).
In this the no of reduntrunt $= D_s$	In this the no of redundants $= D_k$
In this the force are found by compatability equation of displacement	In this the displacement are found by equilibrium equation of force.
In this the type ~~the~~ of indetermnacy is static Indetermnacy	In this the type of indertminancy is Kinamatic Indeterminancy
It is Suitable when $D_s < D_K$	It is suitable when, $D_s > D_K$.

Suitable method

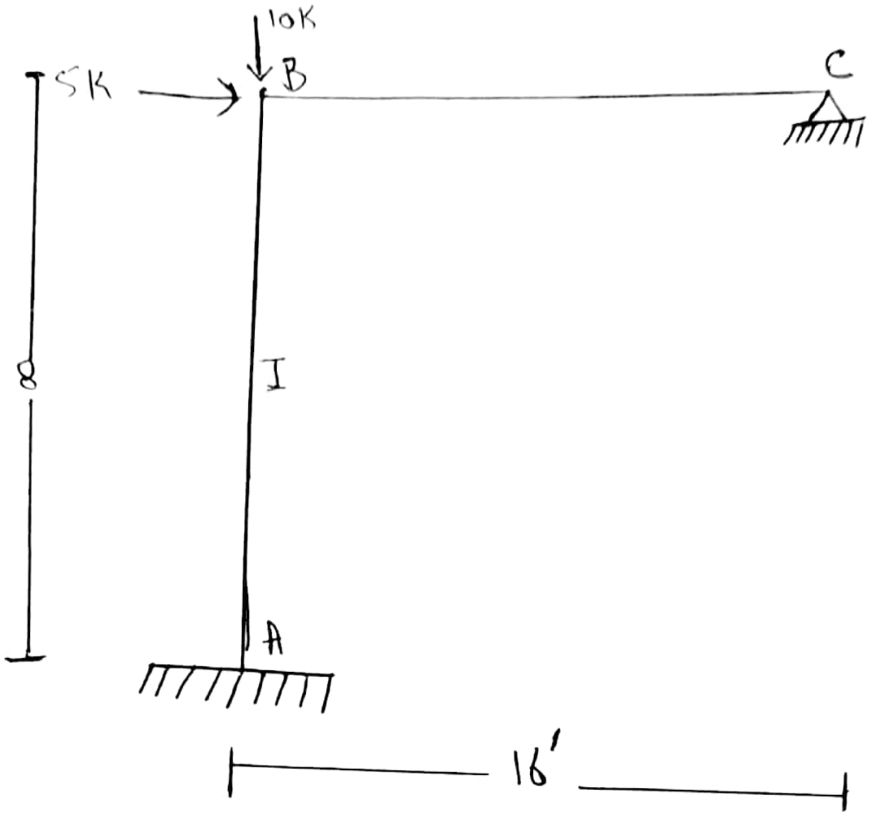
Ans
For Analysis of Structure of matrix approch both the force method or displacement method can be used depend upon situation.

1. When the degree of statica indeterminancy is less than the degree of Kinematic Intermimnancy ie $D_s < D_k$, then It is Suggested to use force method of Analysis.

2. When the degree of Static indeterminancy is more then Kinematic Intermimnancy i-e $D_k > D_s$ then It is Suggested to use displacement method of Analysis.

Q #3

Q#3



E = Constant

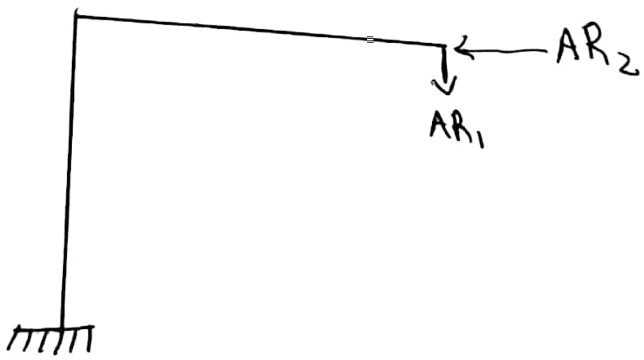
Solution:-

Total statical interdermincy

$R - 3 = 5 - 3 = 2''$

Step#1

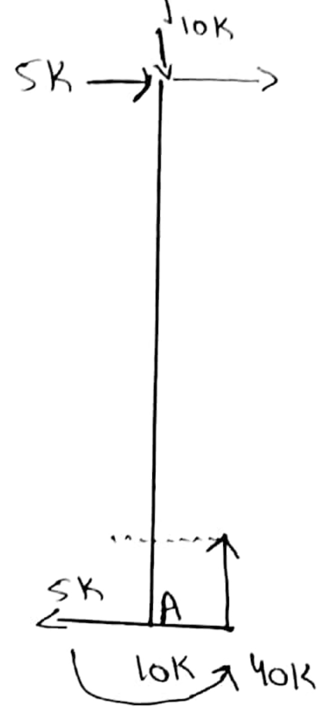
Identifying Reduntant action



$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix} \qquad \begin{bmatrix} DR_1 \\ DR_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

Step #2

compute value of [DRL]



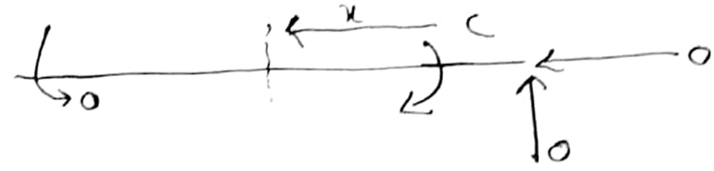
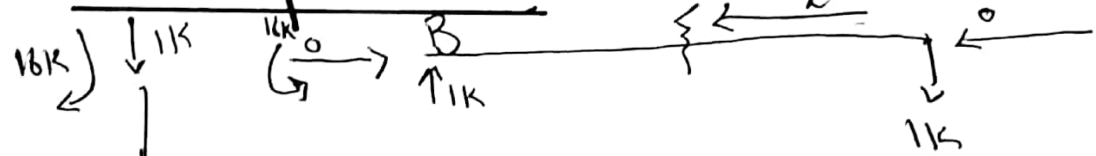


fig AML value
M value

Step #3

[F] or [AMR]



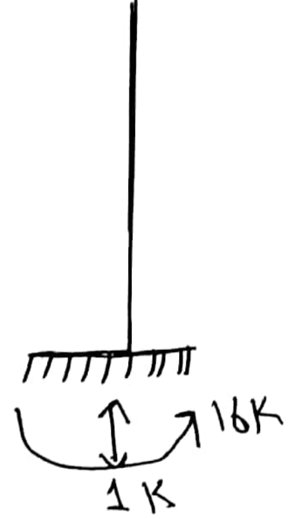
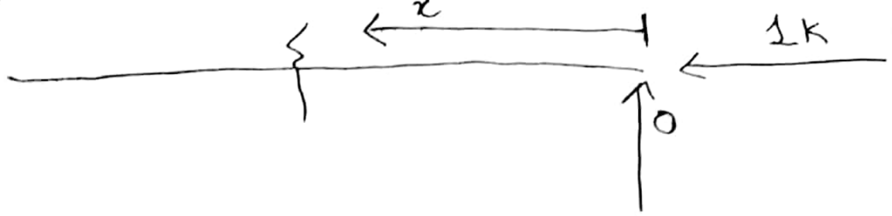


fig AMR value
(M, value)



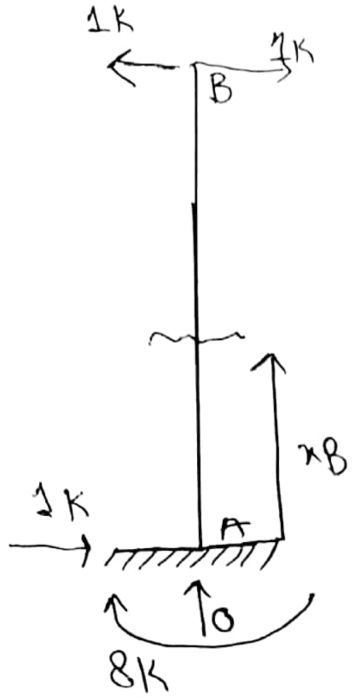


fig AMR value
[M₂ value

Member	AB	BC
orgin·	A	C
limit	0 – 8	0 – 16
I	I	2I
M	5x – 40	0
M_1	–16	– x
M_2	8 – x	0

→ <u>find value of DRL</u>

$$DRL_1 = \int_0^8 \frac{M_{AB} \cdot M_{1\,AB}}{EI} + \int_0^{16} \frac{M_{BC} \cdot M_{2(BC)}}{EI}$$

$$= \int_0^8 \frac{(5x-40)(-16)\,dx}{EI} + \int_0^{16} \frac{0 \cdot x}{E(2I)}\,dx$$

$$\boxed{DRL_1 = \frac{2560}{EI}}$$

$$DRL_2 = \int_0^8 \frac{(5x-40)(8-x)\,dx}{EI} + \int_0^{16} \frac{0 \cdot x}{E(2I)}\,dx$$

$$\boxed{DRL_2 = \frac{-853.33}{EI}}$$

→ **Compute flexibility matrix:**

$$f_{2\times2} = \begin{bmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{bmatrix}$$

$$\Rightarrow f_{11} = \int_0^8 m_1^2 (AB) + \int_0^{16} \frac{m_1^2 (BC)}{EI}$$

$$= \int_0^8 \frac{(-16)^2\,dx}{EI} + \int_0^{16} \frac{x^2\,dx}{E(2I}$$

$$F_{11} = \frac{2730.67}{EI}$$

$$\rightarrow f_{12} = f_{21} = \int_0^8 m_1(AB) \cdot m_2(AB) + \int_0^{16} m_1(Bc) \cdot m_2(Bc)$$

$$= \int_0^8 \frac{(-16)(8-x)\,dx}{EI} + \int_0^{16} \frac{(x)(0)}{E(2I)}\,dx$$

$$\boxed{F_{12} = F_{21} = \frac{-512}{EI}}$$

$$\Rightarrow f_{22} \int_0^8 (m_1)^2 \; AB\,dx + \int_0^{16} (m_2)^2 \, Bc\,dx$$

$$\int_0^8 \frac{8-x}{EI}\,dx + \int_0^{16} \frac{0^2}{E(2I)}\,dx$$

$$\boxed{F_{22} = 170.67}$$

As we Know that

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

$$[AR] = \frac{[DRS] - [DRL]}{[F]}$$

B 6

$$[AR] = [F]^{-1} \times [DRS - DRL]$$

$$= EI \begin{bmatrix} 2730.67 & -512 \\ -512 & 176.67 \end{bmatrix} \times \begin{bmatrix} 0 & -0.0256 \\ 0 & +8.5333 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} -0.0005 \\ 4.97 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \end{bmatrix}$$