Quiz/Assignment

Note: Attempt all questions. Draw sketches where necessary. Assume missing data if any.

Q.NO (01)

(5+5)

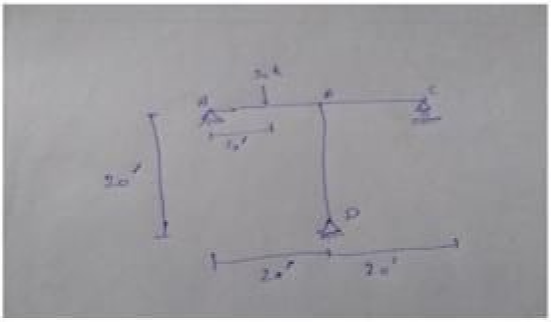
a) Expalin description of flexibility method procedure.
b) Differentiate between flexibility and stiffness method.

Q.NO (02)

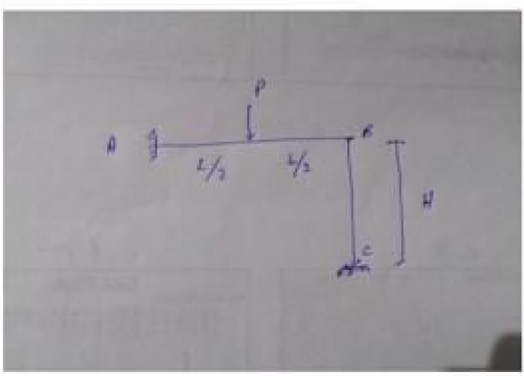
(10+10)

Analyse the frames as shown in figures by using flexibility method.

a)



b)



Name :- ShahZeb

ID :- 15629

Paper :- Advanced Structural Analysis.

Submitted TO :- Engr - Adeel Khan.

IQRA National University

peshawar.

Id = 15629
Name = Shahzeb
Paper = Advanced Structural Analysis

Q#1 part (A)

→ Explain description of flexibility method procedure -

Description of flexibility Method procedure -

① Determine the degree of Structural indeterminacy (SI). A number of releases equal to the degree of S.I are Applied to the Structure - each realised beam made by the removal of internal or External force - The ~~real~~ release structure is reffered to as a primary structure - The release structure much be choosen such that the remaining structure is geometrically stable and S-determinate In some case the no - of release can be less than the degree of indeterminacy.

② In all cases the redundant forces should be carefully choosen so that primary structure are carefully analyzed -

③ The release introduce displacement inconsestancy into the structure and as a 2nd step these inconsestancy are error in the primary structure are determine - In other words, we calculate the error in the displacement corresponding to the R-value. These displacement may be due to external appled load

(4) The 3rd step consist of determination of displacement in primary structure due to unit value of redundents. These displacement are requred at some location and in the some direction as the displacement error determine in step 2.

(5) Value of the reduntant force neccessory to determine the error in the displacement. Theis requred the writing of super position in which the effect of separate redundant are added to the displacement.
The super position at displacement result in the set of simultaneous Linear eq - (No of release) that Express the fact that there is zero relative displacement at each relase.
These compatibility equations gurante a final displaced shape.

Part # B

→ Differentiate between Flexibility and Stiffness method -

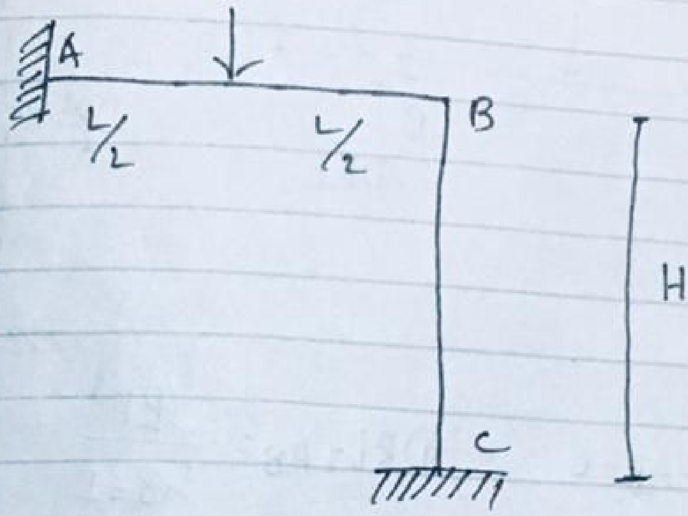
Flexibility Method	Stiffness Method -
1. Determine the degree of static indeterminacy (degree of redundancy) n-	1. Determine the degree of kinematic indeterminacy (degree of freedom).
2. Choose the redundants	2. Identify the independent displacement component -
3. Assign co-ordinate 1, 2 - - - n to the redundants -	3. Assign coordinate 1, 2, - - - to the independents displacement component -
4. Remove all redundants to obtain the released structure	4. Prevent all the independent displacement component to obtain the restrained structure -
5. Determine (Δ) the displacement at the coordinate due to applied load acting on the released structure -	5. Determine (P') the force at the coordinate in the restrained structure due to the load other than those acting at the coordinate -
6. Determine (Δ_R) the displacement at the coordinate due to the redundants acting on the released structure -	6. Determine (P_A) the force required at the co-ordinate in the unrestrained structure to case the the independent displacement components - (Δ)

(7) compute the net displacement at the coordinate $\Delta = [\Delta_L] + [\Delta_R]$	(7) compute the force at the coordinate $[P] = [P'] + [P_\Delta]$
(8) Use the conditions of compatibility of displacement to compute the redundants force $[P] = [A]^{-1}\{A - \Delta_L\}$	(8) Use the condition of equilibrium to compute the displacement. $[\Delta] = [K]^{-1}\{P - P'\}$
9 Knowing the redundants compute the internal member force by using equation of statics.	Knowing the displacement compute the internal member force by using slope deflection equation.

Q#(2)

(Part # B)

Analyse the frame by Using flexibility Method.



Sol:

- Degree of static indeterminacy:

$$Ds = (3M + R) - (3j + A)$$

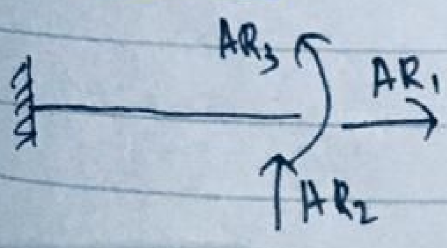
$$Ds = (3(2) + 6) - (3(3) + 0) \qquad M = 2$$

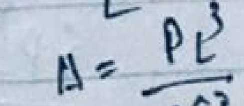
$$R = 6$$

$$Ds = (6 + 6) - 9 \qquad j = 3$$

$$Ds = 12 - 9$$

$$\boxed{Ds = 3}$$

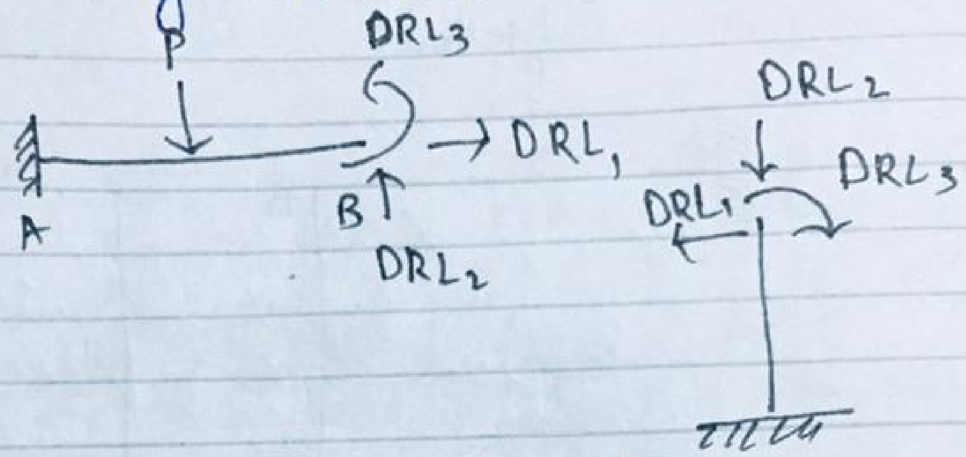




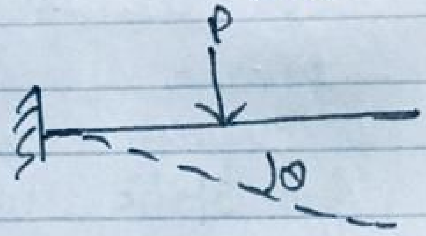
$$\Delta = \frac{PL^3}{3EI}$$

displacement.

Displacement in released structure caused by the Load -



$DRL_1 = A_B = 0$, $DRL_2 A_B = \frac{5PL^3}{48EI}$



$$\frac{P\left(\frac{L}{3}\right)^3}{3EI} \qquad \theta = \frac{P\left(\frac{L}{2}\right)^2}{2EI}$$

$$\Delta = \Delta_1 + \Delta_2$$

$$= \frac{PL^3}{24EI} + \frac{PL^3}{16EI} \qquad \frac{PL^3}{24EI} \qquad = \frac{PL^3}{8EI}$$

$$\Delta_2 = \frac{PL^2}{8EI} \times \frac{L}{2} = \frac{PL^3}{16EI}.$$

$$= \frac{PL^3}{EI}\left(\frac{2+3}{48}\right)$$

$$= \frac{5PL^3}{48EI}$$

$DRL_{3(AB)} = \dfrac{-PL^3}{8EI}$

$DRL_{1(BC)} = 0$ (Because there is no Load.)

$DRL_1 = 0 + 0 = 0$

$DRL_2 = \dfrac{-5PL^3}{48EI} + 0 = \dfrac{-5PL^3}{48EI}$

$DRL_3 = \dfrac{-PL^2}{8EI} + 0 = \dfrac{-PL^2}{8EI}.$

$$[DRL] = \begin{bmatrix} 0 \\ -5PL^3/48EI \\ -PL^2/8EI \end{bmatrix}$$

flexibility matrix :-

Apply $AR_1 = 1$ and obtain F_{11}, F_{21}, F_{31}
the displacements at End B at member AB.

$F_{11_{AB}} = L/EA$, $F_{21AB} = 0$ $F_{31AB} = 0$.

The displacement at End B at member BC

$F_{11BC} = \dfrac{H^3}{3EI}$, $F_{21(BC)} = 0$

$F_{31_{(BC)}} = -H^3/2EI$

The final value of flexibility co-eff are

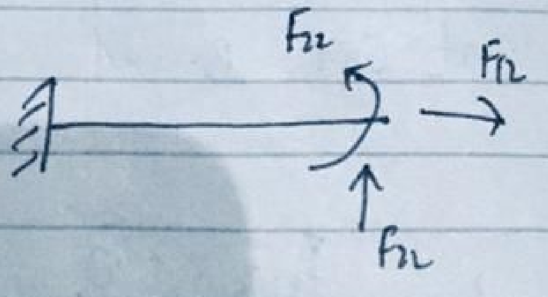
$F_{11} = \frac{L}{EA} + \frac{H^3}{3EI}$ $F_{21} = 0+0=0$

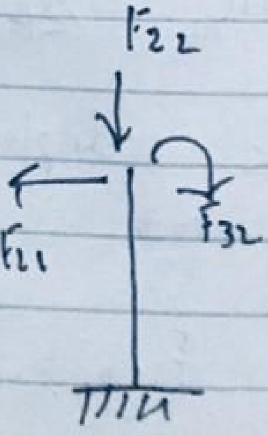
$F_{31} = \frac{0-H^2}{2EI} = \boxed{\frac{-H^2}{2EI}}$

$$[F] = \begin{bmatrix} \frac{L}{EA} + \frac{H^3}{3EI} & 0 & -H^2/2EI \\ 0 & \frac{L^3}{3EI} + \frac{H}{EA} & L^2/2EI \\ \frac{-H^2}{2EI} & L^2/2EI & \frac{L}{EI} + H/EI \end{bmatrix} \quad \text{(A)}$$

Apply $HR_2 = 1$ and obtain

F_{12}, F_{22}, F_{32}



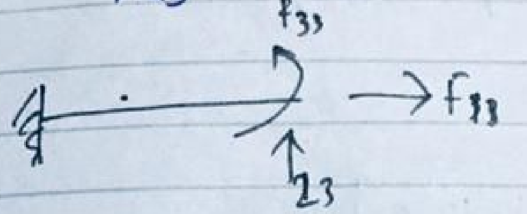


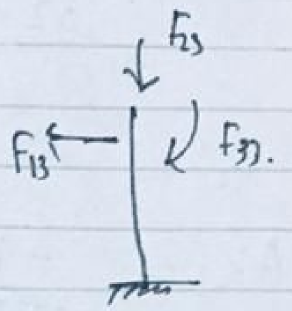
$F_{12} = 0$ $\boxed{F_{22} = \frac{L^3}{3EI} + \frac{H}{EA}}$

$$\boxed{F_{32} = \frac{L^2}{2EI}}$$

Now

$\Delta R_3 = 1$





$$F_{13} = \frac{-H^2}{2EI}$$

$$F_{23} = \frac{L^2}{2EI}$$

$$F_{33} = \frac{L}{EI} + \frac{H}{EI}$$

Now final F Matrix. is A

$$[F] = \begin{bmatrix} \frac{L}{EA} + \frac{H^3}{3EI} & 0 & \frac{-H^2}{2EI} \\ 0 & \frac{L^3}{3EI} + \frac{H}{EA} & \frac{L^2}{2EI} \\ \frac{-H^2}{2EI} & \frac{L^2}{2EI} & \frac{L}{EI} + \frac{H}{EI} \end{bmatrix}$$

$$AR_1 = \frac{-3P}{32}\left[\frac{1-12\gamma}{(1+3\gamma)(1+12\gamma)}\right]$$

where $\gamma = \frac{1}{AL_3}$

$$AR_2 = \frac{13P}{32}\left[\frac{1+84\gamma}{(1+3\gamma)(1+12\gamma)}\right]$$

$$AR_3 = \frac{-PL}{16}\left[\frac{1-12\gamma}{1+12\gamma}\right]$$

for typically plane frame Magnitude of γ is 10^{-3}

$$Q_1 = \frac{-3P}{32}$$

$$Q_2 = 13P/32 \qquad Q_3 = -PL/16$$

$$\begin{bmatrix} 0.127 & 0 & -0.0019 \\ 0 & 0.0519 & 0.0048 \\ -0.0019 & 0.0048 & 0.0018 \end{bmatrix}$$

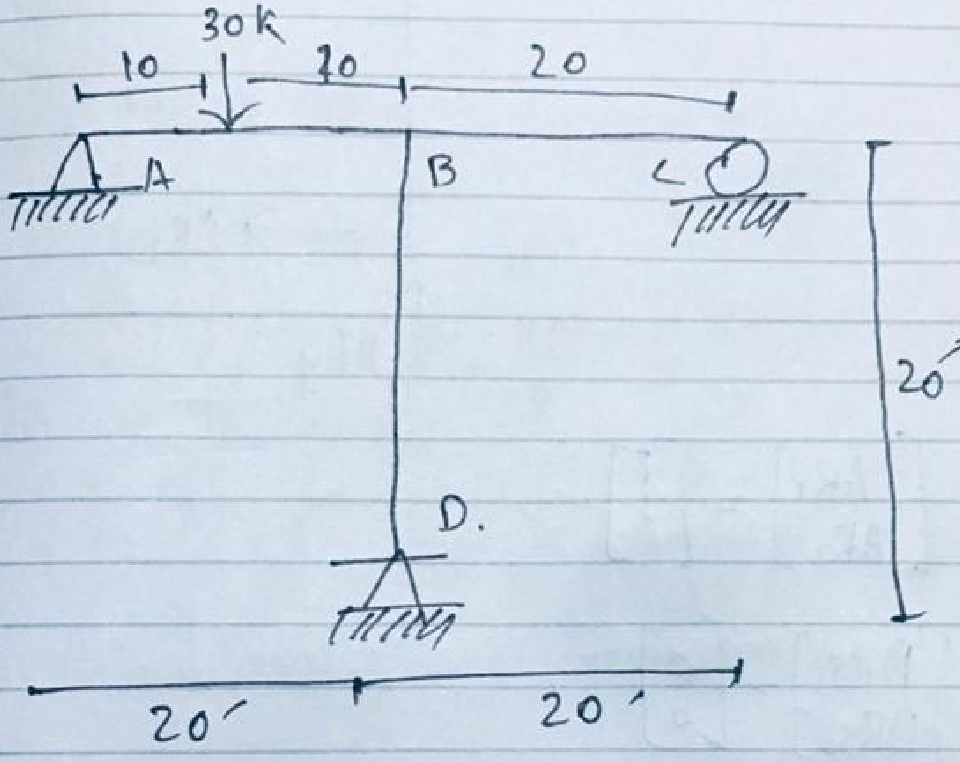
$AR_1 = -2.50$

$AR_2 = 6.25$

$AR_3 = -16.76.$

Q# 2 Part #(A)

Analyse the frame by flexibility Method :-



Sol:-

Degree of static indetermany -

$$Ds = (3M+R) - (3J+A)$$

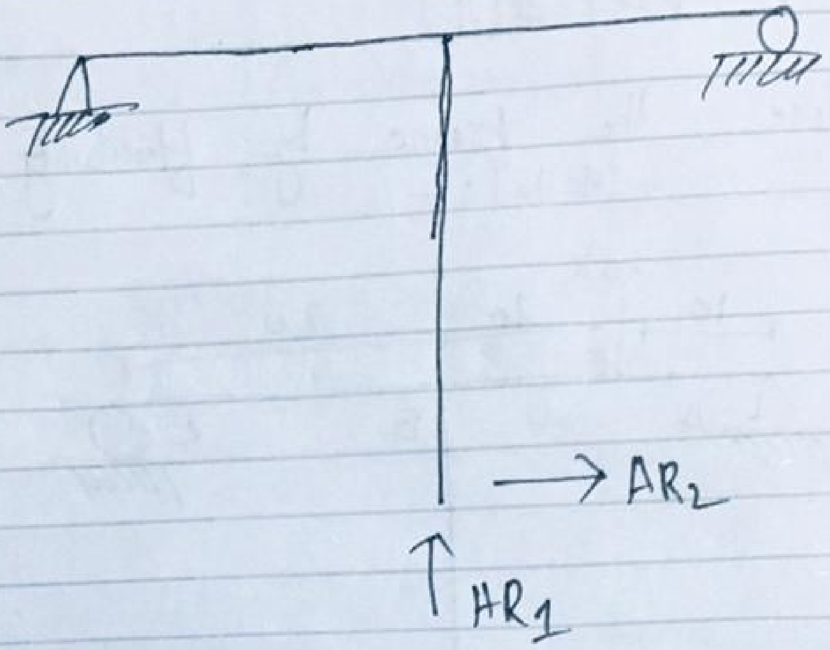
$$Ds = (3(3)+5) - (3(4)+0)$$

$M=3$
$R=5$
$J=4$

$$Ds = (9+5) - (12)$$

$$Ds = 14-12$$

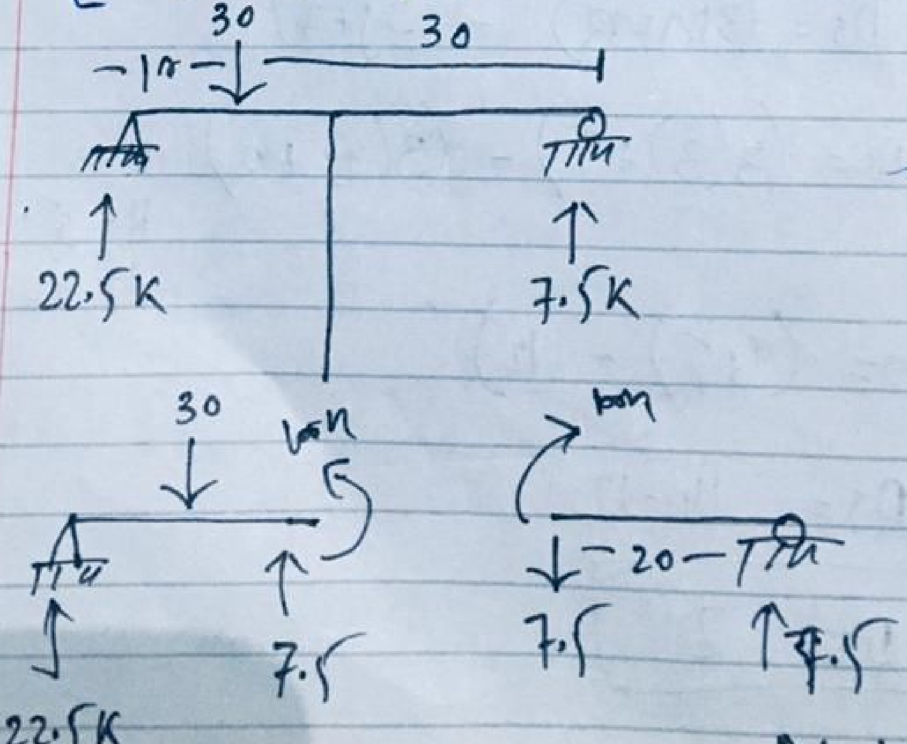
$$\boxed{Ds = 2}$$



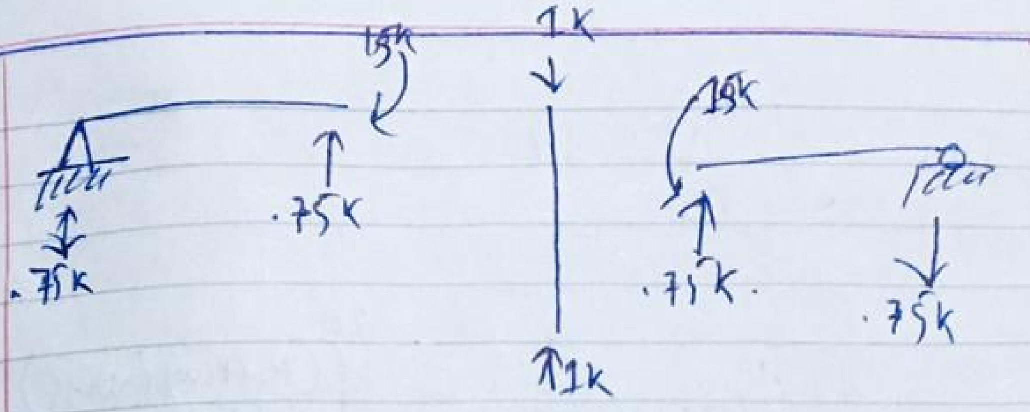
$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} ? \\ ? \end{bmatrix}$$

$$\begin{bmatrix} DRS_1 \\ DRS_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

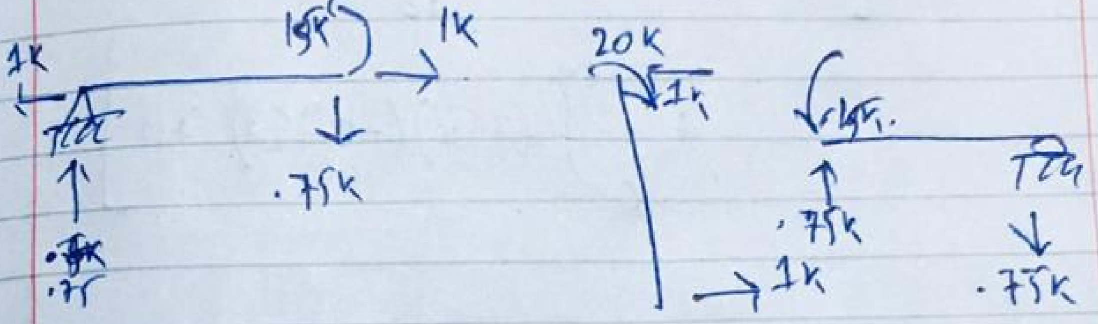
$[DRL]$ and $[F]$.



M-Value

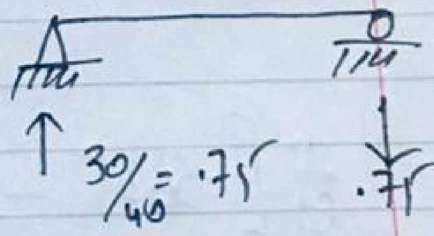


m1 Values -



m2 = Value -

Extra.



Now

Member	AB		BC	BD
origin	A	A	C	D
Limit	0-10	10-20	0-20	0-20
I	I	I	I	I
M	$22.5x$	$(2.5x-200)$ $22.5x-20(x-10)$	$75x$	0
m_1	$-0.75x$	$-0.75x$	$-0.75x$	0
m_2	$0.75x$	0.75	$-0.75x$	x

$$DRL_1 = \int_0^L \frac{M_1 m_1}{EI} dx$$

$$= \frac{1}{EI}\left[\int_0^{10} (22.5x)(-0.75x) + \int_{10}^{20} (2.5x+200)(-0.75) \right.$$

$$\left. + \int_0^{20} (7.5x)(-0.75x) + 0 \right]$$

$$= \frac{1}{EI}\left[-\cancel{16875}\,5625 + (-26875) + (-15000)\right)$$

$$\frac{1}{EI}\left[-5625 - 26875 - 15000\right)$$

$$-47500/EI$$

Now

$$DRL_2 = \int_0^L \frac{M_1 m_2}{EI} dx.$$

15

$$DRL_2 = \frac{1}{EI}\left[\int_0^{10}(22.5x)(0.75x) + \int_{10}^{20}(2.5x+200)(0.75x)\right.$$

$$\left. + \int_0^{20}(7.5x)(0.75x)\right)$$

$$DRL_2 = \frac{1}{EI}\left[5625 + 26875 - 15000\right]$$

$$DRL_2 = \frac{1}{EI}\left[17500\right]$$

$$= 17500/EI$$

Now

flexibility Matrix.

$$f_{11} = \int_0^L \frac{m_1^2}{EI}$$

$$f_{11} = \int_0^{10}(-0.75x)^2 = 187.5/EI$$

$$f_{22} = \int \frac{(m_2)^3}{EI} =$$

$$= \int_0^L \frac{(m_2)^2}{EI}$$

$$= \int_0^{10} \frac{(0.75x)^2}{EI} = 550/EI.$$

$F_{12} = F_{21} = 0.$

Now

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 187.5 & 0 \\ 0 & 550.5 \end{bmatrix}^{-1} \begin{bmatrix} -47500 \\ 17500 \end{bmatrix}$$

$$\begin{bmatrix} AR_1 \\ AR_2 \end{bmatrix} = \begin{bmatrix} 21.15 \\ +1.35 \end{bmatrix}$$

— x —— x —— x —— x —— x —