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CMRIT
CMR INSTITUTE OF TECHNOLOGY, BENGALURU.
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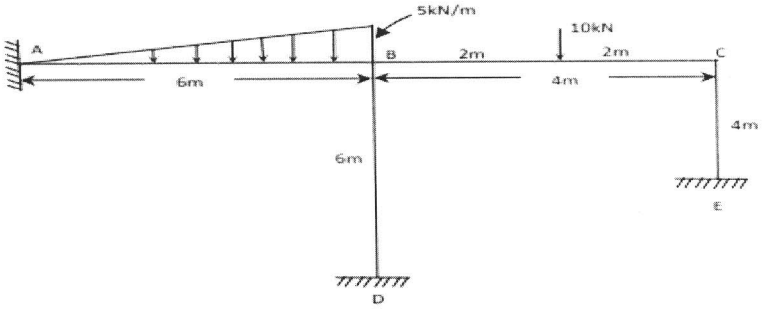
Improvement Test – NOV. 2017

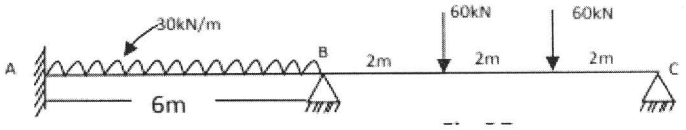
Sub:	Analysis of indeterminate structures					Sub Code:	15CV52	Branch:	CV
Date:	18.11.2017	Duration:	90 min's	Max Marks:	50	Sem / Sec:	V A & B		OBE

ALL QUESTIONS ARE COMPULSORY

		MARKS	CO	RBT
1	Analyze the frame shown in **Fig.** by moment distribution method. Draw	[25]	CO 2	L3



2	Analyze the beam shown in **Fig.** by flexibility matrix method. Draw SFD BMD	[25]	CO 4	L3

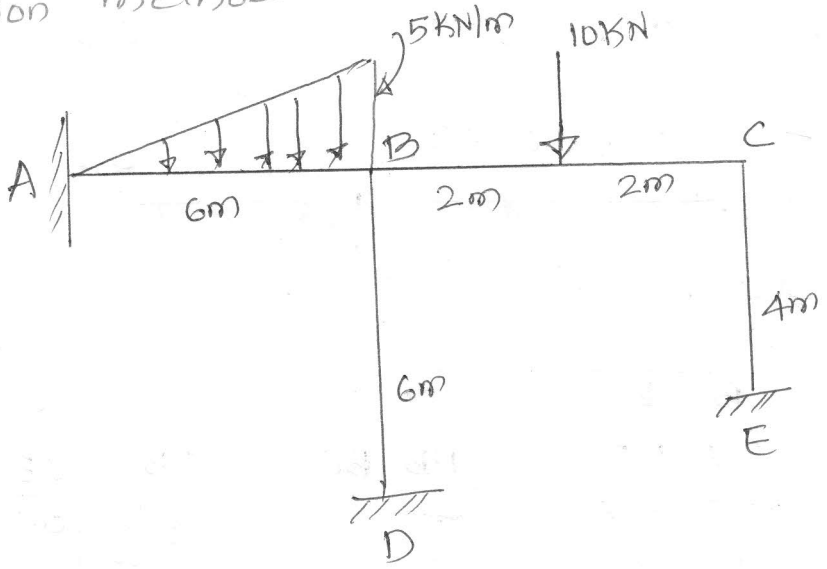


Analysis of Indeterminate structures: 15CV52

Improvement test:

1] Analyze the frame shown in fig by moment distribution method. Draw BMD [25]

Sol^n:-



I] FEM's

$$MF_{AB} = -\frac{wl^2}{30} = -\frac{5\times6^2}{30} = -6\,KNm$$

$$MF_{BA} = \frac{wl^2}{20} = \frac{5\times6^2}{20} = 9\,KNm$$

$$MF_{BC} = -\frac{wl}{8} = -\frac{10\times4}{8} = -5\,KNm$$

$$MF_{CB} = +\frac{wl}{8} = \frac{10\times4}{8} = 5\,KNm$$

II] Distribution factors

Joint	member	stiffness K	ΣK	D.F $= \frac{K}{\Sigma K}$
B	BA	$I/6 = 0.166I$	0.582I	0.28
	BC	$I/4 = 0.25I$		0.43
	BD	$I/6 = 0.166I$		0.28
C	CB	$I/4 = 0.25I$	0.5I	0.5
	CE	$I/4 = 0.25I$		0.5

III] M.D. Table:

Joint	A	B	B	D	B	C	C	E
member	AB	BA	BD	DB	BC	CB	CE	EC
D.F	-	0.28	0.28	-	0.43	0.5	0.5	-
FEM's	-6	9	0	0	-5	+5	0	0
Bal		-1.12	-1.12		-1.72	-2.5	-2.5	
C.O	-0.56	-	-	-0.56	-1.25	-0.86	-	-1.25
Bal		0.305	0.305		0.5375	0.43	0.43	
C.O	0.1075	-	-	0.1075	0.215	0.268		0.215
Bal		-0.0602	-0.0602		-0.094	-0.134	-0.134	

IV] End moments

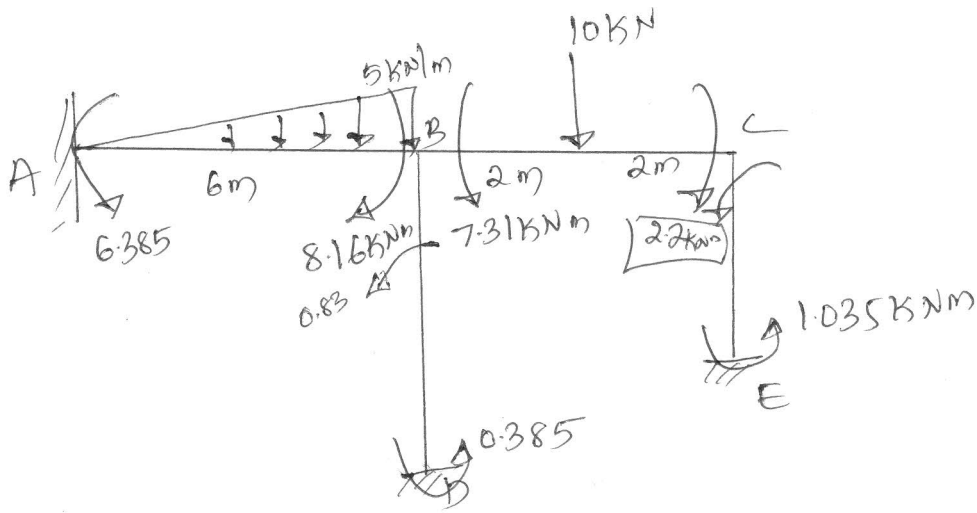
$M_{AB} = -6.385 KNm$ $M_{BA} = 8.16 KNm$

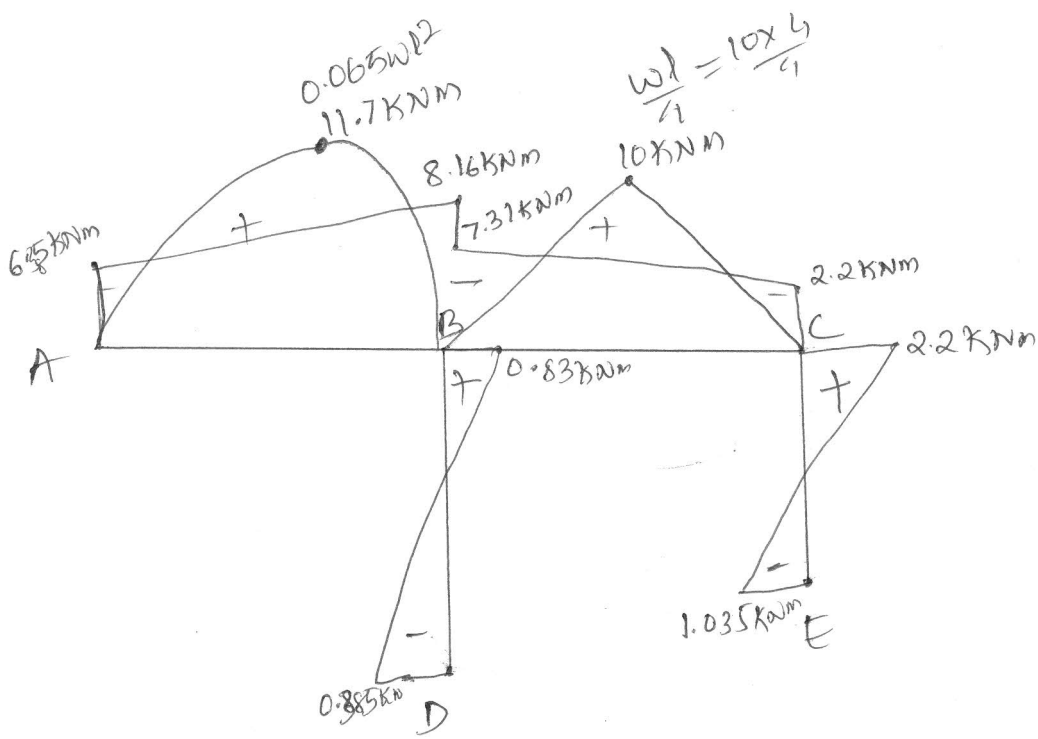
$M_{BD} = -0.83 KNm$ $M_{DB} = -0.385 KNm$

$M_{BC} = -7.31 KNm$ $M_{CB} = 2.204 KNm$

$M_{CE} = -2.204 KNm$ $M_{EC} = -1.035 KNm$

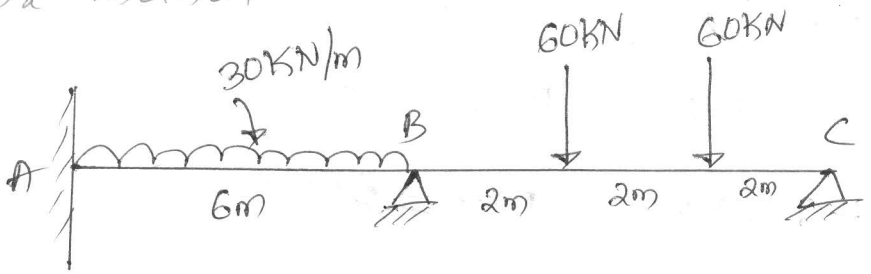
V] BMD





2] Analyze the ~~fo~~ beam shown in fig by flexibility matrix method [25]

Sol?:-



no. of reactions = 4 (V_A, V_B, V_C & M_A)

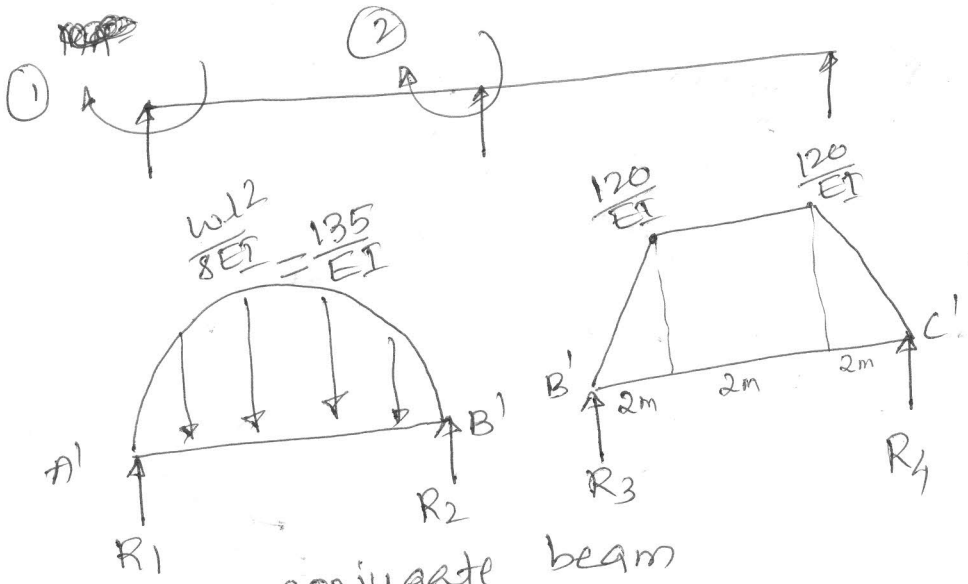
Eqm Eqns = 2

no. of redundants = 4-2
= 2 NO's

choose M_A & M_B as redundants

I] Load displacement matrix [Δ_L]

Released structure



conjugate beam

$$R_1 = R_2 = \frac{2}{3} \times 6 \times \frac{135}{EI} \times 0.5$$

$$= \frac{270}{EI}$$

$$R_3 = \frac{\left(\frac{1}{2}\times 2\times\frac{120}{EI}\right)\times 2 + \left(2\times\frac{120}{EI}\right)}{2}$$

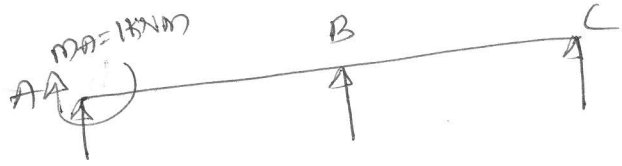
$$R_3 = \frac{240}{EI}$$

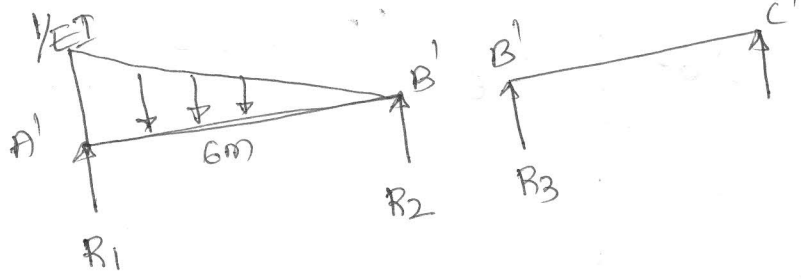
$$\begin{bmatrix}\Delta_{1L}\\ \Delta_{2L}\end{bmatrix} = \begin{bmatrix}R_1\\ R_2+R_3\end{bmatrix} = \begin{bmatrix}270/EI\\ 270/EI + \frac{240}{EI}\end{bmatrix}$$

$$\begin{bmatrix}\Delta_{1L}\\ \Delta_{2L}\end{bmatrix} = \frac{1}{EI}\begin{bmatrix}270\\ 510\end{bmatrix}$$

II] Flexibility matrix [F]

(i) Apply unit force (M_A = 1KNm) along coordinate direction (1)





$\Sigma M_{B'} = 0$

$$R_1\times 6 - \left(\frac{1}{2}\times 6\times\frac{1}{EI}\right)\left(\frac{2}{3}\times 6\right) = 0$$

$$R_1 = \frac{12}{EI}$$

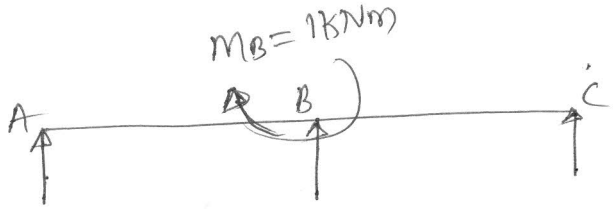
$\Sigma M_{A'} = 0$

$$-R_2\times 6 + \left(\frac{1}{2}\times 6\times\frac{1}{EI}\right)\left(\frac{1}{3}\times 6\right) = 0$$

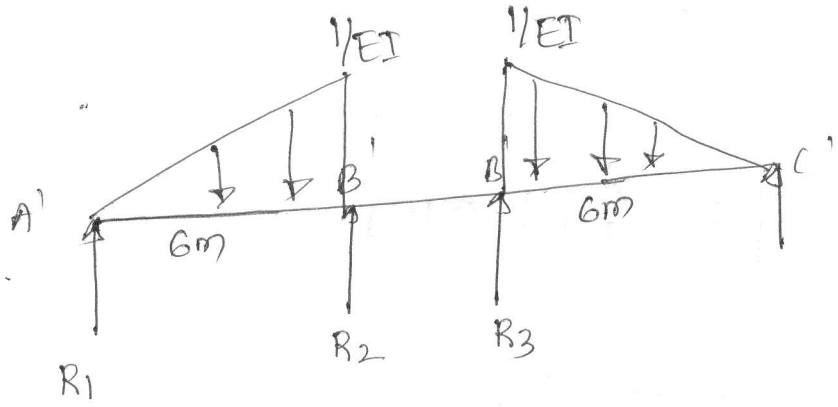
$$R_2 = \frac{1}{EI}$$

$$f_{11} = R_1 = \frac{2}{EI}, \qquad f_{12} = R_2 = \frac{1}{EI},$$

(ii) Apply unit force ($M_B = 1KNm$) along coordinate direction (2)



Released structure



$\Sigma M_{B'} = 0$

$$R_1 \times 6 - \left(\frac{1}{2} \times 6 \times \frac{1}{EI}\right) \times \left(\frac{1}{3} \times 6\right) = 0$$

$$R_1 = \frac{1}{EI}$$

$\Sigma M_{A'} = 0$

$$-R_2 \times 6 + \left(\frac{1}{2} \times 6 \times \frac{1}{EI}\right)\left(\frac{2}{3} \times 6\right) = 0$$

$$R_2 = \frac{2}{EI}$$

$\Sigma M_{C'} = 0$

$$R_3 \times 6 - \left(\frac{1}{2} \times 6 \times \frac{1}{EI}\right)\left(\frac{2}{3} \times 6\right) = 0$$

$$R_3 = \frac{2}{EI}$$

$$f_{21} = R_1 = \frac{1}{EI}, \quad f_{22} = R_2 + R_3$$

$$= \frac{2}{EI} + \frac{2}{EI}$$

$$= 4/EI$$

$$\therefore [F] = \frac{1}{EI}\begin{bmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{bmatrix}$$

$$[F] = \frac{1}{EI}\begin{bmatrix} 2 & 1 \\ 1 & 4 \end{bmatrix}$$

III] Redundant forces

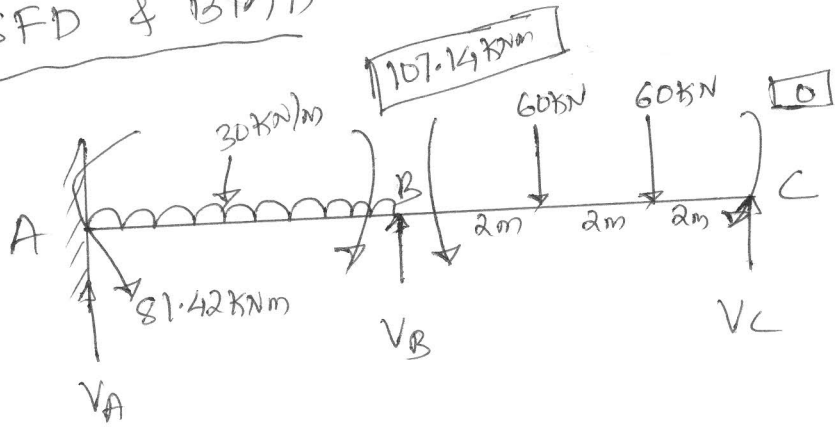
$$[R] = [F]^{-1}\{[\Delta] - [\Delta_L]\}$$

$$\begin{bmatrix} m_A \\ m_B \end{bmatrix} = EI\begin{bmatrix} 2 & 1 \\ 1 & 4 \end{bmatrix}^{-1}\left\{\begin{bmatrix} 0 - 270 \\ 0 - 510 \end{bmatrix}\frac{1}{EI}\right\}$$

$m_A = -81.42\,KNm$ $m_B = -107.142\,KNm$ (Hog)

(Hog)

IV] SFD & BMD



$\Sigma M_B = 0$ (LHS)

$V_A \times 6 - 81.42 - 30 \times 6 \times \frac{6}{2} + 107.14 = 0$

$V_A = 85.72\,KNm$

$\Sigma M_B = 0$ (RHS)

$-V_6 \times 6 + 60 \times 2 + 60 \times 4 - 107.14 = 0$

$V_L = 42.144\,KNm$

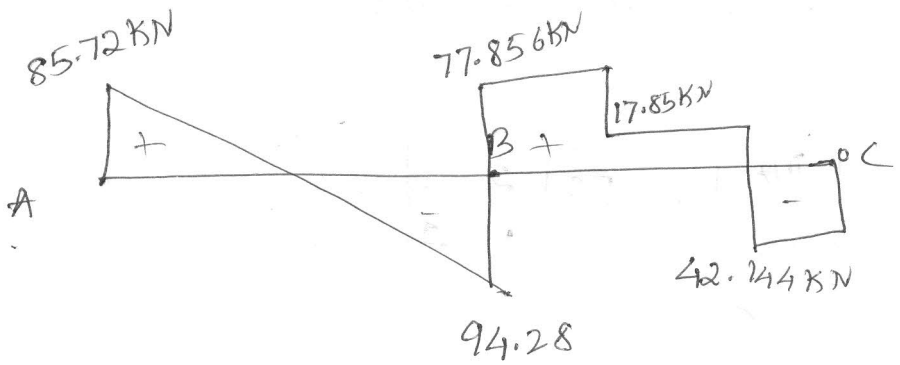
$\Sigma F_y = 0$

$V_A + V_B + V_C = 30 \times 6 + 60 + 60$

$85.72 + V_B + 42.144 = 30 \times 6 + 120$

$V_B = 172.136\ KN$

SFD



BMD