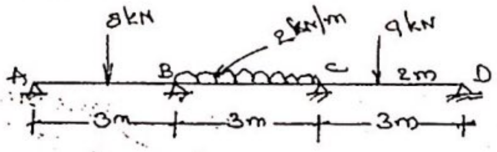
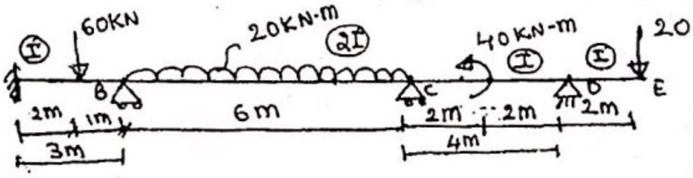
USN

CMRIT

Internal Assessment Test 2 –Oct. 2019

Sub:	Analysis of Indeterminate Structures			Sub Code:	15CV52	Branch:	Civil	
Date:	12/10/2019	Duration:	90 min's	Max Marks:	50	Sem / Sec:	5A and 5B	OBE

	Answer TWO FULL Questions	MARKS	CO	RBT
1.	A horizontal beam ABCD is carried on hinged supports and is continuous overt three equal spans each of 3m. All the supports are initially at the same level. The beam is loaded as shown. Plot BMD for the beam if the support 'A' settles by 10mm, 'B' settles by 30mm and 'C' settles by 20mm. Analyze by Moment distribution method, Take $E=2.0\times10^5$ N/mm^2 and $I=2.4\times10^6$ mm^4  fig 1	[25]	CO1	L3
2.	Analyze the Continuous beam show in fig 2. using Kani's method. Draw **BMD and SFD**  fig 2	[25]	CO2	L3

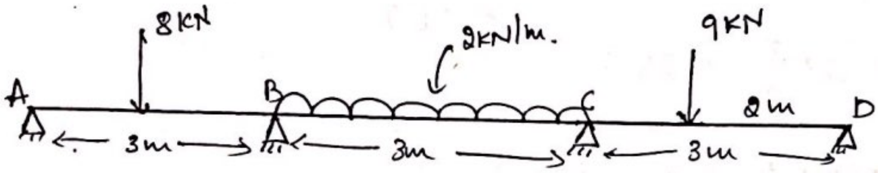
CI

Paper 1

CCI

HOD

1)

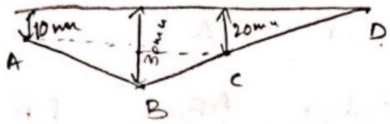


$EI = 2.0 \times 10^5 \times 2.4 \times 10^6$
$= 48 \times 10^{10}\ N\,mm^2$
$= 480\ KNm^2$

Settlement at A = 0.01m in AB member

Settlement at B = −0.01m in BC member

Settlement at C = −0.02m in CD member.



Step-1: Fixed end moments

$$M_{FAB} = \frac{-wl}{8} - \frac{6EI\delta}{l^2} = \frac{-8\times3}{8} - \frac{6\times480\times0.01}{3^2} = -6.2\ KNm$$

$$M_{FBA} = \frac{wl}{8} - \frac{6EI\delta}{l^2} = \frac{8\times3}{8} - \frac{6\times480\times0.01}{3^2} = -0.2\ KNm.$$

$$M_{FBC} = \frac{-wl^2}{12} - \frac{6EI\delta}{l^2} = \frac{-2\times3^2}{12} + \frac{6\times480\times0.01}{3^2} = 1.7\ KNm$$

$$M_{FCB} = \frac{wl^2}{12} - \frac{6EI\delta}{l^2} = \frac{2\times3^2}{12} + \frac{6\times480\times0.01}{3^2} = 4.7\ KNm$$

$$M_{FCD} = \frac{-wab^2}{l^2} - \frac{6EI\delta}{l^2} = \frac{-9\times1\times2^2}{3^2} + \frac{6\times480\times0.02}{3^2} = 2.4\ KNm$$

$$M_{FDC} = \frac{wa^2b}{l^2} - \frac{6EI\delta}{l^2} = \frac{9\times1^2\times2}{3^2} + \frac{6\times480\times0.02}{3^2} = 8.4\ KNm$$

Step-2 :- Distribution factor.

Joint	Member	K	ΣK	DF = K/ΣK
B	BA	$\frac{3}{4}\frac{I}{l} = \frac{3}{4} \times \frac{I}{3} = 0.25I$	0.58 I	0.43
	BC	$\frac{I}{l} = \frac{I}{3} = 0.33I$		0.57
C	CB	$\frac{I}{l} = \frac{I}{3} = 0.33I$	0.58 I	0.57
	CD	$\frac{3}{4}\frac{I}{l} = \frac{3}{4} \times \frac{I}{3} = 0.25I$		0.43

Step-3 :- Moment Distribution table.

Joint	A	B			C			D
Member	AB	BA		BC	CB		CD	DC
DF	–	0.43		0.57	0.57		0.43	–
FEM	-6.2	-0.2		1.7	4.7		2.4	8.4
Release A & D	6.2 →	3.1					-4.2	← -8.4
Final FEM	0	2.9	(-4.6)	1.7	4.7	(-2.9)	-1.8	0
Balancing	–	-1.97		-2.62	-1.65		-1.24	–
Carry over	0	–	(0.82)	-0.82	-1.31	(1.31)	–	0
Balancing	–	0.35		0.46	0.74		0.56	–
Carry over	0	0	(-0.37)	0.37	0.23	(-0.23)	0	0
Balancing	–	-0.15		-0.21	-0.13		-0.09	–
Carry over	0	0	(+0.06)	-0.06	-0.10	(0.10)	0	0
Balancing	–	0.02		0.03	0.05		0.04	–
Final moment	0	1.15		-1.15	2.53		-2.57	0

Step-4 :- Final moments

$M_{AB} = 0$

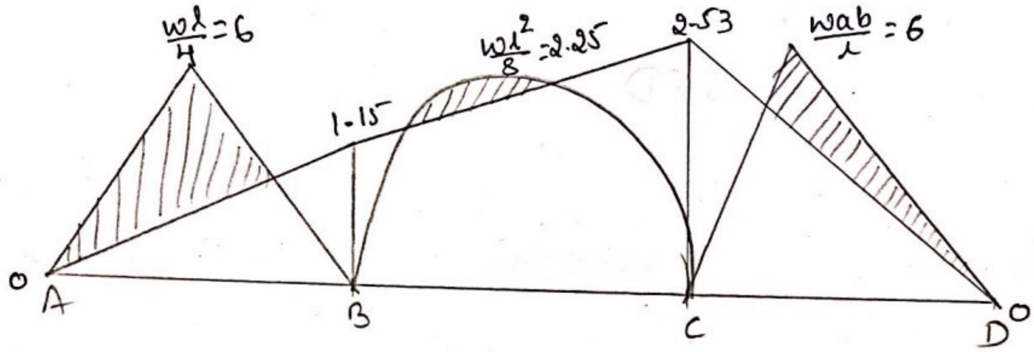
$M_{BA} = 1.15$ KNm

$M_{BC} = -1.15$ KNm

$M_{CB} = 2.53$ KNm

$M_{CD} = -2.57$ KNm

$M_{DC} = 0$



BMD.

Step-5 :- Shear force.

$V_A + V_B + V_C + V_D = 8 + (2\times3) + 9 = 23$ KN.

$\Sigma M_B = 0$ (LHS)

$V_A \times 3 - 8\times1.5 + 1.15 = 0$

$V_A = 3.61$ KN

$\Sigma M_C = 0$ (RHS)

$-V_D \times 3 + 9\times1 - 2.57 = 0$

$V_D = 2.14$ KN

$\Sigma M_B = 0$ (RHS)

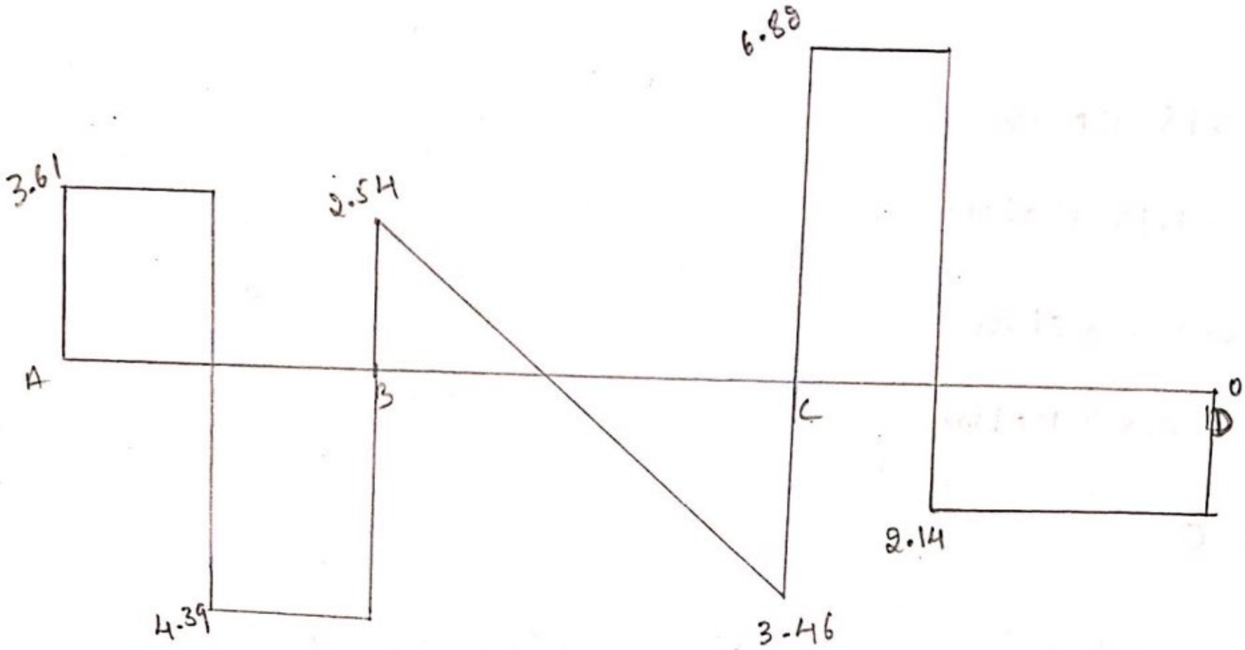
$-V_D\times6 + 9\times4 - V_C\times3 + 2\times3\times\frac{3}{2} - 1.15 + 2.53 - 2.57 = 0$

$-2.14\times6 + 36 - 3V_C + 9 - 1.15 + 2.53 - 2.57 = 0$

$V_C = 10.32$ KN

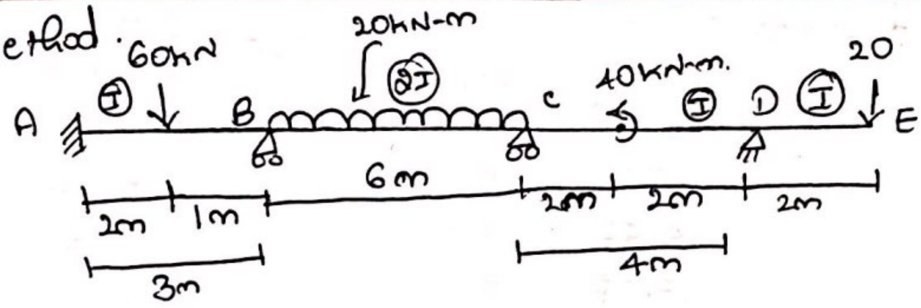
$V_B = 23 - V_A - V_C - V_D$

$V_B = 6.93$ KN



SFD

2) By Kani's method



Step ① Fixed end moment:

$M_{FAB} = \frac{-wab^2}{L^2} = -\frac{60\times2\times1^2}{3^2} = -13.33 kNm$

$M_{FBA} = \frac{wa^2b}{L^2} = \frac{60\times2^2\times1}{3^2} = 26.67 kNm$

$M_{FBC} = -\frac{wL^2}{12} = -\frac{20\times6^2}{12} = -60 kNm.$

$M_{FCB} = \frac{wL^2}{12} = \frac{20\times6^2}{12} = 60 kNm.$

$M_{FCD} = M_{FDC} = -\frac{M}{4} = -\frac{40}{4} = -10 kNm$

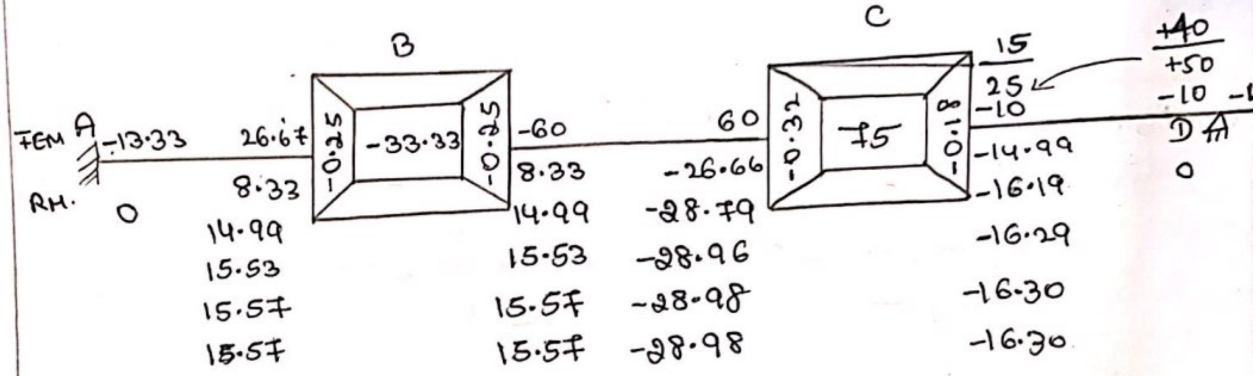
$M_{DE} = -20\times2 = -40 kNm$

Step ② : Rotational factor:

Joint	Member	K	ΣK	$RF = \frac{-1}{2} K/\Sigma K$.
B	BA	I/L = 0.33I	0.66I	-0.25
	BC	I/L = 0.33I		-0.25
C	CB	I/L = 0.33I	0.517I	-0.32
	CD	$\frac{3}{4}$ I/L = 0.187I		-0.18

Step③ Rotational moment :

$$M' = u(\Sigma MF + FERM)$$



(i) $M'_{AB} = 0$

$M'_{BA} = -0.25(-33.33 + 0) = 8.33$

$M'_{BC} = -0.25(-33.33 + 0) = 8.33$

$M'_{CB} = -0.32(75 + 8.33) = -26.66$

$M'_{CD} = -0.18(75 + 8.33) = -14.99$

Step④ final moments:

$$M = M_F + 2NERM + 1FERM$$

$M_{AB} = -13.33 + 2(0) + 15.57 = 2.24$ kNm.

$M_{BA} = 26.67 + 2(15.57) + 0 = 57.81$ kNm

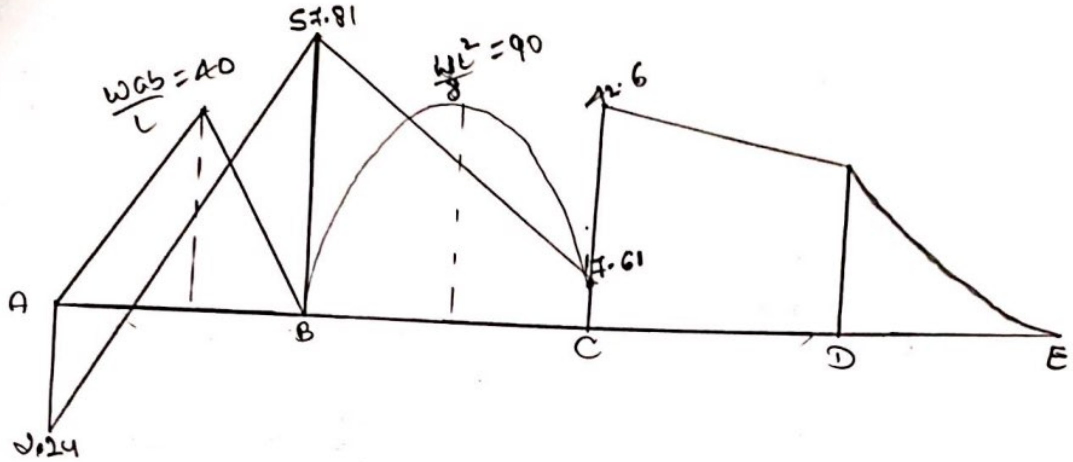
$M_{BC} = -60 + 2(15.57) + 1(-28.98) = -57.84$ kNm

$M_{CB} = 60 + 2(-28.98) + 15.57 = 17.61$ kNm.

$M_{CD} = -10 + 2(-16.30) + 0 = -42.6$ KNm.

$M_{DC} = 40$

$M_{DE} = -40$



Shear force Calculation

$$V_A + V_B + V_C + V_D = 60 + 120 + 20$$

$$V_A + V_B + V_C + V_D = 200$$

$\Sigma M_B = 0$, LHS

$$V_A \times 3 + 2.24 + 57.81 - 60 = 0$$

$$\boxed{V_A = +0.0\,kN}$$

$\Sigma M_C = 0$, LHS

$$V_A \times 9 + V_B \times 6 - 20 \times 6 \times 3 + 2.24 + 57.81 - 57.84 + 17.61 - 60 \times 7 = 0$$

~~$V_B \times 6 = 520.48$~~ $V_B \times 6 = 400.15$

~~$V_B = 86.69\,kN$~~ $\boxed{V_B = 66.69\,kN}$

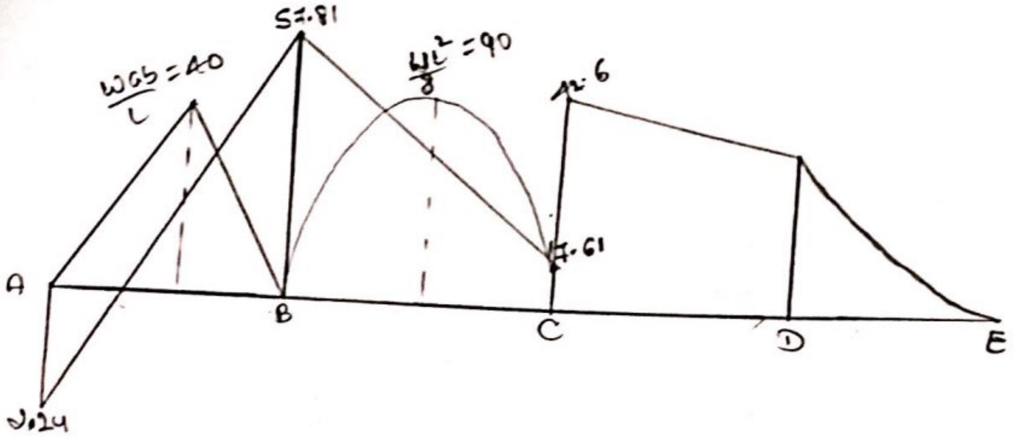
$\Sigma M_C = 0$ RHS.

$$-V_D \times 4 - 40 + 20 \times 6 - 42.6 + 40 - 40$$

~~$-V_D \times 4 = 148.26$~~

$$-V_D \times 4 + 37.4$$

$\boxed{V_D = 9.35\,kN}$ $\boxed{V_C = 83.96\,kN}$ ~~$V_C = 123.96\,kN$~~



<u>Shear force Calculation</u>

$V_A + V_B + V_C + V_D = 60 + 120 + 20$

$V_A + V_B + V_C + V_D = 200$

$\Sigma M_B = 0$, LHS

$V_A \times 3 + 2.24 + 57.81 - 60 = 0$

$V_A = +40.0\,kN$

$\Sigma M_C = 0$, LHS

$V_A \times 9 + V_B \times 6 - 20 \times 6 \times 3 + 2.24 + 57.81 - 57.84 + 17.61 - 60 \times 7 = 0$

~~$V_B \times 6 = 218.85$~~ $V_B \times 6 = 400.15$

~~$V_B = 86.69\,kN$~~ $V_B = 66.69\,kN$

$\Sigma M_C = 0$ RHS.

$-V_D \times 4 - 40 + 20 \times 6 - 42.6 + 40 - 40$

~~$-V_D \times 4 = 148.426$~~

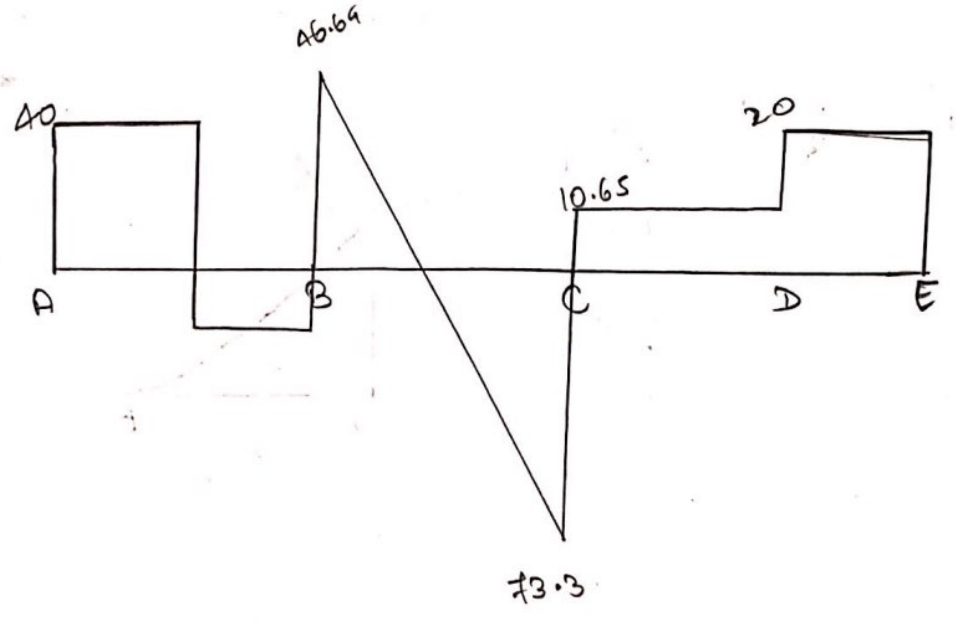
$-V_D \times 4 + 37.4$

$V_D = 9.35\,kN$

$V_C = 83.96\,kN$

~~$V_C = 123.96\,kN$~~

Scanned with CamScanner



46.69
40
20
10.65
A
B
C
D
E
73.3