Internal Assessment Test 2 –QP and Solutions

Sub:	Analysis of Indeterminate structures					Sub Code:	18CV52	Branch:	Civil Engg
Date:	01.12.2022	Duration:	90 min's	Max Marks:	50	Sem / Sec:	4 A		OBE

Question number 1 is mandatory, answer any 2 full question from Q2 to Q4.

		MARKS	CO	RBT
1 (a)	Figure 1 shows a continuous beam ABCD, calculate the fixed end moments, if the end A rotates by 0.002 radians in clockwise direction and supports B and C sinks by 5mm and 2 mm respectively. Take EI=18000 kN-m^2	[10]	CO1	L2

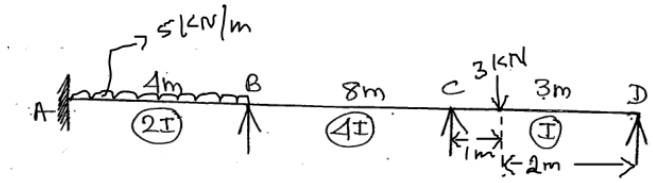
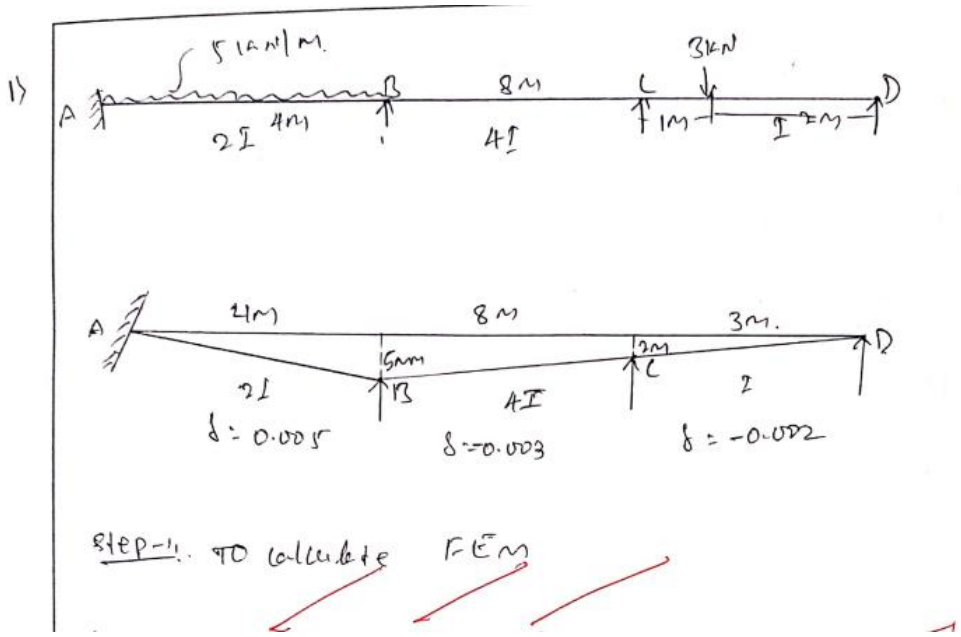


Fig.1.a

Solution:



$$= -\frac{5\times4^2}{12} + 4\frac{(2\times18000)\times0.002}{4} - \frac{6(2\times18000)(0.005)}{4^2} = -2.17\ kN\text{-}M$$

$$MF_{BA} = \frac{wl^2}{12} + \frac{2EI\theta}{L} - \frac{6EI\delta}{l^2}$$

$$= \frac{5\times4^2}{12} + \frac{2(2\times18000)\times0.002}{4} - \frac{6(2\times18000)(0.005)}{4^2} = +0.$$

$$= 11.17\ kN\text{-}M$$

$$MF_{BC} = 0 - \frac{6EI\delta}{l^2} = -\frac{6\times(4\times18000)\times(-0.003)}{8^2} = 20.25\ kN\text{-}M$$

$$MF_{CB} = 0 - \frac{6EI\delta}{l^2} = -\frac{6\times(4\times18000)\times(-0.003)}{8^2} = 20.25\ kN\text{-}M$$

$$MF_{CD} = -\frac{wab^2}{l^2} - \frac{6EI\delta}{l^2} = -\frac{3\times1\times2^2}{3^2} - \frac{6\times18000\times(-0.002)}{3^2} = 22.67\ kN\text{-}M$$

$$MF_{DC} = \frac{wa^2b}{l^2} - \frac{6EI\delta}{l^2} = \frac{3\times1^2\times2}{3^2} - \frac{6\times18000\times(-0.002)}{3^2} = 24.67\ kN\text{-}M$$

2 (a)	Analyse the continuous beam shown in Fig.2.a by moment distribution method and draw BMD, SFD and EC.	[20]	CO1	L3

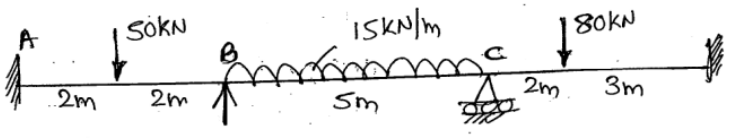


Fig.2.a

Solution:

Sol^n (a) FEM

$$M_{FAB} = -\frac{Wl}{8} = -25\ kN\text{-}m, \quad M_{FBA} = +25\ kN\text{-}m$$

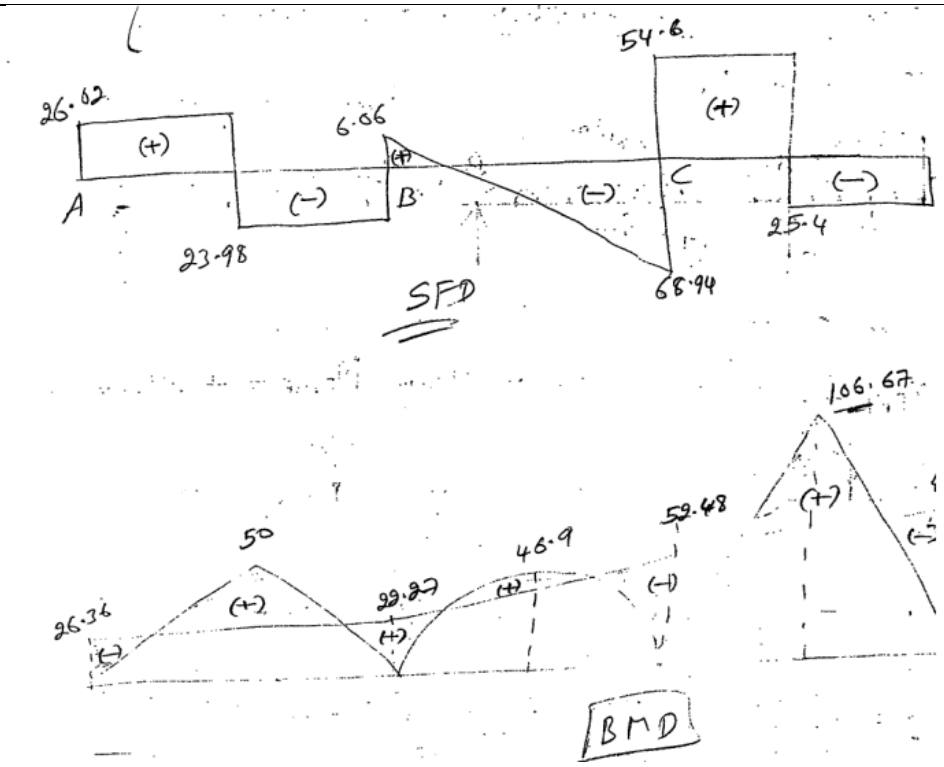
$$M_{FBC} = -\frac{wl^2}{8} = -31.25, \quad M_{FCB} = +\frac{wl^2}{12} = 31.25$$

$$M_{FCD} = -\frac{Wab^2}{l^2} = -57.6; \quad M_{FDC} = +\frac{Wa^2b}{l^2} = 38.4$$

Joint	Member	Relative Stiffness = K	Sum ΣK	DF = $\frac{K}{\Sigma}$
B	BA	$(I/l) = I/4 = 0.25I$	0.45I	$\frac{0.25}{0.45} = 0.5$
	BC	$(I/l) = I/5 = 0.20I$		$\frac{0.2}{0.45} = 0.4$
C	CB	$(I/l) = I/5 = 0.20I$	0.4I	0.5
	CD	$(I/l) = I/5 = 0.2I$		0.5

(c) Moment Distribution Table (38)

A (Fixed)		B ✓		C ✓		D (Fixed)	
AB	BA	BC	CB	CD	DC		Member
-	0.56	0.44	0.5	0.5			DF
-25	25	-31.25	31.25	-57.6	38.4		FEM
1.75 ←	3.5	2.75	13.18	13.18	→ 6.59		Balance
		6.59	1.37				Carry over
-1.84 ←	-3.69	-2.90	-0.68	-0.68	→ -0.34		Bal
		-0.34	-1.45				C.O
0.09 ←	0.19	0.15	0.73	0.73	→ 0.36		Bal
		0.36	0.075				C.O
-0.10 ←	-0.20	-0.16	-0.037	-0.037	→ -0.018		Bal
		-0.018	-0.08				C.O
	0.01	0.008	0.04	0.04			Bal
25.10	24.81	-24.81	44.40	-44.40	44.992		Final Moments



3 (a)	Analyse the continuous beam shown in Fig.3.a by moment distribution method and draw BMD and EC. Consider that supports B and C sink by 8mm and 3 mm respectively. Take, EI=2x10^4 kN/m^2.	[20]	CO1	L3

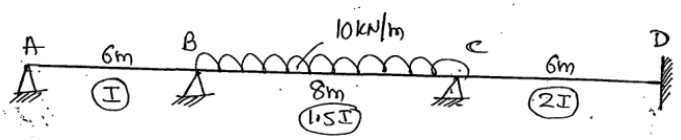
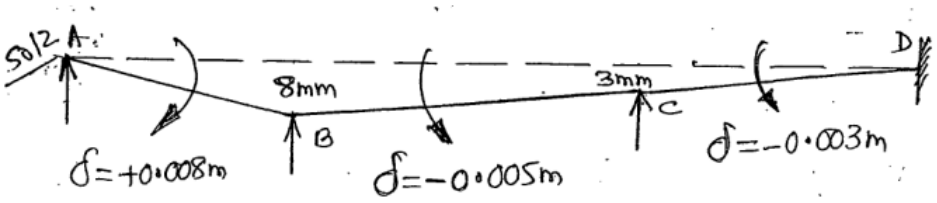


Fig.3.a

Solution:



(a) FEM

$$M_{FBB} = 0 - \frac{6EI\delta}{l^2} = 0 - \frac{6(1\times2\times10^4)(0.008)}{6^2} = -26.67$$

$$M_{FBA} = 0 - \frac{6EI\delta}{l^2} = 0 - \frac{6(1\times2\times10^4)(0.008)}{6^2} = -26.67$$

$$M_{FBC} = -\frac{\omega l^2}{12} - \frac{6EI\delta}{l^2} = \frac{-10\times8^2}{12} - \frac{6(1.5\times2\times10^4)(-0.005)}{8^2}$$

$$= -39.27 \text{ kN-m}$$

$$M_{FCB} = +\frac{\omega l^2}{12} - \frac{6EI\delta}{l^2} = \frac{10\times8^2}{12} - \frac{6(1.5\times2\times10^4)(-0.005)}{8^2}$$

$$= +67.40 \text{ kN-m}$$

$$M_{FCD} = 0 - \frac{6EI\delta}{l^2} = 0 - \frac{6(2\times2\times10^4)(-0.003)}{6^2}$$

$$= +20 \text{ kN-m}$$

$$M_{FDC} = 0 - \frac{6EI\delta}{l^2} = +20 \text{ kN-m}$$

(b) D.F

		k	Σk	DF = $\frac{k}{\Sigma k}$
B	BA	$\frac{3}{4}\left(\frac{I}{l}\right) = \frac{3}{4}\times\frac{I}{6} = 0.125I$	$0.3125I$	0.4
	BC	$\frac{I}{l} = \frac{1.5I}{8} = 0.1875I$		0.6
C	CB	$I/l = \frac{1.5I}{8} = 0.1875I$	$0.5200I$	0.36
	CD	$I/l = \frac{2I}{6} = 0.333I$		0.64

(c) M.D Table

AB	BA	BC	CB	CD	DC	Fixed Memb
	0.4	0.6	0.36	0.64		DF
−26.67	−26.67	−39.27	67.40	20	20	FEM
+26.67 →	13.33					Releas C.O
0	−13.33	−39.27	67.40	20	20	Initia
	21.04 ←	31.56 ↘	−31.46	−55.94 →		Bal
0 ←		−15.88 ↙	15.76		−27.97	C.O
	6.35 ←	9.53 ↘	−5.67	−10.08 →		Bal
0 ←		−2.83 ↙	4.76		−5.04	C.O
	1.13 ←	1.70 ↘	−1.71	−3.04 →		Bal
0 ←		−0.85 ↙	0.85		−1.52	C.O
	0.34 ←	0.51 ↘	−0.30	−0.54 →		Bal
0 ←		−0.15 ↙	0.25		−0.27	C.O
	+0.06	0.09	−0.09	−0.16		Bal
	15.59	−15.59	49.79	−49.48	−14.80	Final

4 (a) Analyse the frame shown in Fig.4.a by moment distribution method and draw BMD and EC. [20] CO1 L3

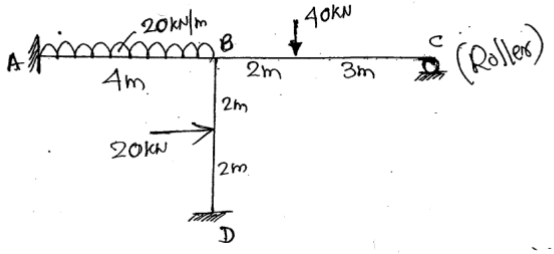


Fig.4.a

Solution:

(a) FEM

$M_{FBA} = -\frac{wl^2}{12} = -26.67$, $M_{FBA} = +26.67$

$M_{FBC} = -\frac{Wab^2}{l^2} = -28.8$, $M_{FCB} = +\frac{Wa^2b}{l^2} = +19.2$

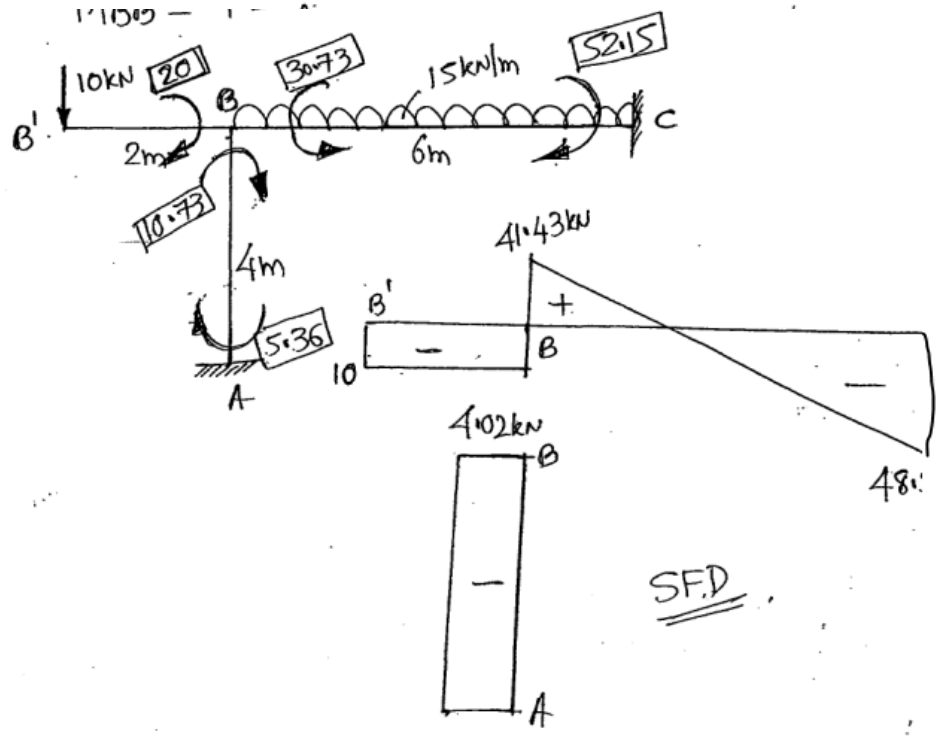
$M_{FDB} = -\frac{Wl}{8} = -10$, $M_{FBD} = +10$

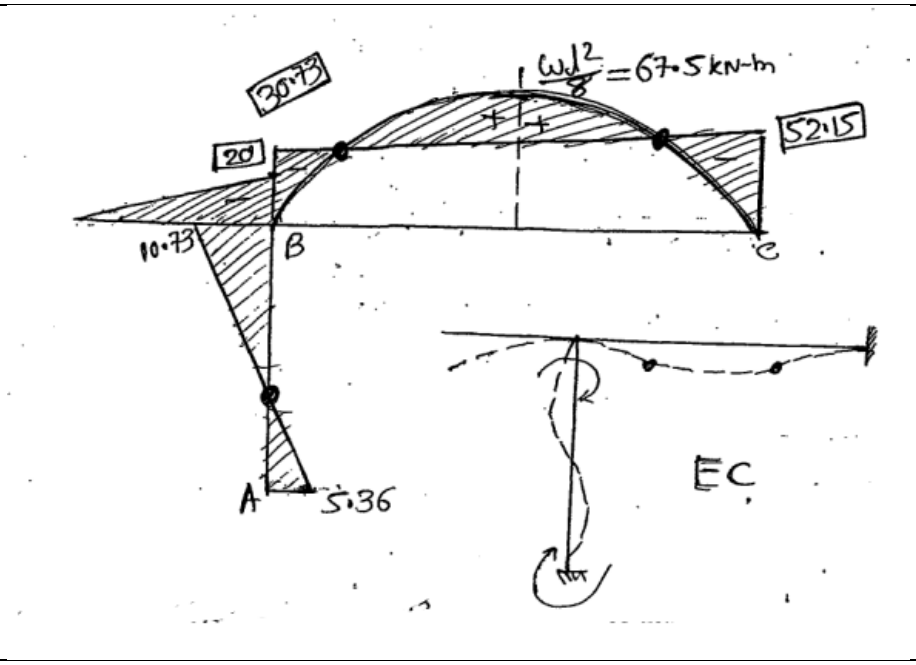
(b) D.F : (For Intermediate)

		K	Σk	DF = k/Σk
B	BA	$I/l = I/4 = 0.25I$	0.65I	0.38
	BC	$\frac{3}{4}(I/l) = \frac{3}{4}(I/5) = 0.15I$		0.24
	BD	$I/l = I/4 = 0.25I$		0.38

(C)

AB	BA	BD	DB	BC	CB	Mem
	0.38	0.38		0.24		DF
-26.67	26.67	+10	-10	-28.8	19.2	FE
					←19.2	Re
				-9.60		C
-26.67	26.67	10	-10	-38.40	0	In Va
0.33 ←	0.66	0.66 →	0.33	0.41 →	0	B
-26.33	27.33	10.66	-9.67	-37.99	0	Fi Va
↷	↶	↶	↷	↷	↺	




$\frac{wl^2}{8}$ = 67.5 kN-m
30.73
20
52.15
10.73
B
C
A
5.36
EC