F → Diagram T → theory N → not mention.
M → mom
S →

16-17

1 (a) → theory
(b) → Flexi
2 (a) → T
(b) → F/N
3 (a) → F/N
(b) → F
4 (a) → S
5 (a) → M
(b) → M
6 (a) → M
(b) → M
7 (a) → M
(b) → S
8 (a) → S
(b) → S

15-16

1 (a) → M
(b) → M
2 (a) S
(b) S
3 (a) S
(b) M
4 (a) M
(b) S
5 (a) F
(b) F
6 (a) F
(b) F
7 (a) F
(b) S
8 (a) N
(b) S

14-15

1 (a) F
(b) F
2 (a) F
(b) F
3 (a) S
(b) S
4 (a) S
(b) → T
5 (a) T
(b) M
6 (a) M
(b) M
7 (a) S
(b) F
8 (a) S
(b) S

13-14

1 (a) M
(b)
2 → F
3 → M
4 → F
5 → M
6 → F
7 → M
8 → S
9 → S
10 → S
11 → S
12 → S
13 → S
14 → F

12-13

1 (a) M
(b)
2 (a) M
(b) S
3 (a) S
(b) S
4 (a) S
5 (a) F
(b) F/T
6 (a) F
(b) F
7 (a) F
(b) F
8 F.

11-12

1 (a) F
(b) S
2 (a) F
(b) S
3 (a) N
(b) S
4 → S
5 (a) M
(b) F
6 (a) Scope
(b) M
7 (a) M
8 (a) Scope
(b) —

S → 4
F → 4
M → 5

S → 5
F → 5
M → 4

13-14

S → 6
F → 5
M → 3

S → 6
F → 4
M → 4

S → 4
F → 6
M → 2

S → 4
F → 3
M → 3

11 12
10 11
8 9

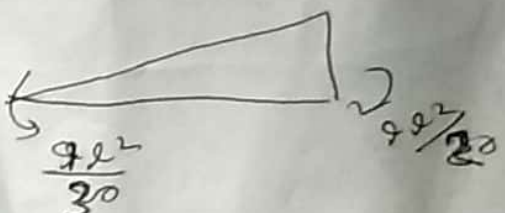
Nothing is certain.

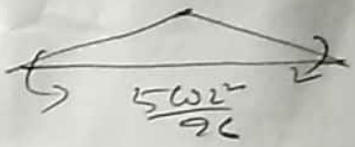
10-11

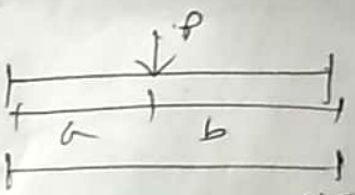
4 (a) IF
(b) M
2 (a) S
(b) M
3 (a) M
(b) IF
4 (a) M
(b) T
5 (a) F
(b) S
6 (a) S
(b) S
7 (a) S
(b) S
8 (a) S

9-10

1 (a) F/S
(b) IF
2 (a) M
(b) M
3 (a) S
(b) M
4 (a) IF
(b) M
5 (a) S
(b)
6 (a)
(b) F
7 (a) S
(b) S
8 (a) S
(b) F

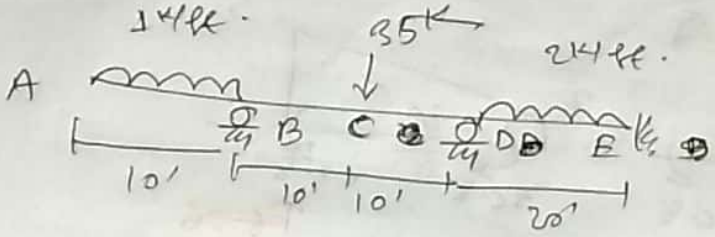


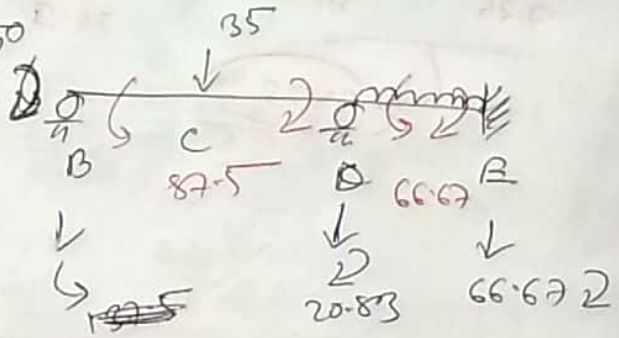




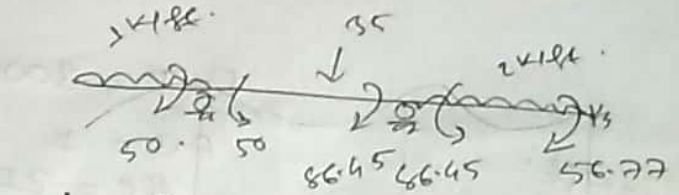
2016-17

5(a)

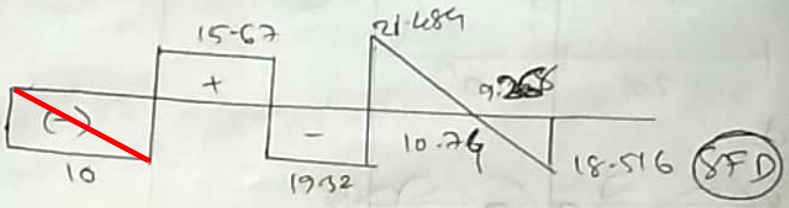




	A	B		D		E
DF	1	1		0.5	0.5	0
FEM	-50	87.5		-87.5	66.67	-66.67
		-37.5		10.42	10.42	
			-18.75		5.21	
			+9.375		+9.375	
					4.688	
	-50	+50		-86.45	86.45	-57



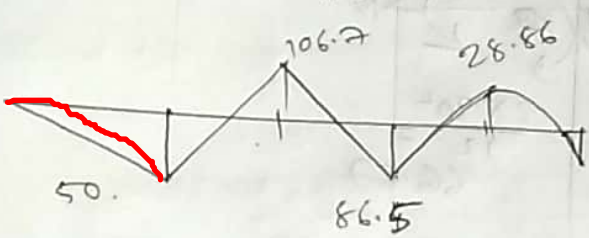
10. ↑10 ↑15.67 ↑19.32 ↑21.484 ↑18.516



SFD

$$\frac{x}{21.484} = \frac{20-x}{18.516}$$

$x = 10.74$



BMD

8.

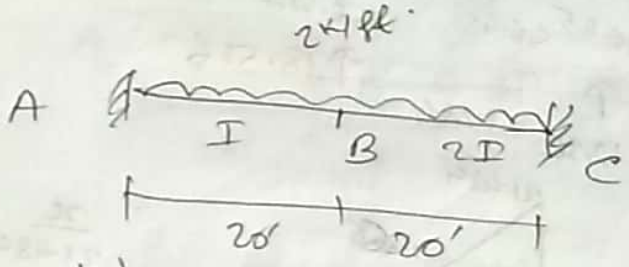
2016-17

5(b)

$EI = 3000$

$AB = I$

$BC = 2I$



Part 1

translation prevented

$\frac{2 \times 20^2}{12} = 66.67$

$\frac{2 \times 20^2}{12} = 66.67$

DF

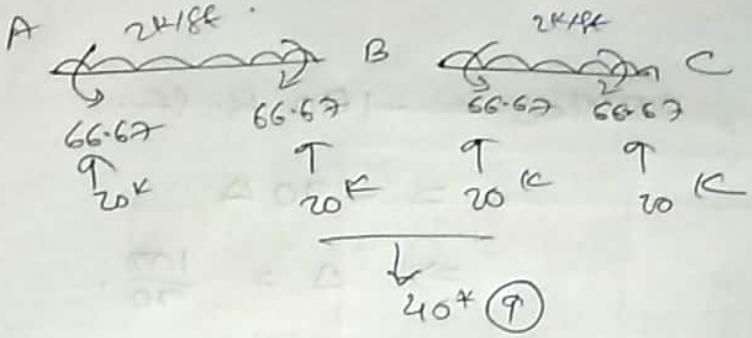
$DF_{AB} = 0$

$DF_{BA} = \frac{I/20}{I/20 + 2I/20} = 0.33$

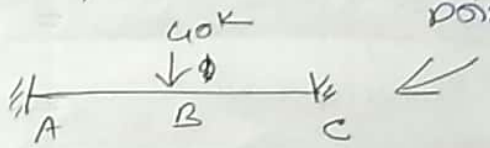
$DF_{BC} = 0.67$

$DF_{CB} = 0.$

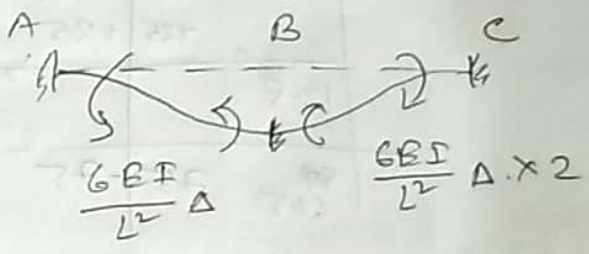
DF	0	0.67	0.33	0
FEM	66.67	-66.67	66.67	-66.67
Σ	66.67	-66.67	66.67	-66.67



We need to apply 40K (↓) to stabilize ~~the~~ point B.



Post-2 translation permitted.



~~We assume~~

$$FEM_{BC} = FEM_{CB} = -\frac{6EI}{L^2}\Delta$$

$$= -\frac{6 \times 3000 \times 2}{20^2} \times \Delta$$

$$= -90\Delta$$

$$FEM_{AB} = FEM_{BA} = \frac{6EI}{L^2}\Delta$$

$$= \frac{6 \times 3000}{20^2} \times \Delta = 45\Delta$$

We assume

$FBM_{BC} = FBM_{CB} = -100$ K-ft.

$= -90\Delta$

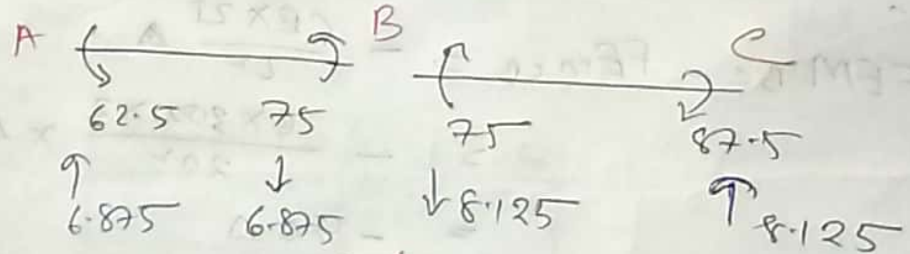
$\Rightarrow \Delta = \frac{100}{90}$.

$\therefore FBM_{AB} = FBM_{BA} = 45\Delta$

$= 45 \times \frac{100}{90}$

$= 50$ K-ft.

	A	B	B	C
DF	0	0.5	0.5	0
FBM	50	50	−100	−100
		+25	+25	
	12.5			12.5
	62.5	75	−75	−87.5



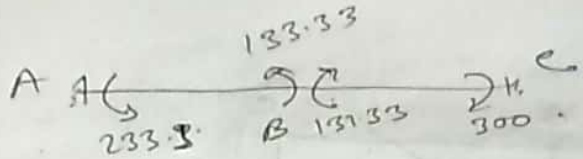
↓ 15 K → 40K (case) part 1

$M_{AB} = 66.67 + \frac{40}{15} \times 62.5 = 233.33$ K-ft

$M_{BA} = -66.67 + \frac{40}{15} \times 75 = 133.33$ K-ft

$M_{BC} = 66.67 + \frac{40}{15} \times (-75) = -133.33$

$M_{CB} = -66.67 + \frac{40}{15} \times (-87.5) = -300$



$FEM_{AB} = \frac{6EI}{L^2}\Delta = 233.33$

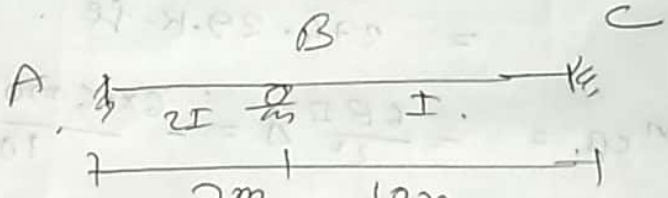
$\Rightarrow \Delta = \frac{233.33 \times 20^2}{6 \times 3000}$

$= 5.18$ ... (1)

$FEM_{BA} = \frac{6EI}{L^2}\Delta = 133.33$

$\Rightarrow \Delta = 2.96$

6 (b)



$E = 70$ GPa.

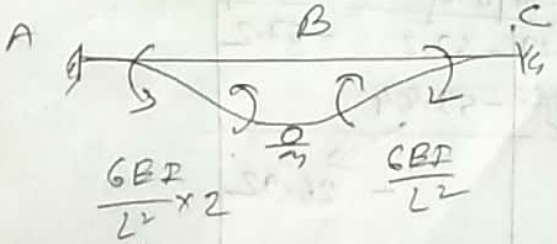
$I = 800 \times 10^6$ mm^4

Settles at

$B = 20$ mm

$EI = 70 \times 800$

$= 56000$ KN-m.



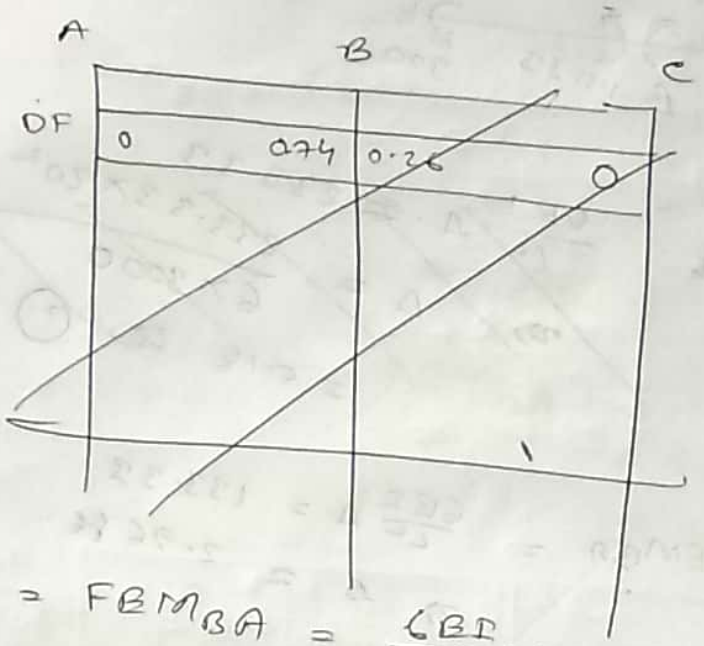
$DF_{AB} = 0$

$DF_{BA} = \frac{2I/7}{2I/7 + I/10} = 0.74$

$DF_{BC} = 1 - 0.74$

$= 0.26$

$DF_{CB} = 0.$



$FEM_{AB} = FEM_{BA} = \frac{6EI}{L^2}\Delta \times 2$ $\quad \Delta = 20mm = 0.02m$

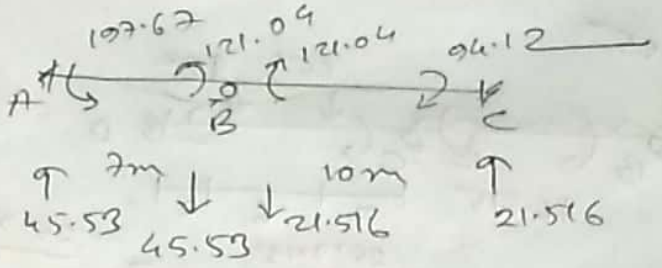
$= \frac{6 \times 56000}{7^2} \times 0.02 \times 2$

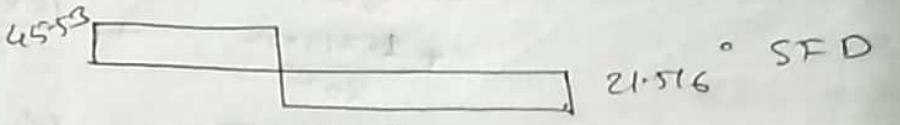
$= 274.29 K\text{-}ft.$

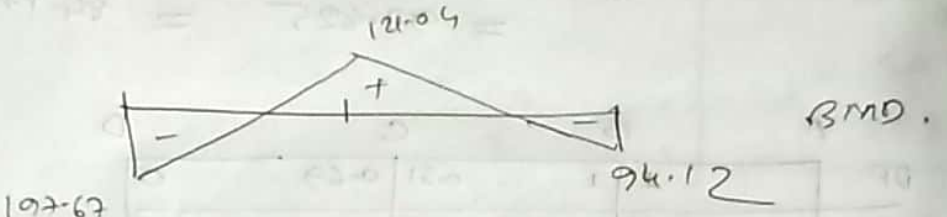
$FEM_{BC} = FEM_{CB} = -\frac{6EI}{L^2}\Delta = -\frac{6 \times 56000 \times 0.02}{10^2}$

$= -67.2$

DF		0.74	0.26	
	A	B		C
FEM	274.29	274.29	-67.2	-67.2
		-153.25	-53.84	
	76.625			
			-26.92	
	197.67	121.04	-121.04	-94.12

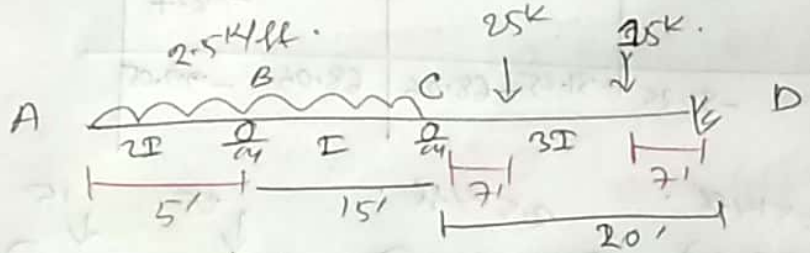






2015-16

1 (a)



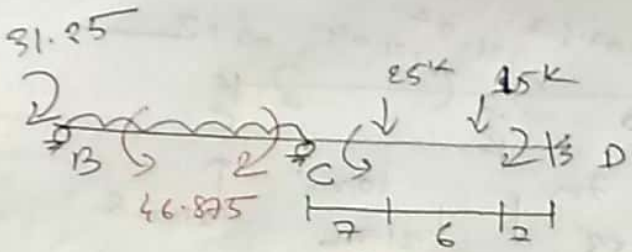
$DF_{BC} = 1.$

$DF_{DC} = 0.$

$$DF_{CD} = \frac{\frac{3I}{20}}{\frac{3I}{20} + \frac{I}{15}} = 0.69$$

$DF_{CB} = 1 - 0.69 = 0.31$

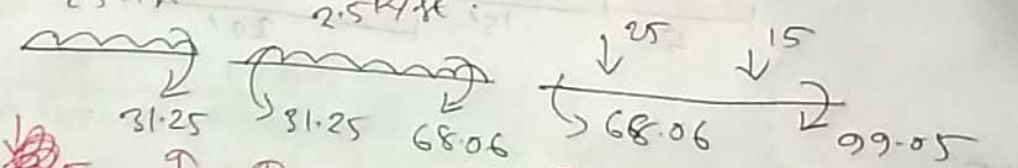
$DF_{BC} = 1.$



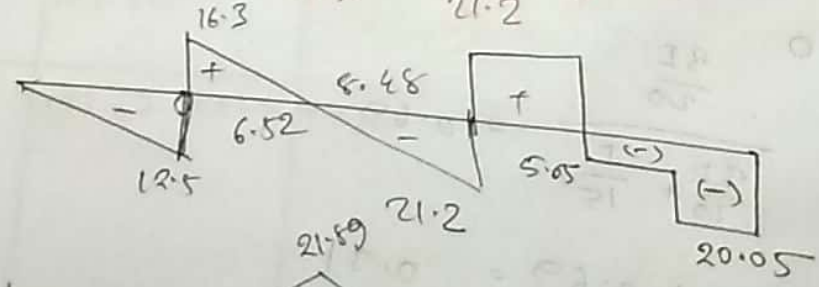
$$= \frac{25 \times 7 \times 13^2}{20^2} + \frac{15 \times 13 \times 7^2}{20^2} = \frac{25 \times 13 \times 7^2}{20^2} + \frac{15 \times 7 \times 13^2}{20^2}$$

$$= 97.825 \qquad = 84.175$$

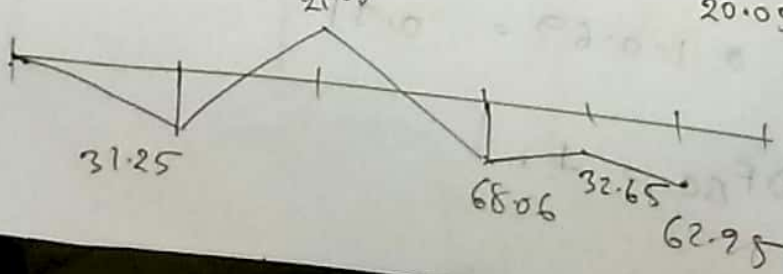
	A	B		C		D
DF		1		0.31	0.69	
FEM	−31.25	46.875	−46.875	97.825	−84.175	0
		−15.625	−15.79	−35.15		
		−7.8125			−17.58	
		+2.42		+5.39		
					2.7	
	−31.25	+31.25	−68.06	68.06	−99.05	



12.5 16.3 21.2 19.95 20.047



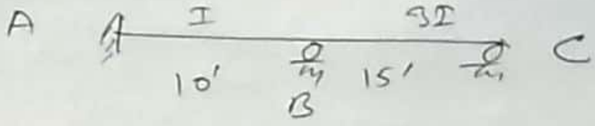
$\frac{x}{16.3} = \frac{16-x}{21.2}$



14-15

5(b) DIY → Do it yourself.

5(c)



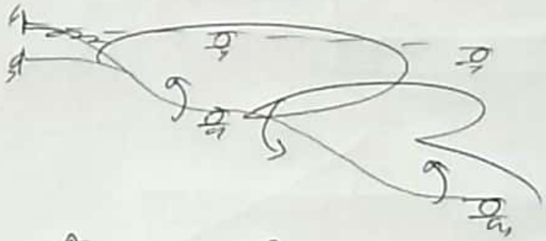
$\theta_A = 0.001$ rad

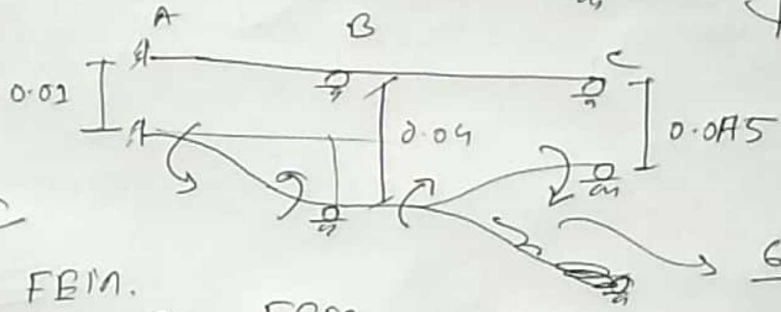
$\Delta_A = 0.01$ ft ↓

$\Delta_B = 0.04$ ft ↓

$\Delta_C = 0.0175$ ↓

$EI = 30\times10^3 \times 10^3 = 30\times10^6$ K-in^2 $= 208320$ K-ft^2





$\frac{6EI}{L^2}\Delta$.

Deflection

FEM.

$BC = FEM_{CB} = -\frac{6EI}{L^2}\Delta = -\frac{6\times208320}{15^2}\times(0.175-0.1)$

$= -416.64$ K-ft

FEM

$AB = BA = \frac{6EI}{L^2}\Delta = \frac{6\times208320}{10^2}\times(0.04-0.01)$

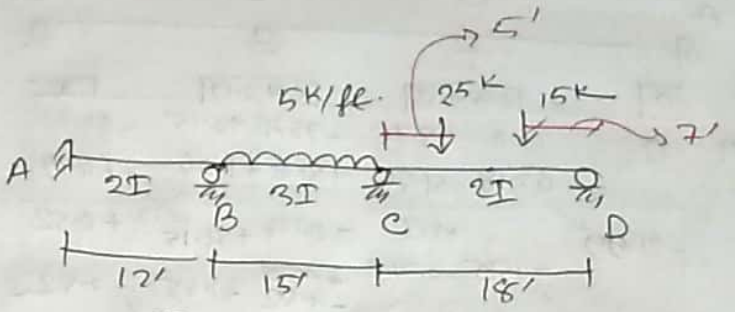
$= 374.976$ K-ft

Rotation

Stiffness method ব্যবহার

2013-14

(1)



$$DF_{BA} = \frac{2I/12}{\frac{2I}{12} + \frac{3I}{15}} = 0.45$$

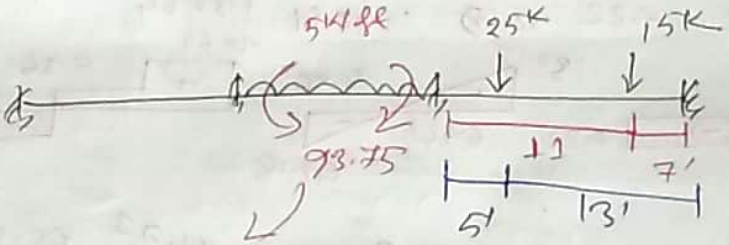
$DF_{AB} = 0$ (fixed)

$DF_{BC} = 1 - 0.45 = 0.55$

$$DF_{CD} = \frac{\frac{2I}{18} \times \frac{3}{4}}{\frac{2I}{18} \times \frac{3}{4} + \frac{3I}{15}} = 0.29$$

$DF_{DC} = 1$

$DF_{CB} = 1 - 0.29 = 0.71$



$\frac{5 \times 15^2}{12}$

$\frac{15 \times 11^2 \times 7^2}{18^2} + \frac{25 \times 5 \times 13^2}{18^2} = 90.15$

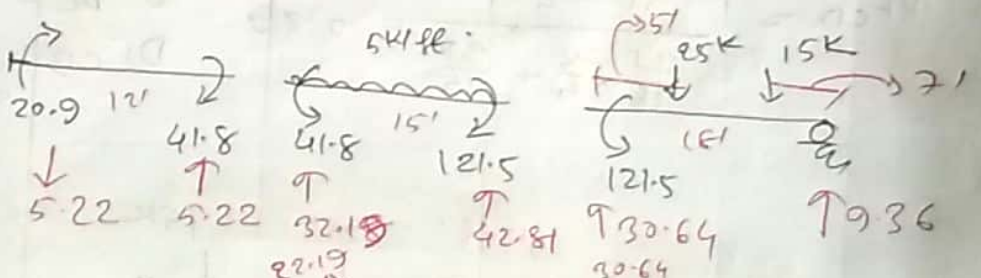
$\frac{15 \times 11^2 \times 7}{18^2} + \frac{25 \times 5^2 \times 13}{18^2} = 64.29$

A B C D

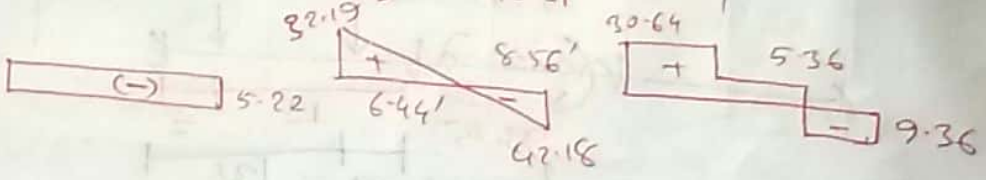
DF: 0 | 0.45 0.55 | 0.71 0.29 | 1

FEM: 0 | 0 93.75 | −93.75 90.15 | −64.29

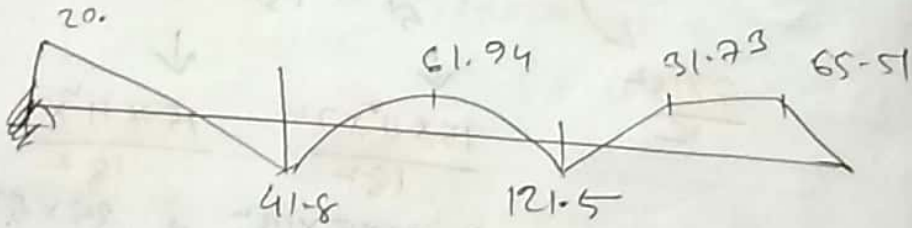
	−42.18	−51.56	+2.6 +1.04	+64.29
−21.09		+1.3	−25.78 +32.15	+0.52
	−0.585	−0.715		
−0.29			−4.52 −1.85	−0.52
	1.01	−2.26	−0.37 −0.26	−0.93
0.505		1.24	+0.45 +0.48	+0.93
		+0.23	0.62 0.465	0.09
	−0.1	−0.13		−0.09
			−0.77 −0.31	
−20.9	−41.8	41.8	−121.5 +121.5	0



SFD



BMD

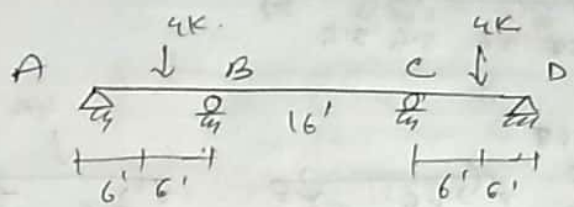


8.

Beam Problem (without Settlement)

2012-13

2(a)

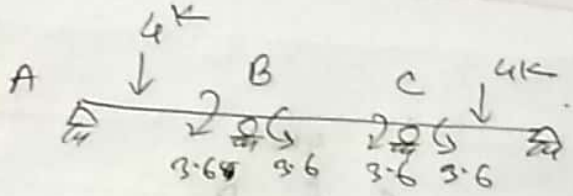


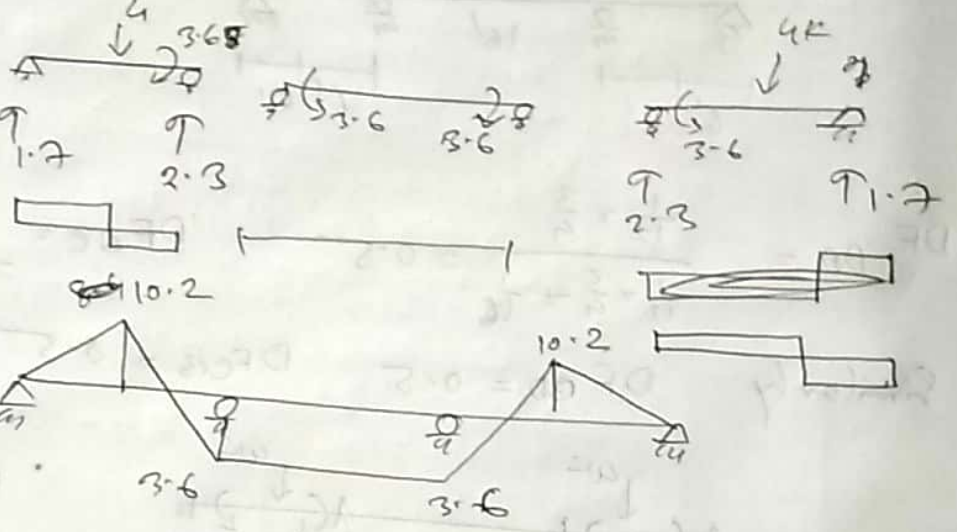
$$DF_{BA} = \frac{\frac{1}{12} \times \frac{3}{4}}{\frac{1}{12} \times \frac{3}{4} + \frac{1}{16}} = 0.5 \qquad DF_{BC} = 1 - 0.5 = 0.5$$

Similarly $DF_{CD} = 0.5$ $\quad DF_{CB} = 0.5$

$$\frac{Pa^2b}{L^2} = \frac{4 \times 6^3}{12^2}$$

	A	B		C	D
DF	1	0.5	0.5	0.5	0.5	1
FEM	6	−6	0	0	6	−6
	−6	+3	+3	−3	−3	+6
	+1.5	−3	−1.5	+1.5	+3	−1.5
	−1.5	+2.25	+2.25	−2.25	−2.25	+1.5
	1.125	−0.8	−1.125	+1.125	+0.8	−1.125
	−1.125	+0.96	+0.96	−0.96	+0.96	+1.125
	0.48	−0.57	−0.48	+0.48	+0.57	−0.48
	−0.48	+0.5	+0.5	−0.5	−0.5	+0.48
	+0.25	−0.24	−0.25	+0.25	+0.24	−0.25
	−0.25	+0.25	+0.25	−0.25	−0.25	+0.25
	+0.125	−0.125	−0.125	+0.125	+0.125	−0.125
	−0.125	+0.125	+0.125	−0.125	−0.125	+0.125
	0	−3.65	+3.6	−3.6	+3.6	0

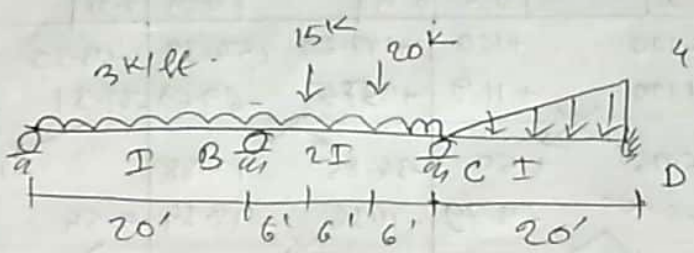

4K
A
B
C
4K
D
3.6
3.6
3.6
3.6


4
3.6
1.7
2.3
3.6
3.6
4K
3.6
2.3
1.7
SFD
10.2
10.2
BMD
3.6
3.6

2011-12 No beam

10-11

1 (b)



$DF_{AB} = 1$

$$DF_{BA} = \frac{\frac{I}{20} \times \frac{3}{4}}{\frac{I}{20} + \frac{3}{4} + \frac{2I}{18}} = 0.252 \approx 0.25$$

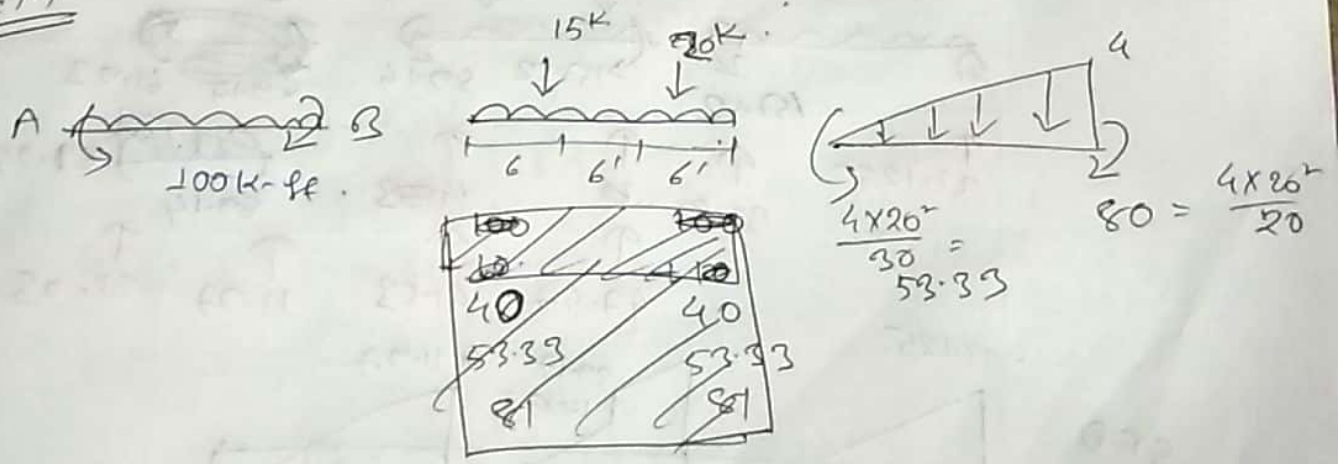
$$DF_{BC} = 1 - 0.252 = 0.748 \approx 0.75$$

$$DF_{CD} = \frac{I/20}{I/20 + \frac{2I}{18}} = 0.31$$

$$DF_{CB} = 1 - 0.31 = 0.69$$

$DF_{DC} = 0.$

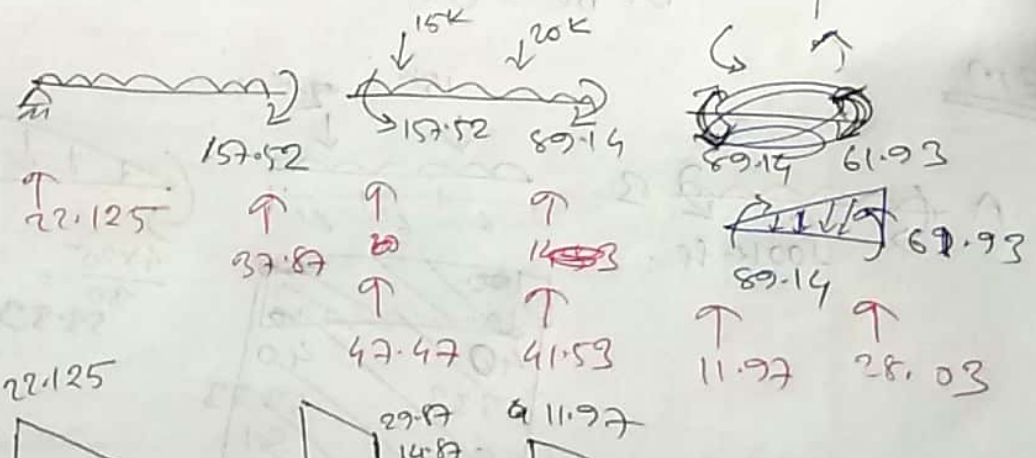
FEM



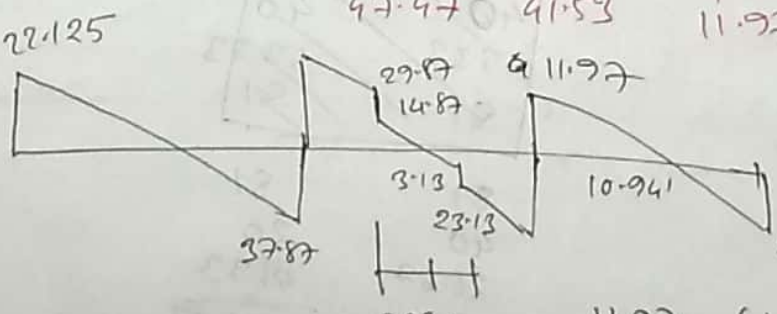
81	81
40	20
26.67	53.33
147.67	154.33

DF	1	0.25	0.75		0.69	0.31	0
FEM	-100	+100	-147.67		154.33	-53.33	80
	+100	+11.9	+33.75		-69.69	-31.31	
	5.95	+50	-34.85		17.88		-15.65
	-5.95	-3.79	-11.36		-12.34	5.54	
	-1.895	-2.98	-6.17		-5.68		-2.77
	+1.895	2.29	6.86		3.92	1.76	
	1.15	0.95	1.96		3.43		+0.88
	-1.15	-0.73	-2.18		-2.37	-1.06	
	+0.37	-0.58	-1.185		-1.09		-0.53
	-0.37	~~-0.45~~ -0.45			+0.75	+0.34	
	0	0.44	1.32				
	0	+157.52	-157.52		+89.14	-89.14	61.93

Need to 2-3 more iteration. pleax DIY



SFD

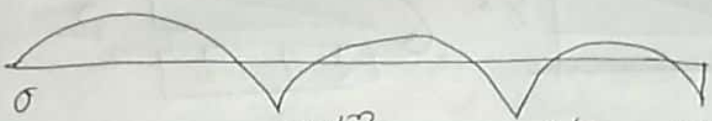


$\frac{4}{20} = \frac{y}{x}$

$11.97 - \left(\frac{1}{2} x \cdot \frac{x}{5}\right) = 0$

$x = 10.94$

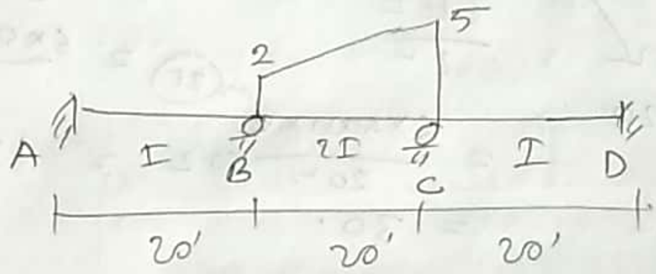
BMD



δ

2010-11

4(b)



EI = 5000 K/ft²

A rotate 0.04 rad

C settles 0.2 ft

DF

$DF_{AB} = 0$

$DF_{BA} = \dfrac{I/20}{I/20 + 2I/20} = 0.33$

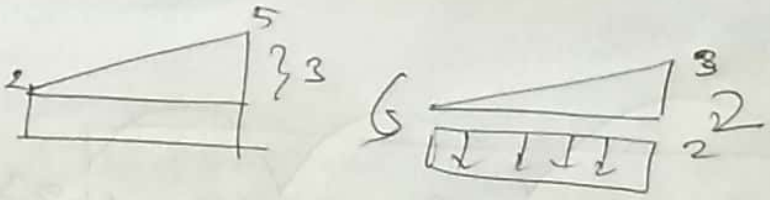
$DF_{BC} = 1 - 0.33 = 0.67$

$DF_{CD} = \dfrac{I/20}{I/20 + 2I/20} = 0.33$

$DF_{CB} = 1 - 0.33 = 0.67$

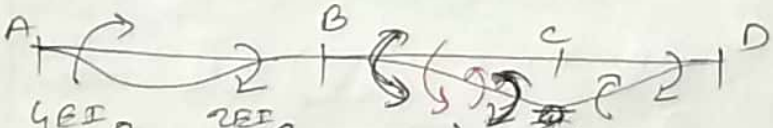
$DF_{DC} = 0$

FEM



$= \frac{wL^2}{12} + \frac{9L}{30}$ $\quad \frac{wL^2}{12} + \frac{8L^2}{20}$

$= 106.67$ $\quad = 126.67$



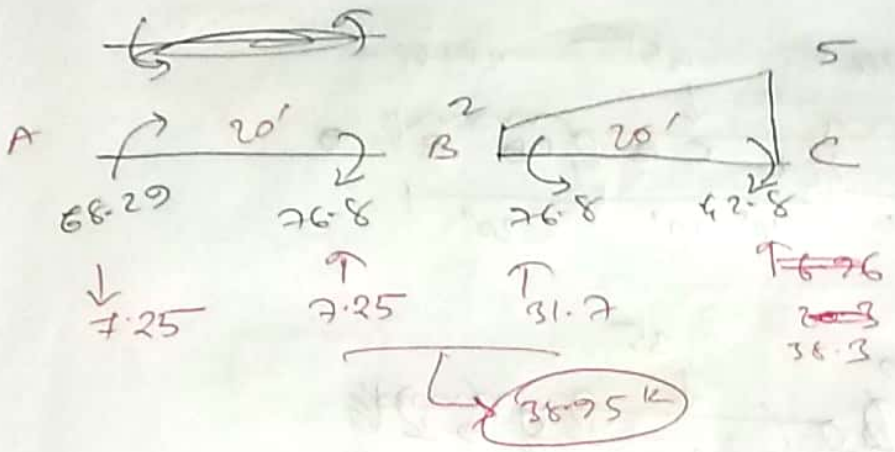
$\frac{4EI}{L}\theta$ $\quad \frac{2EI}{L}\theta$ $\quad \frac{6EI}{L^2}$ $\quad y = \frac{6EI}{L^2}\Delta$

$\frac{4 \times 5000}{20} \times 0.04 = 40$ $\quad = 20$

$= \frac{6 \times 5000 \times 2}{20^2} \times 0.2$ $\quad = \frac{6 \times 5000}{20^2} \times 0.2$

$= 30$ $\quad = 15$

DF	0		0.33	0.67		0.67	0.33		0
FEM	-40		-20	+136.67		~~-30~~	-15		-15
		-38.5		-78.17		-96.67			
	-19.25					+74.81	+36.85		
				37.41		-39.1			+19.43
		-12.35		-25.06		26.2	18.9		
	-6.18								6.45
				13.1		-12.51			
		-4.32		-8.77		8.38	4.13		
	-2.16								2.06
				4.19		-4.39			
		-1.38		-2.81		1.45	2.94		
	-0.7								1.47
				0.73		-1.4			
		-0.24		-0.45		0.46	0.94		
	-68.29		-76.8	+76.8		-42.8	42.8		+14.41


A
20'
B
20'
C
68.29
76.8
76.8
42.8
7.25
7.25
31.7
38.3
38.95 K