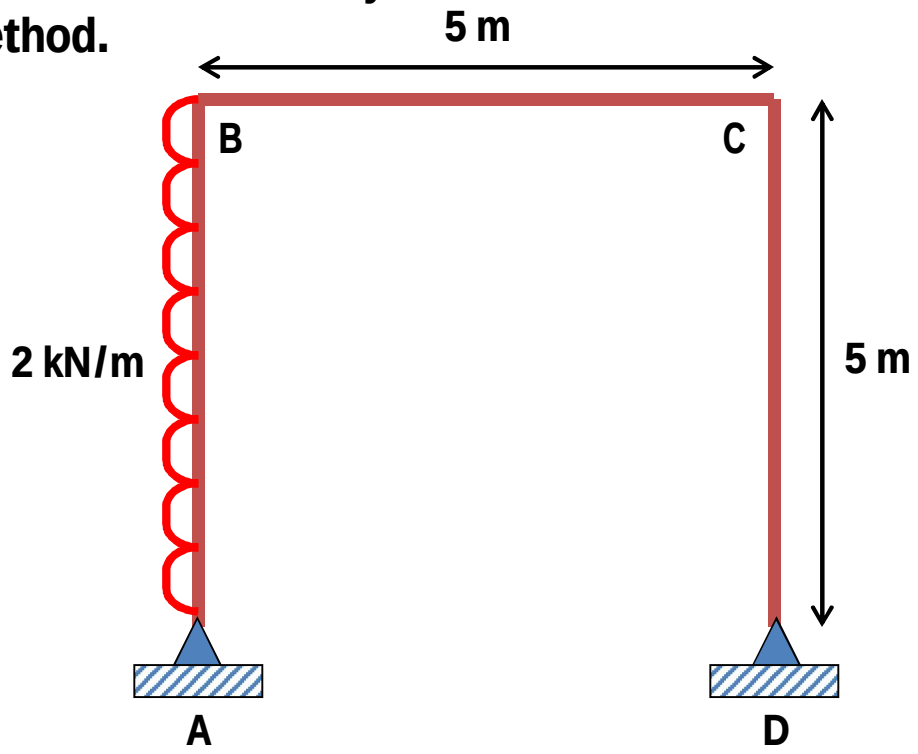
QUIZ (Chapter 3)

A portal frame ABCD as shown in Figure below is subjected to UDL of 2 kN/m on column AB. EI is constant. Analyze the frame structure using Moment Distribution Method.



Case 1:
Fixed End Moment (M^F): Non-sway Analysis

$$Column\ AB$$

$$M_{AB}{}^{F} = -4.17kNm$$

$$M_{BA}{}^{F} = 4.17kNm$$

$$Beam\ BC$$

$$M_{BC}{}^{F} = M_{CB}{}^{F} = 0$$

$$Column\ CD$$

$$M_{CD}{}^{F} = M_{DC}{}^{F} = 0$$

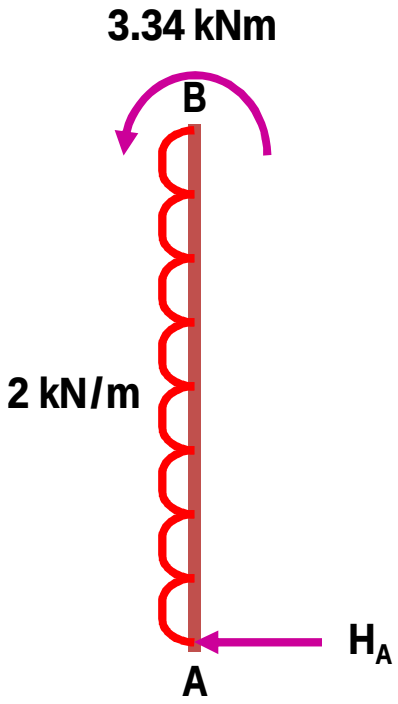
Distribution Factor (DF)

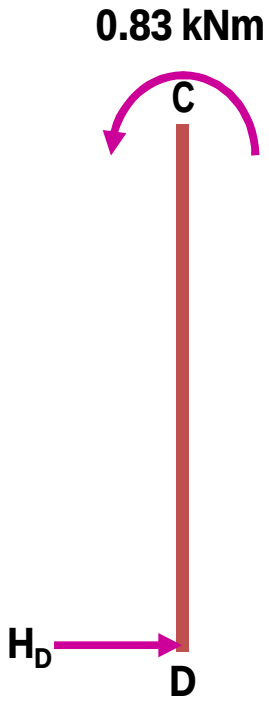
JOINT	MEMBER	K	ΣK	DF
A	AB	$\frac{3EI}{5}$	$\frac{3EI}{5}$	1
B	BA	$\frac{3EI}{5}$	$\frac{7EI}{5}$	0.429
	BC	$\frac{4EI}{5}$		0.571
C	CB	$\frac{4EI}{5}$	$\frac{7EI}{5}$	0.571
	CD	$\frac{3EI}{5}$		0.429
D	DC	$\frac{3EI}{5}$	$\frac{3EI}{5}$	1

Table Moment Distribution (Non-Sway)

Member	AB	BA	BC	CB	CD	DC
DF	1	0.429	0.571	0.571	0.429	1
M^F	-4.17	4.17	0	0	0	0
Bal	4.17	-1.79	-2.38			
CO		2.08	0	-1.19		
Bal		-0.89	-1.19	0.68	0.51	
CO			0.34	-0.60		
Bal		-0.15	-0.19	0.34	0.26	
CO			0.17	-0.10		
Bal		-0.07	-0.10	0.06	0.04	
CO			0.03	-0.05		
Bal		-0.01	-0.02	0.03	0.02	
End Moment	0	3.34	-3.34	-0.83	0.83	0

Horizontal Reactions





$$\sum M_B = 0,$$

$$H_A(5) + 3.34 - 2(5)(5/2) = 0$$

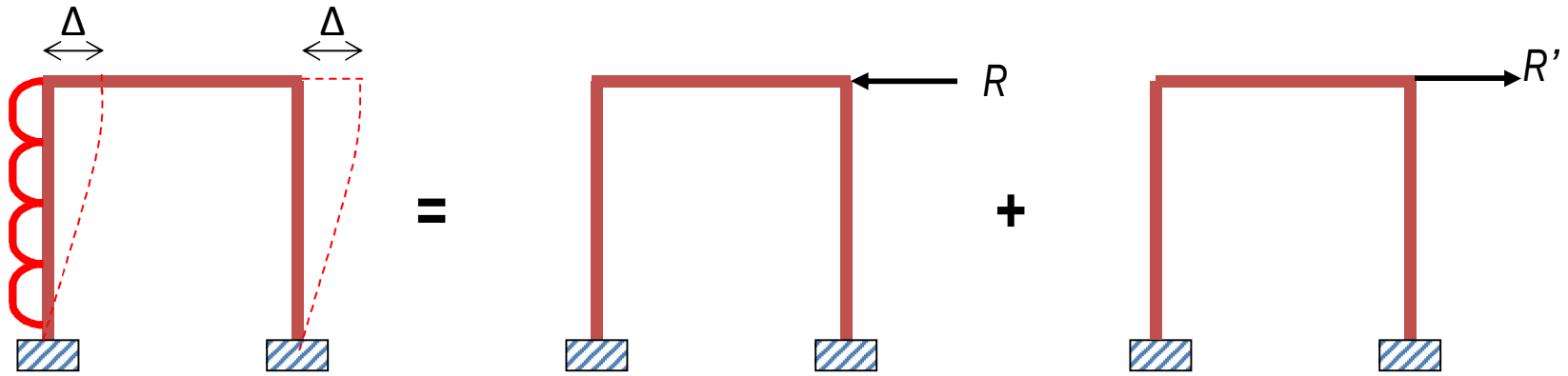
$$\therefore H_A = 4.332 kN$$

$$\sum M_C = 0,$$

$$-H_D(5) + 0.83 = 0$$

$$\therefore H_D = 0.166 kN$$

Forces acting



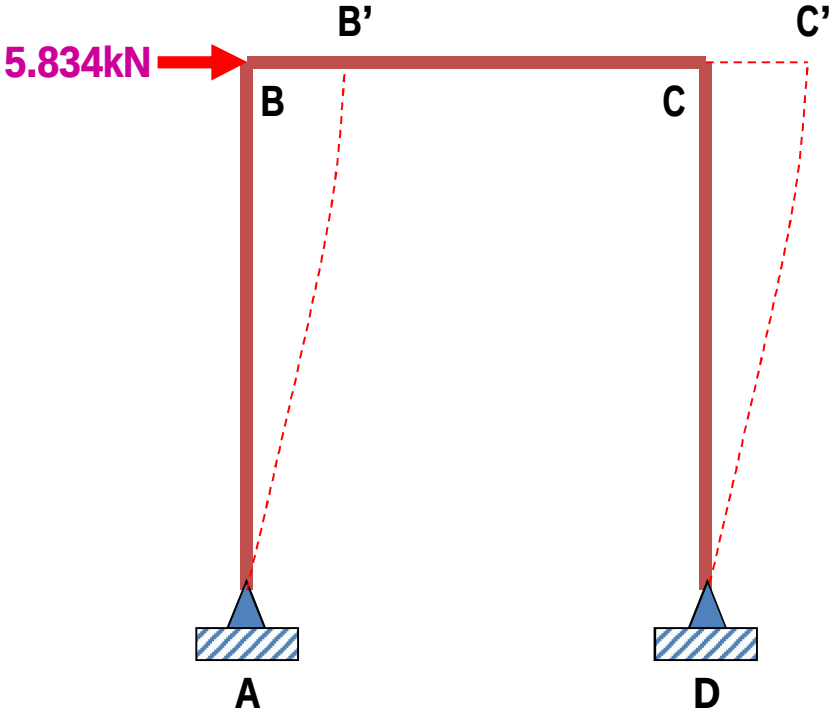
To find sway forces, R

$$\sum^{\rightarrow +} F_H = 0,$$

$$R = 2(5) + 0.166 - 4.332$$

$$\therefore R = 5.834kN$$

Case 2:
Fixed End Moment (M^F): Sway Analysis



$$M_{AB}{}^{F} = M_{BA}{}^{F} = -\frac{3EI\delta}{L^2} = -\frac{3EI\delta}{5^2}$$

$$M_{BC}{}^{F} = M_{CB}{}^{F} = 0$$

$$M_{CD}{}^{F} = M_{DC}{}^{F} = -\frac{3EI\delta}{L^2} = -\frac{3EI\delta}{5^2}$$

therefore,

$$M^{F}{}_{AB,BA} : M^{F}{}_{CD,DC}$$

$$-\frac{3EI\Delta}{5^2} : -\frac{3EI\Delta}{5^2}$$

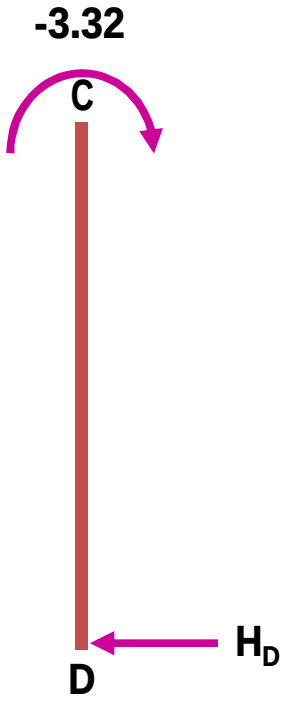
$$(-1:-1) \times 5 \quad \text{....* assume any no.}$$

$$-5:-5$$

Table Moment Distribution (Sway Analysis)

Member	AB	BA	BC	CB	CD	DC
DF	1	0.429	0.571	0.571	0.429	1
M^F	-5	-5	0	0	-5	-5
Bal	5	2.14	2.86	2.86	2.14	5
CO			1.43	1.43		
Bal		-0.61	-0.82	-0.82	-0.61	
CO			-0.41	-0.41		
Bal		0.18	0.23	0.23	0.18	
CO			0.12	0.12		
Bal		-0.05	-0.07	-0.07	-0.05	
CO			-0.04	-0.04		
Bal		0.02	0.02	0.02	0.02	
Assumed Sway Moments	0	-3.32	3.32	3.32	-3.32	0

Horizontal Reactions



$$\sum M_B = 0,$$

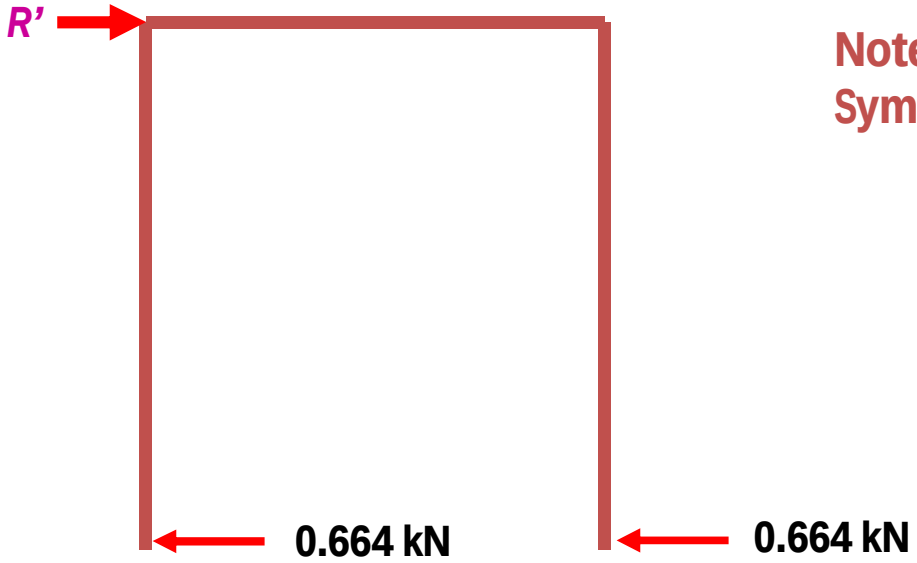
$$H_A(5) - 3.32 = 0$$

$$\therefore H_A = 0.664kN$$

$$\sum M_C = 0,$$

$$H_D(5) - 3.32 = 0$$

$$\therefore H_D = 0.664kN$$



Note:
Symbol of R' = S

To find R'

$$\sum \overset{\rightarrow +}{} F_H = 0$$

$$R' - 0.664 - 0.664$$

$$\therefore R' = 1.328 kN$$

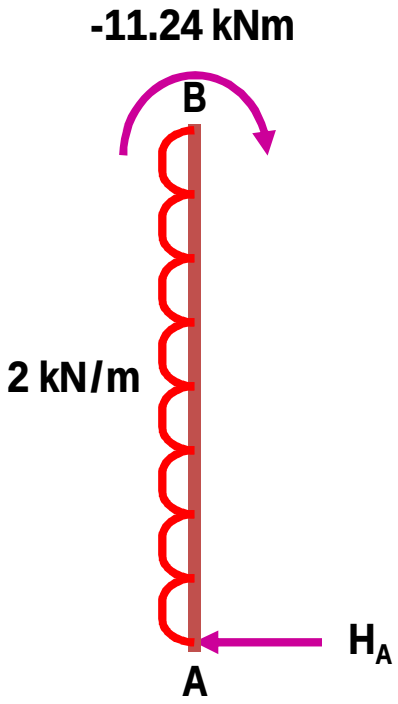
Correction Factor and Final Moment

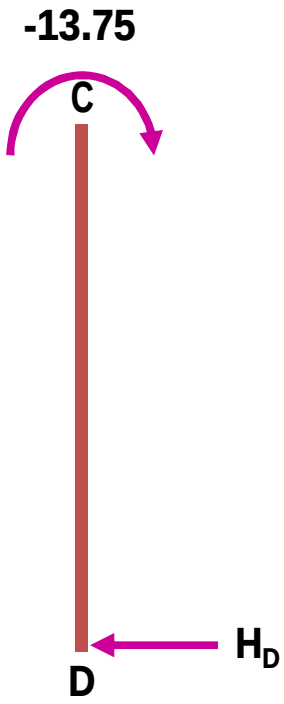
$$\therefore ASM = \frac{R}{R'} = \frac{5.834}{1.328} = 4.39$$

A		B		C		D
Assume sway moment	0	-3.32	3.32	3.32	-3.32	0
Actual sway moment (ASM)	0	-14.58*	14.58	14.58	-14.58	0
(Non-sway moment)	0	3.34	-3.34	-0.83	0.83	0
Final Moments	0	-11.24	11.24	13.75	-13.75	0

**ASM x Assume sway moment

Horizontal Reactions





$$\sum M_B = 0,$$

$$\therefore H_A = 7.25kN$$

$$\sum M_C = 0,$$

$$\therefore H_D = 2.75kN$$