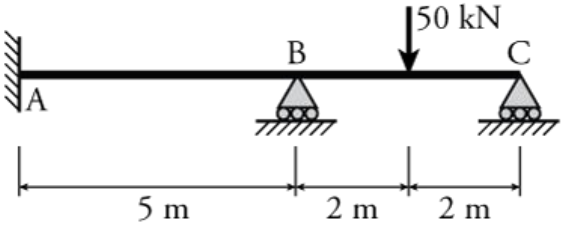
Subject Code & Name**: 23AST205-Aerospace Structures** Date: **22.01.2025**

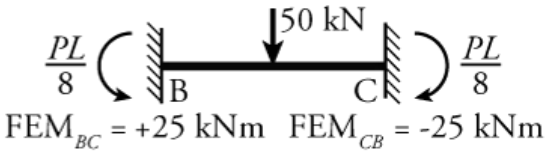
DAY: **03** TOPIC. **Moment distribution method for indeterminate beams**



a) Fix all Interior Nodes

b) Fixed End Moments

None



c) Distribute Unbalanced Moments at B

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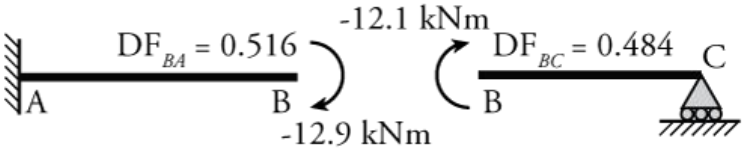
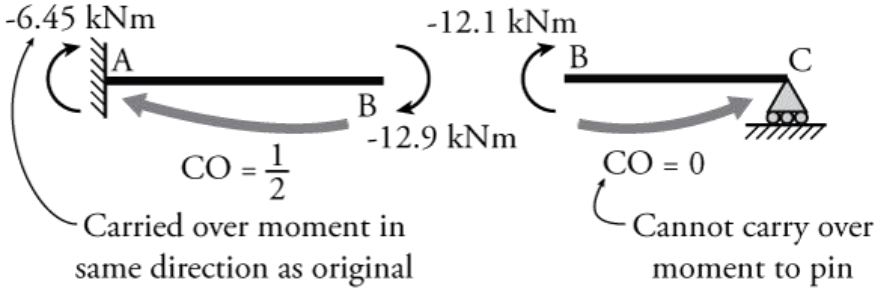
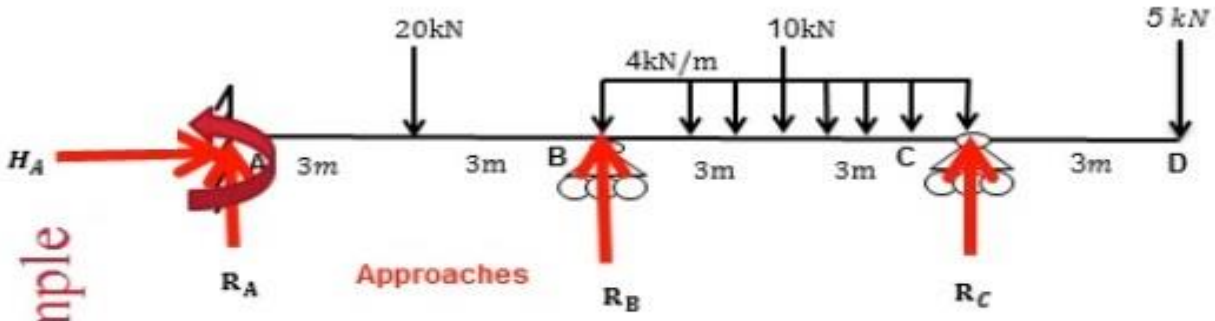
Equal and opposite distributed moment:



d) Carry-over Moments



Moment Distribution Method –beam example



1. Degree of static equilibrium
2. Divide structure into spans and calculate relative stiffness
3. Calculate distribution factors
4. Calculate fixed end moments
5. Distribution table
6. Calculate reactions, shear forces and free bending moment
7. Draw bending moment, shear force diagrams and the deflected shape

Step 1

Degree of static equilibrium

$$I_D = (m + r) - 2j$$

$$no\ of\ \ support\ reactions\ (r) = 5$$

$$\text{number of members(m)} = 3$$

$$no\ of\ joints\ \ (j) = 3$$

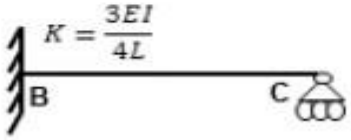
$$I_D = (m + r) - 2j = (3 + 5) - 6 = 2$$

Step 2

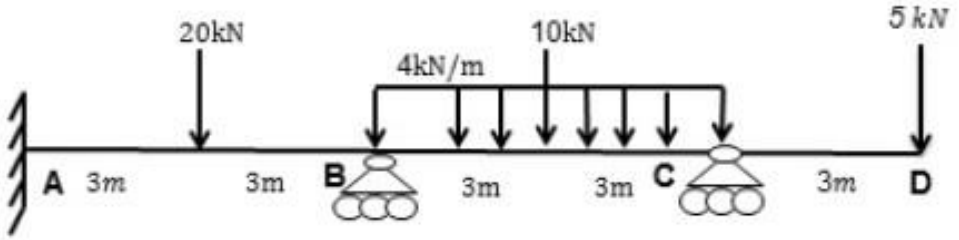
Relative Stiffness

$$K_{BA} = \frac{EI}{L} = \frac{1}{6}$$

$$K_{BC} = \frac{3EI}{4L} = \frac{3}{4} \times \frac{1}{6} = \frac{1}{8}$$



Moment Distribution Method –beam example



Step 3

Distribution Factor

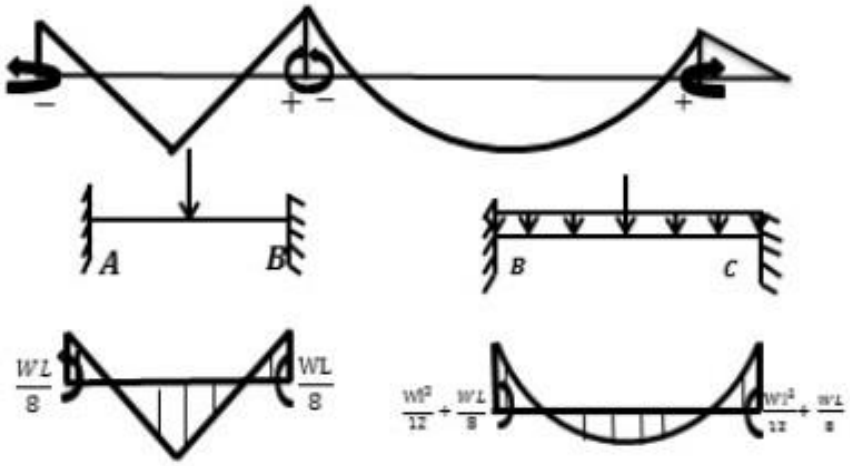
Joint B

$$DF_{BA} = \frac{K_{BA}}{K_{BA}+K_{BC}} = \frac{\frac{1}{6}}{\frac{1}{6}+\frac{1}{8}} = 0.57$$

$$DF_{BC} = 1 - 0.57 = 0.43$$

Step 4

FIXED END MOMENT



$$FEM_{AB} = -\frac{WL}{8} = \frac{20\times 6}{8} = -15kNm \qquad FEM_{BA} = 15kNm$$

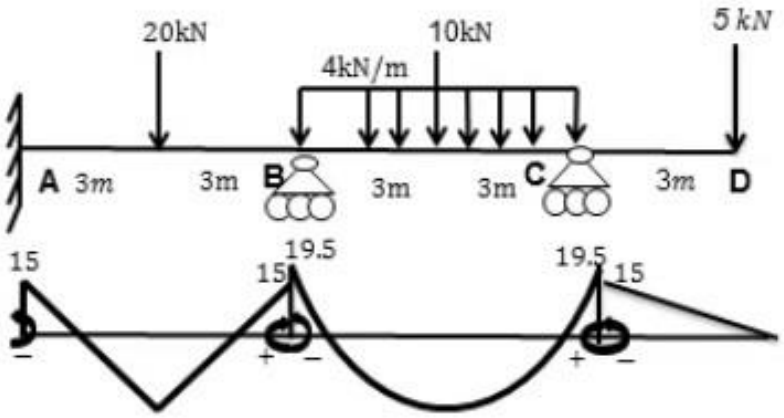
$$FEM_{BC} = -\frac{Wl^2}{12} - \frac{WL}{8} = \frac{6\times 8^2}{12} + \frac{10\times 6}{8} = -19.5kNm \quad FEM_{CB} = 19.5kNm$$

$$FEM_{CD} = 5\times 3 = -15kNm$$

Moment Distribution Method –beam example

Step 5

Distribution Table

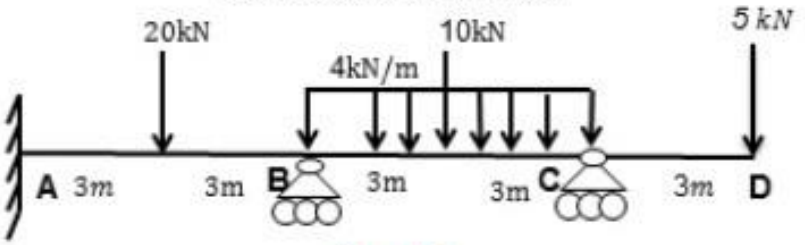


JOINTS	A		B		C	D
MEMBERS	AB	BA	BC	CB	CD	
DF	1	0.57	0.43	1		
FEM	-15	15	-19.5	19.5	-15	
DIS		2.57	1.93	-4.5		
CO	1.29		-2.25			
DIS		1.29	0.96			
CO	0.65					
∑MOMENTS	-13.06	18.86	-18.86	15	-15	

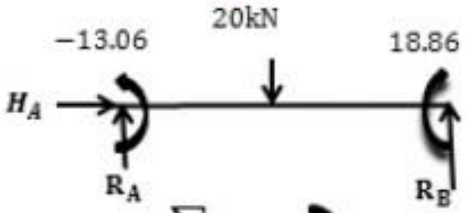
Moment Distribution Method –beam example

Step 6

Reactions and shear forces



Span AB

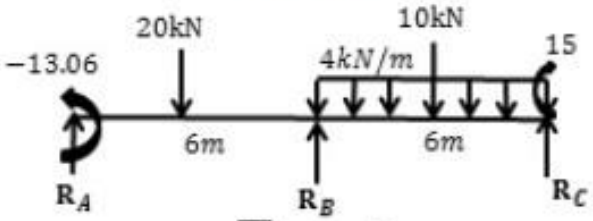


$$\sum M_B = 0 \circlearrowright +$$

$$6R_A - 60 - 13.06 + 18.86 = 0$$

$$R_A = 9.03kN$$

Span AC



$$\sum M_C = 0 \circlearrowright +$$

$$6R_B + 12 \times 9.03 - 20 \times 9 + 15 - 13.06 - 4 \times 6 \times 3 - 30 = 0$$

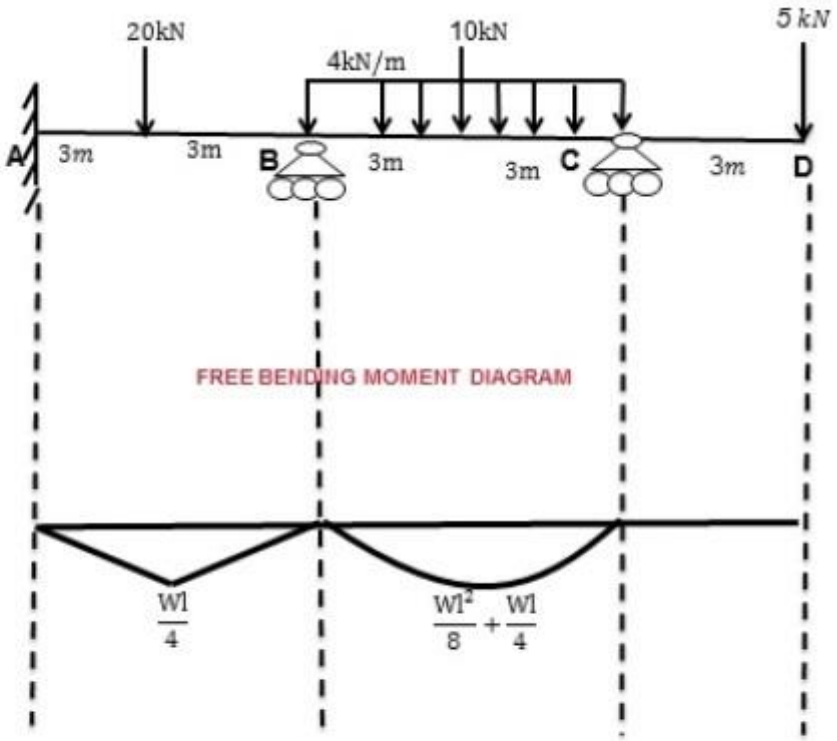
$$R_B = 28.61kN$$

$$\sum F_y = 0 \uparrow +$$

$$R_C + 9.03 + 28.61 - 20 - 10 - 4 \times 6 - 5 = 0$$

$$R_C = 21.36\text{kN}$$

Moment Distribution Method –beam example



FREE BENDING MOMENT

$$M_{AB} = \frac{Wl}{4} = \frac{6 \times 20}{4} = 30kNm$$

$$M_{BC} = \frac{Wl^2}{8} + \frac{Wl}{4} = \frac{4 \times 6^2}{8} + \frac{10 \times 6}{4} = 33kNm$$

Step 7

Deflected shape

Moment Distribution Method –beam example