CE 317: QUIZ 1
Department of Civil Engineering, IIT Bombay

Date: 10th August 2018 **Maximum Marks: 20** **Duration: 60 Minutes**

Instructions:

1. Attempt both questions.
2. Both questions carry equal weight.
3. Consider all members to be inextensible, with ***EI* =** constant.
4. Make suitable assumptions, if necessary, and state the same clearly.

Q. 1. By using ***Slope Deflection Method,*** find shear force at joint ***A*** of the plane frame shown in **Fig. 1.**

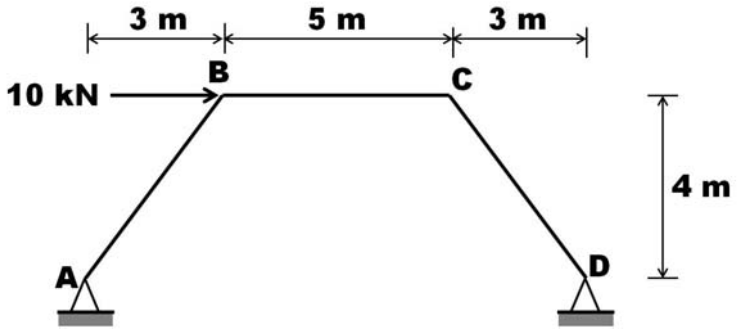

Fig. 1

Q. 2. By using ***Moment Distribution Method,*** find bending moment at joint ***A*** of the plane frame shown in **Fig. 2.**

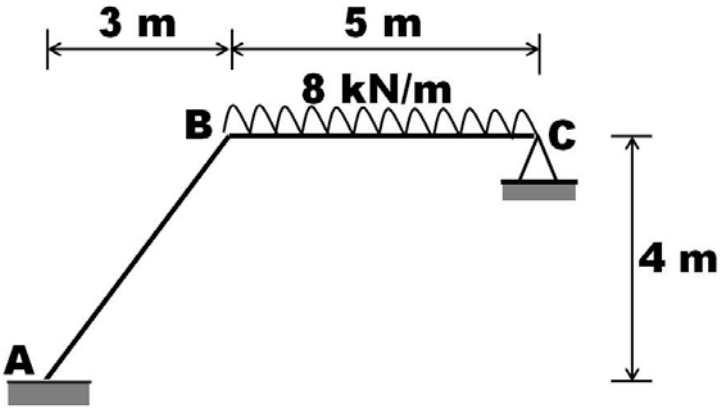

Fig. 2

- E N D -

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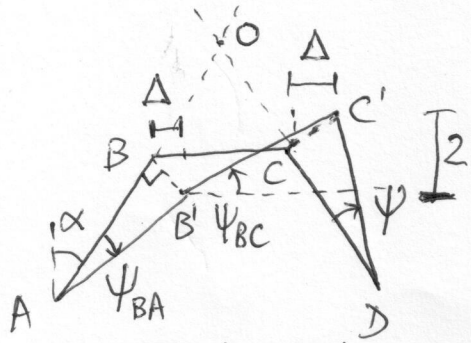
Q1 $\theta_B = \theta_C \Leftarrow$ antisymmetric loading.

For BA used modified stiffness "3".



$$M_{BA} + M_{BC} = 0 = \frac{3EI}{5}\left[\theta_B - \frac{\Delta}{0.8}\frac{1}{5}\right] + \frac{EI}{5}\left[6\theta_B + 6.2\Delta\cdot\frac{3}{4}\cdot\frac{1}{5}\right] \quad \textcircled{1}$$

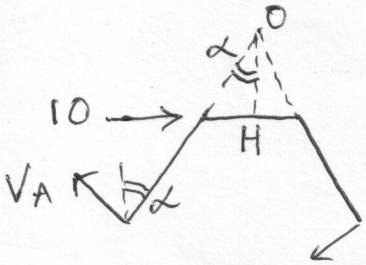
$$AO = \frac{AD/2}{\sin\alpha} = \frac{55}{6};$$

$$\psi_{BA} = \frac{BB'}{5} = \frac{\Delta/\cos\alpha}{5}$$

Sway equation:

$$\sum M_O = 0 = 2V_A\cdot\frac{55}{6} - 10\cdot\left(\frac{55}{6}\cdot\frac{4}{5} - 4\right)$$

$$= -2\cdot\frac{3EI}{5}\left[\theta_B - \frac{\Delta}{0.8}\frac{1}{5}\right]\frac{1}{5}\cdot\frac{55}{6} - \frac{100}{3} \quad \textcircled{2}$$



$V_D = V_A$ (antisymmetry)

$$EI\begin{bmatrix} 0.6+1.2 & 0.21 \\ -2.2 & 0.55 \end{bmatrix}\begin{Bmatrix}\theta_B \\ \Delta\end{Bmatrix} = \begin{Bmatrix}0 \\ 100/3\end{Bmatrix} \Rightarrow$$

$\theta_B = -4.8209/EI$; $\Delta = 41.3223/EI$

$V_A = -\frac{3}{5}EI\left[\theta_B - \frac{\Delta}{4}\right]\frac{1}{5} = 1.818$ kN.

Q2 BC → use modified stiffness "3" and modified (ie RHS Table) FEM.

No Sway problem.

	AB	BA	BC
K		4	3
d.f.		4/7	3/7
FEM		0	25
dist, c.o.	$-\frac{1}{2}\cdot 25\cdot\frac{4}{7}$	$-25\cdot\frac{4}{7}$	$-25\cdot\frac{3}{7}$

$$(FEM)_{BC} = \frac{wL^2}{8} = \frac{8.5^2}{8} = 25$$

$$M_{AB} = \text{BM at } A = -\frac{1}{2}\cdot 25\cdot\frac{4}{7} = -7.1429 \left(\text{ie } \underset{\text{CCW}}{7.1429\ \text{kN.m}}\right)$$