DEPARTMENT OF CIVIL ENGINEERING

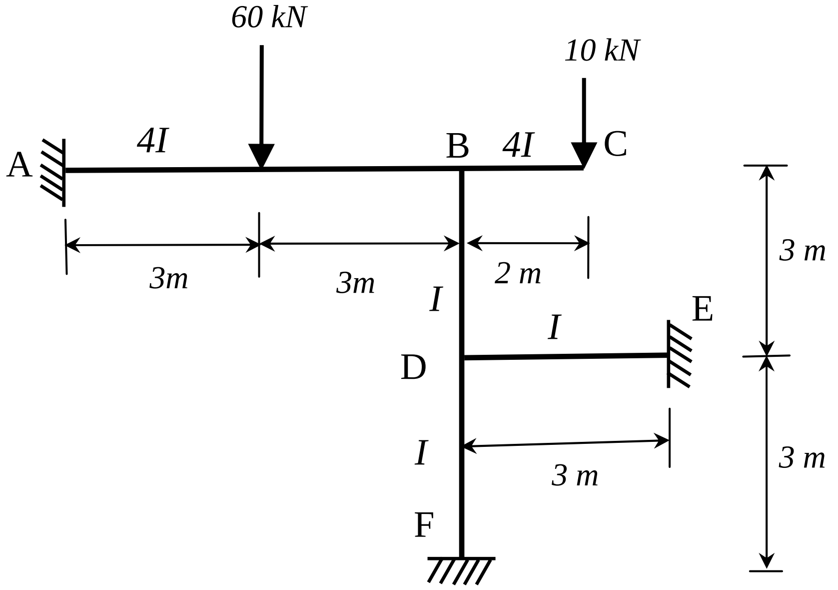
CE-317 STRUCTURAL MECHANICS II

Quiz-1 27/8/12

Problem 1

Use only Slope Deflection Method.
Determine the **horizontal reaction at *A*,** for the frame in **Fig. 1**.

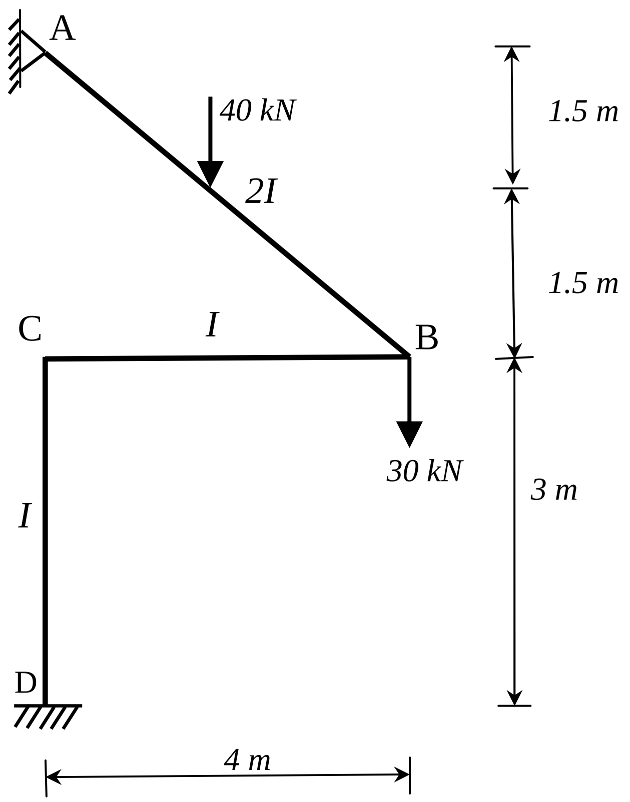
Fig. 1



Problem 2

Use only Moment Distribution Method with modified stiffnesses wherever possible.
Perform 3 iterations. Determine the **reactions at *D*** for the structure in **Fig. 2**.

Fig. 2



CE317 Quiz-I Fall 2012

(1)
$$EI\begin{bmatrix} \frac{4.4}{6}+\frac{4.1}{3} & \frac{2.1}{3} \\ \frac{2.1}{3} & \left(\frac{4.1}{3}+\frac{4.1}{3}+\frac{4.1}{3}\right) \end{bmatrix}\begin{Bmatrix}\theta_B\\ \theta_D\end{Bmatrix} = \begin{Bmatrix}-\frac{60.6}{8}+10.2\\ 0\end{Bmatrix}$$

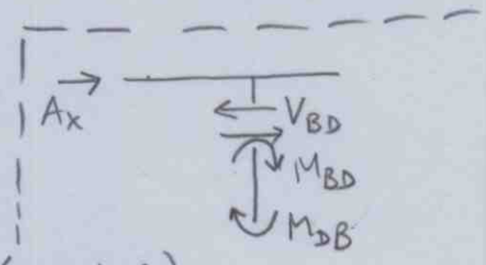
No sway in given problem
$\Rightarrow$ from equilibrium of jts B, D.

$$\begin{bmatrix} 4 & 2/3 \\ 2/3 & 4\end{bmatrix}\begin{Bmatrix}\theta_B\\ \theta_D\end{Bmatrix} = \frac{1}{EI}\begin{Bmatrix}-25\\ 0\end{Bmatrix}$$

$$(24-4)\,\theta_B = \frac{1}{EI}(-100) \Rightarrow \theta_B = \frac{-5}{EI}, \quad \theta_D = \frac{5}{6}\frac{1}{EI}$$

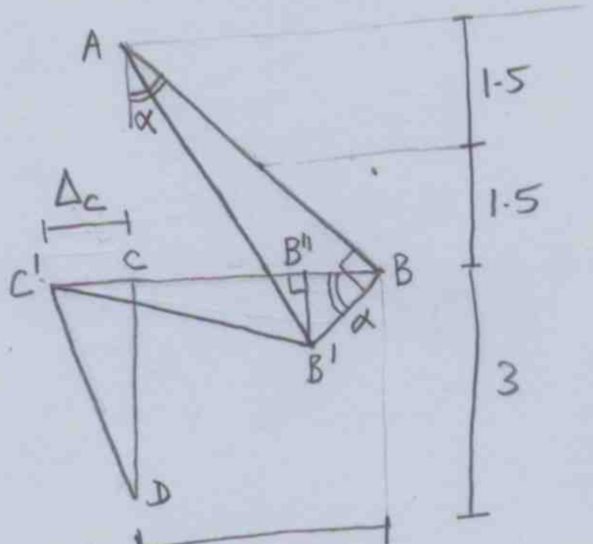
$$M_{BD} = \frac{EI}{3}(4\theta_B + 2\theta_D) = \frac{1}{3}\left(-20+\frac{5}{3}\right) = -\frac{55}{9}$$

$$M_{DB} = \frac{EI}{3}(2\theta_B + 4\theta_D) = \frac{1}{3}\left(-10+\frac{10}{3}\right) = -\frac{20}{9}$$



$$V_{BD} = -\frac{(M_{BD}+M_{DB})}{3} = \frac{75}{9.3} = \frac{25}{3} = A_x \;(\rightarrow +ve)$$

(2)



$BB'' = \Delta_c$; $\cos\alpha = \frac{3}{5}$

$BB' = \frac{BB''}{\cos\alpha} = \frac{5}{3}\Delta_c$; $B'B'' = BB'\sin\alpha = \frac{4}{3}\Delta_c$

Reduced stiffnesses:

$1k \equiv 4\frac{EI}{3} \Rightarrow 4\frac{EI}{4} \equiv \frac{3}{4}k$, $\frac{3E.2I}{5} \equiv \frac{6}{5}.\frac{3}{4}k$

No sway Fem's:

$$(Fem)_{BA} = \frac{3}{16}.40\sin\alpha.5 = \frac{3}{16}.40.\frac{4}{5}.5$$
$$= 30$$

Sway Fem's:

$$(Fem)_{CD} = (Fem)_{DC} = \frac{6EI\Delta_c}{3^2} \equiv 100$$

$$(Fem)_{CB} = (Fem)_{BC} = -\frac{6EI}{4^2}\left(\frac{4}{3}\Delta_c\right) \equiv -\frac{3}{4}.100$$

$$(Fem)_{BA} = -\frac{3E2I}{5^2}\left(\frac{5}{3}\Delta_c\right) \equiv -\frac{3}{5}.100$$

MDM— Method 1 ②

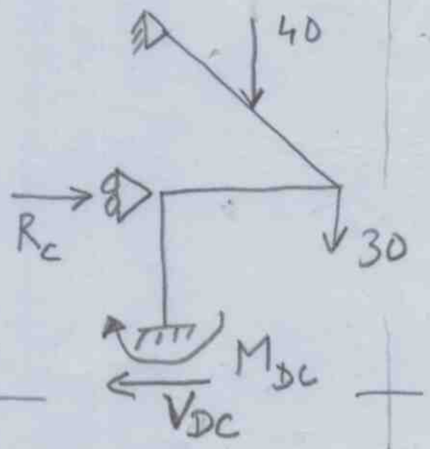
mem-end	AB	BA	BC	CB	CD	DC
red. stiff	0.9	0.9	0.75	0.75	1	1
df	1	6/11	5/11	3/7	4/7	0
fem (no sway)	0	30	0	0	0	0
dist, co		−16.36	−13.64	−6.82		
dist, co			1.46	2.92	3.90	1.95
dist, co		−0.8	−0.66	−0.33		
"			0.07	0.14	0.19	0.1
"		−0.04	−0.03	−0.015		
"				0.006	0.009	0.0045
BM1	0	12.8	−12.8	−4.1	4.1	2.05
fem sway	0	−60	−75	−75	100	100
		73.64	61.36	30.68		
			−11.93	−23.86	−31.82	−15.91

For no sway

① $\leftarrow V_{DC} = -\dfrac{(M_{DC}+M_{CD})}{3} = -2.05$

② $\leftarrow -R_c \cdot 3 + 40.2 + 30.4 + M_{DC} + V_{DC} \cdot 6 = 0$

$R_c = 63.25$



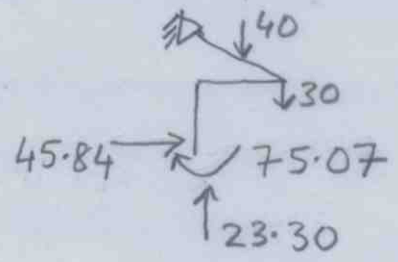
		6.51	5.42	2.71		
			−0.58	−1.16	−1.55	−0.77
		0.32	0.26	0.13		
				−0.06	−0.07	−0.04
BM2	0	20.47	−20.47	−66.56	66.56	83.28
BM = BM1 − Sf.BM2	0	30.75	−30.75	−62.46	62.46	75.07

For sway

From ①, $V'_{DC} = -49.95$; from ② with zero ext loads, $R'_c = -72.14$ (+ve right) ← (→); $Sf = \dfrac{R_c}{R'_c}$

$D_x = V_{DC} = -\frac{(M_{DC} + M_{CD})}{3} = -45.84$, $D_y = V_{CB} = -\frac{(M_{CB} + M_{BC})}{4} = 23.30$

$M_D = M_{DC} = 75.07$



MDM Method 2.

mem-end	AB	BA	BC	CB	CD	DC
df	1	6/11	5/11	3/7	4/7	0
fem (no sway)	0	30	0	0	0	0
dist		-16.36	-13.64	0	0	
CO			0	-6.82		0
dist		0	0	2.92	3.9	
CO			1.46	0		1.95
dist		-0.8	-0.66			
BM1		12.84	-12.84	-3.9	3.9	1.95

$V_{DC} = -1.95$

$R_C = 63.42$

fem (sway)	0	-60	-75	-75	100	100
dist		73.64	61.36	-10.71	-14.29	
CO			-5.36	30.68		-7.15
dist		2.92	2.44	-13.15	-17.53	
CO			-6.58	1.22		-8.77
dist		3.59	2.99	-0.52	-0.7	
BM2		20.15	-20.15	-67.48	67.48	84.08
BM=BM1-sf.BM2	0	30.34	-30.34	-62.52	62.52	74.99

$V'_{DC} = -50.52$; $R'_C = -73.01$, $sf = R_C / R'_C$

$D_x = -45.84$, $D_y = 23.22$