University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2010/2011

Subject :structure II | **Class: Four**
Branch :Structural Eng. | **Time : 3 Hours**
Examiner :Dr. Alaa Kamal | **Date : 2 / 6 / 2011**

Note: Answer FOUR questions only.

Q1/ By using the stiffness displacement method, analyze the beam shown in Fig. (1),
Given: EI = constant, K_{spring}=EI/2 kN/m.

$$[k]^e = \frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

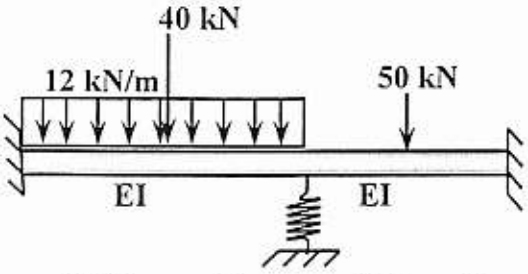
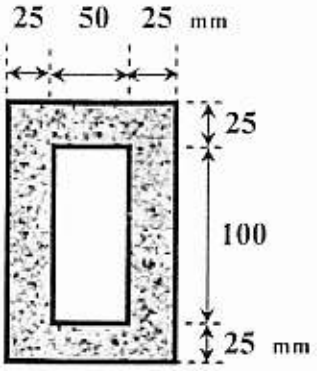
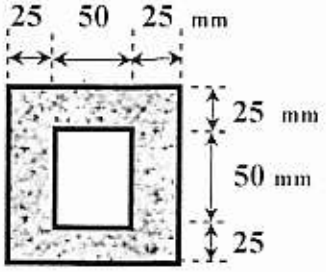


Fig. (1)

Q2/ the frame in Fig. (2-A) has hollow beam and column cross-sections as shown in Fig. (2-B). Find the collapse load ($P_{coll.}$). Given: $\sigma_y = 210\ N/mm^2$



Beam Cross- section



Column Cross- section

Fig.(2-B)

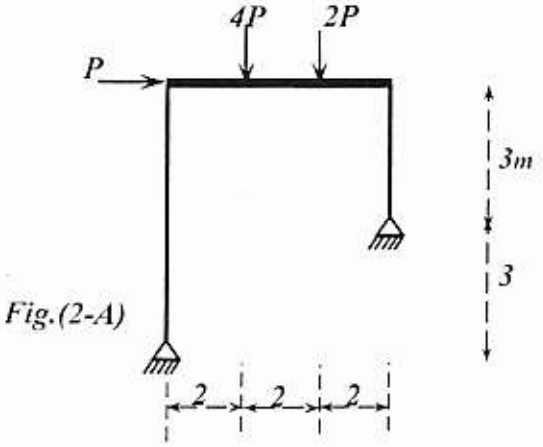


Fig.(2-A)

Q3/ Using the stiffness displacement method to find displacement at node 1 for the truss shown in Fig. (3), then find the support reactions. E ,A and L are constant for all members.

$$[k]^e = \frac{EA}{L}\begin{bmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{bmatrix}$$

$C = \cos\theta$ $\quad$ $S = \sin\theta$

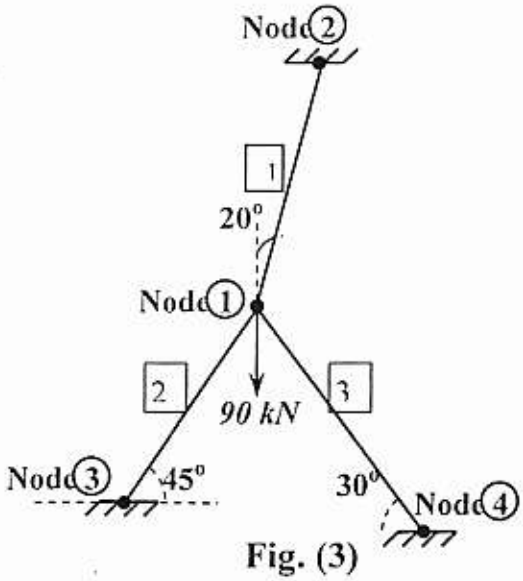


Fig. (3)

Q4/ Answer the following:

(A) Assemble the stiffness matrix for the system of liner spring shown in Fig. (4).

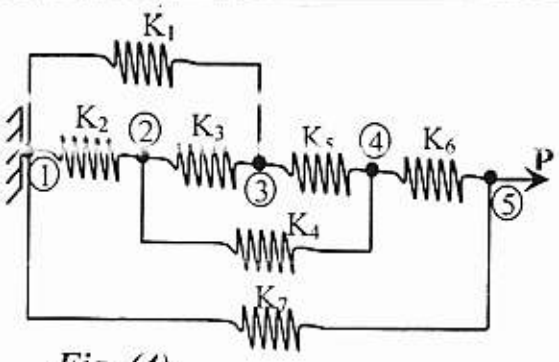


Fig. (4)

b) An infinite beam on a Winkler foundation as shown in Fig. (5). Two concentrated loads, are applied to the beam. Determine the bending stress and deflection at point c. Given:

$k = 10 N/mm^2$

$E = 2.07 * 10^5 N/mm^2$, $I_{N.A} = 53.5 * 10^6 mm^4$,

$\beta = \sqrt[4]{\frac{k}{4EI}}$, $y = \frac{\beta P}{2k} F_1$, $M = \frac{P}{4\beta} F_3$,

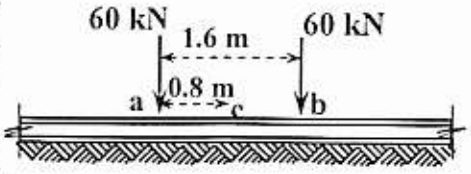
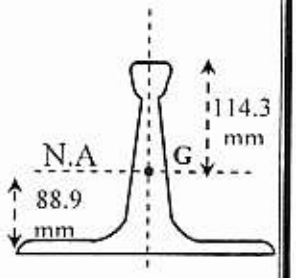


Fig. (5)



Beam Section

Q5/ Calculate the critical load ($P_{cr.}$) for the frame shown in Fig. (6), E,I are constant.

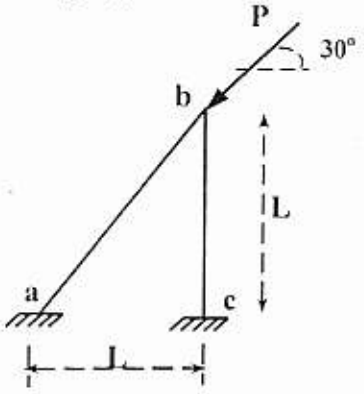


Fig.(6)

Factors value				
βx	F1	F2	F3	F4
0.0	1.0	0.0	1.0	1.0
0.45	0.8406	0.2727	0.2922	0.5664
0.50	0.8134	0.2861	0.2379	0.5256
0.55	0.7853	0.2971	0.1877	0.4865
0.60	0.763	0.310	0.143	0.453
0.75	0.6667	0.3189	0.0249	0.3459
0.80	0.635	0.322	-0.009	0.313
0.90	0.5752	-----	-----	0.2564
1.00	0.508	0.310	-0.111	0.199
1.10	0.4557	0.297	-0.1417	0.1572
1.20	0.390	0.281	-0.172	0.109

Stability functions (compression)				
ρ= P/P_{CR}	S	C	SC	S(1+C)
1.3	1.889	1.424	2.691	4.58
1.4	1.678	1.656	2.779	4.457
1.5	1.457	1.973	2.875	4.332
2.5	-1.75	-2.673	4.678	2.928
2.6	-2.249	-2.231	5.018	2.769
2.7	-2.809	-1.928	5.415	2.606
2.8	-3.445	-1.708	5.884	2.439
Stability functions (tension)				
ρ= P/P_{CR}	S	C	SC	S(1+C)
-3.0	6.988	1.214	1.499	8.487
-4.0	7.737	0.184	1.43	9.167
-5.0	8.417	0.164	1.38	9.797