Department of Civil and Environmental Engineering, Fall Semester, 2015

ENCE 353 Midterm 1, Open Notes and Open Book

Name : _____

Exam Format and Grading. This exam has three questions. Partial credit will be given for partially correct answers, so please show all your working.

Question	Points	Score
1	15	
2	15	
3	10	
Total	40	

Question 1 (15 points): Shear Forces and Bending Moments in a connected Beam Structure.

Consider the multi-span beam structure shown in Figure 1.

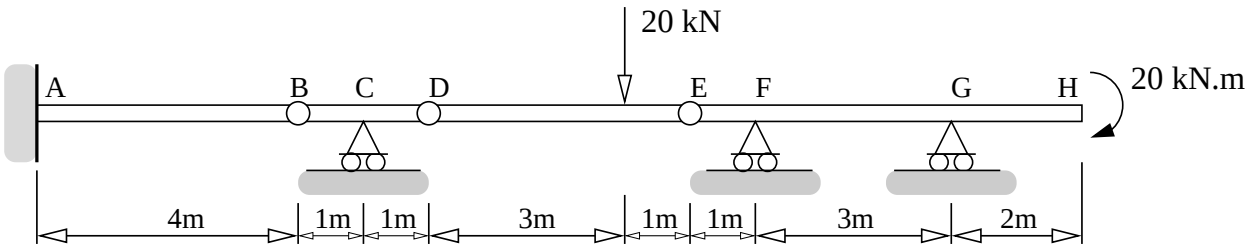

Figure 1: Multi-span beam structure.

The cantilever is fully-fixed to the wall at Point A. Points B, D and E are hinges. An external moment of 20 kN.m is applied at Point H.

[1a] (2 pts). Compute the degree of indeterminacy for the beam structure.

[1b] (4 pts). Compute the reactions at points A, C, F and G.

[1c] (7 pts). Compute and draw the shear force and bending moment diagrams along the beam.

[1d] (2 pts). Indicate on Figure 1 where you believe the beam fibre will be in compression (C) and tension (T).

Question 2 (15 points): Tension, Compression and Zero-Force Members in a Truss Structure.

Consider the truss structure shown in Figure 2.

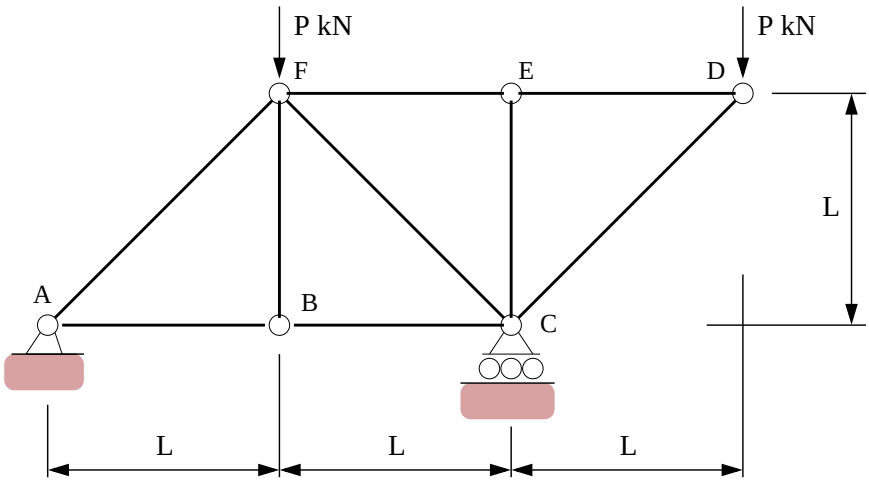

Figure 2: Nine-bar truss structure.

A vertical load of P kN is applied at nodes D and F.

[2a] (4 pts). Compute the support reactions at points A and C.

[2b] (4 pts). Identify the zero-force members.

[2c] (7 pts). Using the method of joints (or otherwise) show that: (1) The maximum tensile force in the structure is P kN, and (2) The maximum compressive force in the structure is $\sqrt{2}\ P$ kN.

Question 3 (10 points): Degree's of Indeterminacy.

[4a] (5 pts). Compute the degree of indeterminacy for the structure shown in Figure 3.

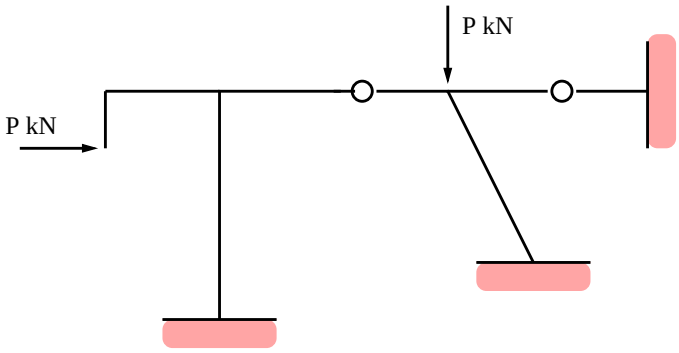

Figure 3: Simple portal frame.

[4b] (5 pts). The degree of indeterminacy for a two-dimensional planar frame is given by: D = n + r - 2j, where n = number of truss members, r = number of reaction forces, and j = number of pin joints in the frame. Compute the degree of indeterminacy for the truss structure shown in Figure 4.

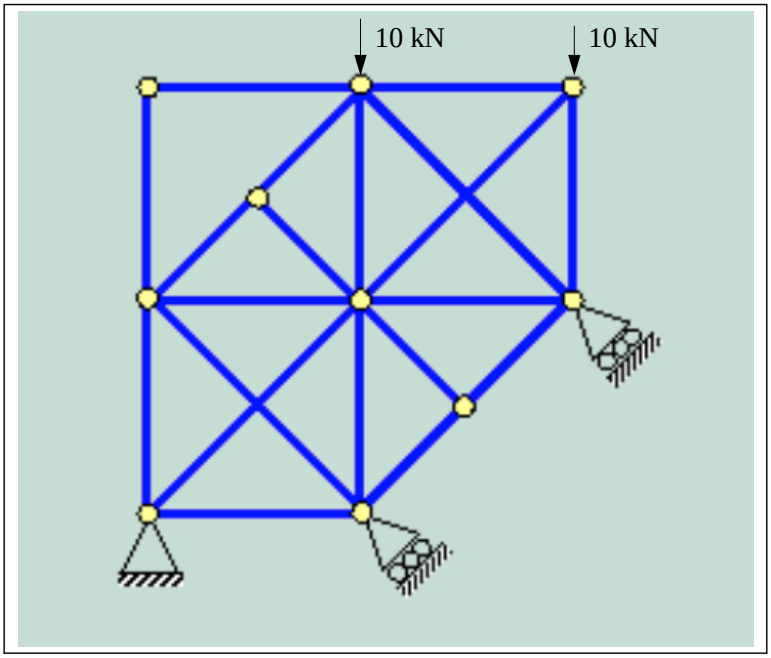

Figure 4: A more complicated frame structure.