THE OPEN UNIVERSITY OF SRI LANKA
Diploma In Technology (Civil) / Bachelor of Technology – Level 3
CEX 3231 – Structural Analysis & Design 1
Final Examination – 2008/2009
Time Allowed 3 hours

179

Date: 31st March 2009 Time: 9:30-12:30 hrs.

Answer **five** questions selecting not less than **two** questions from each section.
Please write answers clearly showing any derivations required and stating necessary assumptions.

SECTION A

Q1). (i). Sketch the three types of supports normally used in structures indicating their reactions clearly.

(5 Marks)

(ii). Figure Q1 & Q2 shows the body diagram of a simply supported plane truss.

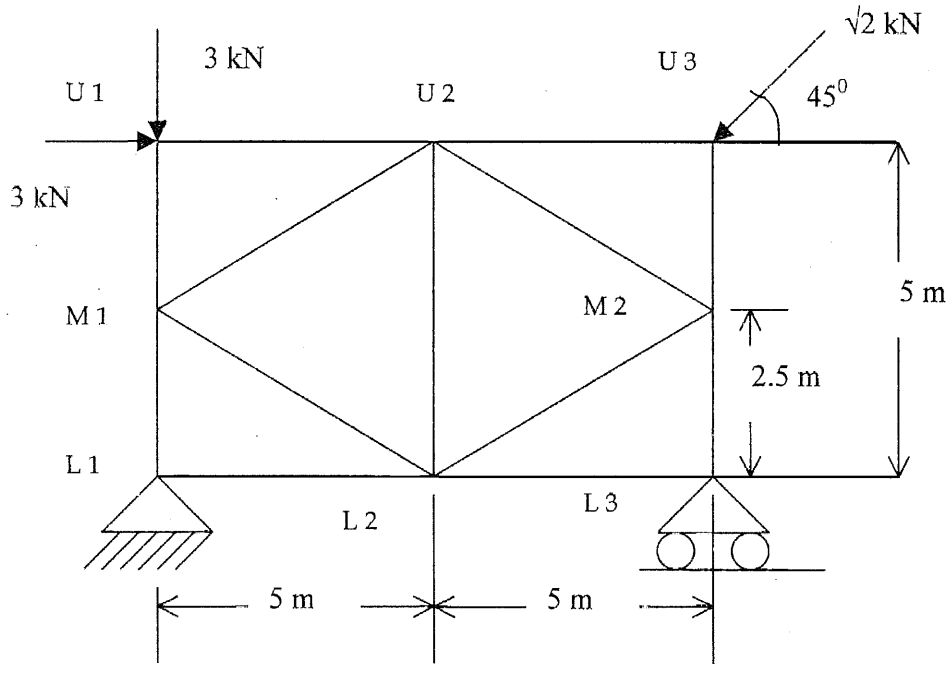

FIGURE Q1 & Q2

a) Find member forces of the truss shown in Figure Q1 using the method of Joints. Indicate the sign of each member force clearly. (Use the sign convention Tension – positive)

(10 Marks)

b) Find member forces of the members U2M2, M1L2 and U2U3 using the method of Sections.

(5 Marks)

Q2). i). Find the displacement of the point U3 of truss given in Figure Q2, if only the load $\sqrt{2}$ kN is applied to the structure. (Assume AE is constant for all the members)

(12 Marks)

ii). Find horizontal displacement of point U1 if all the loads given are applied to the structure.

(8 Marks)

Q3) Figure Q3 shows a continuous beam with a hinge at C.

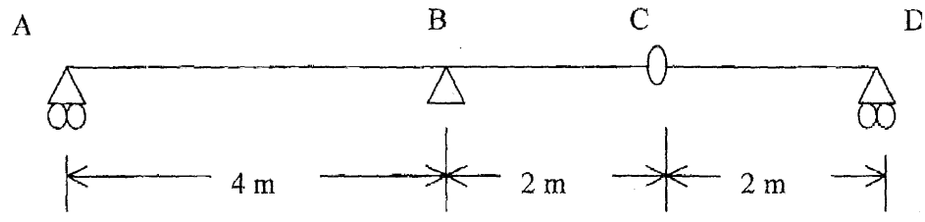

Figure Q3

i). Draw the Influence lines for the following

a). Reaction at A
b). Reaction at D
c). Bending moment at mid span of the AB
d). Shear force at support B

(8 Marks)

ii). If following loads are moving on the beam, find out the maximum Bending Moment at mid span of AB and their respective load positions.

a). Two concentrated loads of 5 kN each at 2 m apart.
b). A Uniformly distributed load of 2 kN /m and 10 m in length.
c). A Uniformly distributed load of 2 kN /m and 2 m in length.

(12 Marks)

SECTION B

Data sheets are available and should be returned please, before you leave the examination hall

Q4. i).Define the term "Eccentricity of connection" used in the design of tension steel members.

(5 Marks)

ii). Check the suitability of a 60 x 60 x 10 mm equal angle member which is subjected toa 50 kN tension load. Assume that the member is connected with 18 mm bolts at both ends.

(8 Marks)

iii). Find the number of 18 mm Diameter bolts that should be used for connection of the above mentioned member.

(7 Marks)

The properties of a 60 x 60 x 10 equal angle as follows
Area of Section = 11.1 cm^2, distance to center of gravity c = 1.85 cm,
Second moment of area
relative to xx-axis , y-y axis = 35.3 cm^4
Radius of gyration
relative to x-x axis and y-y axis = 1.78 cm and vv-axis =1.16 cm

The allowable strengths are:

the allowable stress in bolts in clearance holes, in shear = 80 N/mm^2
the allowable stress in bolts in clearance holes, in bearing = 250 N/mm^2
the allowable bearing stresses on connected parts = 250 N/mm^2
the end distance of 20 mm diameter holes = 30 mm

Q 5(i). Define the term slenderness ratio used in steel design and explain its requirements
(4 Marks)

(ii). A single angle member of 60 x 60 x 10 mm used in roof truss is 2.0 m long and is connected by two 18 mm bolts. Determine its compressive strength.
(10 marks)

(iii). If the same member is subjected to 30 kN axial compression load and 3 kNm Bending Moment, check the suitability of the section.
(6 Marks)

Q6). Figure Q6 shows the body diagram of a Continues steel beam with hinge support at C.

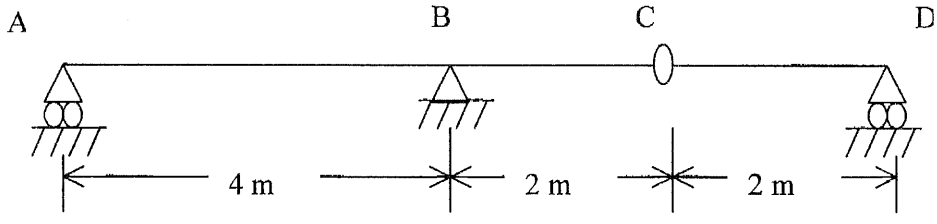

Figure Q3

The beam supports the concrete slab of 125 mm in thickness and following details are provided.

Spacing of the beams = 2.5 m
Density of Concrete = 24 kN/m^3
Imposed load from the people = 1.5 kN/m^2
Imposed load from the furniture = 0.5 kN/m^2
Dead load from the finishers = 1.0 kN/m^2

i). Find the design load applied on the beam.
(4 Marks)

ii). Draw the Shear Force diagram and the Bending Moment diagram for the beam under the given loading. Also find the design Bending moments and Shear forces.
(8 Marks)

iii). If a structural Tee 419 x 457 x194 mm is selected for this beam check the suitability of the beam considering the flexural strengths..

(8 Marks)

From the tabulated properties 419 x 457 x194
Plastic Modulus Z_{xx} =2190 cm^3
Depth of Section, D = 460.2 mm
Flange Thickness, T = 36.6 mm
Radius of gyration, r_x = 13.4 cm and r_y = 9.58cm

Q7). i). State and describe the factors used in finding the factor S2 of design wind speed calculation of a steel roof truss.

(6 Marks)

ii). Discuss why the Police station of a particular area is considered as a post disaster structure in wind load calculation.

(3 Marks)

iii). Sketch the "Leeward slope" and "Windward Slope" of roof truss.

(3 Marks)

iv). The roof of a building proposed for police station should have to be designed for wind loads. Following data are available and missing data can be assumed.

Data

- Building is situated in Hambanthota District
- Terrain category 1
- Building Class A
- Maximum height – 5 m
- Maximum width – 8 m
- Cpi – + 0.1
- Spacing of the truss – 5 m
- Roof angle - 18^0

Calculate the design wind load acting on the roof

(8 Marks)