Diploma In Civil Engineering

Term-End Examination

December, 2007

BCE-032 : THEORY OF STRUCTURES-I

Time : 2 hours *Maximum Marks : 70*

Note : *Question no. 1 is* ***compulsory****. Attempt any* ***four*** *questions from the remaining. Total number of questions to be attempted are* ***five****. Assume suitable data wherever necessary and mention it clearly. Use of calculator and steel tables is permitted.*

1. Choose the most appropriate answer from the following alternatives : *7×2=14*

(i) If 'p' and 'd' are the pitch and gross diameter of the rivets, the efficiency of the joint is given by

(a) p/(p – d)

(b) (p – d)/p

(c) (p + d)/d

(d) p/(p + d)

(ii) For fillet welded lap joint the overlap should not be less than

(a) five times the thickness of the thinner part connected

(b) five times the thickness of the thicker part connected

(c) seven times the thickness of the thinner part connected

(d) seven times the thickness of the thicker part connected

(iii) The maximum permissible slenderness ratio for a steel tension member is

(a) 180

(b) 250

(c) 350

(d) 400

(iv) The permissible stress in single angle discontinuous struts, connected by a single rivet designed for axial load only, is given by

(a) $0{\cdot}6\ p_{ac}$

(b) $0{\cdot}7\ p_{ac}$

(c) $0{\cdot}8\ p_{ac}$

(d) $1{\cdot}0\ p_{ac}$

where p_{ac} is the allowable axial stress in the strut.

(v) Lacings or Battens in compound columns are mainly provided

(a) to prevent buckling of the column

(b) to decrease the buckling of the members

(c) to increase the capacity of the columns

(d) to ensure the unified behaviour of the compound column

(vi) If 'd' is the clear depth of web between the roots of fillets and t_w is web thickness, the slenderness ratio of steel beams for checking web buckling is given by

(a) d/t_w

(b) $\sqrt{d/t_w}$

(c) $d\sqrt{3}/t_w$

(d) $d\sqrt{2}/t_w$

(vii) The minimum size of angles used for principal rafter and main tie in a roof truss should not be less than

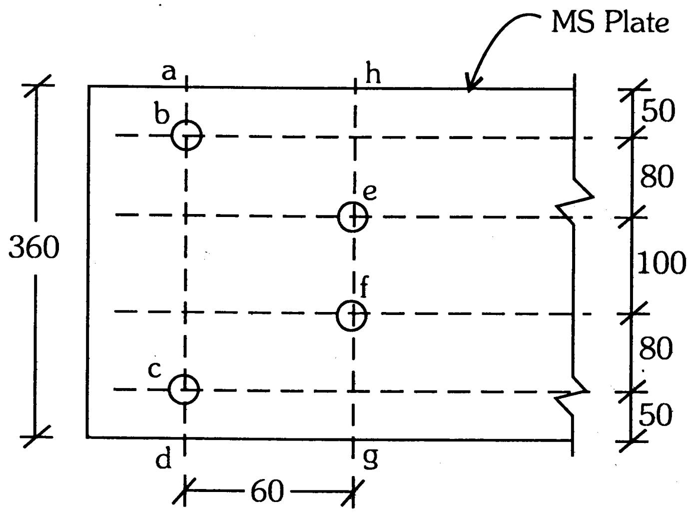
(a) 100 × 100 × 10 mm

(b) 60 × 60 × 6 mm

(c) 90 × 90 × 6 mm

(d) 50 × 50 × 6 mm

2. (a) Determine the least effective width of the plate shown in the figure. The nominal diameter of the rivets is 20 mm. 7

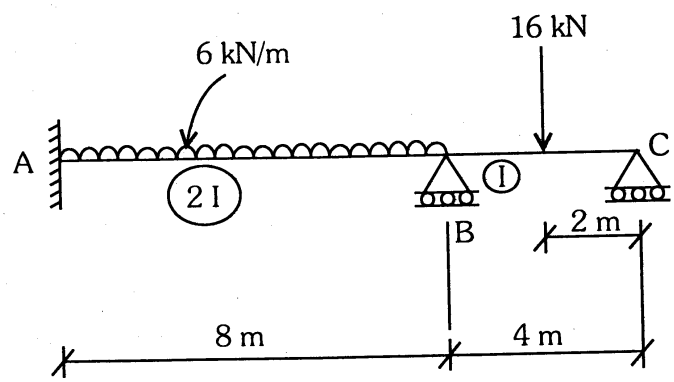


(b) Design a suitable fillet welded joint between two plates of size 180 × 8 mm and 200 × 8 mm to develop the full strength of the smaller plate in tension. Adopt allowable tensile stress in plate as 150 N/mm^2 and shear stress in fillet weld as 108 N/mm^2. Weld size not to exceed 6 mm. Sketch the plan and elevation of the joint. 7

3. (a) Draw the influence line diagrams for shear force and bending moment for a simply supported beam AB of span 15 m at a section X which is at a distance of 6 m from the left hand support. 7

(b) Determine the maximum negative and positive shear force at X of the above beam when a uniformly distributed load of 3 kN/m of length 3 m crosses the beam from left to right. 7

4. Analyse the continuous beam shown below and draw the bending moment and shear force diagrams. Calculate the support reactions also. *14*



Moment of inertia of the beams is shown in the circles.

5. A masonry dam is 8 m high and is 1·5 m wide at the top and 5 m wide at base. It retains water to a depth of 7·5 m. The water face of the dam is vertical. Find the maximum and minimum stresses at the base. The weight of masonry is 22·4 kN/m^3. *14*

6. (a) Calculate the vertical and wind loads per panel and show these loads on the truss given below. The roof carries ACC sheet covering.

The wind pressure may be assumed as 1·250 kN/m^2 of the surface area normal to roof. These roof trusses are spaced at 4 m centre to centre. These trusses are supported on 25 cm thick RCC columns. The following load data can be assumed :

(i) Weight of ACC roof covering — 160 N/m^2 of plan area

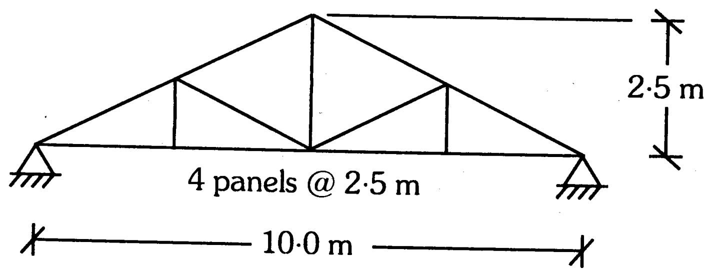
(ii) Weight of purlin — 80 N/m^2 of plan area

(iii) Weight of bracings — 15 N/m^2 of plan area

(iv) Weight of roof truss — 85 N/m^2 of plan area

(v) Live load (750 – 20 for every degree increase) N/m^2 in slope over 10°

Assuming the wind blowing from left, calculate the reactions for vertical and wind load. 7



Roof Truss

(b) Design the angle purlin for this truss. 7

7. Design a double angle strut placed back to back on the opposite sides of a 10 mm thick gusset plate to carry a compressive force of 120 kN. The length of the strut between intersections is 2·8 m (f_y = 250 MPa). The allowable axial compressive stress σ_{ac} for different l/r is given below : 14

l/r	10	20	30	40	50	60	70	80	90	100	110	120
σ_{ac}	150	148	145	139	132	122	112	101	90	80	72	64

8. A simply supported beam has a span of 4 m. It carries a uniformly distributed load of 15 kN/m over its entire length and concentrated point load of 20 kN at mid span. The compression flange may be assumed to be laterally supported throughout its length. Design an I-section beam using steel of grade f_y = 250 MPa. *14*