B.E. (CE) Part-III 6th Semester Examination, 2007

Design of Structure-II

(CE-602)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
Two marks are reserved for neatness in each half.
Assume any data, suitably, if required.

FIRST HALF

1. Calculate the stresses developed at the section of a gantry girder made with ISMB 450 and ISMC 250 for crane capacity = 100 kN, crab weight = 20 kN and maximum static wheel load = 200 kN, span of Gantry Girder = 6 m. Assume wt of Gantry girder = 1.5 kN/m. Assume wheel base = 2 m.

   Sectional properties

   ISMB 450

$w = 72.4$ kg/m,	$a = 9227$ mm^2,	$Z_{xx} = 1350.7$ cm^3
$Z_{yy} = 111.2$ cm^3,	$b_f = 150$ mm,	$t_f = 17.4$ mm
$t_w = 9.4$ mm	$I_{xx} = 30390.8$ cm^4,	$I_{yy} = 834$ cm^4
$\gamma_{xx} = 73.3$ mm	$\gamma_{yy} = 25.9$ mm	

   ISMC 250

$w = 30.4$ kg/m,	$a = 3867$ mm^2,	$Z_{xx} = 305.3$ cm^3
$Z_{yy} = 38.4$ cm^3,	$b_f = 80$ mm,	$t_f = 14.1$ mm
$t_w = 7.1$ mm	$I_{xx} = 3816.8$ cm^4,	$I_{yy} = 219.1$ cm^4
$\gamma_{yy} = 23.8$ mm	$C_{yy} = 23$ mm	**[16]**

2. A bracket supporting a gantry girder is connected to a steel column of ISHB 450 @ 92.5 kg/m at the height of 3.5 m from base of the column, maximum vertical forces from gantry girder = 150 kN, which is acting at a distance of 175 mm from column face. Axial load on column = 200 kN. Effective length = 4.5 m. Check the adequacy of the given section.

   Assume $C_{xx} = C_{my} = 0.85$ & $f_{cb} = \dfrac{26.5 \times 10^5}{(l/r_y)^2}$ MPa.

   For ISHB 450 @ 92.5 kg/m

$a = 11789$ mm^2,	$Z_{xx} = 1743.1$ cm^3	$Z_{yy} = 242.1$ cm^3,
$b_f = 250$ mm,	$t_f = 13.7$ mm	$t_w = 11.3$ mm
$I_{xx} = 40349.9$ cm^3,	$I_{yy} = 3045$ cm^4	$\gamma_{xx} = 18.5$ mm **[16]**

3. Design a combined footing for supporting two columns of size 300 x 300 mm each, carrying axial loads of 900 kN and 1100 kN. The columns are spaced at 3.5 m centre to centre. The bearing capacity of soil is 120 kN/m^2. Use M20 & Fe415 grades of concrete and steel. Design for flexure only. [16]

4. a) Design and detail the longitudinal beam (as singly reinforced rectangular beam) of a slab-beam type combined footing for the two columns A (400 mm square, carrying 240 kN axial load), B (300 mm square, carrying 150 kN axial load), situated at a centre line distance of 1.56 m apart in a building. Due to property line restriction, the foundation can not be extended 640 mm beyond the centre line of column B. The safe bearing of soil is 70 kN/m^2. Take permissible shear stress as 0.4 MPa. Use M20 grade concrete and Fe415 grade steel.

   b) Prepare suitable layout of a trapezoidal footing for the two columns of Question 4(a). Given, the property line are 640 mm and 700 mm beyond the face of B and A, respectively. [10+6]

5. Design a suitable pile cap to support column of size 500 mm x 500 mm, carrying an axial load of 600 kN. The maximum capacity of 400 mm & 500 mm diameter piles are 150 kN and 200 kN respectively. Use M25 grade concrete and Fe415 grade steel. Take permissible shear stress as 0.35 MPa. [16]

SECOND HALF

6. Design a column base of a column having section as ISHB 300 @ 0.588 kN/m and carrying an axial load of 350 kN with a moment of 45 kN-m in the plane of web. The allowable pressure on the footing is 4 MPa. For ISHB 300, given that $a = 74.8$ cm^2, $b = 250$ mm, $t_f = 10.6$ mm, $t_w = 7.6$ mm. [16]

7. A simply supported welded plate girder of span 24 m is made up of 2200 mm x 12 mm web plate and 500 x 50 mm flange plates. The girder carries a u.d.l. of 40 kN/m, inclusive of self-weight. Design the end bearing stiffener. [16]

8. Design the mid-span section of a simply supported welded plate girder, carrying a uniformly distributed load of 80 kN/m, exclusive of self-weight, on an effective span of 25 m. Check both the flexural stresses and shear stresses, considering permissible stress as $\sigma_{bc} = 145$ MPa. [16]

9. Design a suitable rivetted web splice at one third span of the plate girder with span and loading as mentioned in (Q.8), with the following components of the plate girder : (i) Flange plate = 2 nos. 500 x 10 mm; (ii) Web plate = 2200 x 8 mm, (iii) Flange angles : 2 nos. ISA 125 x 95 x 12 at each flange plate, (iv) 18 mm power driven rivets. [16]

10. An ISHB 300 @ 58.8 kg/m column carries an axial load of 500 kN. The column has to be spliced at a section, which is subjected to a moment of 15 kN-m, about the X-X axis of the section. Design the splice. Use 20 mm diameter rivets. [16]

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