Exam Date & Time: 29-Apr-2019 (02:00 PM - 05:00 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

## INTERNATIONAL CENTRE FOR APPLIED SCIENCES IV SEMESTER B.Sc. (APPLIED SCIENCES) IN ENGINEERING END SEMESTER THEORY EXAMINATION-APRIL/MAY 2019

## **BASIC STRUCTURAL STEEL DESIGN [ICE 244]**

Marks: 100

Duration: 180 mins.

(10)

Answer 5 out of 8 questions.

Use of IS800-2007 and SP-6 is Permitted

Assume suitable data if missing. All plates are Fe410(E250) grade and bolts are grade 4.6 unless specified in the question. <sup>1)</sup> Find the allowable load at the joint shown in fig.Q.No.1A,

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A)

and find efficiency of Joint. Given M20 bolts of grade 4.6 and Fe410 grade plates are used.



B) Design the bolted connection for the bracket to the flange of a column as shown in fig Q.No.1(B),if <sup>(10)</sup> M22 bolts of grade 4.6 grade are used .Assume shop bolts. Adopt a pitch of 55 mm and edge /end distance of 40 mm. Load of 150 kN is acting at an eccentricity of 100mm from the flange edge of column ,ISHB 450@ 77.4kg/m.The distance between bolt lines is 140mm.

22 bolh @ Smitable fitch 150KN ACTORED 0



2)

A)

Check the adequacy of welded connection shown in fig.Q.2 (A) with fillet weld of size 10 mm. (10) Assume field welding. (The weld length parallel to the width of flange is 200 mm at top & bottom of the bracket and 600 mm in vertical direction). The thickness of the bracket plate is 20 mm. A factored load of 300 kN is acting at an eccentricity of 200 mm from the edge of the flange.



<sup>B)</sup> i) Write the advantages of steel construction over concrete construction. (10) ii) In a joint shown in fig. Q.2(B) ,Calculate the safe load 'P' that can be applied at 'O'. The pitch is 80mm. and horizontal spacing between the bolts is 100 mm c/c,  $\theta = 30^{\circ}$  The bolt has shear capacity of 25 kN,bearing strength of 20 kN and Tensile capacity of 40 kN at ultimate limit state. (4+6)



- 3) Find the tension carrying capacity of a single angle ISA  $150 \times 115 \times 15$  mm connected to gusset plate (10) by means of three bolts of 22 mm diameter bolts @ 80 mm pitch and 40 mm end distance, in one line. A)
  - Consider Gross yielding and Rupture .Do not consider block shear.



B)

Calculate the ultimate load carrying capacity of a compression member made up of two ISA 150 × (10) 115 × 15 connected back to back to a gusset plate of 18 mm at their longer legs. Length of the member is 5.25 m and its ends are connected with Three bolt on each side. Also find out the allowable load , if ends are connected by welds.



(10) 4) Two ISMC 300 @ 35.8 kg/m back to back are used as a column to carry a factored load of 1050kN, at a clear spacing of 200 mm.Both the ends of the column are restrained in position ,but not restrained in A) rotation.Overall length of the column is 6.4m. Design battened system with bolted connection.



B) Calculate the ultimate load carrying capacity of a tension member made up of two ISA 150 × 115 × 15 <sup>(10)</sup> connected back to back to a gusset plate of 16 mm at their longer legs. Length of the member is 5.25 m and its ends are connected with 6 bolts of 22 mm diameter, in two rows(i.e. In one row-there are 3 bolts). The guage distance of bolts is 60 mm and edge distance /end distance is50 mm.Pitch is also 60 mm. Consider only Block shear.



5)

An upper storey column ISHB 300 @ 63 kg/m needs to be connected to lower storey column (10)
ISWB 550@ 112.5 kg/m, carries a factored load of 2000 kN and a factored moment of 25 kN-m.
Design a suitable size of bearing plate and splice plates. Assume that ends of columns are not milled. Connections need not be designed.

- <sup>B)</sup> Explain the design Principles of a laterally Unsupported beam with high shear completely. <sup>(10)</sup>
- An ISMB 400 is used as a beam to carry an udl over a simply supported span of 5m.Determine (10) the maximum working load (considering bending only,) that the beam can carry ,if the ends are restrained against torsion , and warping is not restrained in both the flanges. The flanges are not laterally supported. Assume width of bearing as 100 mm and beam is subjected to low shear. (Consider bending only)
  - <sup>B)</sup> A beam ISMB 400, of effective span of 8.3 m is carrying an UDL throughout the span. Find out <sup>(10)</sup>

the allowable factored  $\,$  udl ,it can carry considering bending , low shear and Web buckling . Assume the beam as laterally supported. Assume Bearing length on the support is 100mm.

A laterally Unsupported beam has to carry a Factored load of 25kN/m (inclusive of self weight) over a simply supported span of 5m. The beam is fully restrained against torsion and warping is not restrained in both the flanges. Design a suitable beam adopting an ISMB section. (Check for bending, Low shear & deflection are required. But check for Web Buckling & web crippling, are not required).

ı)

8)

B) A section of a beam is as shown in the fig.Q.No.7B.It consists of an ISMB 400 connected by two <sup>(10)</sup> cover plates of 200 x 10 mm both at top and bottom flange. Find the allowable maximum factored concentrated load 'W' at the centre of a laterally simply supported beam having an effective span of 4m. Consider bending ,low shear and deflection.(Neglect self weight of beam.Web buckling and web crippling is not required)



- A) Design a Gussetted Base for a column ISHB 350@710 N/m with two plates 450 x 20 mm (10) connected to flanges on both sides ,carrying a factored load of 3600 kN. The column is supported on concrete pedestal to be built with M20 concrete. Assume the ends of the column are machined properly.
- <sup>B)</sup> Design a welded plate girder , simply supported having a span of 24 m,to carry a superimposed (10) load of 35 kN/m. Avoid use of bearing stiffner and intermediate stiffners (Check for shear,deflection,web buckling and web crippling are **not** required.) **Only bending check is required.**

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