

**DR. BABASAHEB AMBEDKAR TECHNOLOGICAL  
UNIVERSITY, LONERE  
WINTER SEMESTER EXAMINATION - Dec 2019**

**B. Tech. Civil Engineering**  
**Subject: Design of Steel Structures (BTCVC501)**  
**Date: 09/12/2019**

**V Semester**  
**Marks: 60**  
**Time: 03 Hours**

**Instructions to the Students**

1. Solve any five questions from Q. no. 1 to Q. no 6
2. Use of Non Programmable Scientific Calculator is allowed.
3. Assume Suitable data wherever necessary.
4. Use of IS 800:1984, IS 808, Steel table or IS handbook no. 1 and IS 875 is allowed.

**Q.1 A)** i) Write down the advantages and disadvantages of welded **(06)** connections.

ii) Explain various failure modes possible in a riveted joint with the suitable diagrams.

**B)** A joint in a truss girder consists of a double cover butt joint used to connect two bracing flats (ISF 200 x 12). The thickness of each cover plate is 8 mm. The flats have been joined by 9 power-driven field rivets in chain riveting pattern at a gauge of 50 mm as shown in the Figure 1. The nominal diameter of the rivets used is 22 mm. The yield strength of the flats used is 260 MPa. Find the capacity of the joint.

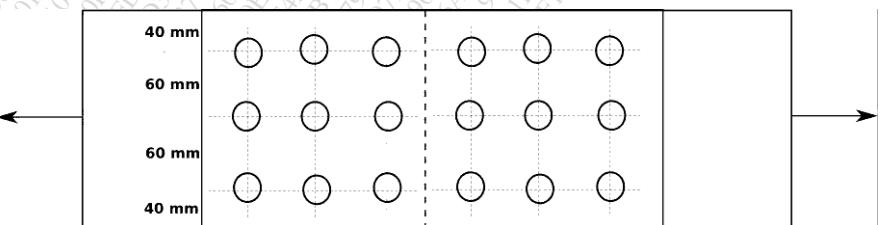


Figure 1

- Q.2 A)** A double angle tie ISA 150 x 115 x 10 mm ( $f_y = 250$  MPa) with long **(06)** leg connected to the same side of a gusset plate of 12 mm thickness by 18 mm diameter rivets, such that each angle is reduced in section by one rivets hole only. Determine the tensile strength of the member.
- B)** A single angle discontinuous strut ISA 150 x 150 x 12 mm **(06)** ( $f_y=250$  MPa) with single riveted connection is 3.5 m long.

Determine the load carrying capacity of the compression member.

- Q.3** Design a beam of 5m effective span carrying a uniformly distributed load of 15kN/m, if the compression flange is laterally unsupported. (12)

( $f_y=250\text{MPa}$ ) assume dead load of the beam = 500 N/m.

- Q.4** Solve any one one question.

- A)** Design a column with two channel sections (placed back-to-back) laced together to support a load of 750 kN. The effective length of the column is 10m. Provide single lacing system with riveted connection. Assume ( $f_y=250\text{MPa}$ ).

**OR**

- B)** A column section I.S.H.B 350 @ 674 N/m carries an axial load of 1100kN. Design a suitable gusset base using riveted connection. (12)

- Q.5 A)** Determine the design forces on the panel points of a steel roof truss (as shown in Figure 2) 16 m in span and resting on brick masonry walls. The trusses are placed at 8 m c/c. The rise of truss is 1/4 of span. The roofing is of asbestos cement sheets of weight 171 N/m<sup>2</sup>. The wind normal to roof is 940 N/m<sup>2</sup>.

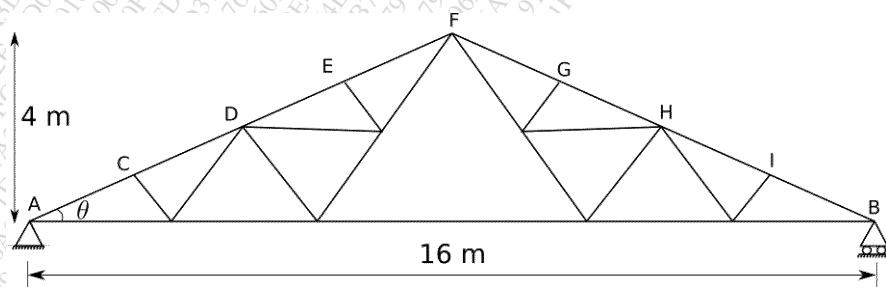


Figure 2

- B)** Explain in brief types of load acting on a gantry girder. (04)

- Q.6 A)** Define the plastic hinge. Find the length of plastic hinge for a simply supported rectangular beam subjected to a gradually increasing concentrated load P at the centre of its span. (08)

- B)** State the difference between working stress method and limit state method of design (04)

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Seat No.	
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**T.E. (Civil) (Part – I) (New CBCS) Examination, 2018**  
**DESIGN OF STEEL STRUCTURES**

Day and Date : Friday, 30-11-2018

Total Marks : 70

Time : 2.30 p.m. to 5.30 p.m.

- N. B. :**
- 1) **Use of IS 800-2007 and IS 875 are allowed, but not allowed for MCQ (Q. No. 1)**
  - 2) **Use of scientific non programmable calculator is allowed.**
  - 3) **Figures to the right indicate the full marks.**
  - 4) **Assume suitable data if necessary and mention it clearly before the solution.**
  - 5) **Draw the appropriate sketches whenever necessary.**
  - 6) **Q. No. 1 is compulsory. It should be solved in first 30 minutes in Answer Book Page No. 3. Each question carries one mark.**
  - 7) **Answer MCQ/Objective type questions on Page No. 3 only. Don't forget to mention, Q.P. Set (P/Q/R/S) on Top of Page.**

**MCQ/Objective Type Questions**

Duration : 30 Minutes

Marks : 14

1. Choose the correct option : 14
  - i) The maximum strain at the end of plastic hinge for structural steel is about \_\_\_\_\_  
a) 0.11%      b) 1.5%      c) 15%      d) 25%
  - ii) The design wind speed is V. The design wind pressure will be given as  
\_\_\_\_\_  
a)  $0.4 V^2$       b)  $0.5 V^2$       c)  $0.6 V^2$       d)  $0.8 V^2$
  - iii) The collapse load for a propped cantilever of span 1 subjected to central point load is  
a) 0.414 Mp/l      b) 0.586 Mp/l      c) 11.656 Mp/l      d) None of the above
  - iv) Which of the following sections has maximum value of shape factor ?  
a) Triangular section      b) I – section  
c) Rectangular section      d) Circular section



- v) The bending moment at plastic hinge is
    - a) equal to zero
    - b) equal to yield moment of the section
    - c) equal to plastic moment of the section
    - d) greater than the plastic moment of the section
  - vi) If the same number of bolts has been used in the joints, then which of the following patterns will yield highest efficiency ?
    - a) Chain
    - b) Staggered
    - c) Diamond
    - d) Staggered diamond
  - vii) The value of load factor which occurs for margin of safety in plastic design for gravity load is about
    - a) 1.15
    - b) 1.65
    - c) 1.85
    - d) 2.25
  - viii) The most economical section for column is
    - a) rectangular
    - b) solid round
    - c) tubular
    - d) hexagonal
  - ix) Web crippling generally occurs at the point where
    - a) Bending moment is maximum
    - b) Shear force is maximum
    - c) Concentrated load acts
    - d) Deflection is maximum
  - x) The maximum permissible slenderness ratio of a member carrying loads resulting from wind is
    - a) 180
    - b) 200
    - c) 250
    - d) 350
  - xi) The rolled steel I section are most commonly used as beam because these provides
    - a) Large moment of inertia of less cross sectional area
    - b) Large moment of resistance as compared to other section
    - c) greater lateral stability
    - d) all the above
  - xii) The thickness of single flat lacing should not be less than
    - a)  $1/30^{\text{th}}$  length between inner rivets
    - b)  $1/40^{\text{th}}$  length between inner rivets
    - c)  $1/50^{\text{th}}$  length between inner rivets
    - d)  $1/60^{\text{th}}$  length between inner rivets
  - xiii) Shape factor is the property which depends
    - a) Only on ultimate stress of material
    - b) Only on yield stress of material
    - c) Only on geometry of section
    - d) Both on yield stress and ultimate stress of material
  - xiv) The number of seismic zones in which the country has been divided as
    - a) 3
    - b) 5
    - c) 6
    - d) 7



<b>Seat No.</b>	
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**T.E. (Civil) (Part – I) (New CBCS) Examination, 2018**  
**DESIGN OF STEEL STRUCTURES**

Day and Date : Friday, 30-11-2018

Marks : 56

Time : 2.30 p.m. to 5.30 p.m.

- N. B. :**
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  - 6) **Draw the appropriate sketches whenever necessary.**

**SECTION – I**

2. Determine the tensile strength of ISMC 175 when it is connected to gusset plate through the web by two rows of 16 mm bolts with a connecting length of 100 mm. 9
3. Design single angle discontinuous strut to carry a factored axial compressive load of 62 kN the length of the strut is 2.9 m between intersections. It is connected to 12 mm thick gusset plate by 20 mm diameter 4.6 grade bolts. Use Fe410 grade of steel. 9
4. Design a built up column of two rolled I sections to resist an axial load of 3500 kN. The length of the column is 4.6 m. It is restrained against rotation and translation at bottom and restrained against rotation and free at top. Take Fy = 250 Mpa. Design the suitable lacing or battening system. 10
5. Attempt the following : 9
  - a) Explain web buckling and web crippling with neat sketch.
  - b) Classification of cross sections such as plastic, compact, semi-compact, slender with necessary sketches.
  - c) Theorems of plastic analysis.



## SECTION – II

6. A simply supported beam of span L of circular section is subjected to central point load W find  
a) Shape factor of circular section  
b) Length of plastic hinge. 10
7. A proposed cantilever beam is built in a concrete wall. It supports a dead load of 20 kN/m and a live load of 10 kN/m. The length of beam is 5 m. Select a suitable section with necessary checks. Assume stiff bearing length of 100 mm. 9
8. A 10 m × 10 m godown is to be constructed. The steel roof trusses will be used for roofing. The trusses will be supported over masonry walls 300 mm thick. Galvanized corrugated iron sheets will be used for covering. Propose a suitable type of roof truss.  
The basic wind pressure is 1.0 KN/m<sup>2</sup> and there is no any snowfall. Determine load at each panel point. 9
9. A column ISHB 300 @ 0.630 kN/m with one cover plate 400 mm × 20 mm on either side is carrying axial load of 1700 kN. Design gusseted base.  
M20 grade of concrete is to be used under the base slab. 9



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Set **Q**

## T.E. (Civil) (Part – I) (New CBCS) Examination, 2018 DESIGN OF STEEL STRUCTURES

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### MCQ/Objective Type Questions

Duration : 30 Minutes

Marks : 14

1. Choose the correct option : 14
  - i) The most economical section for column is
    - a) rectangular
    - b) solid round
    - c) tubular
    - d) hexagonal
  - ii) Web crippling generally occurs at the point where
    - a) Bending moment is maximum
    - b) Shear force is maximum
    - c) Concentrated load acts
    - d) Deflection is maximum
  - iii) The maximum permissible slenderness ratio of a member carrying loads resulting from wind is
    - a) 180
    - b) 200
    - c) 250
    - d) 350
  - iv) The rolled steel I section are most commonly used as beam because these provides
    - a) Large moment of inertia of less cross sectional area
    - b) Large moment of resistance as compared to other section
    - c) greater lateral stability
    - d) all the above

P.T.O.



- v) The thickness of single flat lacing should not be less than  
a)  $1/30^{\text{th}}$  length between inner rivets b)  $1/40^{\text{th}}$  length between inner rivets  
c)  $1/50^{\text{th}}$  length between inner rivets d)  $1/60^{\text{th}}$  length between inner rivets
- vi) Shape factor is the property which depends  
a) Only on ultimate stress of material  
b) Only on yield stress of material  
c) Only on geometry of section  
d) Both on yield stress and ultimate stress of material
- vii) The number of seismic zones in which the country has been divided as  
a) 3                      b) 5                      c) 6                      d) 7
- viii) The maximum strain at the end of plastic hinge for structural steel is about \_\_\_\_\_  
a) 0.11%                b) 1.5%                c) 15%                d) 25%
- ix) The design wind speed is V. The design wind pressure will be given as  
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a)  $0.4 V^2$               b)  $0.5 V^2$               c)  $0.6 V^2$               d)  $0.8 V^2$
- x) The collapse load for a propped cantilever of span 1 subjected to central point load is  
a) 0.414 Mp/l            b) 0.586 Mp/l        c) 11.656 Mp/l      d) None of the above
- xi) Which of the following sections has maximum value of shape factor ?  
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- xii) The bending moment at plastic hinge is  
a) equal to zero  
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- xiii) If the same number of bolts has been used in the joints, then which of the following patterns will yield highest efficiency ?  
a) Chain                                      b) Staggered  
c) Diamond                                  d) Staggered diamond
- xiv) The value of load factor which occurs for margin of safety in plastic design for gravity load is about  
a) 1.15                      b) 1.65                      c) 1.85                      d) 2.25



<b>Seat No.</b>	
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**T.E. (Civil) (Part – I) (New CBCS) Examination, 2018**  
**DESIGN OF STEEL STRUCTURES**

Day and Date : Friday, 30-11-2018

Marks : 56

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**SECTION – I**

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## SECTION – II

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The basic wind pressure is 1.0 KN/m<sup>2</sup> and there is no any snowfall. Determine load at each panel point. 9
9. A column ISHB 300 @ 0.630 kN/m with one cover plate 400 mm × 20 mm on either side is carrying axial load of 1700 kN. Design gusseted base.  
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**Set Q**



Seat No.	
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**T.E. (Civil) (Part – I) (New CBCS) Examination, 2018**  
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P.T.O.



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**T.E. (Civil) (Part – I) (New CBCS) Examination, 2018**  
**DESIGN OF STEEL STRUCTURES**

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Set R



Seat No.	
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    - b) 1/40<sup>th</sup> length between inner rivets
    - c) 1/50<sup>th</sup> length between inner rivets
    - d) 1/60<sup>th</sup> length between inner rivets



- iv) Shape factor is the property which depends  
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- N. B. :**
- 1) Attempt **any three** questions from **each** Section.
  - 2) **Use of IS 800-2007 and IS 875 are allowed, but not allowed for MCQ (Q. No. 1)**
  - 3) **Use of scientific non programmable calculator is allowed.**
  - 4) **Figures to the right indicate the full marks.**
  - 5) **Assume suitable data if necessary and mention it clearly before the solution.**
  - 6) **Draw the appropriate sketches whenever necessary.**

**SECTION – I**

2. Determine the tensile strength of ISMC 175 when it is connected to gusset plate through the web by two rows of 16 mm bolts with a connecting length of 100 mm. 9
3. Design single angle discontinuous strut to carry a factored axial compressive load of 62 kN the length of the strut is 2.9 m between intersections. It is connected to 12 mm thick gusset plate by 20 mm diameter 4.6 grade bolts. Use Fe410 grade of steel. 9
4. Design a built up column of two rolled I sections to resist an axial load of 3500 kN. The length of the column is 4.6 m. It is restrained against rotation and translation at bottom and restrained against rotation and free at top. Take Fy = 250 Mpa. Design the suitable lacing or battening system. 10
5. Attempt the following : 9
  - a) Explain web buckling and web crippling with neat sketch.
  - b) Classification of cross sections such as plastic, compact, semi-compact, slender with necessary sketches.
  - c) Theorems of plastic analysis.



## SECTION – II

6. A simply supported beam of span L of circular section is subjected to central point load W find  
a) Shape factor of circular section  
b) Length of plastic hinge. 10
7. A proposed cantilever beam is built in a concrete wall. It supports a dead load of 20 kN/m and a live load of 10 kN/m. The length of beam is 5 m. Select a suitable section with necessary checks. Assume stiff bearing length of 100 mm. 9
8. A 10 m × 10 m godown is to be constructed. The steel roof trusses will be used for roofing. The trusses will be supported over masonry walls 300 mm thick. Galvanized corrugated iron sheets will be used for covering. Propose a suitable type of roof truss.  
The basic wind pressure is 1.0 KN/m<sup>2</sup> and there is no any snowfall. Determine load at each panel point. 9
9. A column ISHB 300 @ 0.630 kN/m with one cover plate 400 mm × 20 mm on either side is carrying axial load of 1700 kN. Design gusseted base.  
M20 grade of concrete is to be used under the base slab. 9

Set S