**Examination Control Division**
**2079 Ashwin**

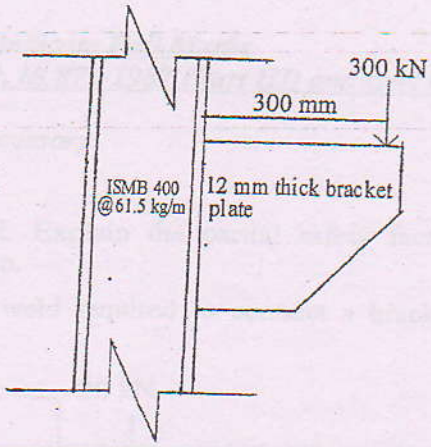
| | | | |
|---|---|---|---|
| Level | BE | **Full Marks** | **80** |
| Programme | BCE | **Pass Marks** | **32** |
| Year / Part | III / II | **Time** | 3 hrs. |

***Subject:*** - Design of Steel and Timber Structure *(CE 651)*

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt **All** questions.*
- *The figures in the margin indicate **Full Marks**.*
- ***IS 800:2007, IS 875 – 1987 (part 3), IS 883 – 1994 and Structural Steel Sections Books are allowed to use.***
- *Assume suitable data if necessary.*

1. Explain design methods of steel structure and also explain the failure of bolted connections. [3+3]

2. Design welded connection for the bracket-loaded with factored load 300 kN as shown in the figure. [10]




3. A single angle member carries a working axial tensile load of 250 kN. Design the member and the connection with a 10 mm gusset plate and a lug angle. The yield strength and ultimate strength of the material are 250 MPa and 410 MPa respectively. [12]

4. Design a built-up column with two channel sections placed toe-to-toe. The column is 9 m long and supports a factored axial compressive load of 1500 kN. The ends of the column are effectively held in position at both ends but not restrained against rotation. Design a single lacing system with bolted connection. Use E250 grade of steel, M16 bolt of property class 5.6. [14]

5. Design the column base for an ISHB 300 column to carry a factored load of 1000 kN. Assume Fe410 grade steel and M25 grade concrete. [6]

6. A simply supported steel joist of 6.0 m span has to support a load of 50 kN/m (inclusive of self-weight). The beam's compression flange is laterally supported. Design an appropriate section using steel of grade Fe410. [10]

7. Find the wind pressure for design of a sloping roof of span 25 m and roof slope of 1 to 5. The clear height of building at eaves level is 8 m. The basic wind speed is 47 m/s and terrain is open industrial area, building is class A and permeability is normal. [8]

8. Design a circular Sal wood column of length 4.5 m to be used in an open shed, to carry an axial load of 350 kN. [6]

9. A timber beam is 150 mm wide and 300 mm deep and is simply supported on a span of 6 m. It carries a uniformly distributed load of 3000 kN/m run over the whole span and two equal concentrated loads W each placed at mid span and quarter span points. If the stress in timber is not exceed 8 N/mm$^2$, find the maximum value of W. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2079 Jestha

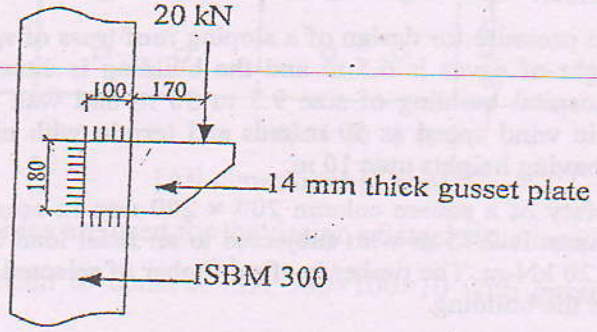
| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

*Subject:* - Design of Steel and Timber Structure *(CE 651)*

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt All questions.*
- *The figures in the margin indicate Full Marks.*
- *IS 800-2007, IS 883-1994, IS 875-1987 (Part III) and steel table data or steel tables are allowed to used.*
- *Assume suitable data if necessary.*

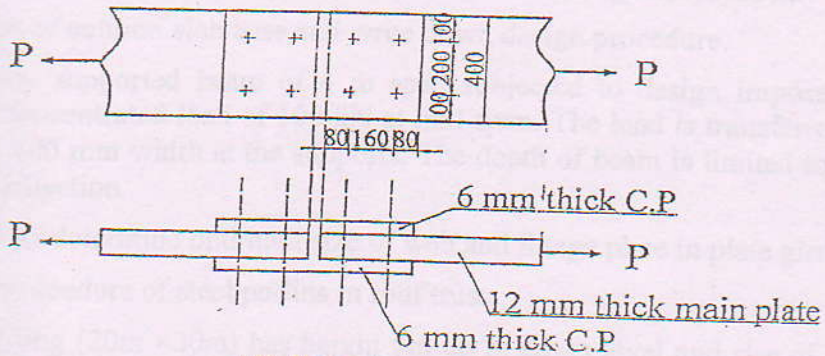
a) Define structural steel. Explain the partial safety factor for materials and loads required for steel design. [2+3]

b) Calculate the size of weld required to connect a bracket plate to the flange of a column as shown. [9]




All dimensions are in mm.

a) Two 12 mm thick steel flats are spliced by two 6 mm thick plates with four M16 bolts of the product grade C and the property class 4.6. Determine the ultimate design load carrying capacity of the connection. The steel used are E250. [10]




All dimensions are in mm

b) A column ISMB 300 is to support a load 700 kN. The column section is to be spliced at a height of 2.5 m. Design the splice plate using 4.6 grade bolts. Use steel of grade Fe 410. [7]

3. a) A steel column to take a central factored load of 1600 kN is to be built of four equal angles forming square box of size 500 mm × 500 mm. The height of the column is to be 6.5 m with both end hinged, Design

   (i) a suitable column section
   (ii) a lacing system with using fillet weld.

   b) Design a single angle section to carry a tension of 210 kN. The end condition is done using fillet welds. The yield and ultimate strengths of steel are 250 MPa and 410 MPa respectively.

4. a) The roof of a hall of 12 m × 8m consists of RC slab of 110 mm thick and a 50 mm floor finish. The slab is supported on steel beams spaced at 3 m centre to centre. The liveload on the slab is 3 kN/m$^2$. Design an suitable section of an intermediate steel beam using I-section. Assume that the compression flange is laterally supported throughout the span.
   For the same design section of beam, if a concentrated load of 450 kN acts at mid span through a stiff bearing plate of dimension 150 mm along the length of the beam, check the web buckling and web crippling again.

   b) Explain the properties of structural timber with considering factors affecting the strength of timber.

5. a) Find the wind pressure for design of a sloping roof truss of span 9.30 m and slope of 30°. The height of eaves is 6.5 m and the building is situated in Kathmandu. The building is hospital building of size 9.3 m 30 m and wall opening as about 25%. Consider basic wind speed as 50 m/secs and terrain with numerous closely spaced obstructions having heights upto 10 m.

   b) Check the safety of a square column 200 × 200 mm in cross-section. The effective length of column is 2.75 m with subjected to an axial load of 27 kN and a bending moment of 1.20 kN-m. The timber is of sal timber of selected grade and the column is located inside the building.

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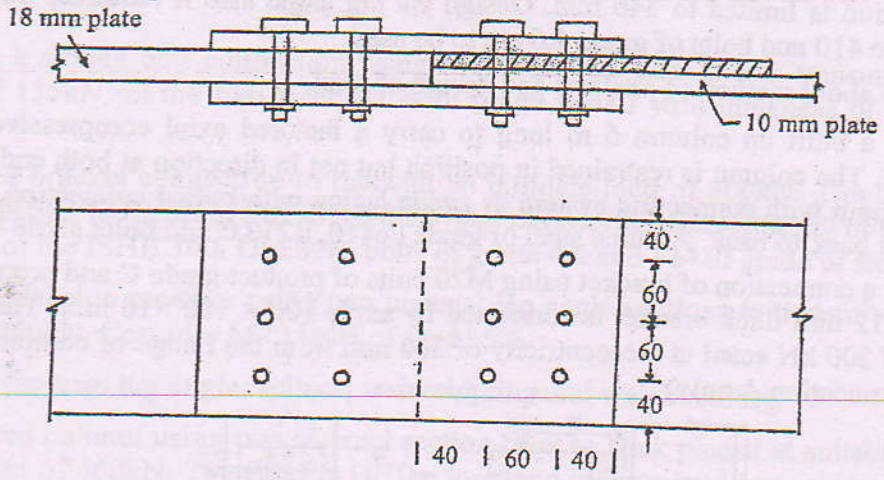
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2078 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure (*CE651*)

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt **All** questions.*
- *The figures in the margin indicate **Full Marks**.*
- ***IS 800:2007 (Code of Practice for General Construction in Steel), Steel section book, IS 875:1987 and IS 883: 1994 (Design of Structural Timber in Building) are allowed to use.***
- *Assume suitable data if necessary.*

1. Two plates, 10 mm and 18 mm thick are connected by a double cover butt joint using 6 mm plates as shown in figure below. Find the strength of the joint. Given M20 bolts of grade 4.6 and E250 plates are used. [8]




[All dimensions in mm]

2. Which design philosophies are used for the design of steel structures? [4]
3. Design welded connection to connect ISA 100×100×10 with gusset plate of thickness 12mm. [6]
4. Design of braced built-up column using double channel-section, having unsupported length 3.0m, subjected to factored axial load of 1600 kN. Use single lacing as lattice member and bolted connection to connect lacing and column. The ends of the columns are effectively held in position at both ends but not restrained against rotation. [14]
5. Draw neat sketch of column slab base and write down design procedure. [6]
6. Design a laterally supported beam of 4 m span subjected to design imposed load of 45 kN/m and a concentrated load of 100 kN at mid span. The load is transferred through stiff bearings of 300 mm width at the supports. The depth of beam is limited to 350 mm. Also check for deflection. [12]
7. Describe process to determine optimum size of web and flange plate in plate girder. [3+3]
8. Describe design procedure of steel purlins in roof truss. [6]
9. A roof truss building (20m ×30m) has height 5m up to eaves level and rise of a truss is 2m and is designed for the highly- dense city (Kathmandu). The minimum lifetime of the structure is 50 years. The site should be located 15m above the mean ground level and 100m far. If the crest level of the ridge is 200m from mean ground level, determine the maximum wind force on the roof truss. [8]
10. Design a spaced column 3.5m long of Sal timber to carry 120kN load. [10]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2078 Poush**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

*Subject:* - Design of Steel and Timber Structure *(CE 651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***IS 800:2007, IS 808:1989, IS 883:1994 and IS 875:1987 (Part III) are allowed.***
- ✓ *Assume suitable data if necessary.*

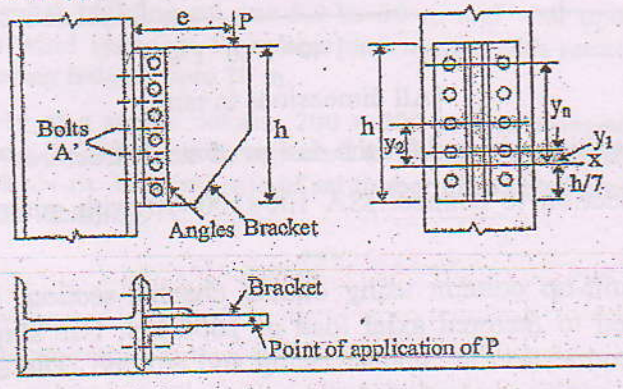
1. a) A ISLC 300@ 324.7 N/m (Fe 410 grade of steel) is to carry a factored tensile force of 600 kN. The channel section is to be welded at the site to a gusset plate 10 mm thick. Design a fillet weld, if the overlap is limited to 300 mm.

   b) A diagonal member of a roof truss carries a maximum pull of 300 kN. Design the section and its connection with 16 mm thick gusset plate. The length of the connection is limited to 340 mm. Design the lug angle also if required. The steel is grade Fe 410 and bolts of grade 4.6 are to be used.

   c) Explain about method of analysis and design of steel.

2. a) Design a built up column 6 m long to carry a factored axial compressive load of 900 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as single lacing with bolted connection. Use two channel back to back. Assume steel of grade Fe410, E250 C and bolts grade 4.6.

   b) Design a connection of bracket using M20 bolts of product grade C and property class 4.6, if 12 mm thick bracket is connected by angle 100 × 100 ×10 mm. The factored load of 200 kN acted at a eccentricity of 300 mm from the flange of column. (Design Bolt connection A only)




3. a) Check the safety of a square column 200 × 200 mm in cross section. the effective length of the column is 2.5 m, the axial load and bending moment in the column are 30 kN and 1.5 kN-m respectively. The material is Sal wood and the column is located outside the building.

   b) The High Rise building at Sundhara Kathmandu is to be constructed for a 50 years life, the size of the building is over 30 m. The height of the building is 50 m. Determine the wind pressure at the site and force on the truss. Take basic wind speed of Kathmandu is 47 m/sec.

4. a) A column ISHB 350@ 661 N/m carries an axial compressive factored load of 1700 kN. Design a suitable bolted gusset base. The base rest on M15 grade concrete pedestal. Use M24 bolts of grade 4.6 for making the connection.

   b) Design a simply supported beam having unsupported span of 4.0 m, support width 250 mm. Beam is subjected to imposed load (including self-weight) 30 kN/m and 120 kN from secondary beam at mid-span of beam. Depth of beam is limited 300 mm. Consider laterally restrained beam.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2078 Baishakh**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

*Subject:* - Design of Steel and Timber Structures *(CE 651)*

Candidates are required to give their answers in their own words as far as practicable.
Attempt ***All*** *questions.*
*The figures in the margin indicate* ***Full Marks.***
***Steel codes (IS:800), Steel tables are allowed to use.***
*Assume suitable data if necessary.*

a) Design a simple butt connection using M16 bolts of grade 5.6 to transmit a service load of 135kN on the two steel plates of grade Fe410 with thickness of 10mm and 18mm. [5]

b) Design a bracket connection to transmit an ultimate load of 300kN. The bracket lies perpendicular to the flange of ISHB300. The load acts at an eccentricity of 20cm from the end of the ISHB 300. Use M16 bolts of grade 4.6 and Fe410 grade of steel. [7]

c) Design a tension member using two unequal leg angle sections to transmit a factored load of 450kN. Consider M20 bolts of grade 5.6. [7]

d) Explain the term lug angle, splices, web crippling and web buckling. [6]

e) Design a laced column using two channel section back to back placed at suitable spacing to carry a load of 600kN. The column is 10m long and is restrained in position but not in direction at both ends. [12]

f) Design a laterally unsupported beam of 6m long to carry a uniformly distributed load of 40kN/m excluding its self-weight. The beam has bearing of 300mm in each ends. [12]

g) What do you understand by plate girder? Explain in detail the components of plate girder. [2+3]

h) Design a column base to transmit a factored load of 1200kN at an eccentricity of 50mm from the column of ISHB 250. Consider M25 grade of concrete and Fe410 grade of steel. [6]

i) Design a purlin for a roof truss from the following data. [8]
Spacing of the truss = 5m c/c
Spacing of the Purlin = 1.5m c/c
Span of truss = 16m.
Live load = 1.7kN/m$^2$
Roof angle = 21 degrees

j) Design a solid Sal timber column to carry the load of 500kN. The length of the column is 3m and location of use is inside. [7]

k) Explain working stress method and limit state method. [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

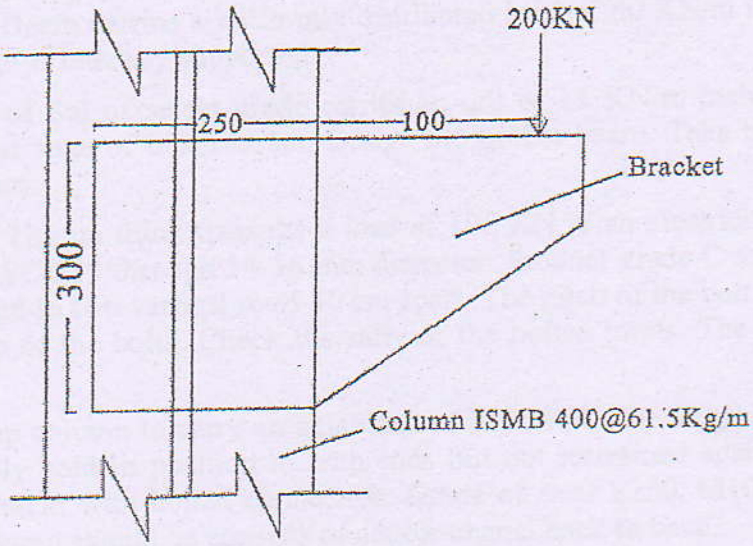
| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure *(CE 651)*

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt **All** questions.*
- *The figures in the margin indicate **Full Marks**.*
- ***IS 800-2007, IS 875-1987, IS 883-1994 and Structural Steel Books are allowed to use.***
- *Assume suitable data if necessary.*

a) What is the safety and serviceability requirements of structures. [8]

b) A bracket plate is welded to the flanges of a column section ISMB 400 @ 61.5kg/m as shown in figure below. If the width of weld is 250mm, depth 300mm and eccentricity from the face of column is 100mm. Determine the size of the weld to support a factorized load of 200KN. [12]




a) Calculate the moment carrying capacity of laterally unrestrained beam made of ISMB500 and length of member is equal to 6m. Assume necessary data suitably. [10]

b) Design slab base for a column SC300 carrying factor axial lead of 1200KN if concrete grade used is M20. [10]

a) Design a suitable angle section to carry a factored tensile force of 250KN assuming a single row of M20 bolts. The yeild strength and ultimate strength of the material is 250MPa and 410MPa respectively. The length of member is 3m. [10]

b) Design a 5m long rectangular box columns built up by 5cm thick Sal wood planks to carry on axial load 400KN. [10]

a) Determine wind load on a roof truss for an industrial building with 40m span and 100m length. The roofing is galvanized iron sheeting. The basic wind speed is 47m/s and terrain is open industrial area and building is class A. The clear height of building at the eaves level is 10m. [10]

b) Design a gusseted base for a column ISHB 350 @ 710 N/m with two plates 450mm×20mm carrying factored load 2000KN. The column is to be supported on Concrete pedestal with M20 grade concrete. [10]

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS: 800-2007, Steel Tables, IS: 883-1994 and IS: 875-1987, IS SP 6-1 are allowed.*

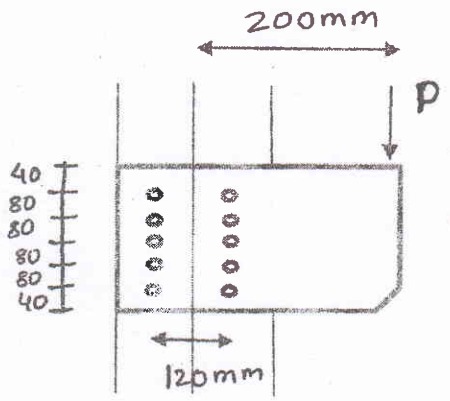
1. a) In at truss angle ISA 100 100×8 is subjected to the factored tension of 200 kN. It is to be connected to a gusset using fillet welds at the toe and back. Find the length of weld required. Take Fe 410 steel. [10]

   b) Design a double angle section to carry a tension of 400 kN. The end, connection to be made using M20 bolts at product grade C and property class 5.6. Assuming the angle sections are providedon the both sides of gusset plate. The steel used are E 250. [10]

2. a) Design a built up column 10 m along to carry a factored axial compressive load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as single lacing with bolted connection. Use two channel back to back. Assume steel of grade Fe 410, E250 C and bolts grade 4.6. [14]

   b) Explain about design process and Basis for design. [6]

3. a) Determine the safe load P that can be carried by the joint shown in figure below. Use M20 bolts of grade 4.6. The thickness of the flange of I-section is 9.1 mm and that of bracket plate 10 mm thick. [4]




   b) Check the safety of a square column 200×200 mm in cross section. The effective length of the column is 2.5 m, the axial load and bending moment in the column are 30 kN and 1.5 kN-m respectively. The material is Debdar wood and the column is located outside the building. [8]

   c) The High Rise building at Kathmandu is to be constructed for a 50 years life; the size of the building is over 30 m. The height of the building is 50 m. determine the wind pressure at the site and force on the truss. Where basic wind speed of Kathmandu is 47 m/sec. [8]

4. a) A simply supported beam of span 6 m supports a reinforcement concrete slab. The compressive flange of the beam is restrained due to its connection with the slab. The beam is subjected to a dead load of 10 kN/m and imposed load of 30 kN. Design the beam. Assume the beam is sufficiently stiff against bearing. [14]

   b) Explain about structural timber and factors affecting the strength of timber. Write the

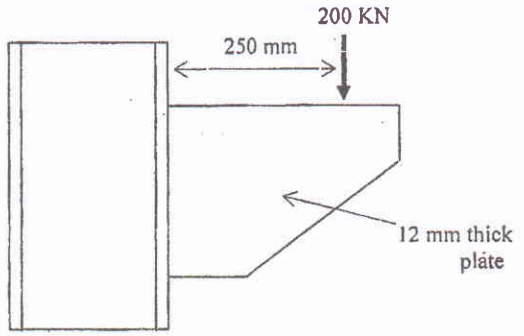
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Baisakh**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***IS 800 - 2007, IS 875 - 1987, IS 883 - 1994 and Structural Steel Section Books are allowed to use.***
- ✓ *Assume suitable data if necessary.*

1. a) Design bolted connection for the bracket loaded as shown in figure. [12]

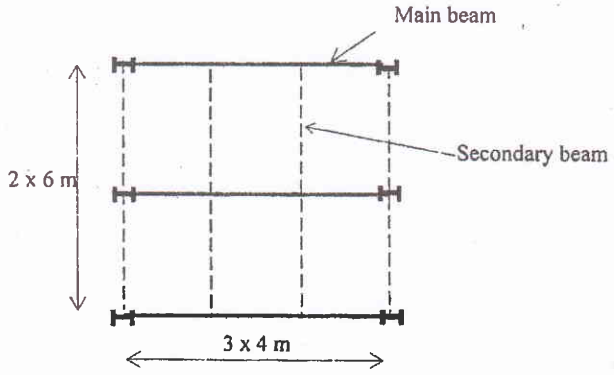



b) Design a fillet welded channel section to act as a tension member subjected to an axial tensile load of 200 KN. [8]

2. Design a column section subjected to axial load of 1500 KN using rolled steel 'I' sections. Height of the column is 8 m. Both ends of column are fixed and exits sway condition. Also design lateral bracing of column using battening system. [20]

3. a) Write the design process and basis of design of steel structures. [10]

b) A floor 12 m ×12 m in plan as shown in figure to be covered with a floor made up of secondary and main beams. The secondary beams of 5 KN/m are spaced at 3 m intervals. It supports reinforced concrete slab 125 mm thick and floor finish 0.5 KN/m$^2$. If live load on the floor is 3 KN/m$^2$, design main beam located at end of floor for bending. Compression flange of main beam is laterally restrained. [10]




4. a) Design a timber column of Sal species to carry the axial load of 50 KN. Unsupported length of column is 4 m. [10]

b) Specify the types of timber columns according to their slenderness ratio. How the slenderness ratio is defined in solid, built-up and spaced column. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2074 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***IS 800-2007, IS 875-1987, IS 883-1994 and Structural steel Section Books are allowed to use.***
- ✓ *Assume suitable data if necessary.*

1. Design a tension member of double angle section connected on the both sides of gusset plate. Member is subjected to an axial tension of 300 KN. [8]
2. Design a simply supported beam with an effective span of 6m for bending, shear and lateral stability. Beam carries a uniformly distributed load of 60 KN/m inclusive of self-weight. The beam is laterally supported. [14]
3. A timber beam of Sal of select grade carries an udl of 15 KN/m inclusive of its self-weight. The clear span of beam is 4m. Design the timber beam. Take bearing length of support = 230 mm. [12]
4. A bracket plate 12 mm thick transults a load of 100 KN at an electricity of 25 cm to a column section SC 250 through 14-16 mm diameter. Product grade C and property class 4.6 bolts arranged in two vertical rows 10 cm apart. The pitch of the bolt is 8 cm and load lies in the plane of the bolts. Check the safty of the bolted joints. The grade of steel is Fe410. [10]
5. Design a built up column to carry an axial load of 1100 KN. The length of column is 8m and is effectively held in position at both ends but not restrained against rotation. Use single lacing system with bolted connection. Grade of steel E250, M10 Bolt, 4.6 grade. The built up column should be consists of double chanel back to back. [12]
6. Define the terms structural steel, factor of safety and partial safety factor. Explain briefly, how structural steel can resist loads even after local yielding. [3+3]
7. An ISHB 250 @ 536 N/m column carrying a factored axial load of 900KN. The column ends of machined. Design the splice connection. Use M16 bolts. [8]
8. Explain the method of calculation of wind load on roof truss. [4]
9. Design a solid wood column to resist a factored axial load of 75 KN and Factored moment of 12 KNm. The column is made of Sal wood and is 2m long. [6]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2073 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 800-2007, IS 883-1994, IS 875 and steel tables are allowed.*
- ✓ *Assume suitable data if necessary.*

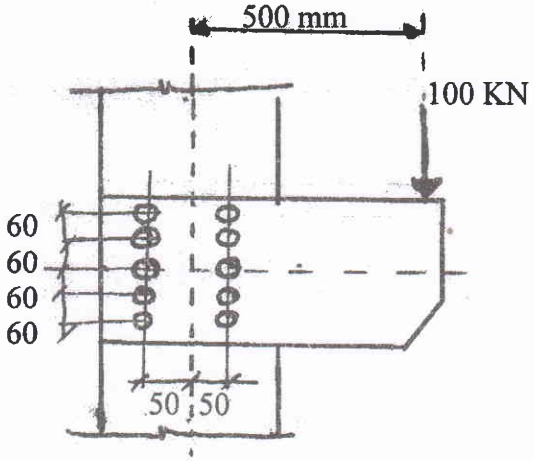
1. a) Why limit state method is better than working stress method. Explain in brief. [5]

   b) Design a built up column 10 m long to carry a factored axial compressive load of 1080 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as battens with bolted connection. Use two channel back to back assume steel of grade Fe 410, E250A and bolts grade 4.6. [15]

2. a) Write design procedure of steel purlin in roof truss. [5]

   b) Design a simply supported I-section beam of span 6 m supports a RCC slab. The compression flange beam is restrained due to its connection with the slab. The beam is subjected to a dead load of 25 kN/m and an imposed load of 20 kN/m. Design the beam. Assume the beam is sufficiently stiff against bearing. [15]

3. a) A shaft transmits load of 100 kN at an eccentricity of 500 mm across a bracket plate bolted to a stanchion. Two rows of bolts 100 mm apart are provided with five bolts per row. The pitch of bolts in each row is 60 mm. Find the greatest force induced in bolt. [8]




   b) Explain the design concepts of plug and slot weld and its requirement for the connection of members. [5]

   c) Design a solid sal (Select grade) wood column to resist an axial load of 500 KN and moment of 50 KN-m. The length of column is 2 m. [7]

4. a) The High Rise building at Sundhara Kathmandu is to be constructed for a 50 years life, the size of the building is $40 \times 30 m^2$. The height of the building is 50 m. Determine the wind pressure at the site and force on the truss. Where basic wind speed of Kathmandu is 47 m/sec. [10]

   b) Design a slab base for a column ISHB 350 @ 710.2 N/m subjected to an factored axial compressive load of 1000 kN. Concrete pedestal of grade M20. [6]

   c) What is effect of laterally restrained and unrestrained compression flange in bending

01RE TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2073 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS 800-2007, IS 883-1994, IS 875 and steel tables are allowed.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe different methods of design with their basic assumptions. [8]
   b) How the steel sections are classified according t their local bucking behaviors? [4]
   c) A single angle ISA 100×75×8 mm is connected to 12 mm thick gusset plate at the ends with six bolts of M20 in one row to transfer tension. Determine the design tensile strength of the angle if gusset is connected to the 100 mm leg. Take fy = 250 MPa, and Fu = 410 MPa, pr.cl.4.6. [8]
2. a) Explain the method of wind load calculation in the sloped roof as per IS875. [5]
   b) A 7.5m long built-up and laced column has to carry a factored axial load of 1250KN. The column is restrained in position but not in direction at each end. Design the column with single lacing system. Connection shall consist of two channels placed back to back at a suitable spacing. [15]
3. a) Design a built up beam having laterally unsupported span of 4 m, support width 300 mm. Beam is subjected to design imposed load of 40 KN/m and 100 KN at mid span. Depth of beam is limited to 350 mm. [15]
   b) Describe use of stiffners in plate girder with their types and their function. [5]
4. a) Design a single bolted double cover butt joint to connect boiler plates of thickness 12mm for maximum efficiency. Use M16 bolts of grade 4.6. Boiler plates are of Fe410. Find the efficiency of the joint. [10]
   b) Design a timber beam of sal wood having clear span 2.5 m, support width 300 mm and subjected to imposed load of 20 KN/m. [10]

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16

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2072 Ashwin**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ ***IS 800-2007, IS 875-1987, IS 883-1994 and Structural Steel Section Book is allowed to use.***

1. a) Explain about grade and classification of structural steel as per Indian Standard. [8]
   b) Design a single angle to carry a tension of 100 kN. The end connection is to done using M20 bolts of product Grade C and property class 4.6. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [12]
2. a) What are the basic assumptions of Working Stress Design method? [4]
   b) Design column to carry an axial load of 1200 kN. The column is effectively held in position but not restrained against rotation at both ends. Design the column using two channels placed toe to toe if center to center distance between connections is 6 m. Design the column using lacing and Fe 410 steel. [16]
3. a) The building is to be constreucted in core city area for a 50 years life, the size of the building is over 30 m. The height of the building is 36 m and is classified as 1$^{st}$ category building. Determine the wind pressure at the site and force on the truss. [10]
   b) What do you mean by safety and serviceability requirements of steel structures? Explain it. [4]
   c) Design a slab base for a column ISHB 350@ 710.2 N/m subjected to an factored axial compressive load of 1000 kN. Concrete pedestal of grade M20. [6]
4. a) Design a simply supported I-section to support the slab of a hall 9m×24m with beams spaced at 3 m c/c. The thickness of the slab is 100 mm. Consider a floor finish load of 0.5 kN/m$^2$ and live load of 3 kN/m$^2$. The grade of the steel is E250. Assume that an adequate lateral support is provided to the compression flange. [12]
   b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take E = 12700 N/mm$^2$, $f_{cp}$ = 10.6 N/mm$^2$ constant U = 0.6 and q = 1. [8]

***

15

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2072 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Use of IS: 800-2007, Steel Tables, IS: 883-1994 and IS: 875-1987 are allowed.***
- ✓ *Assume suitable data if necessary.*

1. a) Design a suitable bolted bracket connections of a 12 mm thick bracket plate to the flange of a ISHB 300 @ 577 N/m to carry a vertical factored load of 600 KN at an eccentricity of 300 mm from face of column. Consider the eccentric load not lying in the plane of bolted joints. Use M24 of grade 4.6. [12]

   b) Find the ultimate design strength of angle 100×100×10 mm in tension which is connected to a gusset 12 mm thick through 100 mm leg using M20 bolts of product Grade C and property class 4.6 in single line. Assume that the bolt threads are outside the shear plane. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [8]

2. a) Design a built up column 10 m long to carry a factored axial compressive load of 1000 kN. The column is restrained in position but not in direction at both ends. Design the column with connecting system as lacing with bolted or welded connection. Use two channel back to back. Assume steel of grade Fe 410, E250 C and bolts grade 4.6. [12]

   b) Design a slab base for a column ISMB 350 @ 52.4 kg/m to carry a service load of 850 KN. Assume Fe410 grade steel and M25 concrete. [8]

3. a) Design a simply supported beam of span 3.5 m subjected to a factored bending moment of 470 KN-m and factored shear of 180 KN. The beam is laterally unsupported. Steel grade of Fe 410. Check for web bucking, web crippling and maximum deflection is required. [14]

   b) Design a built up salwood column fabricated with 50 mm thick and 250 mm width planks to carry an axial load of 925 kN. The effective length of the column is 3.5 m. Take E = 12700 N/mm$^2$, $f_{cp}$ = 10.6 N/mm$^2$ constant U = 0.6 and q = 1. [6]

4. a) The bottom chord of a truss is subjected to an axial pull of 400 KN. The length of joint available is only 300 mm. Design the tension member using s single equal angle section with requirements of LUG ANGLE if necessary. Use M20 bolts of 4.6 grade and steel as Fe410. [12]

   b) The building is to be constructed in core city area for a 50 years life. The size of the building is over 30 m. The height of the building is 36 m and is classified as 1$^{st}$ category building. Determine the wind pressure at the site and force on the truss. [8]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2071 Bhadra**

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS: 800-2007, IS: 875 (II) IS: 1730-1989 and IS: 809-1989 (Steel tables); IS: 883-1995, (Timber) are allowed.*
- ✓ *Assume suitable data if necessary.*

1. a) An truss ISA 90 × 90 × 12 mm is subjected to the factored tension load of 100 kN. It is to be connected to a gusset using fillet welds at the toe and back. Find the length of welds required so that the centre of gravity of the welds lies in plane of the centre of gravity of angle. Fe410 [10]

   b) Find the ultimate load carrying capacity of 2 ISA 100 × 100 × 8 mm in tension which is connected to both sides of gusset plate 12 mm thick using M16 bolts of property class 5.6 in single line. One shear is in shaft and another is in thread. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]

2. a) A hall measuring 15 m × 6 m consists of beams spaced at 3 m c/c. R.C.C. slab of 110 mm is cast over the beam. The imposed load is 4 kN/m$^2$. The beam is supported on 250 mm wall. Design intermediate beam and check for shear, deflection and lateral stability. [15]

   b) Write about factor of safety and partial safety factors used in steel structures. [5]

3. a) Design a built-up column of the effective length of 5 m to carry an axial load of 900 kN using two channels and single lacing. Design the connections using bolt. The grade of the steel is Fe410. [14]

   b) Explain about elements of plate girders, web and flange splices of plates. [6]

4. a) A timber column 225 × 225 in cross section having an unsupported length of 3 m. Assuming the column to be of sal wood of selected grade, find the safe axial load. [8]

   b) Find the design wind pressure on a sloping roof of span 10 m and pitch ¼. The height of the eves is 6 m above ground. The building is situated in Madras and its permeability is normal. [6]

   c) Design a slab base for a column SC220 to transfer an axial load of 1000 kN. Take Fe410 grade steel and M30 for concrete. [6]

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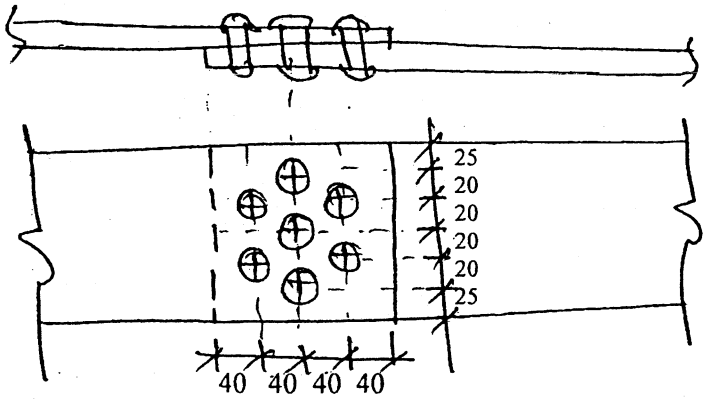
07 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2071 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

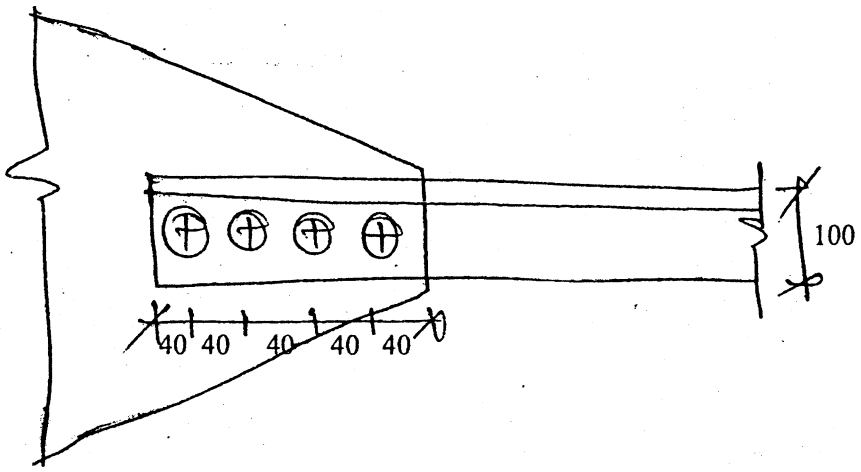
***Subject:*** - Design of Steel and Timber Structures *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Use of IS:800-2007, IS1730-1989 and IS809:1989 (Steel tables); IS883-1995 (timber) are allowed.*
- ✓ *Assume suitable data if necessary.*

1. a) Two plates of 16 mm thick are jointed by M16 bolts of property class 8.6 in a triple staggered lap joint as shown. Show how the joint will fail and calculate efficiency of the joint. Assume Fe410 grade of plate. [10]




b) Longer leg of a ISA 100 × 75 × 8 is connected to a gusset plate of thickness 10 mm by M16 bolts of property class 8.8 as shown. If Fe410 grade steel is used, determine the design tensile strength of the angle. [10]



2. a) Design a simply supported I section to support a moment of 700 kNm. The beam is laterally supported and grade of steel is Fe410. [14]

   b) What do you mean by structural steel? Explain classification of structural steel sections. [6]

3. a) Design a bridge compression member using two channels placed back to back to carry a factorial load of 1200 kN, if effective length of column is 8.5 m. Also design the single racing system using tie bar. [5+7]

   b) Explain about design steps of column bases. [8]

4. a) A high rise building is to be constructed in Kathmandu at city area for a 50 year life, the size of building is over 30 m. The height of building is 36 m and it is classified as 1st category building. Determine the wind pressure at the site and force on truss members. [10]

   b) Design a 5 m long rectangular box column built by 60 mm thick deodar planks to carry ax axial load of 350 kN. [10]

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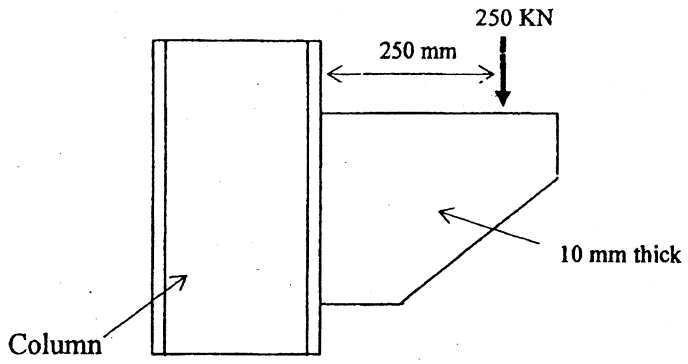
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2071 Magh**

| Exam. | OLD Back (2065 & Earlier Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Timber and Steel Structures *(EG662CE)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ IS 800 - 1984, IS 875 - 1987, IS 883 - 1994 and Structural Steel Section Books are allowed to use.

1. a. Design welded connection between flange of column and a bracket using fillet and but weld loaded as shown in figure. [12]

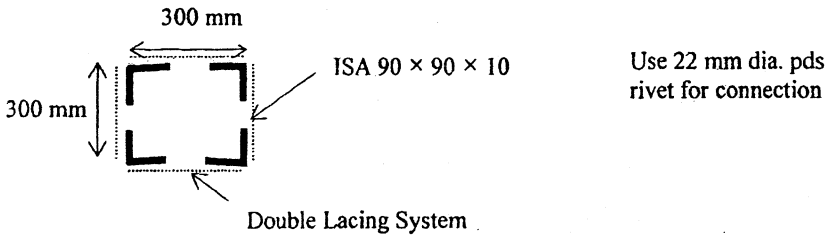



b. Design a fillet welded channel section to act as a tension member carrying an axial tension of 350 KN [8]

2 a. Design a column splice for column sections ISSC 250 and ISSC 220 carrying a load of 500 KN. [7]

b. Design a simply supported beam with a clear span of 5m for bending and shear. Beam carries a uniformly distributed load of 40 KN/m inclusive of self-weight and a point load of 60 KN at mid span from sub beam. The beam is laterally unsupported. [13]

3. Find load carrying capacity of the column made up of four rolled steel angle sections ISA 90 × 90 × 10 as shown in fig. Take height of the column 11m, one end of the column fixed, other end hinged and no sway condition. Also design lateral bracing of column using double lacing system. [20]




4. a. Design a timber column of Sal species to carry the axial load of 45 KN. Unsupported length of column is 3m. [10]

b. What are the different factors, which govern the design of beam?
Specify the types of timber columns according to their slenderness ratio. How the slenderness ratio is defined in solid, built-up and spaced column. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2070 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Steel & Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ ***All*** *questions carry equal marks.*
- ✓ *The figures in the margin indicate* ***Full Marks****.*
- ✓ *Show the results with sketches when and where required.*
- ✓ *IS 800 : 2007 (Code of Practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of Structural Timber in Building) are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) A bridge compression member is built using two channels ISLC 400 @ 45.8 kg/m placed toe to toe. The effective length of the member is 8.0 m. The width over the backs of two channels is 40 cm. The channels are properly connected by lacings. [12]

   i) Calculate the safe load for the member.
   ii) Design the lacing systems using M16 properly class 4.6 grade bolts.

   b) Design the base plate for the column ISHB 450 to carry a factored load of 1400 kN. Take E250 grade of steel and M20 grade of concrete. [8]

2. a) A office hall of clear dimension 18 m × 6 m is provided with 12 cm thick RC slab over rolled steel beams 3 m c/c. A wearing coat of 2 cm thick lime concrete is provided over RC concrete slab. The compression flange would be supported throughout its length by providing grooves in slabs. Design an intermediate beam with the following data. [14]

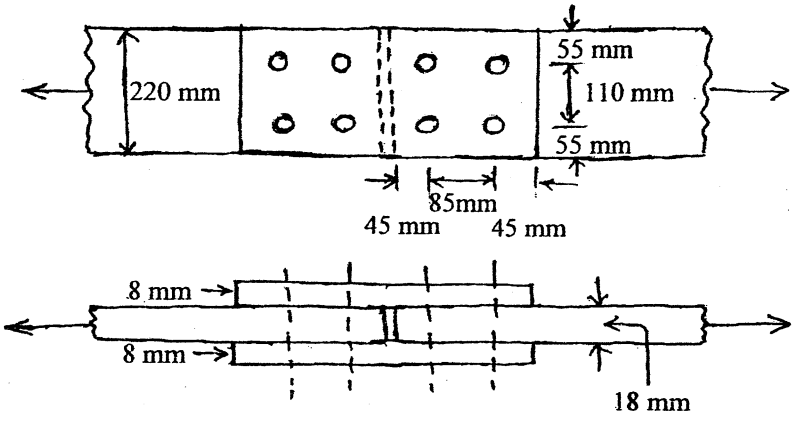
   Live load = 5.5 kN/m$^2$

   Unit wt. of cement concrete = 25 kN/m$^3$

   Unit wt. of lime concrete = 18 kN/m$^3$

   b) Find the design wind pressure on a sloping roof of span 10 m and pitch 1/4. The height of the eaves is 5 m above ground. The building is situated in Delhi and its permeability is normal. [6]

3. a) Two 18 mm thick steel flats are spliced by two 8 mm thick plates with four M18 high strength bolts of property class 10.9. Determine the ultimate design load carrying capacity of the connection (i) if slip is permitted at the ultimate load and (ii) if slip is not permitted at ultimate load. Assume that one shear plane intercepts the threads of the bolts. fy = 250 MPa and fu = 410 MPa. [14]



b) Explain why limit state design method has become more popular than the working stress design method. [6]

4. a) Design a suitable angle section to carry a tensile force of 250 kN (Factored). The end connection is to be done by using (i) fillet welds (ii) bolts. The yield and ultimate strengths of the steel are 250 MPa and 410 MPa, respectively. [12]

b) Differentiate between the terms "factor of safety" and "partial safety factor" in the structural steel design. Design a circular salwood column to be used in an open shed, to carry an axial load of 200 kN. The column is 3.5 m high. [8]

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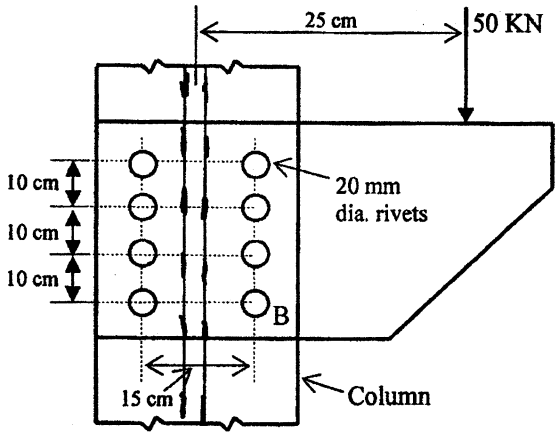
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2070 Magh**

| Exam. | Old Back (2065 & Earlier Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structures *(EG662CE)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ Use of IS: 800-1984; IS: 1730-1989 (Steel Tables); IS: 883–1995 (Timber) and IS: 875 are followed.
- ✓ *Assume suitable data if necessary.*

1. Discuss briefly the principles of working stress design of steel structures. (6)
2. Determine the resultant stress on the rivet B of the eccentric connection shown in figure below. Compare this stress with the allowable rivet value if 20 mm dia. rivets are used. The bracket plate and column flange are both 10 mm thick, and allowable stresses of 102.5 N/mm$^2$ in shear and 236 N/mm$^2$ in bearing may be assumed. (14)




3. A strut in a roof truss carries 80 KN maximum compressive load. Design the member and the end connection if it is to be of single angle section. The centre to centre distance of the member between the fastenings is 3.5 m. (14)
4. Explain, with a neat sketch, the various components of a plate girder. (6)
5. A column is made of one ISHB 300 @58.8 Kg/m, with one plate 400 mm × 12 mm, symmetrically placed on each flange. The column section thus measures 324 mm × 400 mm overall. The column carries an axial load of 2000 KN. The column is to be provided with a base plate resting on concrete base. Design the base plate giving the full details of the connections. Take safe compressive stress in concrete as 4 N/mm$^2$. (14)
6. Describe the procedure for the design of the purlin of a roof truss. (6)
7. Design one sal timber joist of clear span 3.5 m at spacing of 60 cm in a roof. The bearing at each end is 12 cm. The dead load of roof covering is 2.1 KN/m$^2$ and live load is 2.6 KN/m$^2$ (12)
8. Design a tension member using a channel section to carry an axial tension of 300KN. (8)

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2070 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Show the results with sketches when and where required.*
- ✓ *IS 800 : 2007 (Code of practice for general construction in steel), Steel section book, IS 875 and IS 883 : 1994 (Design of structural Timber in Building) are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Design a single angle (unequal angle) to carry a working tensile load of 150 KN, If the end connection is done using fillet welds. The yield and ultimate strength of the steel are 250 MPa and 410 MPa respectively. [10]

   b) Design a single equal angle to carry a compression of 50 KN. The centre to centre distance between the end connections is 2.0 M. Assume that at least two bolts are used for the end connections. [10]

2. a) A building is situated in Birgunj, where the basic wind speed is found to be 60 m/sec. Find the wind pressure for the design of sloping roof of the building having following data: [6]

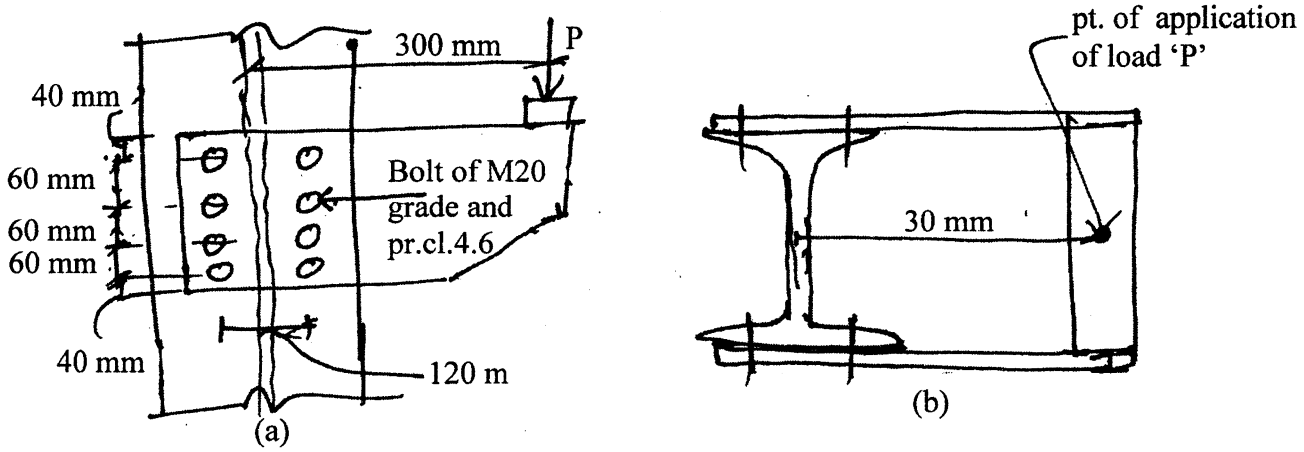
   Angle of slope of roof, $\alpha = 28°$
   Building height ratio, h/w = 0.75
   $K_1 \times K_2 \times K_3 = 0.70$

   b) A simply supported steel beam of 6 m effective span carries a total uniformly distributed load of 46 KN/m (inclusive of self-weight). Design the beam (Fe 410 steel) if the compression flange is restrained throughout the span against lateral bending. Apply all the necessary checks. [14]

3. a) Explain the advantages and disadvantages of steel structures compared to timber structures. [4]

   b) Explain in salient features of the working stress method and limit state method for structural steel design. [4]

   c) If two bracket plates are connected to the flanges of the column SC 250 as shown in figure below find the design load 'P' that can be applied at an eccentricity of 300 mm. [12]




4. a) Design a deodar column 4 m long to carry an axial load of 300 kN. [10]

   b) Design the foundation base for an ISHB 350 column to carry factored load of 120 KN. Assume steel and M20 concrete. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2069 Poush**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III/II | Time | 3 hrs. |

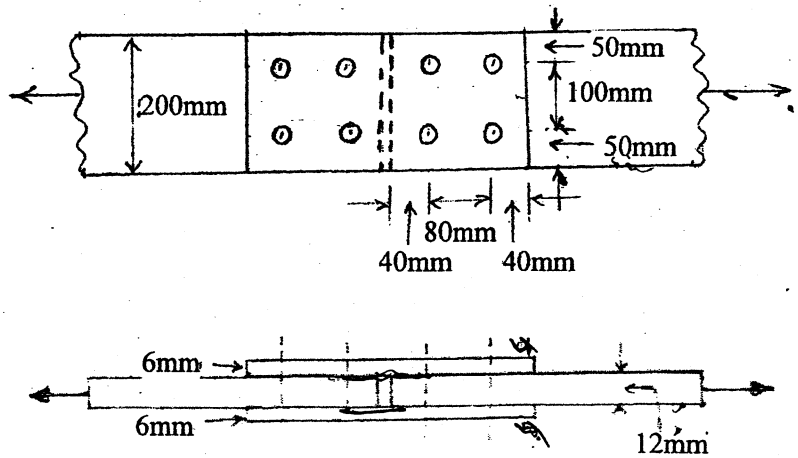
***Subject:*** - Design of Steel and Timber Structures *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS:800-2007, Steel Tables, Is:883-1994 and IS 875-1987 are allowed.*

1. a) Design an I-section purlin for a trussed roof from the following data: [8]

   Span of roof = 12m
   Spacing of truss = 5m
   Spacing of purlins along slope of roof truss = 2m
   Slope of roof truss = 1 vertical, 2 horizontal
   Wind load on roof surface normal to roof = 1000N/m$^2$
   Vertical load from roof sheets, etc = 200N/m$^2$

   b) Two 12mm thick steel flats are spliced by two 6mm thick plates with four M16 bolts of the product grade C and the property class 4.6, Determine the ultimate load carrying capacity of the connection and check cover plate. Take fy = 250MPa and fu = 410MPa. [12]




2. a) Design a laced column 10m long to carry an axial load 800KN. The column is restrained in position but not in direction at both ends. Design the lacing system with welded connections. Design column for channel section placed back-to-back. [16]

   b) Briefly describe about the nail joint used in timber structures. [4]

3. a) What are the basic assumptions in working stress method of steel design. Also mention it demerits. [2+2]

   b) Design a simply supported beam of 6 meter span carrying a reinforced concrete floor capable of providing lateral restraint to the top compression flange. The total UDL is

made up of 80KN dead load including self weight plus 120KN imposed load. Checks for sheat deflection and lateral stability are also necessary. [16]

4. a) Select a suitable angle section to carry a factored tensile force of 170KN assuming single row of 20mm dia bolts take bolt grade 4.6 and E250 grade of steel. [6]

b) How the steel sections are classified according to their moment rotation capacity. [4]

c) A column ISHB 300@ 576.8N/m is to support a load of 1000KN. The column section is to be spliced at height of 2 m. Design the splice plate using 4.6 grade bolts and Fe 410. [10]

5. a) Design a built up salwood column fabricated with 50mm thick and 250mm width planks to carry an axial load of 800KN. The effective length of column is 3.5m. Take $E = 12700N/mm^2$, $f_{cp} = 10.6N/mm^2$ constant U=0.6 and q=1. [8]

b) Design one of the intermediate Deodar timber joists used in the timber roof of a hall from the following data:

Spacing of joists C/C = 50cm
Clear span of the joist = 2.0m
Bearing at each end = 8.0cm
Dead load of roof covering = $2KN/m^2$
Superimposed load on roof = $1.5KN/m^2$

The roofing material consists of wooden planks which support asbestos sheets. The timber is of standard grade and shall be used in inside location. [12]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division.**
**2069 Bhadra**

| Exam. | Regular (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* -Design of Steel and Timber Structural *(CE651)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*
- ✓ *Use of IS:800-2007, Steel tables: IS 883-1994; IS 875:1987 (timber) are allowed.*

1. a) Design a double cover butt joint to transmit a working load of 300KN to connect two flats 100mm wide and 20mm thick using M16 high strength bolts of property class 10.9 if slip is permitted at design load. The cover plates are 12mm thick. Assume that one shear plane intercepts the threads of the bolts. [10]

   b) The center to center distance between the end connections of a discontinuous strut consisting of two L75 75×8 is 3.0m. Calculate the design load carrying capacity in compression if angles are connected to the same side of a gusset by more than one bolt in each angle. The grade of the steel is E250. [10]

2. a) Find the design wind pressure on a slopping roof of span 10 meter and pitch ¼ . The height of eaves is 5 meter above ground. The building is situated in Delhi and it's permeability is normal. Assume $K_1 = 1$; $K_2 = 0.8$; $K_3 = 1$. [6]

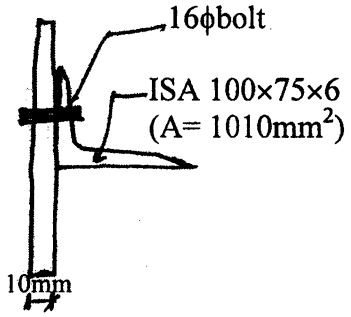
   (b) Design a built-up column of the effective length of 6m to carry an axial load of 1000KN using two channels and laces. Design the connections using welds. The grade of the steel is E250C. [14]

3. a) A beam of effective span 6.0m carries a uniformly distributed load of 30KN/m with a concentrated load of 16KN at mid span. The depth of the beam is limited to 300mm. Design the beam with additional plates to the flanges. Assume that the beam is laterally supported throughout. The grade of steel is E250. M16 bolts of property class 4.6 and product grade C may be used for connection. Checks for shear, deflection and lateral stability are necessary. [16]

   b) Discuss briefly the different types of limit states in steel design. [4]

4. a) Design the base plate for a ISHB 350 column to carry factored load of 1200KN. Take E250 grade of steel and M20 grade of concrete. [10]

   (b) A single unequal angle 100×75×6 is connected to a 10mm thick gusset plate at the ends with six 16mm diameter bolts to transfer tension as shown in figure below. Determine the design tensile strength of the angle assuming that the yield and the ultimate stress of steel used are 250MPa and 410MPa if the gusset is connected to the 100mm leg. Also design connection for its full capacity. [10]




5. (a) Describe design methods and design basis for timber structure. [4]

   (b) Design a 4m long square column of deodar planks to carry an axial load of 350KN. Take outside location and select grade of timber. [12]

   (c) Explain simple timber beam and flitched beam with neat sketches. [4]

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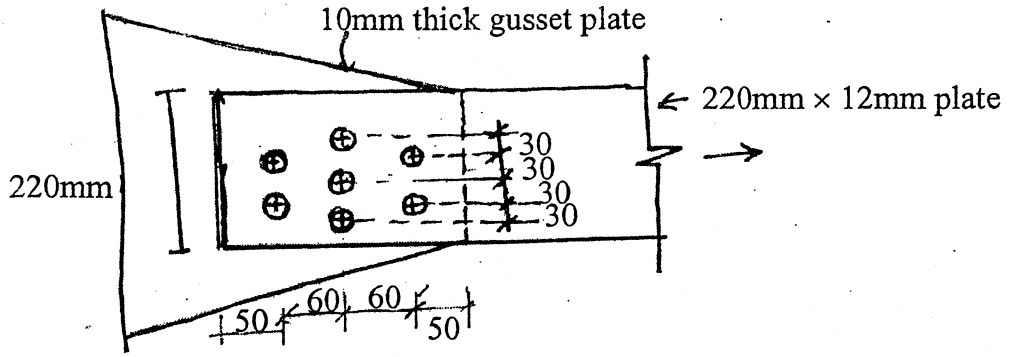
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2068 Bhadra**

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Timber and Steel Structures

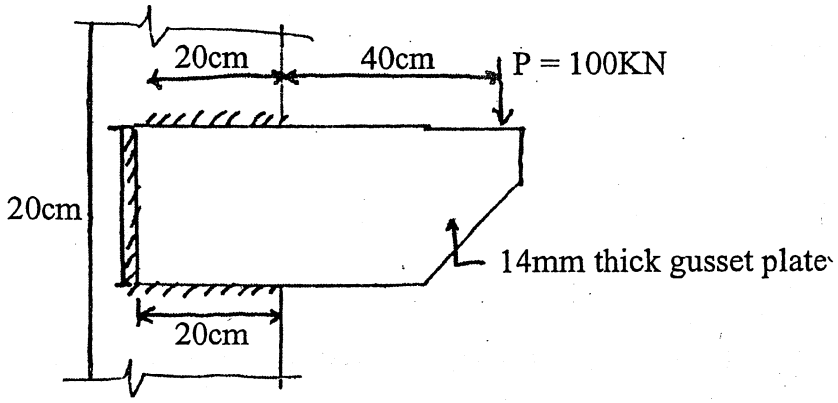
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *IS 800, IS 875, IS 883 and structural steel selection book is allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) A flat plate (220mm × 12mm) is loaded in tension and connected with 10mm thick gusset plate as shown. If the rivets are 20mm dia power driven shop rivets, calculate the maximum tension the flat can carry. [14]




b) Describe the horizontal load resisting system in steel structure building. [6]

2. a) For the electric connection as shown, determine whether the joint is safe or not. Size of the fillet weld is 8mm and load P is equal to 100KN. Assume that permissible shear stress in the weld is 108 MPa. [14]




b) For a steel of yield stress as $f_y$, what are the permissible stresses in tension compression, bending, shear and bearing according to IS 800? [6]

3. a) Design a column to carry an axial load of 800KN using two channels laced together. The length of the column is 6m and is effectively held in position at both ends but not restrained against rotation. [14]

b) Describe the process to find thickness of slab base foundation. Show the sketch. [6]

4. a) Design a beam of 6m span carrying UDL of 20KN/m including self wt. The beam is laterally restrained by a concrete slab and is simply supported at the ends on wall of 350mm width. Check for shear, deflection, web crippling and buckling. [14]

   b) Derive a relation for economical depth of a girder. [6]

5. a) Design a purlin using suitable section for a roof-truss. Span of roof = 10m, spacing of truss is 4m and pitch is1/4. Assume vertical load of 500N/m (including self wt) and wind load 2 KN/m. [10]

   b) If a sal-wood column of 25cm × 25cm has a length of 4m, determine whether the column can carry 200KN axial load and 20KNm bending moment. Assume suitable data if necessary. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2067 Mangsir

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Timber and Steel Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *IS 800, IS 875, IS 883 and structure steel section are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) List the hot rolled steel sections used in practice with sketches. Also discuss the uses of structural steel in building structure. [6]

   b) A 20mm thick plate is jointed by double cover butt joint using a 12mm thick cover plate. The steel of main and cover plate have permissible tensile strength of 150MPa. Determine the strength and efficiency of the joint per pitch of 90cm if 20mm dia close tolerance and turned bolts of property class 5.6 are used. [14]

2. a) Describe the types of weld used in structural joints with sketches. [7]

   b) Design a lap joint for two plates of size 120×10mm and 120mm × 12mm. The permissible stresses for plate in tension and weld are 150 MPa and 108 MPa respectively. [13]

3. a) In a truss bridge, a diagonal consists of a 14mm thick flat carrying a pull of 400KN and connected to a gusset plate by a double cover butt joint. The thickness of each cover plate is 8mm. Determine the number of rivets and width of flat required. [10]

   b) Design a single unequal angle strut to carry a load of 100KN. The angle is connected by its longer leg to a 10mm thick gusset plate. Design if it is connected by two rivets. The length of member is 3m. [10]

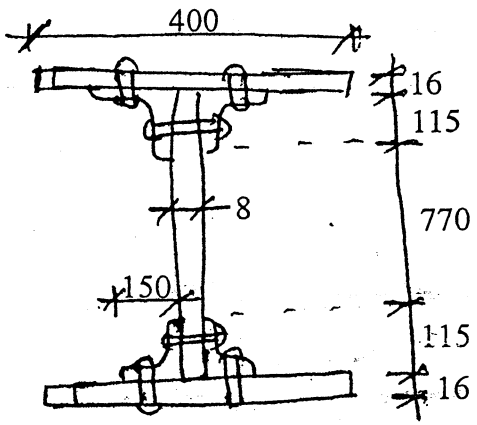
4. a) Find the wind pressure for design of a sloping roof of span 10m and pitch 1 in 4. The height of eaves is 5 m above ground. Assume building permeability as normal and $K_1 = 1.0$, $K_2 = 0.8$ and $K_3 = 1.0$ [6]

   b) A hall of clear dimensions 15m × 6m is provided with 15cm thick concrete slab over rolled steel beam spaced at 3mc/c. A wearing coarse of 2cm thick cement sand punning is proceeded over concrete slab. The compression flange would be supported throughout its length by providing grooves in the slab. Design an intermediate beam with following data. Live load = 4KN/m$^2$, unit wt. of concrete = 24KN/m$^3$, unit wt. of punning = 22KN/m$^3$. Also check the above beam for web crippling and web buckling. [14]

5. a) Design a solid wood column to resist an axial load of 45KN and moment of 5KN-m. The column is made of sal wood and is 2m long. [10]

   b) Design a web splice for the plate girder section, if the moment and shear force applied at the section are 1500KN-m and 200KN respectively. [10]

Dimension in mm.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2066 Magh

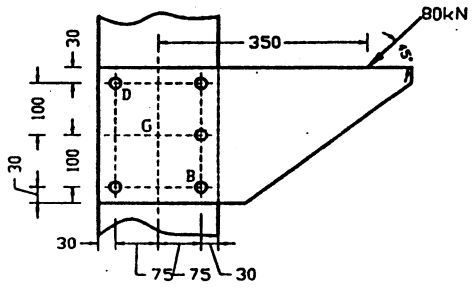
| Exam. | Regular/Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Timber and Steel Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe physical and mechanical properties of mild steel grade structural steel. Also draw the stress-strain curve showing important points. [6]

   b) In the given eccentric riveted connection, subjected to a load of 80 kN, find the resistance offered by the rivet D. [14]




2. a) Explain the salient features of the working stress method and limit state method for structural steel design. [6]

   b) An angle section ISA 50 × 30 × 5mm is used as a tension member with its longer leg connected by one 14mm dia. rivet. Calculate tensile strength of the member. What will be its strength if it is fillet welded? Take $\sigma_{at}$ = 150 MPa. [14]

3. a) Explain about loads and its combination for roof trusses. [6]

   b) Design a square column 4m long to carry an axial load of 250 KN and moment of 5 KN-m. Assume I-grade timber of group A. [14]

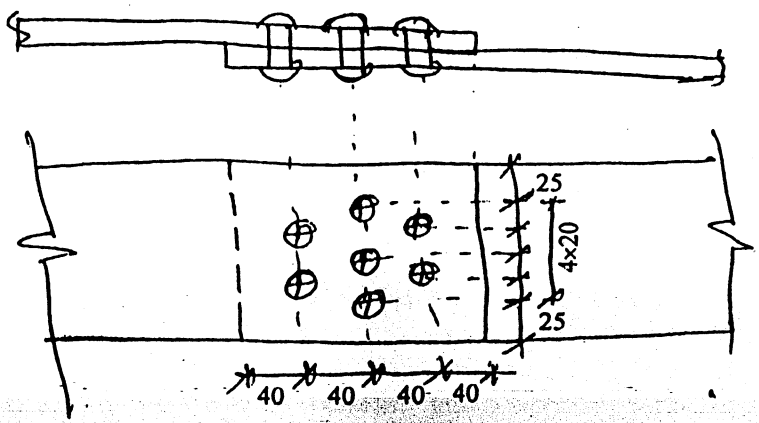
4. a) Design a built-up column composed of two channels placed back to back, carrying an axial load of 1000 KN. Effective length of column is 6.0m. Also design the single lacing system for it. [10]

   b) A beam simply supported over an effective span of 6m, carries a uniformly distributed load of 70 kN/m, inclusive of its own weight. The depth of the beam is restricted to 500mm. Design the beam, assuming that the compression flange of the beam is laterally supported by floor construction. Take fy = 250 N/mm$^2$ and E = 200 GPa. Assume width of support = 200mm. [10]

5. a) Write short notes on: [6]

   i) Plate girder
   ii) Eccentrically loaded column
   iii) Group and grade of structural timber

   b) Two plates 10mm thick are jointed by 20mm diameter power driven field rivets in a triple staggered riveted lap joint. Show how the joint will fail and how much load can be transmitted through the joint. [14]



01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2065 Kartik

| Exam. | | Back | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

***Subject:*** - Design of Timber and Steel Structures

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures are attached herewith.***
- ✓ *IS 800-1994, IS 875-1987, IS 883-1994 and Structural Steel Section Book is allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain the physical meaning of radius of gyration and buckling of compression member. [6]

   b) A double riveted double cover butt joint with the one cover plate wider than the other is shown in figure. If 20mm diameter rivets are used at a pitch of 60mm in the inner raw and at a pitch of 120mm in the outer raw, calculate the strength and efficiency of the joint, The permissible stress, are: $\tau vf = 80$ N/mm$^2$; $\sigma pf = 270$ N/mm$^2$; $\sigma at = 150$ N/mm$^2$. (See figure) [14]

2. a) Design a fillet welded end connection for a tension member ISA 125×75×8mm connected by longer leg to 10mm thick gusset plate. Assume that the steel conforms to IS: 226-1975. [10]

   b) A bracket plate 12mm thick transmits a load of 180 kN at an eccentricity of 25cm to a column section SC 250 through 10-22mm dia. power-driven shop rivets arranged as shown. Check the safety of the joint. (See figure) [10]

3. a) A secondary beam ISLB 400 @ 56.9 kgf/m is to be connected to the web of a main beam ISLB 600 @ 99.5 kgf/m. the end reaction of the secondary beam is 160 kN. Design the connection using 20mm dia pds rivets. [10]

   b) Design a I-section purlin of a roof truss spaced at 6m c/c. The slope of the roof is 30o. The 10m wide building is situated in Birgunj. Purlin is to be placed at an spacing of 1.2m c/c. Take basic wind speed 200 kmph, k1 = 1.05, k2 = 1.15, k3 = 1.0. [10]

4. a) What is meant by efficiency of a joint? How the efficiency of the riveted joint can be increased, explain with reasons. [4]

   b) A bridge compression member is built using two channels ISLC 400 @ 45.7 kgf/m placed back to back. The effective length of the member is 8m the width over the backs of the channel is 30cm. The channels are properly connected by lacings. (i) Calculate the safe load for the member. (ii) Design the lacing system. [16]

5. a) Derive the expression for the economic depth of plate girder. [9]

   b) A timber beam having a clear span of 6 meters carrying a uniformly distributed load of 15 kN/m, excluding self weight of the beam. Assuming the beam to be made of sal wood, design the beam. [11]

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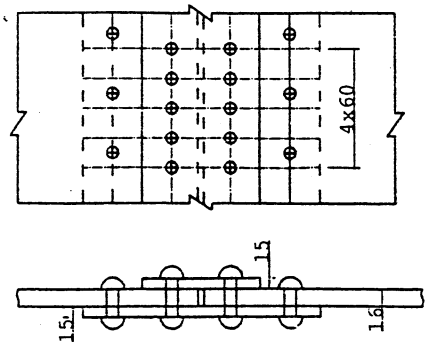
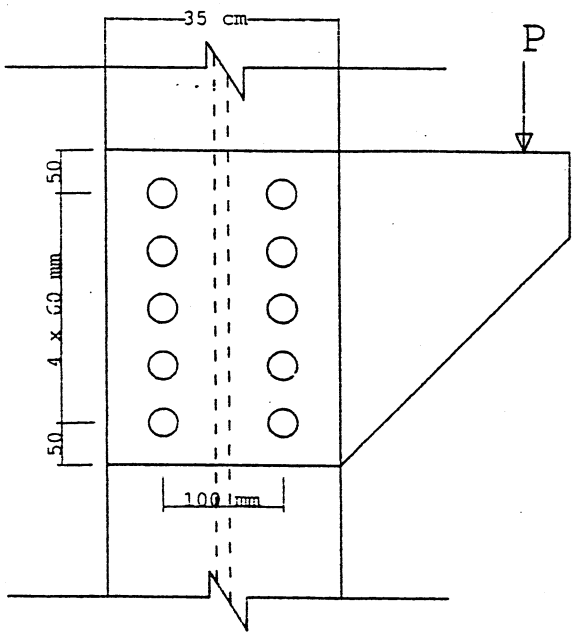



Q.No.1. (b)




Q.No.2. (b)

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2064 Shrawan

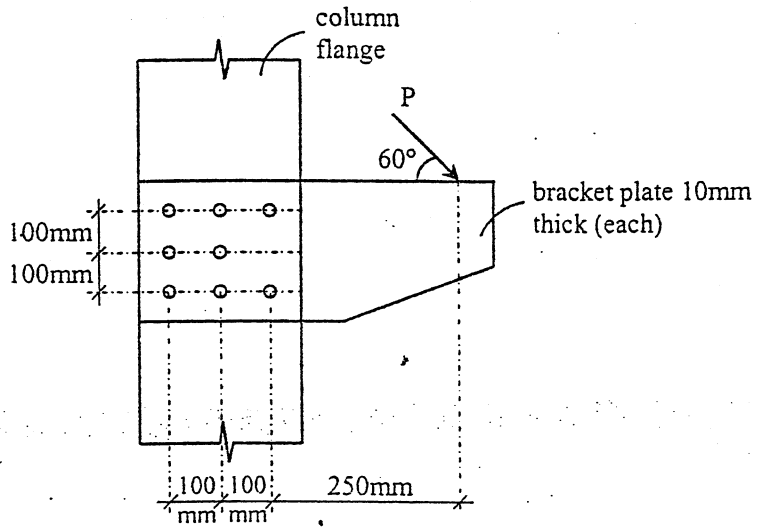
| Exam. | | Back | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Timber and Steel Structures

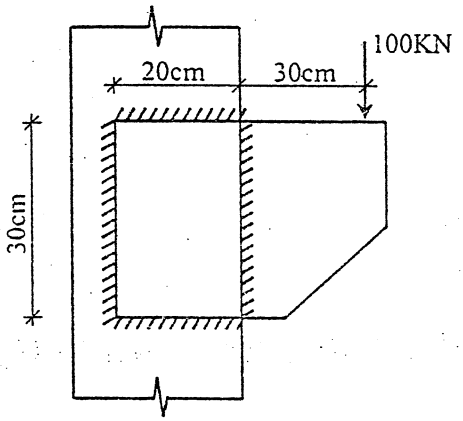
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Indian Standard Code of practices IS:800; Steel Tables and IS:883 are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the assumptions of riveted joint? Explain them. [6]

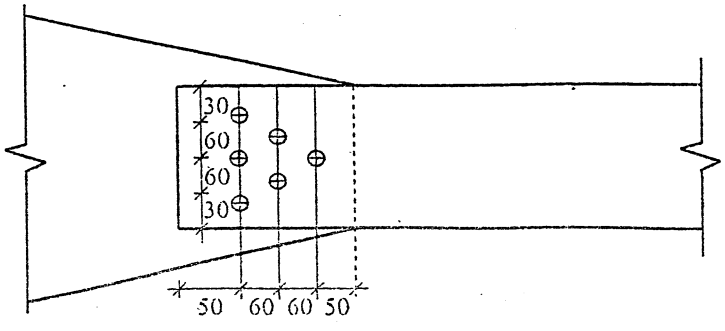
   b) Find the maximum load inclined at 60° to the horizontal (as shown in fig.) the rivet connection can transfer. 20mmϕ power driven shop rivets are used for connections. The bracket plates are attached on both sides of the column flanges. [14]




2. a) Calculate the size of the weld required for the welded bracket loaded as shown. The bracket is welded to flange of I-section by side fillet weld on four sides as shown. [10]




   b) A flat of size 180×10mm is used as tension member in a roof truss. It is connected to a gusset plate by riveting as shown in figure. Calculate the maximum tension the member can carry. The permissible stress in flat is 150 N/mm$^2$ and 18mmϕ pds rivets are used. Find also efficiency of the joint. [10]

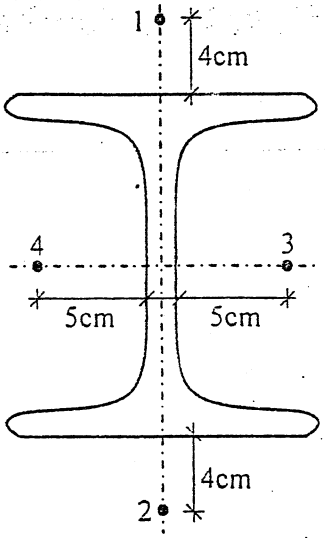


3. a) Explain the steps for design of gusseted base for a column. [8]

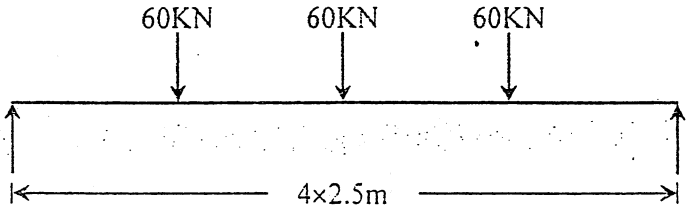
b) Design a column of a height 5m for intermediate floor. The load from upper floor is 320 KN. The column is connected to four beams transfering load as follows. [12]

Beam 1 = 140 KN Beam 2 = 120 KN Beam 3 = 55 KN Beam 4 = 160 KN

The column can be assumed as effectively held in position and restrained against rotation at both ends.



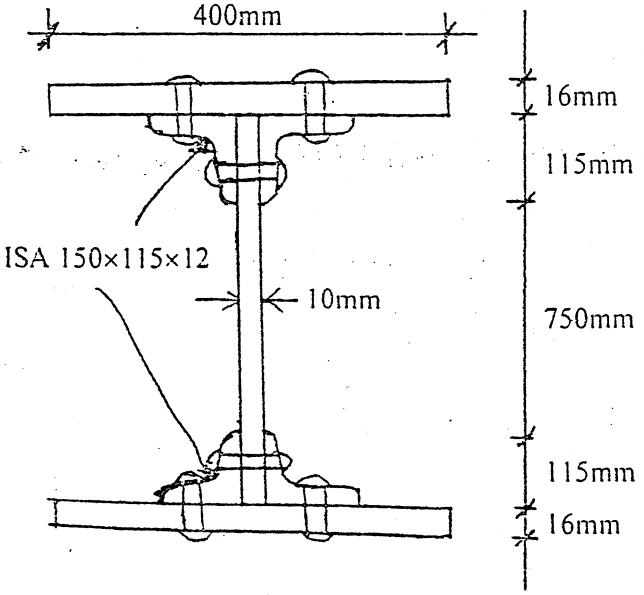

4. a) Design a main floor beam supporting three equidistant floor joist over a span of 10m. Each joists provide lateral restraint to main beams and transmits a load of 60KN on the main beam. [12]




b) Describe the steps for the design of purlins for a sloped roof. [8]

5. a) A compression member is made of 150mm×150mm deodar wood. The member is 2m long. The member is subjected to a compressive load of 16.5KN and a bending moment of 800 N-m. Calculate the safety of the design. Assume appropriate conditions if needed. [10]

b) Design web splice type-II for a plate girder section shown in figure, if the moment and shear force applied at the section are 1500 KN-m and 200 KN respectively. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2063 Kartik

| Exam. | Regular/Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Timber and Steel Structures

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt any **Four** questions.*
- *The figures in the margin indicate **Full Marks**.*
- *Use of IS:800-1984; IS:1730-1989 and IS:808-1989 (steel tables); IS:883-1970 or 1995 (Timber) are allowed.*
- *Assume suitable data if necessary.*

1. a) List the advantages and disadvantages of steel structures. [6]

   b) A beam ISMB 550 rests on 250mm thick brick masonry walls on either side. The clear span of beam is 7.85m. Calculate its effective span. Two floor joists transmit the floor load at a distance of 2.7m from each end of the effective span. Determine the safe load which the two floor joists can transmit individually on the beam. The beam is to be considered effectively restrained laterally by the floor joists. Consider the self weight of the beam in the analysis. Take $f_y = 250$ MPa. [14]

2. a) Explain in brief the four methods of design stated in the design code for the steel framework design. [8]

   b) Design an unequal angle section as a tension member 2m long and with axial tension force of 150KN. Use 12mm thick gusset plate and power driven shop rivets for connection design. Provide check for stress reversal. [12]

3. a) What are the different types of failures of a rivet in case of riveted joint? Explain with sketches. [6]

   b) Design a slab base for concentrically loaded column section consisting of one SC 220 with two cover plates 250×25mm carrying an axial load of 2000KN. The safe bearing capacity of soil is 250KN/m$^2$ and the permissible bearing pressure on concrete is 4 MPa. Provide nominal cleat angle with 20mm power driven shop rivets. Design also the concrete base for it. [14]

4. a) Design a full penetration butt weld to connect a 14mm thick bracket plate to the flange of the column SC 180. The bracket is to transmit a load of 120KN at an eccentricity of 200mm (from the axis of the column) and the steel confirms to IS:226-1975. Consider permissible bending stress in weld as 165 MPa and the permissible equivalent stress as 90% of the yield stress of the steel. [10]

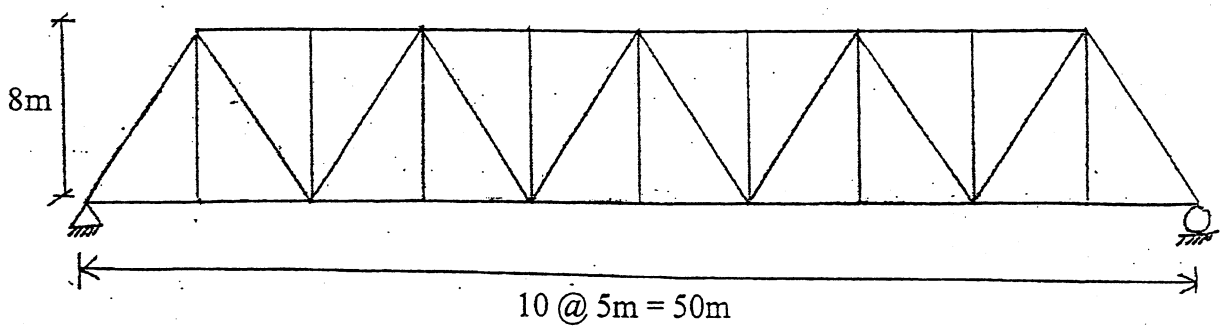
   b) Check the safety of a square column 200mm×200mm in cross-section. The effective length of column is 3m. The axial load and bending moment in the column is 25 KN and 2KN.m respectively. The material is timber sal wood and the column is located inside the building. [10]

5. a) List all the components of a plate girder and indicate them in a drawing. Explain how theoretical cut-off points of flange plates can be carried out graphically? [5+5]

b) The figure below shows a bridge truss of span 50m and height 8m. The two trusses constituting the bridge truss girder are spaced 7m c/c. Estimate the wind load across the bridge if the basic wind speed of the locality is 50 m/sec. The width of the members across the wind is as follows: [10]

i) Bottom and top chords = 500mm
ii) Verticals = 350mm
iii) Diagonals = 400mm
iv) Gusset plates = 15% of total area of the top and bottom chords only.

Calculate solidity ratio and framing ratio. Take design wind speed factors $K_1 \times K_2 \times K_3 = 1.1$; wind force coefficient $C_f = 1.8$ for calculated solidity ratio; wind shielding factor = 0.9 for calculated solidity ratio and framing ratio.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2062 Bhadra

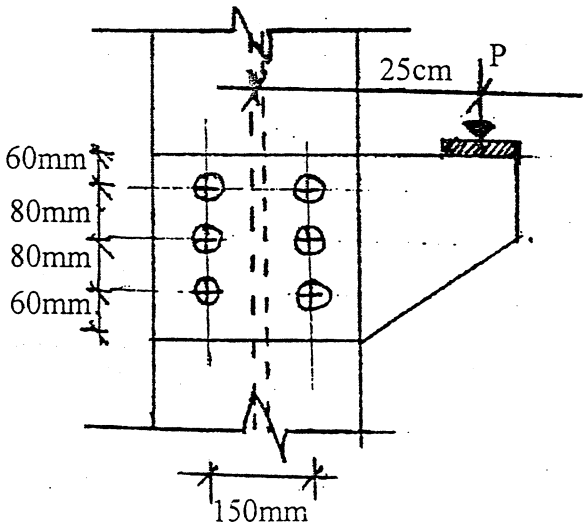
| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structures

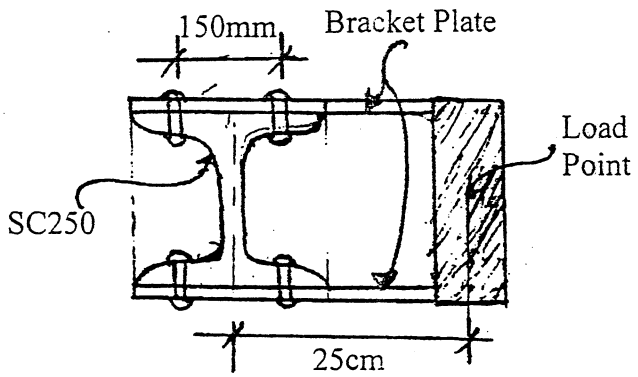
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *IS 800-1984; IS 883-1970 or 1995; IS 875-1987 and structural and steel section book are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Differentiate the riveted joint in comparison to welded joint. State the types of failure of riveted joints with sketch. [5+5]

   b) Bracket plate shown in figure consists of pair of mild steel plates fy 250 MPa riveted to both flanges of a ISLB 300 column. If 20mm dia. power driven shop rivets are used, calculate the maximum load 'P' the bracket can support. The thickness of each bracket plate is 10mm. [10]




**Elevation**




**Sectional Plan**

2. a) Design an unstiffened seated connection for a beam MB 400 transmitting and reaction of 150 KN to the flange of a column section SC 250. Also explain web crippling. [9+4]

   b) A tie member of length 1.6m long in a roof truss has to carry an axial tensile load of 130KN. Design an unequal angle section transferring the load through a joint with the longer leg. (Design of connection not required.) [7]

3. Design a bridge compression member consisting of two channels placed toe-to-toe. The length of member is 8m. It carries a load of 1350KN. Channels are connected by battens. Design the batten system also. [20]

4. a) Critically explain various types of simple beam end connections with sketches. [6]

b) Design the following elements of a plate girder of span 20m (effective) under an uniformly distributed load of 60KN/m including self weight. Elements to be designed: web plate, flange plates, connections between flange and web. Also specify whether stiffeners are required. Adopt steel with fy 250 MPa. (Compression flange of the beam is laterally restrained) [14]

5. a) Design a purlin for a trussed roof from the following data using steel rolled section with fy = 250 MPa. [8]

span of roof = 10m;
truss spacing = 4.0m;
spacing of purlins along the slope = 2.6m;
slope of the roof = 20°;
wind load on roof surface = 800 $N/m^2$;
vertical load (dead + live) = 600 $N/m^2$.

b) Teak wood floor beams are used at spacing of 3m centres. The span of the beam is 5m. The dead load of span is 3 $KN/m^2$ and live load 2 $KN/m^2$. Design the beam if end bearings are 25cm at both ends. Assume necessary data if required. [12]

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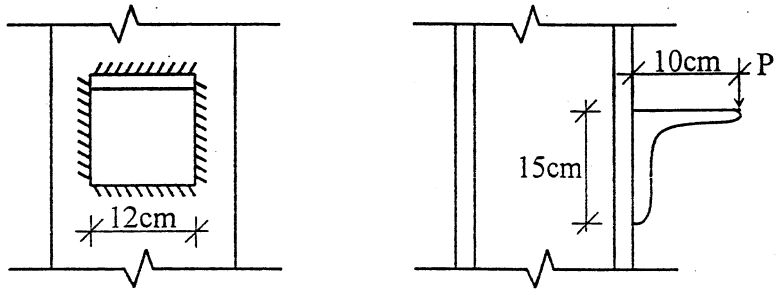
01/2-17 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
2062 Baishakh

| Exam. | Back | | |
|---|---|---|---|
| Level | B.E. | Full Marks | 80 |
| Programme | BCE | Pass Marks | 32 |
| Year / Part | III / II | Time | 3 hrs. |

## *Subject:* - Design of Steel and Timber Structure

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *IS 800-1984, IS 875-1987, IS 883-1970 and structural steel section book are allowed to use.*
- ✓ *Assume suitable data if necessary.*

1. a) Calculate the safe load P to connect a bracket plate to the flange of a column as shown in figure. Weld size is 6mm. [12]




   b) Explain laterally unrestrained beam and method of calculation of permissible compressive stress in bending ($\sigma_{bc}$). [8]

2. a) Design tension member using two angle sections to carry a load of 250kN. Both angles are connected on the same side of the gusset plate. [10]

   b) Design frame connection between a beam section MB 400 and column section SC 250 if the beam is to transmit end reaction of 180 kN. [10]

3. Design a built up column to carry an axial load of 1500KN. The column is built up of I-sections and battened together. The effective length is 8m. [20]

4. Design the main section (i.e. web plate, flange plate and their connections and stiffeners) of a plate girder to following data: [20]

   Span of girder = 16m
   External Dead load = 50kN/m
   and live load = 45 kN/m

5. a) Determine the safe axial load of a timber column having diameter 25cm and length 4m. [10]

   Permissible compressive stress = 1.06 kN/cm$^2$
   Young's modulus of elasticity = 1270 KN/cm$^3$

   b) Explain method of calculating wind load in roof truss. [10]

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