UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: CIVIL*
SUBJECT	:	**STRUCTURAL STEEL AND TIMBER DESIGN III**
CODE	:	**TSS31-1**
DATE	:	SUMMER EXAMINATION 11 NOVEMBER 2019
DURATION	:	12:30 – 16:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	108
EXAMINER	:	MR C BRUWER
MODERATOR	:	MR B RAATH
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	THIS IS A PARTIAL OPEN BOOK TEST, THE FOLLOWING IS ALLOWED: • SANS 10162 • SANS 10160 • STEEL TABLES • ADDITIONAL STEEL TABLES • 2 PAGES WITH STUDENT NOTES
REQUIREMENTS	:	PROGRAMABLE POCKET CALCULATORS ALLOWED.

QUESTION 1

The figure below show a truss with pin-jointed members subjected to the following point loads:

- Nominal point load at B: Permanent (Dead) = 178 kN
  Imposed (Live) = 112 kN
- Neglect the own weight of the structure.

Answer the following questions whilst determining if members AD and AE can resist the ultimate forces.

- 1.1 Determine the ultimate forces in elements AD and AE (4)
- 1.2 Check if the compression member (bolted on the one end and welded on the other). is adequate to resist the generated force by investigating the following:
  - 1.2.1 Slenderness limits (5)
  - 1.2.2 Local buckling (3)
  - 1.2.3 Member buckling due to torsional-flexural buckling (9)
  - 1.2.4 Member buckling due to flexural buckling (2)
  - 1.2.5 Compare the minimum compression resistance force to the ultimate compression force and comment. (1)
- 1.3 Check if the tension member (bolted on the one end and welded on the other) is adequate to resist the generated force by investigating the following:
  - 1.3.1 Slenderness limit (2)
  - 1.3.2 Yielding failure (1)

  Bolted side of the element
  - 1.3.3 Bolt hole layout is given below, check if it meets the minimum requirements (6)
  - 1.3.4 Bolt shear, also check for reduction of long lap splices (4)
  - 1.3.5 Bearing resistance of the member (2)
  - 1.3.6 Fracture failure (2)
  - 1.3.7 Tension fracture and shear fracture (4)
  - 1.3.8 Tension fracture and shear yielding (4)

  Welded side of the element
  - 1.3.9 Weld shear failure (3)
  - 1.3.10 Fracture failure (5)

  Compare minimum tensile resistance against ultimate tensile force.
  - 1.3.11 Determine and name the minimum tensile resistance force and compare it to the ultimate tensile force and comment. (2)

Use the following information:

- All members are 100x100x10 Equal Angle, sawn to length, grade 350W steel. r_o = 54.1 mm, $C_w = 45.3 \times 10^6$ mm^6 and $\Omega = 631.8 \times 10^{-3}$
- All bolts are 16mm fully threaded Class 8.8 bolts. One line of 7 bolts. End distance is 30mm, pitch is 55mm and edge distance is 25mm.
- All holes are drilled.
- Parallel weld (6mm E70XX) 90 mm long on both sides and transvers weld on the end of element
- Connection plates are 350W steel and 14mm thick

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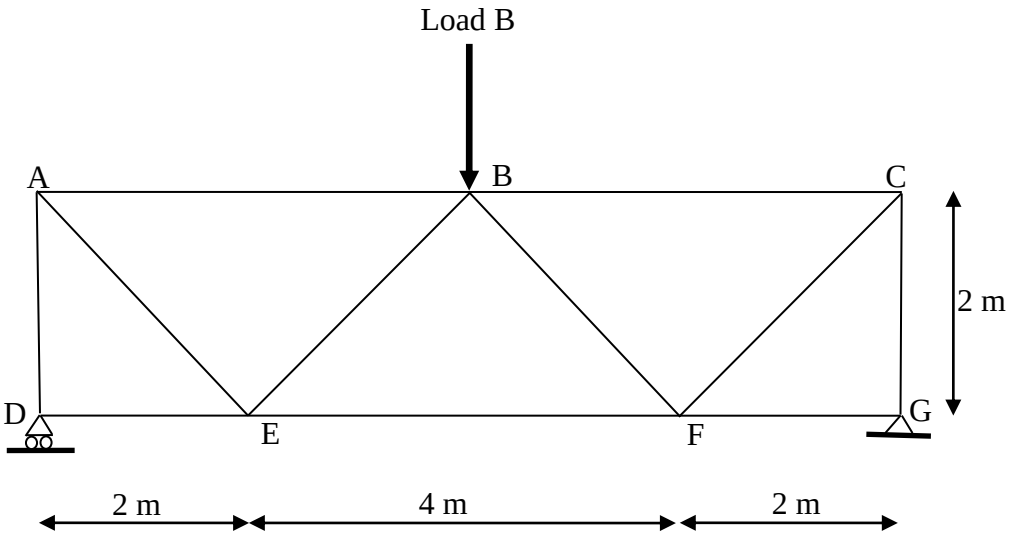

QUESTION 2

Check if a 50x100 mm timber member (3.2m long) which is part of a truss spanning 6.5 m is adequate to resist an ultimate tensile force of 8.9 kN by:

- 2.1 Check the maximum slenderness ratio and maximum slenderness value (6)
- 2.2 Determining the tensile resistance of the member (11)
- 2.3 Compare the resistance force to the ultimate force (1)

Additional notes:

- The tensile force is parallel to the grain of the solid SA pine, grade 06.
- The tie is connected by means of 4 x 16 mm bolts spaced in 2 rows and 2 lines
- The ultimate tensile force results from the following loads applied permanently onto the truss:
  - Ultimate dead load = 3.5 kN/m^2
  - Ultimate live load = 2.0 kN/m^2
  - Ultimate wind load = 2.5kN/m^2
- The trusses will be spaced at 700mm apart
- The member is treated with a water-borne preservative or a fire retardant
- The moisture content will not exceed 20%

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QUESTION 3

The figure below shows a beam A-E (406x178x67 I section Grade 350W) simply supported at A and E with a lateral support the compression flange at D. Beam A-E is carrying two beams at B and C, attached to the bottom flange, which impose the following loads:

- Nominal fixed point load at B: Permanent (Dead) = 25 kN
  Imposed (Live) = 25 kN
- Nominal fixed point load at C: Permanent (Dead)= 45 kN
  Imposed (Live) = 35 kN
- Nominal fixed point load at D: Permanent (Dead)= 25 kN
  Imposed (Live) = 25 kN
- Neglect the beam's own weight

Determine if the beam (both segments) is adequate to support the applied loads by checking the following:

- 3.1 Determine the ultimate loads (3)
- 3.2 Draw the ultimate shear force and bending moment diagrams (5)
- 3.3 Determine the class of the beam (6)
- 3.4 Bending for segment A-D
  - 3.4.1 Determine the moment of resistance (9)
  - 3.4.2 Compare the ultimate moment to the moment of resistance (1)
- 3.5 Shear
  - 3.5.1 Determine shear resistance (6)
  - 3.5.2.Compare the ultimate shear resistance to shear resistance (1)

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