UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: CIVIL*
SUBJECT	:	**STRUCTURAL STEEL AND TIMBER DESIGN III**
CODE	:	**TSS31-1**
DATE	:	SUMMER EXAMINATION 1 NOVEMBER 2014
DURATION	:	(SESSION 1) 8:30 – 12:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	115
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 • 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 = 50 kN
  Imposed = 30 kN
- Nominal point load at C: Permanent = 60 kN
  Imposed = 20 kN

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

- 1.1 Determine the ultimate forces in elements AB and AD (8)
- 1.2 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:
  - 1.2.1 Slenderness limit (2)
  - 1.2.2 Yielding failure (1)

  Bolted side of the element
  - 1.2.3 Bolt hole layout is given below, check if it meets the minimum requirements (6)
  - 1.2.4 Bolt shear, also check for reduction of long lap splices (4)
  - 1.2.5 Bearing resistance of the member (3)
  - 1.2.6 Fracture failure (3)
  - 1.2.7 Tension fracture and shear fracture (4)
  - 1.2.8 Tension fracture and shear yielding (4)

  Welded side of the element
  - 1.2.9 Weld shear failure (2)
  - 1.2.10 Fracture failure (5)

  Compare minimum tensile resistance against ultimate tensile force.
  - 1.2.11 Determine and name the minimum tensile resistance force and compare it to the ultimate tensile force and comment. (2)
- 1.3 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:
  - 1.3.1 Slenderness limits (6)
  - 1.3.2 Local buckling (2)
  - 1.3.3 Member buckling due to torsional-flexural buckling (8)
  - 1.3.4 Member buckling due to flexural buckling (2)
  - 1.3.5 Compare the minimum compression resistance force to the ultimate compression force and comment. (1)

Use the following information:

- All members are 120x120x15 Equal Angle, gas cut to length, grade 350W steel. r_o=64.4mm, $C_w = 244x10^6mm^6$ and Ω=0.6325
- All bolts are 16mm fully threaded Class 8.8 bolts. One line of 3 bolts. End distance is 25mm, pitch is 45mm and edge distance is 25mm.
- All holes are drilled.
- Transverse weld (5mm E70XX) on the end and a 20mm long parallel weld.
- Connection plates are 300W steel and 16mm thick

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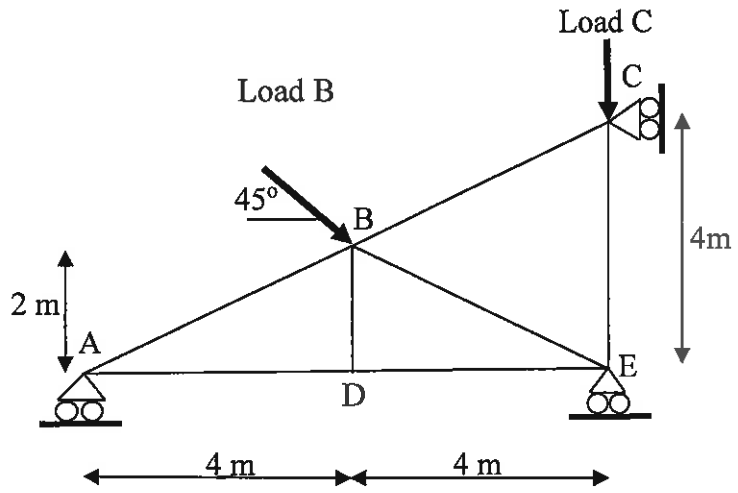

QUESTION 2

The figure below shows a beam ABCD (305x165x46 I section Grade 350W) simply supported at A and C, subjected to the following loads:

- Nominal point load at B: Permanent = 18 kN/m
  Imposed = 16 kN/m
- Nominal point load at D: Permanent = 4 kN/m
  Imposed = 6 kN/m
- Neglect the own weight of the member

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

- 2.1 Determine the ultimate loads (2)
- 2.2 Draw the ultimate shear force and bending moment diagrams (4)
- 2.3 Determine the class of the beam (4)
- 2.4 Bending for section A-C
  - 2.4.1 Determine the moment of resistance (9)
  - 2.4.2 Compare the ultimate moment to the moment of resistance (1)
- 2.5 Bending for section C-D
  - 2.5.1 Determine the moment of resistance (5)
  - 2.5.2 Compare the ultimate moment to the moment of resistance (1)
- 2.6 Shear
  - 2.6.1 Determine shear resistance (5)
  - 2.6.2.Compare the ultimate shear resistance to shear resistance (1)

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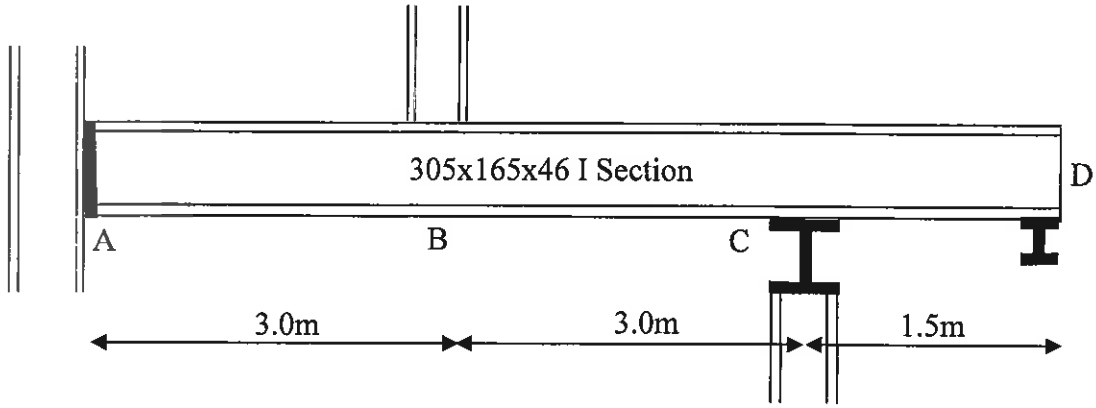

QUESTION 3

The roof of a building consists of timber trusses which span 6m and are placed 610mm centre to centre. The trusses has been analysed and the ultimate tensile force in the lower tie member of the truss is 13kN and is made up of the following loads:

- Ultimate dead load = 1.9kN/m^2
- Ultimate live load = 1.5kN/m^2
- Ultimate wind load = 4.8kN/m^2

Check the following:

- 3.1 The slenderness ratio and slenderness value (10)
- 3.2 Determining the resistance force of the member (9)
- 3.3 Compare the resistance force to the ultimate applied force of 13kN (1)

Additional notes:

- The tension force is parallel to the grain of the pine plank.
- This truss member will have to support the maximum loads, given above, in the long term
- The member will be bolted to the connecting members by means of 4x12mm bolts all in one line.
- The SA pine plank is not treated with any preservatives

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