UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: CIVIL*
SUBJECT	:	**STRUCTURAL STEEL AND TIMBER DESIGN III**
CODE	:	**TSS31-1**
DATE 2013	:	SUMMER SUPPLMENTARY EXAMINATION 2 DECEMBER 2014
DURATION	:	(SESSION 2) 11:30 – 15:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	108

EXAMINER	:	MR C BRUWER
MODERATOR	:	MR B. RAATH
NUMBER OF PAGES	:	4 PAGES

REQUIREMENTS	:	2 EXAMINATION SCRIPTS PER STUDENT
INSTRUCTIONS	:	THIS IS A PARTIAL OPEN BOOK EXAMINATION, THE FOLLOWING IS ALLOWED: • 2 PAGES WRITTEN ON BOTH SIDES WITH STUDENT'S OWN NOTES • SANS 10162-1 • SANS 10160-1 • STEEL TABLES WITH 2 PAGES OF ADDITIONAL SECTIONAL PROPERTIES • PROGRAMMABLE POCKET CALCULATOR

QUESTION 1

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

- Vertical nominal point load at B: Permanent = 10 kN
  Wind = 8 kN
- Horizontal nominal point load at B: Wind = 6 kN
- Vertical nominal point load at C: Permanent = 5 kN
  Wind = 4 kN
- Horizontal nominal point load at C: Wind = 5 kN
- Vertical nominal point load at D: Permanent = 10 kN
  Wind = 9 kN
- Horizontal nominal point load at D: Wind = 2 kN

Determine if members DE and HE can resist the ultimate forces by answering the following questions:

- 1.1 Determine the ultimate forces in elements DE and HE. (15)
- 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 meet 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 (2)
  - 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)

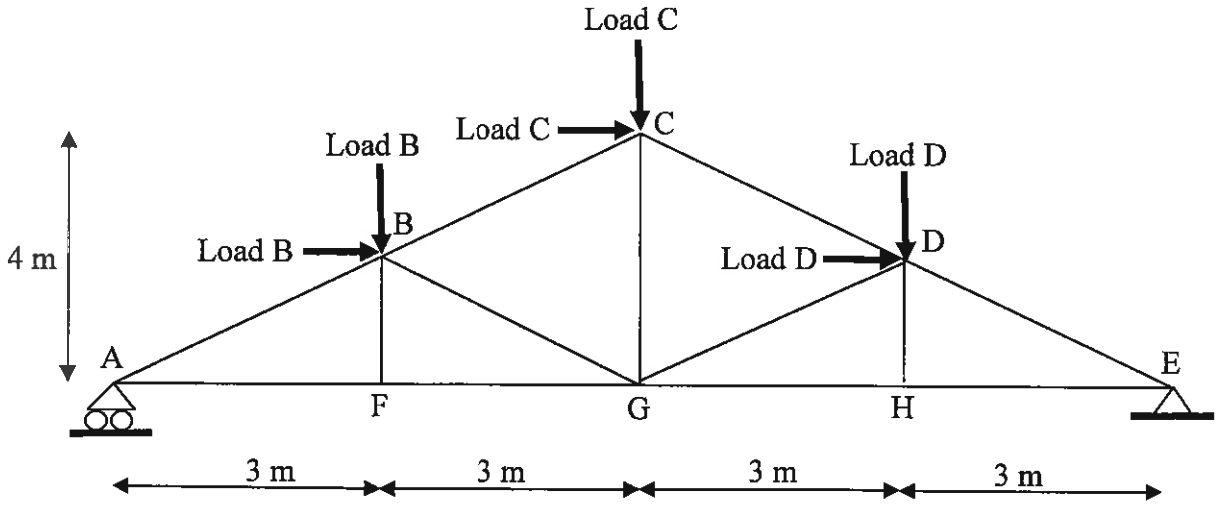
  Compare minimum tensile resistance against ultimate tensile force.
  - 1.2.11 Determine and name the minimum tensile resistance force and compare it to the ultimate tensile force and comment. (2)
- 1.3 Check if the compression member (bolted on the one end and welded on the other) is adequate to resist the generated force by investigating the following:
  Design the element as pinned at both ends.
  - 1.3.1 Slenderness limits (5)
  - 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 100x100x10 Equal Angle, sawn to length, grade 350W. r_o=54.1mm, $C_w = 45.3x10^6 mm^6$ and Ω=0.6318
- All bolts are 16mm fully threaded Class 8.8 bolts. One line of 2 bolts. End distance is 25mm, pitch is 45mm and edge distance is 25mm.

- All holes are drilled.
- Parallel weld (5mm E70XX) is 40mm long.
- Connection plates are 300W steel and 16mm thick

[68]



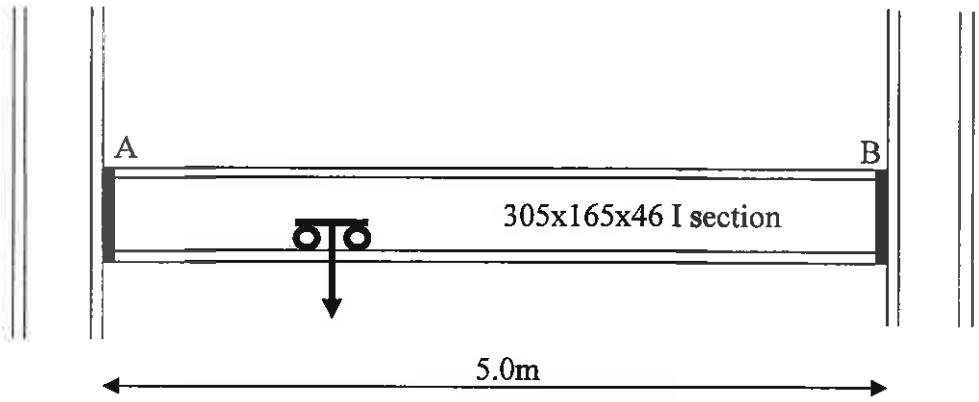
QUESTION 2

The figure below shows a crane beam (305x165x46 I section, Grade 350W) connected to columns on both ends by means of end plates. The supports can be considered as simply supported. The ultimate load (180kN) can move along the entire beam by means of a trolley. Ignore the own weight of the beam.

Check if the beam is adequate to support the imposed ultimate loads by considering the following:

- 2.1 Bending
  - 2.1.1 Determine the maximum ultimate bending moment (1)
  - 2.1.2 Determine class of the beam (4)
  - 2.1.3 Determine the critical elastic moment (4)
  - 2.1.4 Determine the moment resistance (4)
  - 2.1.5 Compare the moment resistance to the ultimate bending moment (1)
- 2.2 Shear
  - 2.2.1 Determine the maximum shear force (1)
  - 2.2.2 Determine the shear resistance of the beam (5)
  - 2.2.3 Compare the shear resistance to the ultimate shear force (1)

[21]



QUESTION 3

Check if a simply supported SA pine solid beam (75x200mm grade 10) spanning 3m is adequate to resist the load given below. The beam is not laterally supported along the length. Determine the following:

- 3.1 The ultimate generated moment (2)
- 3.2 The moment resistance of the member (16)
- 3.3 Compare the moment resistance of the beam to the ultimate moment and comment (1)

Additional notes:

- Check for flexure only.
- The nominal loads to be carried by the simply supported beam over the complete span consist of the following:
  - Permanent UDL = 1.25kN/m
  - Imposed UDL = 1.5kN/m
- Neglect the own weight of the timber beam.
- The timber beam will carry the above specified loads permanently.
- The member is treated with a water-borne preservative

[19]