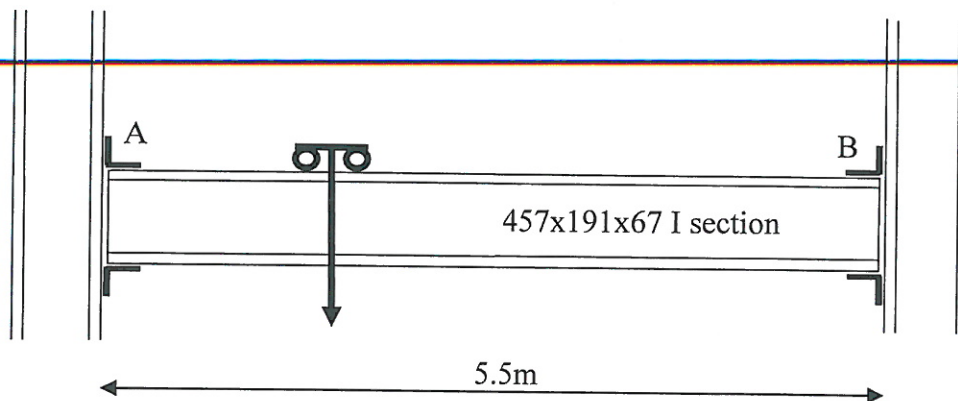|		
PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: CIVIL*
SUBJECT	:	**STRUCTURAL STEEL AND TIMBER DESIGN III**
CODE	:	**TSS31-1**
DATE	:	SUMMER SSA EXAMINATION 2017 10 JANUARY 2017
DURATION	:	(SESSION 2) 11:30 – 15:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	110
EXAMINER	:	MR C BRUWER
MODERATOR	:	MR B. RAATH
NUMBER OF PAGES	:	4 PAGES
REQUIREMENTS	:	2 EXAMINATION SCRIPTS PER STUDENT
INSTRUCTIONS	:	THIS IS A PARTIAL OPEN BOOK EXAMINATION. THE FOLLOWING IS ALLOWED:

- 2 x A4 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 shows a crane beam (457x191x67 I section, Grade 350W) connected to columns on both ends by means of cleats. The supports can be considered as simply supported. A nominal live load of 110 kN 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:

- 1.1 Bending
  - o 1.1.1 Determine the maximum ultimate bending moment   (2)
  - o 1.1.2 Determine the class of beam   (6)
  - o 1.1.3 Determine the critical elastic moment   (5)
  - o 1.1.4 Determine the moment resistance   (5)
  - o 1.1.5 Compare the moment resistance to the ultimate bending moment   (1)
- 1.2 Shear
  - o 1.2.1 Determine the maximum shear force   (1)
  - o 1.2.2 Determine the shear resistance of the beam   (5)
  - o 1.2.3 Compare the shear resistance to the ultimate shear force   (1)

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457x191x67 I section

5.5m

QUESTION 2

The figure below show a truss with pin-jointed members subjected to the following point loads:
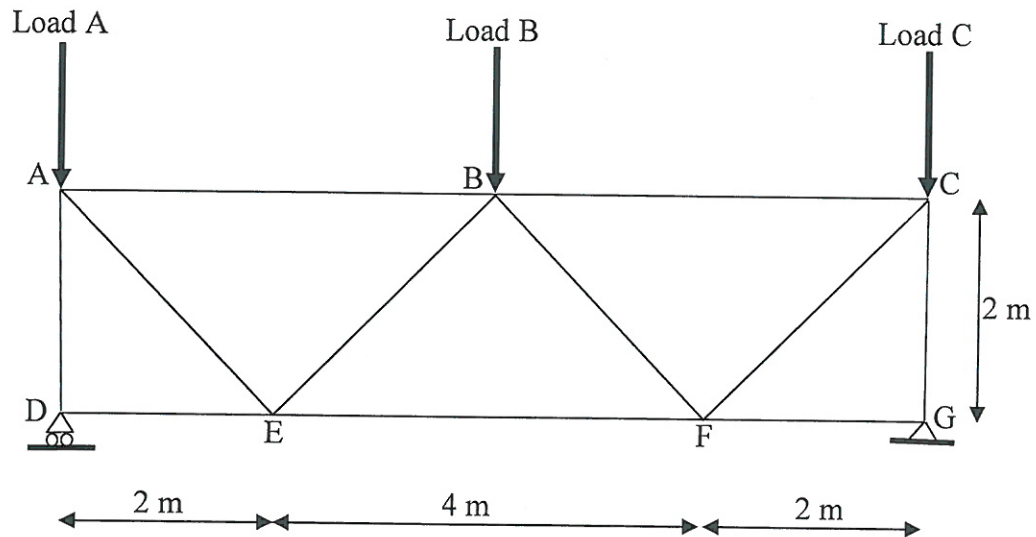
- Nominal point load at A: Permanent (Dead) = 25 kN
  - Imposed (Live) = 25 kN
- Nominal point load at B: Permanent (Dead) = 35 kN
  - Imposed (Live) = 20 kN
- Nominal point load at C: Permanent (Dead) = 45 kN
  - Imposed (Live) = 55 kN
- Neglect the own weight of the structure.

Answer the following questions whilst determining if members AD and AE can resist the ultimate forces.
- 2.1 Determine the ultimate forces in elements AD and AE   (7)
- 2.2 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:
  - o 2.2.1 Slenderness limits   (5)
  - o 2.2.2 Local buckling   (3)
  - o 2.2.3 Member buckling due to torsional-flexural buckling   (9)
  - o 2.2.4 Member buckling due to flexural buckling   (2)
  - o 2.2.5 Compare the minimum compression resistance force to the ultimate compression force and comment.   (1)
- 2.3 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:
  - o 2.3.1 Slenderness limit   (2)
  - o 2.3.2 Yielding failure   (1)
  - Bolted side of the element
  - o 2.3.3 Bolt hole layout is given below, check if it meets the minimum requirements   (6)
  - o 2.3.4 Bolt shear, also check for reduction of long lap splices   (5)
  - o 2.3.5 Bearing resistance of the member   (3)
  - o 2.3.6 Fracture failure   (3)
  - o 2.3.7 Tension fracture and shear fracture   (4)
  - o 2.3.8 Tension fracture and shear yielding   (4)
  - Welded side of the element
  - o 2.3.9 Weld shear failure   (2)
  - o 2.3.10 Fracture failure   (4)
  - Compare minimum tensile resistance against ultimate tensile force.
  - o 2.3.11 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 80x80x8 Equal Angle, sawn to length, grade 350W steel. r_0 = 43.3 mm, C_w = 11.3x10^6 mm^6 and Ω=630.3x10^{-3}
- All bolts are 16mm fully threaded Class 8.8 bolts. One line of 5 bolts. End distance is 30mm, pitch is 55mm and edge distance is 25mm.
- All holes are drilled.
- Transverse weld (8mm E70XX) on the end of the member.
- Connection plates are 350W steel and 14mm thick   [63]

QUESTION 3

Determine if a simply supported SA Pine solid beam (75 x 300 grade 10) spanning 3.5m is adequate to resist the load given below. The beam is laterally supported along the entire compression edge.

Determine the following:

- 3.1 The maximum generated ultimate moment and ultimate shear force   (4)
- 3.2 The bending resistance of the beam   (11)
- 3.3 Shear resistance of the beam   (4)
- 3.4 Compare the moment and shear resistance of the beam to the ultimate generated moment and shear.   (2)

Additional notes:

- The beams are spaced at 1 m centres
- The nominal uniformly distributed loads over the entire span of the beam is:
  - Permanent (Dead) UDL = 3.0kNm (Inclusive of the beam's own weight)
  - Imposed (Live) UDL = 4.2kNm
- This timber beam will support the above specified loads permanently.
- The SA pine beam is treated with preservatives

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