PROGRAM	:	**B.ENG TECH** **ENGINEERING: CIVIL**
SUBJECT	:	**STRUCTURAL STEEL AND TIMBER DESIGN III**
CODE	:	**SSDCIA3**
DATE	:	WINTER SUPPLEMENTARY EXAMINATION ? JULY 2019
DURATION	:	(SESSION 1) 8:30 – 12:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	103
EXAMINER	:	MR C BRUWER
MODERATOR	:	MR G ROBBERTS
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

Figure A 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 (cable hanger) : Permanent (Dead) = 55 kN
  Imposed (Live) = 45 kN
- Nominal fixed point load at C (cable hanger) : Permanent (Dead)= 85 kN
  Imposed (Live) = 65 kN
- The beam at D has no load
- Include the beam's own weight

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

- 1.1 Determine the ultimate loads (3)
- 1.2 Draw the ultimate shear force and bending moment diagrams (6)
- 1.3 Determine the class of the beam (6)
- 1.4 Bending for segment A-D
  - 1.4.1 Determine the moment of resistance (9)
  - 1.4.2 Compare the ultimate moment to the moment of resistance (1)
- 1.5 Bending for segment D-E
  - 1.5.1 Determine the moment of resistance (5)
  - 1.5.2 Compare the ultimate moment to the moment of resistance (1)
- 1.6 Shear
  - 1.6.1 Determine shear resistance (6)
  - 1.6.2.Compare the ultimate shear resistance to shear resistance (1)

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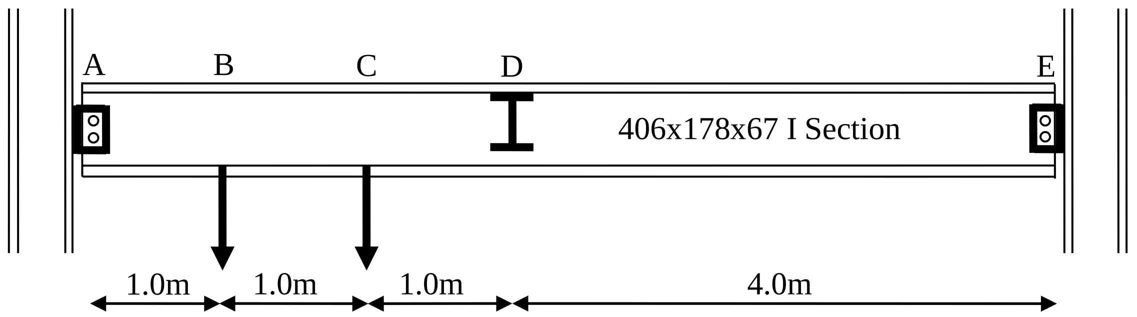

Figure A

QUESTION 2

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

- Nominal point load at F: Permanent (Dead) = 40 kN
  Imposed (Live) = 35 kN
- Nominal point load at G: Permanent (Dead) = 50 kN
  Imposed (Live) = 55 kN
- Neglect the own weight of the structure.

Answer the following questions whilst determining if members BF and CF can resist the ultimate forces.

- 2.1 Determine the ultimate forces in elements BF and CF (8)
- 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:
  - 1.2.1 Slenderness limits (6)
  - 1.2.2 Local buckling (2)
  - 1.2.3 Member buckling due to torsional-flexural buckling (8)
  - 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)
- 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:
  - 2.3.1 Slenderness limit (2)
  - 2.3.2 Yielding failure (1)

  Bolted side of the element
  - 2.3.3 Bolt hole layout is given below, check if it meets the minimum requirements (6)
  - 2.3.4 Bolt shear, also check for reduction of long lap splices (5)
  - 2.3.5 Bearing resistance of the member (3)
  - 2.3.6 Fracture failure (3)
  - 2.3.7 Tension fracture and shear fracture (4)
  - 2.3.8 Tension fracture and shear yielding (4)

  Welded side of the element
  - 2.3.9 Weld shear failure (3)
  - 2.3.10 Fracture failure (5)

  Compare minimum tensile resistance against ultimate tensile force.
  - 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 100x100x15 Equal Angle, sawn to length, grade 350W steel. r_o=53.0mm, $C_w = 0.14 \times 10^9 mm^6$ and Ω=0.63
- All bolts are 20mm fully threaded Class 8.8 bolts. One line of 5 bolts. End distance is 30mm, pitch is 55mm and edge distance is 30mm.
- All holes are drilled.
- Transverse weld (8mm E70XX) on the end and a 105mm long parallel welds on both sides.
- Connection plates are 350W steel and 16mm thick

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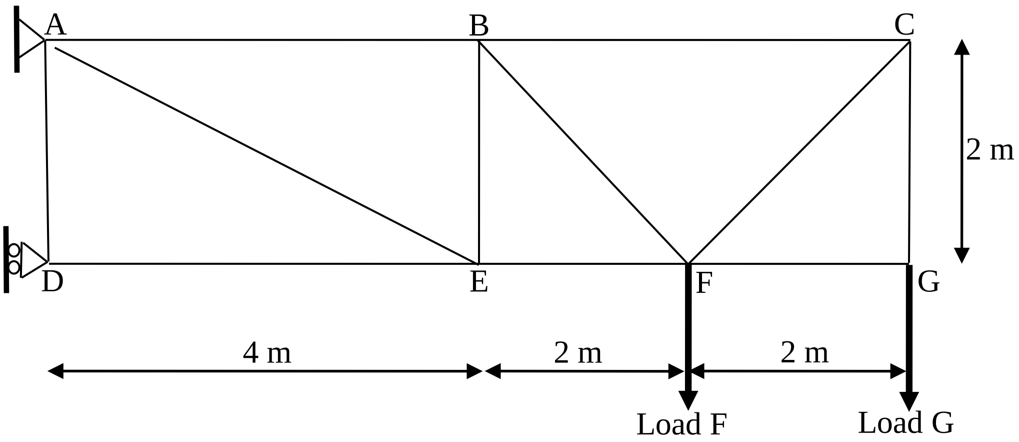
A
B
C
2 m
D
E
F
G
4 m
2 m
2 m
Load F
Load G