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# UTHM

Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

- COURSE NAME : STRUCTURAL STEEL DESIGN
- COURSE CODE : BFC 44903
- PROGRAMME CODE : BFF
- EXAMINATION DATE : JULY 2022
- DURATION : 3 HOURS
- INSTRUCTION
1. ANSWER ALL QUESTIONS
  2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSED BOOK**.
  3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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**Q1** Steel H-section 305×305×283 kg/m UC grade S275, fixed base and restrained as shown in **Figure Q1**.

- (a) Calculate the axial capacity of the column,  $N_{c,Rd}$ . (6 marks)
- (b) Sketch the buckling shape about the minor and major axes. (4 marks)
- (c) Determine the effective length about the minor and major axis. (4 marks)
- (d) Calculate the non-dimensional slenderness for both axes. (5 marks)
- (e) Calculate the buckling capacity,  $N_{b,Rd}$  for both axes. (6 marks)

**Q2** Consider design compression force acting on the column,  $N_{Ed} = 2000$  kN and design shear force,  $V_{Ed} = 75$  kN.

- (a) Determine the required area of column base. Use concrete class of C30/37. Consider a square plate/area. (4 marks)
- (b) Suggest and sketch simple connection of base plate with the arrangement of four bolts. (4 marks)
- (c) Determine the effective area by assuming the base plate size of 520×520 plate with four bolts of grade 4.6 with 20 mm and column perimeter of 1820 mm. (6 marks)
- (d) Verify the suitability of plate thickness 40 mm grade 275 and suggest other suitable plate if necessary. Use weld size 10mm. (3 marks)
- (e) Propose the suitable weld thickness based on weld arrangement as in **Figure Q2**. (8 marks)

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**Q3** The purlins were designed and installed on the Pratt truss as shown in **Figure Q3**. However, during the construction, the contractor adds more services equipment on the purlins that were not considered during the design stage.

Given :

Design load on purlins with additional services = 30 kN

Size of purlin (equal angle) = 120 x 120 x 10L

- (a) Check whether the size of purlins are satisfactory or not with the new design load. (5 marks)
- (b) If the purlins are not satisfied, suggest the new size of the purlins. (10 marks)
- (c) If the purlins cannot be replaced because the construction work had been done, discuss in detail (including sketches if needed) how to make sure the truss system can be used. (10 marks)

**Q4** A pin-jointed portal frame shown in **Figure Q4** carries permanent actions including its own self-weight amounting to  $0.55 \text{ kN/m}^2$ . The variable action is  $0.6 \text{ kN/m}^2$ .

- (a) Estimate the required rafter and column size using design charts. Take frame spacing as 5 m. (5 marks)
- (b) Determine the position of first torsional restraint in UB column by taking bending moment at Point C as 1800 kNm. Assume absence of axial load. (10 marks)
- (c) Determine the position of intermediate restraint within first torsional restraint in Q4(b). (10 marks)

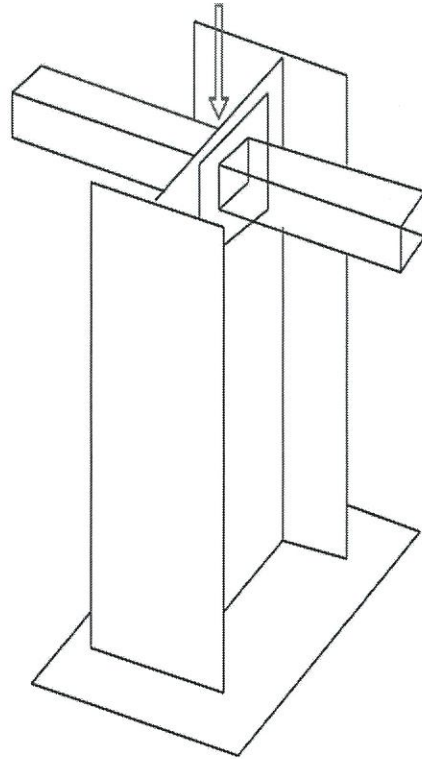
– END OF QUESTIONS –

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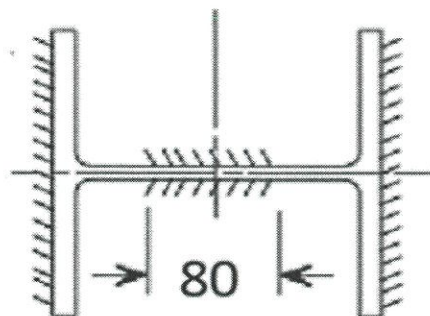
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**FIGURE Q1**



All units in mm

**FIGURE Q2**

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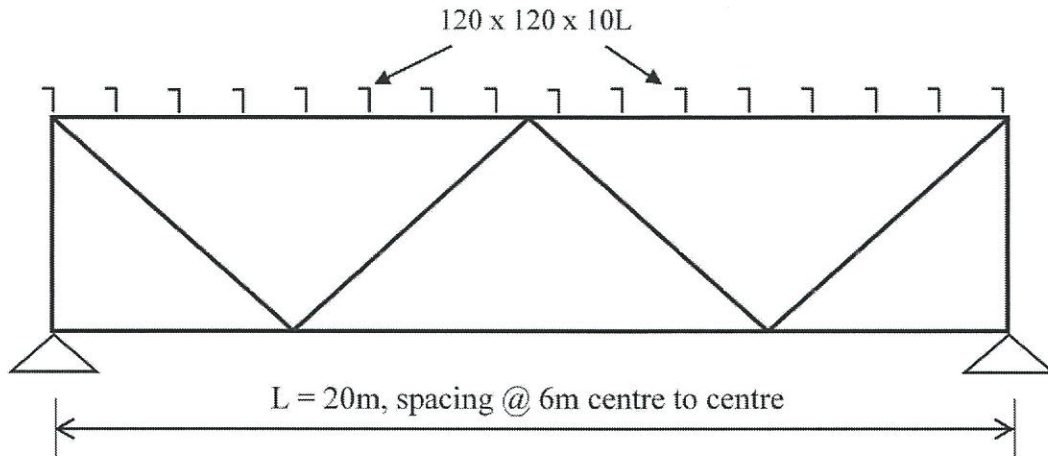


FIGURE Q3

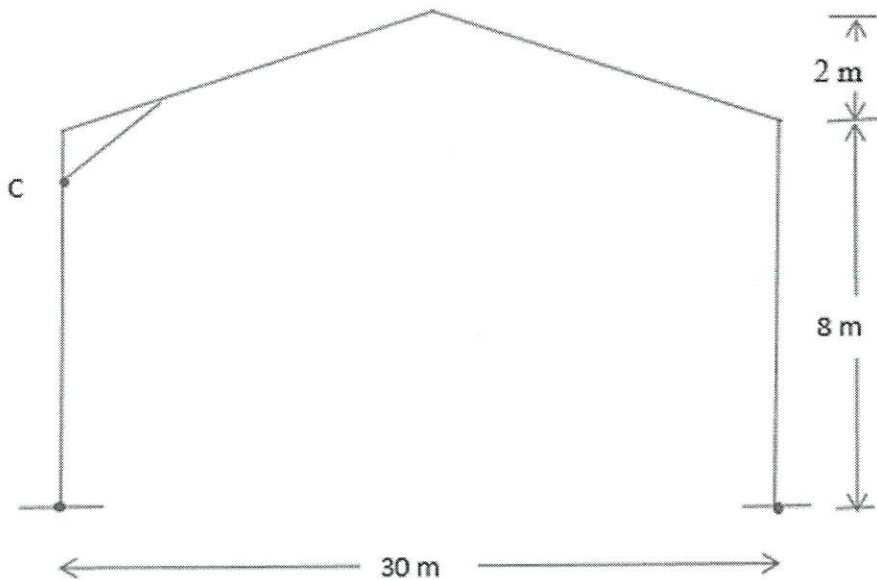


FIGURE Q4

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**APPENDIX:**

Concrete class	C20/25	C25/30	C30/37	C35/45
Cylinder strength, $f_{ck}$ (N/mm <sup>2</sup> )	20	25	30	35
Cube strength, $f_{ck,cube}$ (N/mm <sup>2</sup> )	25	30	37	45

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