Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	STRUCTURAL STEEL DESIGN
COURSE CODE	:	BFC 44903
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA OPEN BOOK. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

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THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 All questions are referring to the layout plan and elevation plan as shown in **Figure Q1**.

Given;

Unit weight of in-situ concrete = 25 kN/m^3

Thickness of slab = 200 mm

Unit weight of sandcrete block = 3.47 kN/m^2 (The sandcrete block only on the external beams)

Screeding and furnished = 1.35 kN/m^2

Variable action = 4 kN/m^2

(a) Determine the total load on beam A/2-3 and beam 2/A-B in kN/m

(10 marks)

(b) Determine the shear force and bending moment of beam A/2-3 and beam 2/A-B

(10 marks)

(c) Based on Q1(c) propose the suitable size for the beams based on deflection criteria.

(10 marks)

(d) Calculate the total axial load on column A/3 at ground floor level. Given total load from roof level is 45 kN.

(12 marks)

(e) Propose the suitable column size in Q1(d) based on cross - section resistance.

(3 marks)

(f) Calculate the nominal moment of column A/3. Assume all connections are pinned to all beams.

(5 marks)

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Q2 (a) With the aid of a sketch, explain the analysis process of a truss where purlins are not positioned at the nodes.

(6 marks)

(b) A double angle with the dimension of 125 x 75 x 8 mm are connected together to form a compression member. Determine the elastic buckling load of the member.

Given:

$L\ cr,_y = 2.5$ m

$Lcr,_z = 1.25$ m

$2I_y = 1222.7\ cm^4$

$2I_z = 135.2\ cm^4$

$I_y = 302\ cm^4$

$I_z = 82.1\ cm^4$

(7 marks)

(c) Sketch **TWO** (2) possible failure paths of staggered bolts under applied load given in **Figure Q2.**

(3 marks)

(d) Design a flat plate of tie member to carry the axial load of 400 kN, with staggered bolts configurations as shown in **Figure Q2**. Use M20 bolt and S275 steel plate.

(9 marks)

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Q3 **Figure Q3** shows a proposed new covered extension between gridline B and C. In the original recommendation, the New Structural Beam PQR is to be constructed with glued laminated timber spaced at 2 m centre to centre. Propose a new recommendation for a full structural steel construction.

(a) Draw and label **TWO** possible connection representing simple construction at P between beam PQR and the column at gridline B.

(4 marks)

(b) The vertical downward load (permanent action only) carried by the pin at Q is 70 kN. Design the smallest possible CHS to be used as tie member SQ.

(6 marks)

(c) Consider if the pin support of tie member is moved from Q to R and the vertically downward load (permanent action only) carried by the pin at R is now reduced to 50 kN. Design the pin support eye plate connection to the new structural beam using fillet weld. The design must include load components, weld type, weld strength, and clear detailing with dimensions and label together with 3-dimensional view of the connection.

(11 marks)

(d) Draw and label **ONE** possible connection at P between beam PQR and the column at gridline B for case when tie member SQ is taken out from the construction.

(4 marks)

–END OF QUESTIONS –

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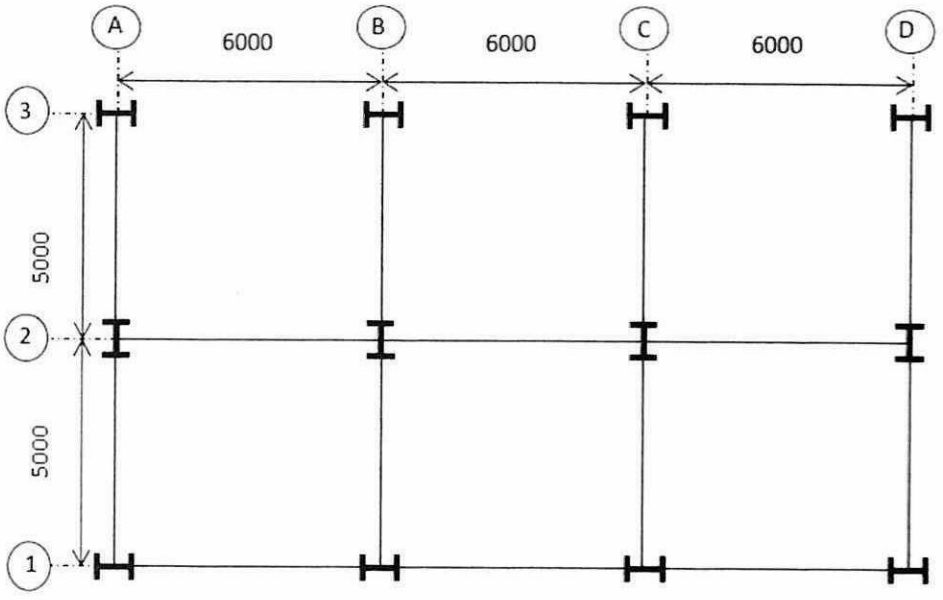
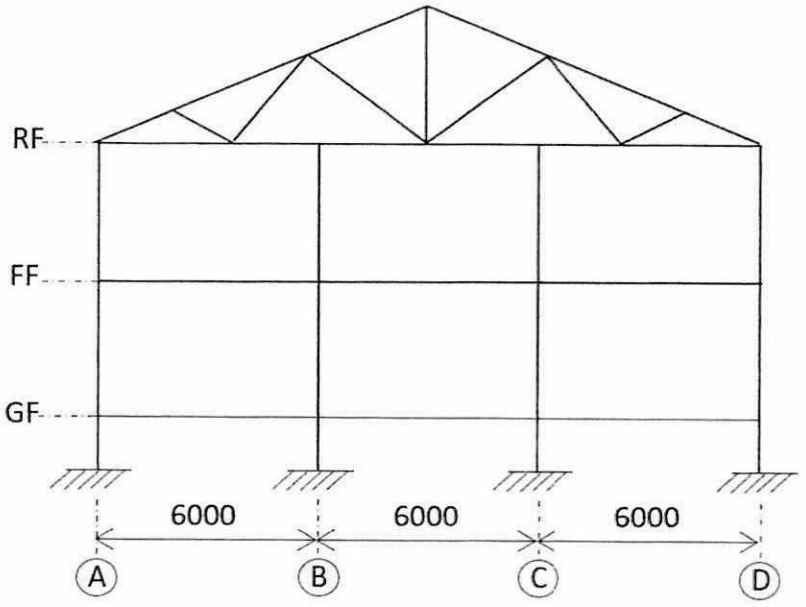


(a) Plan View (all unit in mm)



(b) Elevation view (all unit in mm)

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FIGURE Q1

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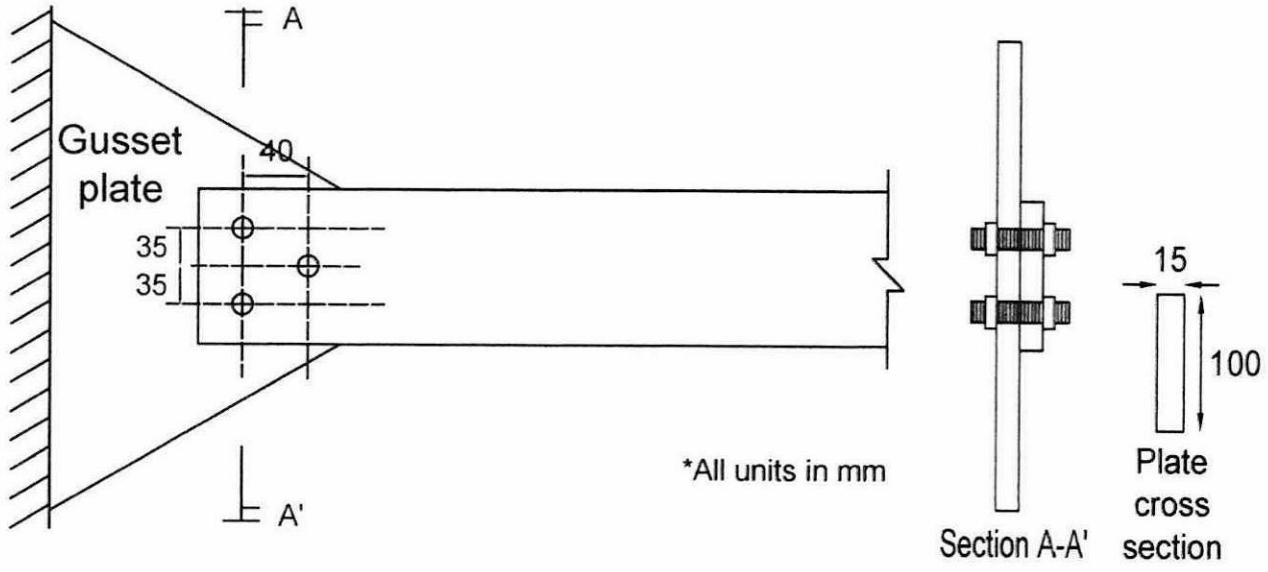

FIGURE Q2

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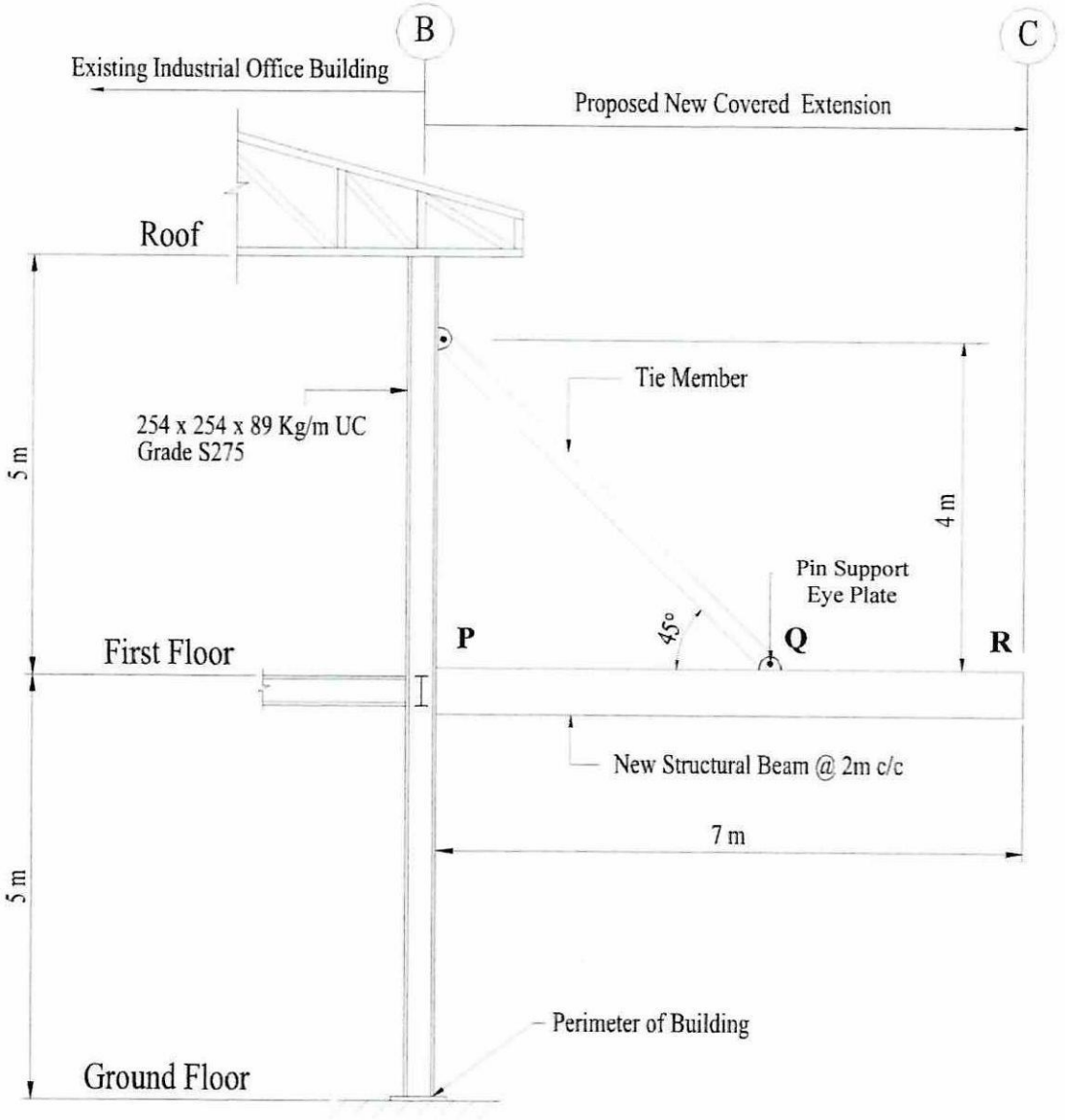

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FIGURE Q3

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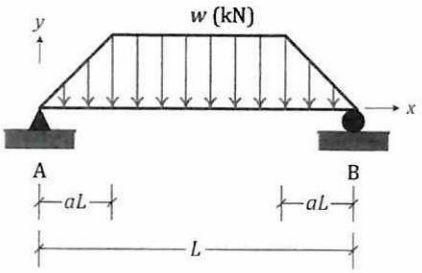
APPENDIX



Reaction force = R_A=R_B= $\frac{W}{2}$

Maximum Moment (mid span) = $\frac{3-4a^2}{24(1-a)}WL$

Deflection, δ_{max} = $\frac{(4a^2-5)^2 WL^3}{1920(1-a)EI}$

$N_{cr.min} = \pi^2 EI_z / {L_{cr.z}}^2$

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