



UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : ADVANCED STRUCTURAL TIMBER DESIGN
COURSE CODE : BFK 40303
PROGRAMME CODE : BFF
EXAMINATION DATE : FEBRUARY 2023
DURATION : 3 HOURS
INSTRUCTIONS : 1. ANSWER ALL QUESTIONS

2. THIS IS AN **OPEN BOOK** FINAL EXAMINATION. DESIGN SHOULD BE BASED ON BS EN 1995 PART 1-1:2004 AND SPECIFIC ENGINEERING DESIGN FOR ENGINEERED TIMBER.

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 SIX (6) PAGES

- Q1** Figure Q1(a) shows an existing first floor level plan of a commercial office building. The location of this building is in Kuala Lumpur. The Service Class used for the following design exercises shall be decided based on the location, the function and exposure of the building.

You are the principal design engineer appointed to look into the design of the Proposed New Covered Area B-C/2-3.

All design in this question and subsequent questions are to be in accordance to BS EN 1995-1-1. Relevant Eurocodes for actions and relevant specific engineering design guides can be used.

Data for design such as values of actions, structural member types and geometry are to be proposed by you with correct engineering judgement and reasoning. Such engineering judgement and reasoning must be written clearly in your answer script. Marks will be given based on the suitability of your reasons and decisions. This applies to ALL questions in this Final Examination.

Figure Q1(b) presents the cross-section Y-Y of the Proposed New Covered Area. This question specifically refers to the design of the New Structural Beam PQR spaced at 2 m centre to centre that acts as the main support member for the Proposed New Covered Area. The top level of this New Covered Area is not meant to be accessible and is to be constructed using lightweight prefabricated roofing aluminium panel. The unit weight of the prefabricated roofing aluminium panel is 30 kg/m^2 .

- (a) Specify the types and quantity of load that are carried by the New Structural Beam. (4 marks)
- (b) Consider the connection at P is simple construction. Calculate the ULS load demand in kN/m for the New Structural Beam and draw the Bending Moment Diagram and Shear Force Diagram. (10 marks)
- (c) Make the first estimation of size for the New Structural Beam based on strength requirement. Carry out bending and shear checks. (11 marks)
- Q2** This question concerns the design of the Tie Member that supports the New Structural Beam that is spaced at 2 m centre to centre.
- (a) Calculate the ULS tensile load demand in kN for the Tie Member. Draw the free body diagram of the Tie Member and include the load components. (8 marks)

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- (b) Make a first size estimation for the Tie Member and make the necessary checks for this estimated size. (8 marks)
- (c) Suppose the angle of the Tie Member is changed to 30° , compare the differences and comment if this is a better solution. Your comparison should include facts on load, size and design. (9 marks)
- Q3** A variation order has been received to change the non-accessible top level of the New Covered Area into an accessible balcony for viewing purposes using Timber-Concrete Composite (TCC) floor solution. The architect has asked to move the existing Pin Support at Q to R.
- (a) Propose the layout and orientation of this TCC floor with sufficient sketches / drawings. The drawing must be well labeled for the different important components of the TCC floor. Make decision on the spacing of New Structural Beam whether you want to maintain at 2 m centre to centre or change it to a different spacing. Explain your decision. (8 marks)
- (b) List the loads suitable for the design. Calculate the ULS and SLS load demand in kN/m for the proposed TCC joist based on your answer in **Q3(a)**. (8 marks)
- (c) Propose the connection system and connection spacing to be used in the design and construction of the TCC floor in panel T. Your proposal must include explanation to the choice of connection and spacing given. Clear drawing and design values of the connection are required in your proposal. (9 marks)
- Q4** This question concerns the design of Column B/3 as shown in **Figure Q1(a)** and **Figure Q1(b)**. All beam-column connections are of simple construction. The existing column is a steel solution. Propose a LVL column solution.
- (a) Calculate the axial load demand in kN from Roof to First Floor. Use the loads that you have given in your answer for **Q2**. (5 marks)
- (b) Calculate the axial load demand in kN from First Floor to Ground Floor. Use the loads that you have given in your answer for **Q2**. (5 marks)

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- (c) Draw a free body diagram of the load demands for Column B/3 from Roof to Ground Floor. (5 marks)
- (d) Make a first size estimation for Column B/3. Calculate the relative slenderness ratios and decide which design equations that are to be used. (10 marks)

- END OF QUESTIONS-

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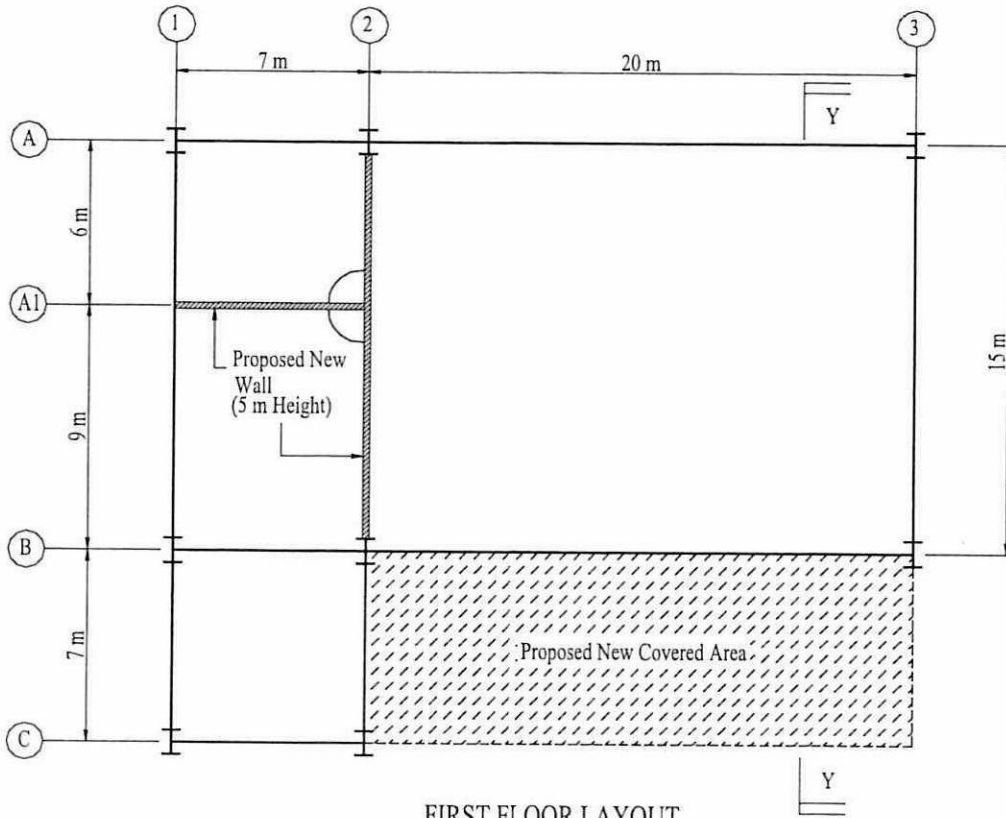
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FIRST FLOOR LAYOUT

FIGURE Q1(a)

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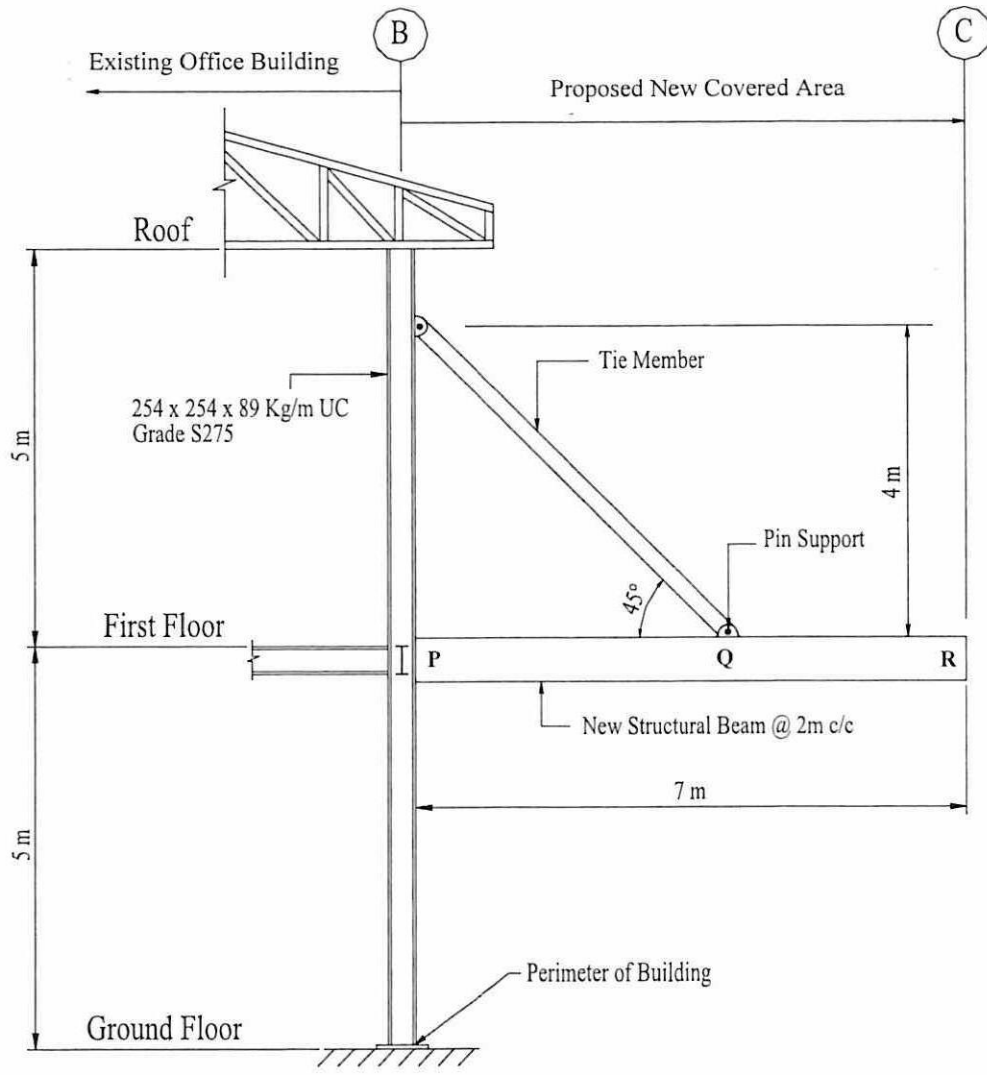
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Cross-Section Y-Y

FIGURE Q1(b)

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