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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	ADVANCED STRUCTURAL TIMBER DESIGN
COURSE CODE	:	BFK 40303
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS OPEN BOOK EXAMINATION

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

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Q1 **Figure Q1(a)** shows a pedestrian bridge to provide connectivity between two identical buildings (Building A and Building B) that are separated by 8 m. The bridge is built from two 8 m long Primary Beams which forms the main support for a Timber-Concrete Composite (TCC) deck as shown in **Figure Q1(b)**. Support Struts placed at 45° helps to reduce the bending moment demand of the Primary Beam. Double LVL which forms the TCC joists are spaced at 0.75 m centres and spans between the two Primary Beams as shown in **Figure Q1(b)**.

This question concerns the design of the TCC deck on the pedestrian bridge. Consider the worst case exposure condition in the design. Given as follows are design data to be used in your design solutions based on BS EN 1995-1-1:

<u>Recommended actions for design:</u>

Variable action on bridge	=	3 kN/m^2
Permanent action for finishes and services on bridge	=	1 kN/m^2
Density of concrete	=	24 kN/m^3
Concrete thickness in TCC	=	75 mm
LVL Type Nelson-Pine	=	LVL13

<u>TCC design data:</u>

Mean compressive strength of concrete	=	48 MPa
Mean Young's modulus of concrete	=	35 GPa
Characteristic strength of connection, F_k	=	275 kN
Connection stiffness for SLS, K_{SLS}	=	400,000 N/mm
Connection stiffness for SLS, K_{ULS}	=	300,000 N/mm
Effective spacing of connection, s_{eff}	=	250 mm
ULS design load for TCC joist	=	6.62 kN/m
SLS design load for TCC joist	=	4.65 kN/m

(a) Calculate the effective bending stiffness, $(EI)_{ef}$ to be used for short-term SLS design of TCC. Given the corresponding gamma coefficient, γ_1 is 0.75.

(8 marks)

(b) On the assumption that SLS deflection governs, propose the smallest possible TCC double joists (LVL13) to satisfy deflection limit of span/300.

(12 marks)

(c) Provide a drawing sketch of your proposed preliminary design. The sketch should include important labels and dimensions.

(5 marks)

Q2 This question is linked to **Q1** as a continuation of the TCC deck design for short-term ULS.

(a) Given the gamma coefficient, γ_1 and effective bending stiffness, $(EI)_{ef}$ for short-term ULS are 0.69 and 3.5×10^{13} Nmm^2, respectively. Perform a short-term ULS design check for the proposed TCC deck. Your design check should include checks for timber, concrete and connection.

(22 marks)

(b) Make a summary comment on your design with regards to the suitability of your proposed size of TCC double joists.

(3 marks)

Q3 This question concerns the design of the pedestrian bridge Primary Beam as shown in **Figure Q1(a)** and **Figure Q1(b).**

(a) Calculate the load demand (in kN/m), moment demand (in kNm) and shear force demand (in kN) on the Primary Beam.

(9 marks)

(b) Perform a design check for this Primary Beam. Given the initial proposed size is 63 mm × 400 mm LVL13. The design check should include checks for bending, shear and deflection. Make a summary comment on your design with regards to the suitability of the proposed size.

(16 marks)

Q4 **Figure Q4(a)** and **Figure Q4(b)** show a shelter to be built over a basketball court. The on-plan permanent action (inclusive of all roofing materials and self-weight) and variable action on the truss are 0.5 kN/m^2 and 0.5 kN/m^2, respectively. All connections including column to base form a simple type construction. Study the given drawings carefully and attempt the following questions relating to the design of an intermediate Column.

(a) Calculate the load demand (in kN) on an intermediate Column.

(9 marks)

(b) Perform a design check for this intermediate Column. Given the initial proposed size is Double 90 mm × 300 mm LVL11. The design check should include checks for axial capacity and, combined compression and bending. Make a summary comment on your design with regards to the suitability of the proposed size.

(16 marks)

- END OF QUESTIONS-

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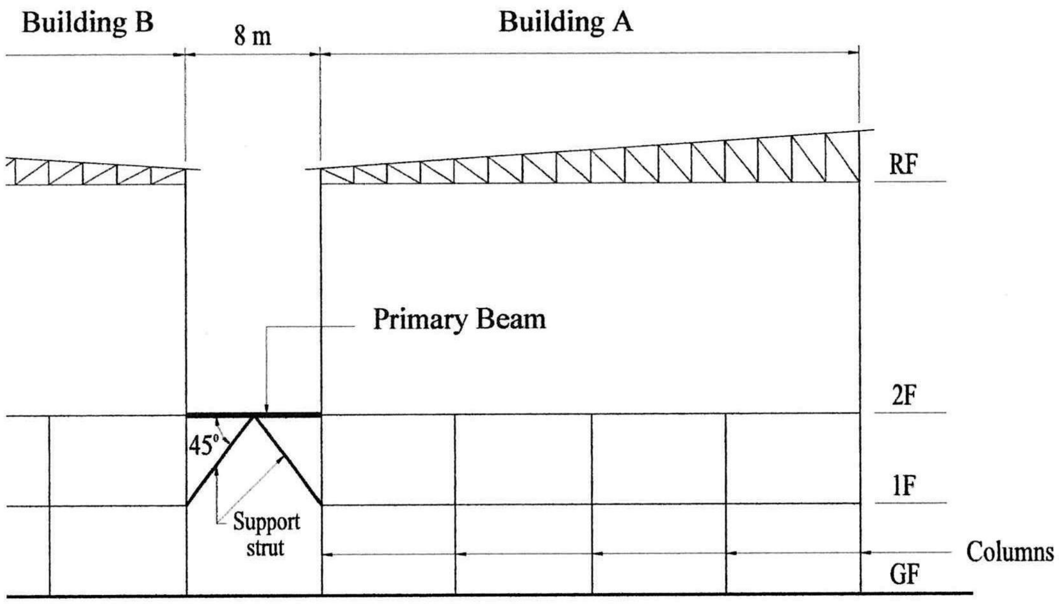

FIGURE Q1(a)

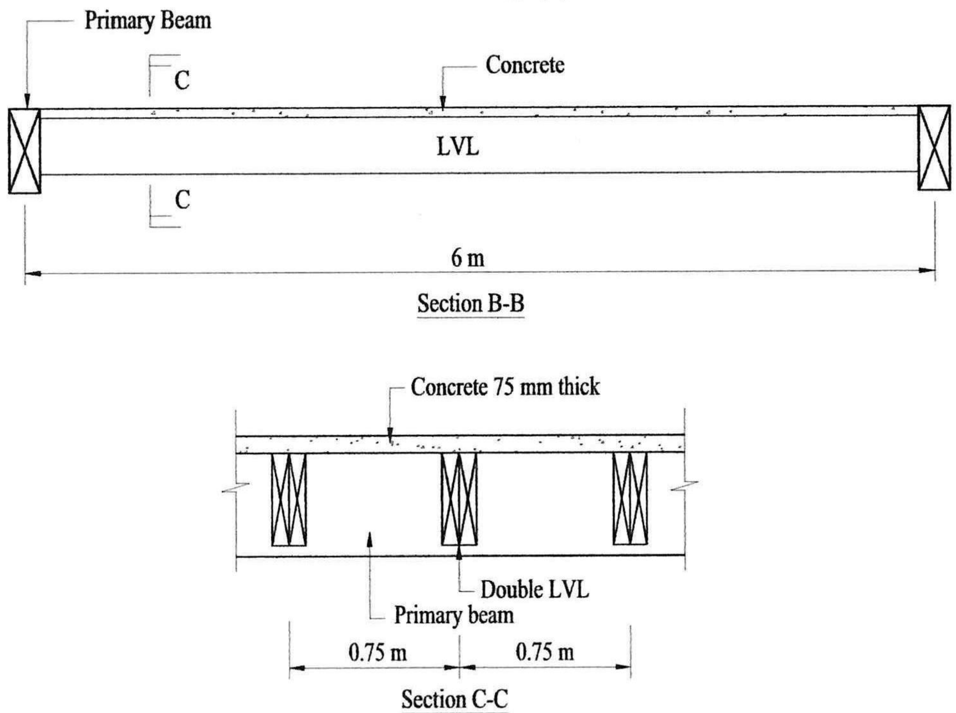

FIGURE Q1(b)

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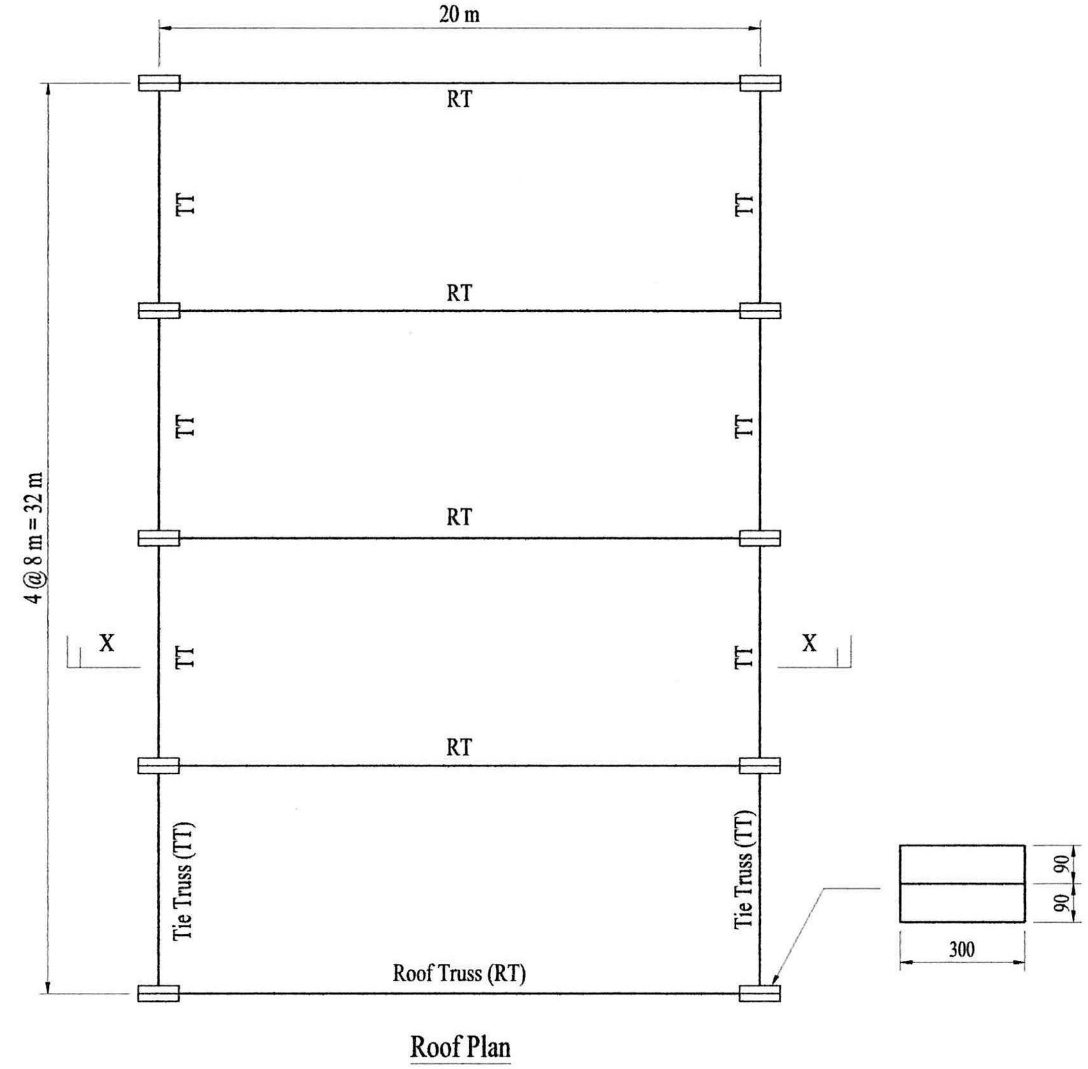

FIGURE Q4(a)

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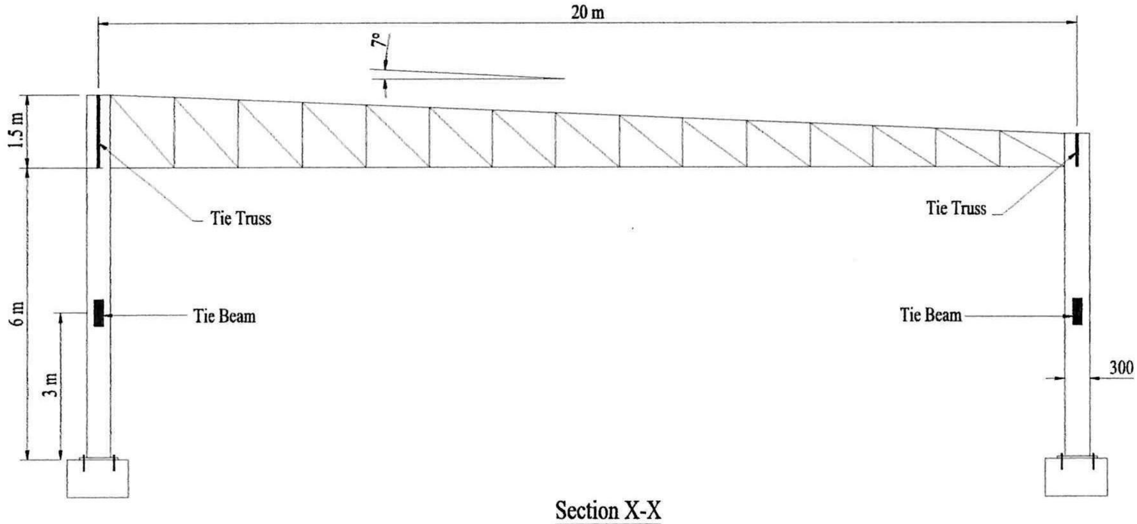

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FIGURE Q4(b)