UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	REINFORCED CONCRETE DESIGN I
COURSE CODE	:	BFC32102
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JUNE 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. OPEN BOOK EXAMINATION 2. ANSWER **ALL** QUESTIONS IN SECTION A AND **TWO (2)** QUESTIONS ONLY FROM SECTION B 3. DESIGN SHOULD BE BASED ON BS EN 1992 AND BS 8110 PART 1:1997.

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

SECTION A

Q1 (a) Concrete structures which have been properly designed and constructed are long lasting and required little maintenance. Identify **FIVE (5)** factors that influence the durability of concrete structures.

(5 marks)

(b) Draw and briefly explain the parabolic curve for stress strain relationship of the concrete and reinforcing steel.

(6 marks)

(c) Limit state design of an engineering structure must ensure that the structures are safe for worst loading and during normal working condition. The deformation of the members will not detract the appearance, durability or performance of the structure. Describe **THREE (3)** design methods based on factor of safety that have been used over many years.

(9 marks)

Q2 (a) Reinforced concrete structures that exposed to sea water will gradually fail due to deterioration and corrosion. Explain **TWO (2)** prevention approaches in the design to avoid these problems.

(4 marks)

(b) A two-span beam, as shown in **Figure Q2**, has dimension of 250 mm x 450 mm and non-direct long term interaction with sea water. The preliminary design of the beam indicates that there is a necessary requirement to utilize As_{req} = 1513 mm^2 of steel reinforcement at spans AB and BC. The beam is also subjected to hogging moment of 146 kNm at support B. Given the following data: A_{gg} = 25mm, $M_{Ed} < M_{bal}$ and $Q_k = 0.32G_k$.

(i) Propose the suitable nominal cover of the beam. Use fire resistance, R = 120 and diameter link, $Ø_{link}$ = 8 mm.

(5 marks)

(ii) Check the clear distance, maximum diameter and maximum spacing of steel reinforcement provided in the design that should comply with the crack control.

(6 marks)

(iii) Draw the complete detailing of the beam. Consider that the beam requires singly reinforcement and maximum lever arm.

(5 marks)

SECTION B

Q3 (a) Determine the ultimate moment resistance of the T-beam section shown in **Figure Q3(a)**. Given f_{yk} = 500 N/mm^2 and f_{ck} = 25 N/mm^2.

(15 marks)

(b) The beam in **Figure Q3(b)** spans 8.0 m long on 300 mm wide supports. It is required to support a uniformly distributed ultimate load, w_u of 200 kN/m. The characteristics material strength are f_{ck} = 30 N/mm^2 for the concrete and f_{yk} = 500 N/mm^2 for the steel. Check if the shear reinforcement in the form of the vertical links shown can support the shear under the given ultimate load.

(15 marks)

Q4 A T-section beam has a web breadth, b_w =350 mm and overall depth, h = 650 mm with equal span of 6 m as shown in **Figure Q4.** The transverse direction spacing, b are specified as 4 m and slab thickness, h_f = 180 mm. The uniformly distributed ultimate design load, w_u = 200 kN/m. The characteristic strengths of concrete and steel used are 30 N/mm^2 and 460 N/mm^2 respectively.

(i) Draw the bending moment diagram (BMD) and shear force diagram (SFD) of the continuous beam.

(5 marks)

(ii) Design the bending reinforcement for mid-span of AB by using T-section.

(5 marks)

(iii) Check for crushing of concrete strut at support B.

(5 marks)

(iv) Check the end span shear link at support A.

(5 marks)

(v) Check the minimum shear resistance of the links.

(5 marks)

(vi) Draw the detailing of the midspan section AB.

(5 marks)

Q5 (a) Durability is the ability of a material or structure to withstand its design service conditions or its design life without significant deterioration. Explain the factors contributing to the durability of the reinforced concrete slab member.

(10 marks)

(b) **Figure Q5** shows part of the first floor layout plan of a double storey residential building. The concrete for slabs and beams are poured together and the thickness of the slab is 150 mm. The information for all slabs are as follows:

Ceiling and tile finishes	=	2.5 kN/m^2
Variable action	=	3.0 kN/m^2
Concrete strength class	=	C25/30
Characteristic strength of steel, f_{yk}	=	500 N/mm^2
Concrete cover	=	30 mm

(i) Determine the positive and negative moments for BEDROOM 2 slab.
(5 marks)

(ii) Determine the minimum and maximum reinforcement required.
(3 marks)

(iii) Design the flexural reinforcement required at mid span. Assume bar size is 10 mm.
(9 marks)

(iv) Draw the cross section of the slab in X – X view to show the reinforcement.
(3 marks)

–END OF QUESTIONS–

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017 PROGRAMME CODE : 3BFF
COURSE NAME : STRUCTURAL CONCRETE DESIGN I COURSE CODE : BFC32102

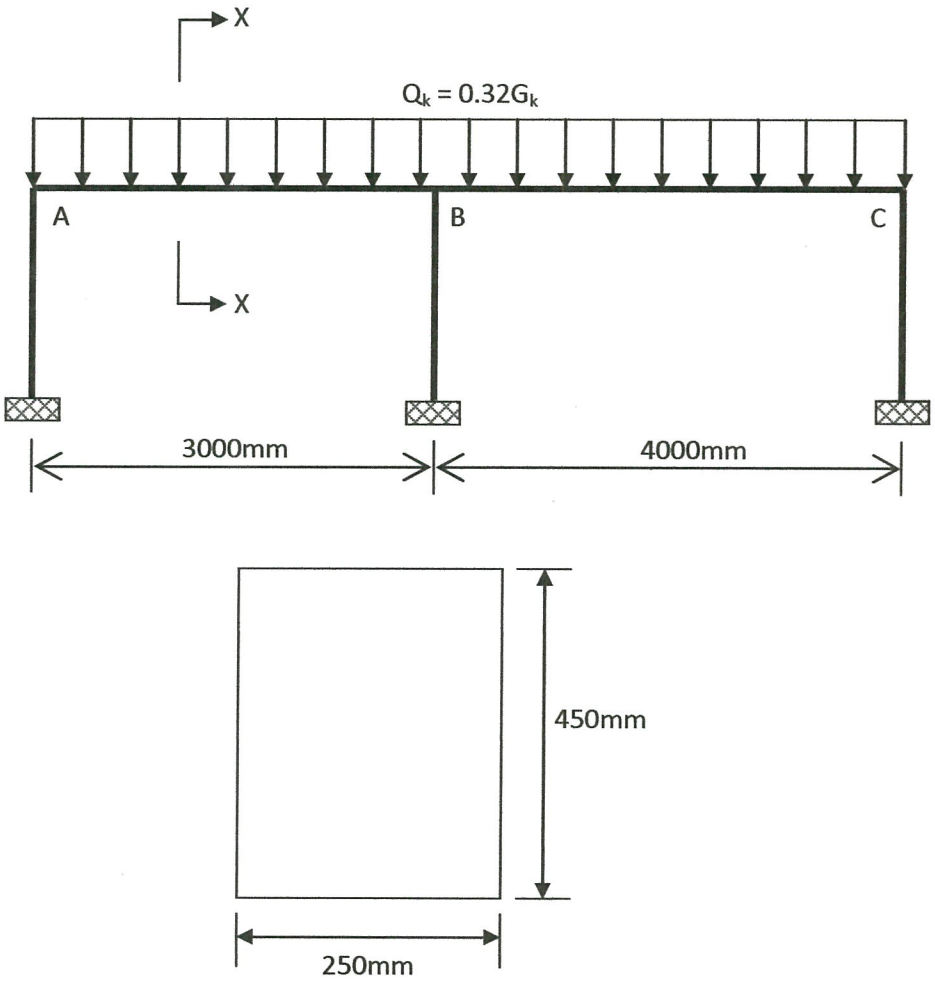

FIGURE Q2

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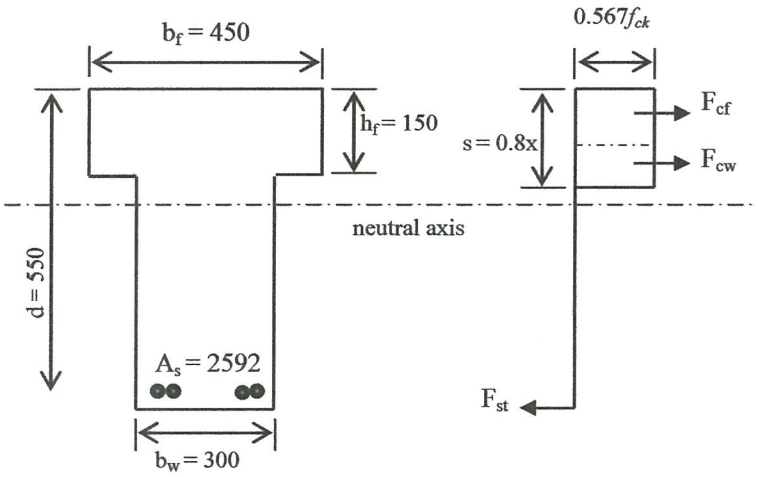
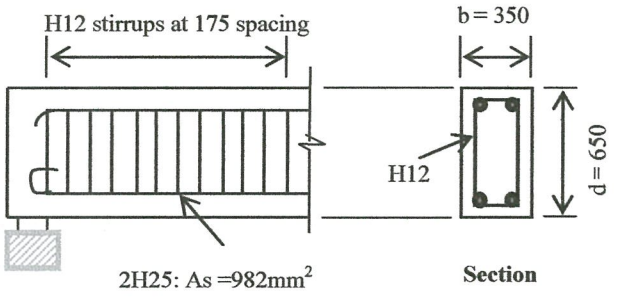
SEMESTER/SESSION : SEM II / 2016/2017 PROGRAMME CODE : 3BFF
COURSE NAME : STRUCTURAL CONCRETE DESIGN I COURSE CODE : BFC32102



*All units in mm

FIGURE Q3(a)



*All units in mm

FIGURE Q3(b)

FINAL EXAMINATION

SEMESTER/SESSION : SEM II / 2016/2017 PROGRAMME CODE : 3BFF
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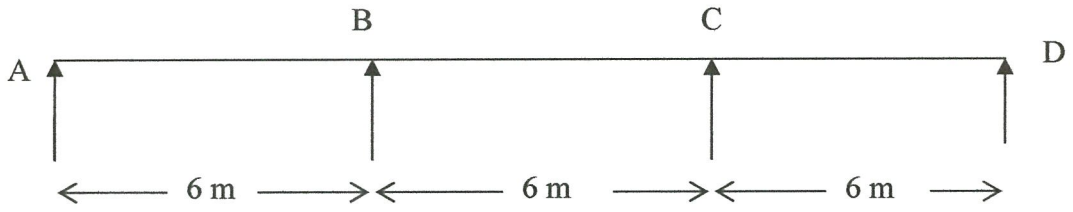

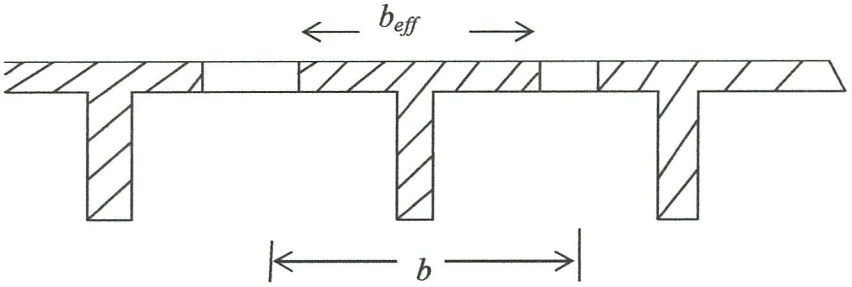

FIGURE Q4

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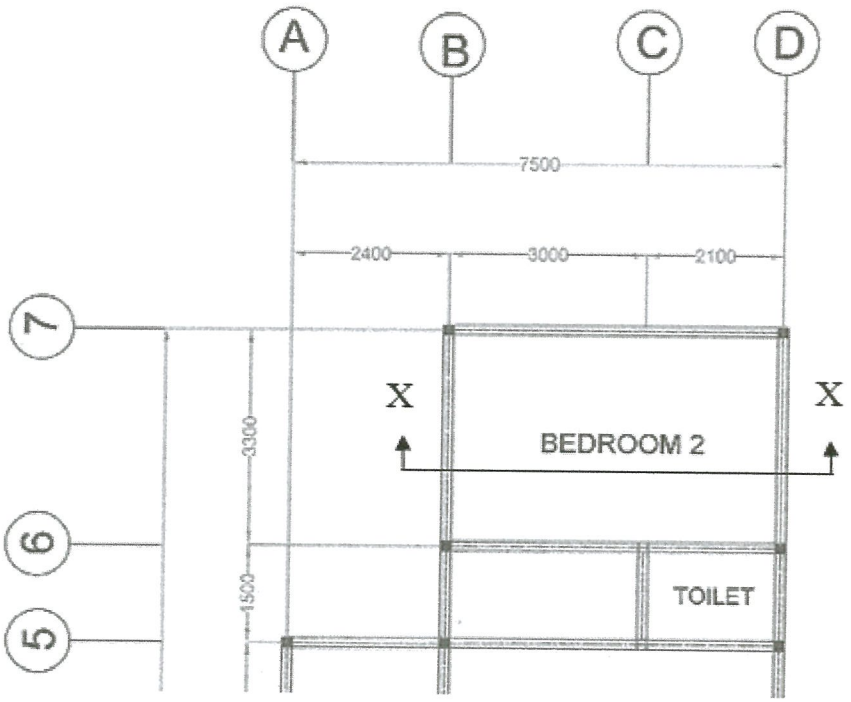

*All units in mm

FIGURE Q5