UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	REINFORCED CONCRETE DESIGN I
COURSE CODE	:	BFC 32102 / BFC 3142
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	DECEMBER 2014/JANUARY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS FROM SECTION A AND **TWO (2)** QUESTIONS FROM SECTION B 2. DESIGN SHOULD BE BASED ON: BS EN 1990:2002+A1:2005 NA BS EN 1990:2002+A1:2005 BS EN 1991-1-1:2002 NA BS EN 1991-1-1:2002 BS EN 1992-1-1:2004 BS 8110:PART 1:1997

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

Q1 Ideally, the owner and the architect, the architect and the engineer, the engineer and the contractor/fabricator will collaborate and interact to conceive, develop, design and build the structure in most efficient manner. Discuss your responsibilities as a structural engineer.

(8 marks)

Q2 Describe clearly the terms below:

(a) Ultimate limit state.

(2 marks)

(b) Accidental design situation of limit state.

(2 marks)

(c) Under-reinforced failure (reinforced concrete beam failure).

(2 marks)

Q3 Reinforced concrete is one of the principal materials used in many civil engineering application. Explain **FOUR (4)** factors affecting choice of reinforced concrete for a structure compare to timber or masonry.

(4 marks)

Q4 Figure **Q4** shows a cross section for a simply supported beam. Given the following data:
Characteristic strength of concrete, $f_{ck} = 30$ N/mm^2
Characteristic strength of steel reinforcement, $f_{yk} = 500$ N/mm^2

(a) Illustrate and label simplified rectangular stress block

(5 marks)

(b) Determine the ultimate moment resistance.

(7 marks)

SECTION B

Q5 A simply supported beam of 5.6 m carries a design action of 77 kN/m. The beam is 250mm x 500mm (bxh). Assume f_{ck}= 25N/mm^2 and f_{yk}= 500N/mm^2.The beam is inside building (XC 1), subjected to 1 hour fire resistance and design life of 50 years. Assume diameter of bar used are 16mm for compression (if required) and 20mm for tension. Diameter of the link is 8mm.

(a) Calculate the nominal cover for the beam.

(5 marks)

(b) Design the flexural reinforcement and then sketch simple detailing for the beam.

(14 marks)

(c) Verify that area of steel determined in (b) is within the limit required by the EC2.

(4 marks)

(d) Verify the deflection of the beam.

(6 marks)

(e) Verify the cracking of the beam.

(6 marks)

Q6 A part of first floor slab plan view for a terrace house is shown in Figure **Q6**. The slab carries a variable action of 3.0 kN/m^2 and permanent action of 1.5 kN/m^2. The materials used are grade C30 concrete and grade 500 steel reinforcements.

(a) Identify the type of slab C-D/1-2.

(2 marks)

(b) Calculate the design action of the slab by assuming the slab thickness is 150mm.

(6 marks)

(c) Calculate the bending moment at mid span of the slab.

(8 marks)

(d) Determine the main and secondary reinforcement of slab by assuming the bar size is 10 mm and nominal cover is 25 mm.

(12 marks)

(e) Evaluate the deflection for that slab. Propose the solution if the checking is failed.

(7 marks)

Q7 (a) Discuss the provisions of EC2 specifications for concrete cover.

(6 marks)

(b) A continuous beam in Figure **Q7** has a width, b_w = 300 mm and an effective depth, d = 600 mm with three equal spans, L = 5 m. In the transverse direction the beams spacings are B = 4.0 m centres with a slab thickness and h_f = 180 mm. The supports have a width of 300 mm. The uniformly distributed ultimate design load, w_u = 190 kN/m. The characteristic strengths of the concrete and steel are f_{ck} = 30 N/mm^2 and f_{yk} = 500 N/mm^2.

(i) Determine maximum shear force, V_{max} and maximum bending moment, M_{max}.

(5 marks)

(ii) Design for bending reinforcement at mid-span of interior first end-span AB. Design as T-section.

(10 marks)

(iii) Check for crushing of the concrete strut at the maximum shear force.

(7 marks)

(iv) Design of shear link at supports A and D. Use H8 links.

(4 marks)

(v) Design extension of shear links from the face of the end supports A and D. Use H8 links.

(3 marks)

-END OF QUESTION-

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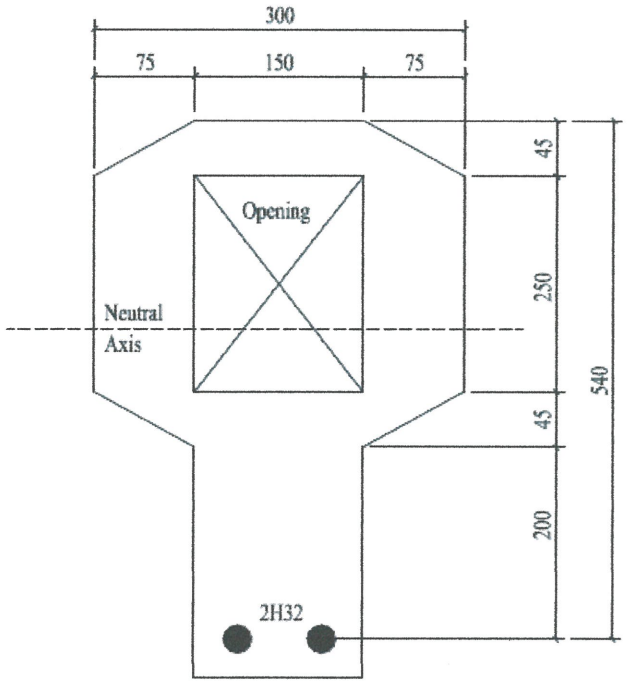

All unit in mm

FIGURE Q4

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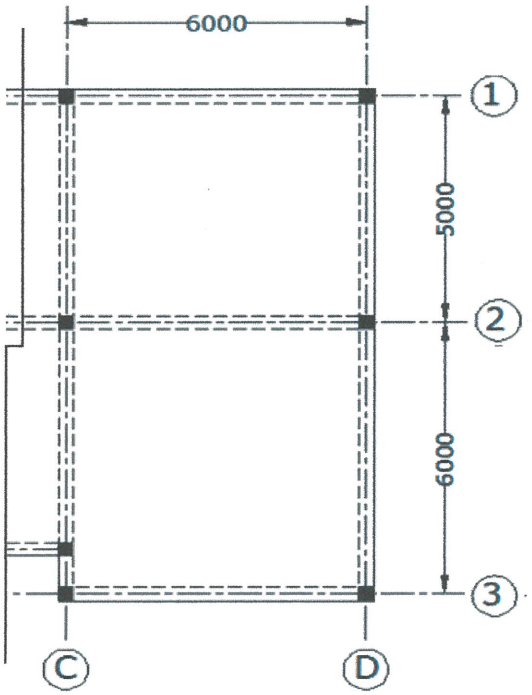

All unit in mm

FIGURE Q6

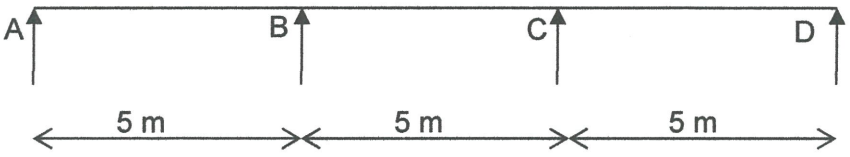

FIGURE Q7 (a)

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$$A_S{}' = \frac{(K - K_{bal}) f_{ck} b d^2}{0.87 f_{yk} (d - d')}$$

$$A_S{}' = \frac{(K - K_{bal}) f_{ck} b d^2}{f_{sc} (d - d')}$$

$$f_{sc} = 700\left(1 - \frac{d'}{x}\right)$$

$$A_S = \frac{K_{bal} f_{ck} b d^2}{0.87 f_{yk} (d - d')} + A_S{}'\left(\frac{f_{sc}}{0.87 f_{yk}}\right)$$

$$A_s = \frac{K_{bal} f_{ck} b d^2}{0.87 f_{yk} z} + A_s{}'$$

$$f_s = \frac{f_{yk}}{1.15}\left[\frac{G_k + 0.3Q_k}{1.35G_k + 1.5Q_k}\right]\frac{1}{\delta}$$

$$M_{bal} = (0.454 f_{ck} b_w 0.45d)(d - 0.4(0.45d) + (0.567 f_{ck})(b_{eff} - b_w) h_f (d - 0.5 h_f)$$

$$z = d\left[0.5 + \sqrt{(0.25 - K/1.134)}\right]$$

$$x = (d - z)/0.4$$

$$M_f = (0.567\ f_{ck}\, b_{eff}\, h_f)(d - h_f / 2)$$