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# UTHM

Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

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

COURSE NAME : REINFORCED CONCRETE DESIGN

COURSE CODE : BFC 34803

PROGRAMME CODE : BFF

EXAMINATION DATE : JULY/AUGUST 2023

DURATION : 3 HOURS

INSTRUCTION :  
1. ANSWER ALL QUESTIONS  
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **OPEN BOOK**  
3. STUDENTS ARE **ALLOWED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES. DESIGN SHOULD BE BASED ON BS EN 1990: 2002+A1:2005, BS EN 1991-1-1:2002, BS EN 1992-1-1:2004, MS 1553: 2002

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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**Q1** **Figure Q1** shows the front view plan for an unbraced frame building at hilly area. The total characteristic wind load is non-linear and varies at different height as shown in the figure. According to MS 1553:2002:

- (a) Under what condition, the designer should apply simplified, analytical and wind tunnel procedure in calculating wind pressures on the building. Propose the suitable procedure and wind pressure equation that need to be used for design of this building. (5 marks)
- (b) Calculate the design wind load for each floor level of sub frame, considering the maximum loading imposed to the building and wind intensity is similar from any directions. Then, draw the point load of each level of the building according to front view plan. (8 marks)
- (c) Analyse the axial forces, shear forces and bending moments in beams and columns at Level 7. State the importance value. (12 marks)

**Q2** **Figure Q2** shows a braced frame structure of a laboratory building. The connection between column is fixed at top and bottom. Bending moments for column B are  $M_y = 15$  kNm (top) and 20 kNm (bottom) at negative and positive side respectively. Given the following data:

Characteristic strength of concrete, $f_{ck}$	=	25 N/mm <sup>2</sup>
Characteristic strength of steel, $f_{yk}$	=	500 N/mm <sup>2</sup>
Nominal concrete cover	=	30 mm
Assumed diameter of reinforcement, $\phi_{bar}$	=	20 mm
Assumed diameter of link	=	8 mm

- (a) Classify column B either short or slender based on BS EN1992-1-1:2004. (11 marks)
- (b) Calculate the possible design bending moment for column B by considering given  $M_y$  for both sides. Use ultimate axial load = 1000 kN. (5 marks)
- (c) By using suitable Column Design Chart, design the reinforcement of the column. (9 marks)

**Q3** A five-storey hostel building will be built at soft soil area in Batu Pahat. A pile foundation needs to be designed and required to support an ultimate axial load 4500 kN. The prestressed spun pile with 600 mm diameter and 1500 kN service load will be used. By using maximum spacing factor of pile and given the following data:

Characteristic strength of concrete, $f_{ck}$	=	C35/40
Characteristic strength of steel, $f_{yk}$	=	500 N/mm <sup>2</sup>
Nominal concrete cover	=	75 mm
Unit weight of concrete	=	25 kN/m <sup>3</sup>
Column size	=	400 x 400 mm

Diameter of reinforcement,  $\phi_{bar}$  = 25 mm  
Safety factor = 1.4

- (a) Determine the required number of piles and size of pile cap. (8 marks)
- (b) Draw the pile cap complete with dimensions and provide required necessary checking. (4 marks)
- (c) Design the main reinforcement based on relevant theory. (8 marks)
- (d) Check the serviceability of the pile cap in term of cracking control and sketch the detailing. (5 marks)

- Q4** (a) The design of retaining wall requires careful consideration of various factor to ensure its safety and stability over time. Some of the key design considerations are site condition, wall height, etc. Discuss 4 key design consideration of retaining wall. (4 marks)
- (b) **Figure Q4** shows the cross section of a cantilever retaining wall to be constructed for a rural road development at Batu Pahat area. The backfill soil is a well-compacted laterite soil having a density,  $\gamma = 18 \text{ kN/m}^3$ , angle of internal friction,  $\phi = 32^\circ$ , cohesion,  $c = 0$ , friction coefficient,  $\mu = 0.45$ , and ultimate bearing capacity,  $= 180 \text{ kN/m}^2$ .
- (i) Calculate the total positive and negative moments, vertical load and horizontal load imposed to the retaining wall associated with the wall elements, and the backfill soil. Use unit weight of reinforced concrete of  $25 \text{ kN/m}^3$ . (10 marks)
- (ii) Check stability of the retaining wall against overturning, sliding and settlement. (11 marks)

–END OF QUESTIONS–

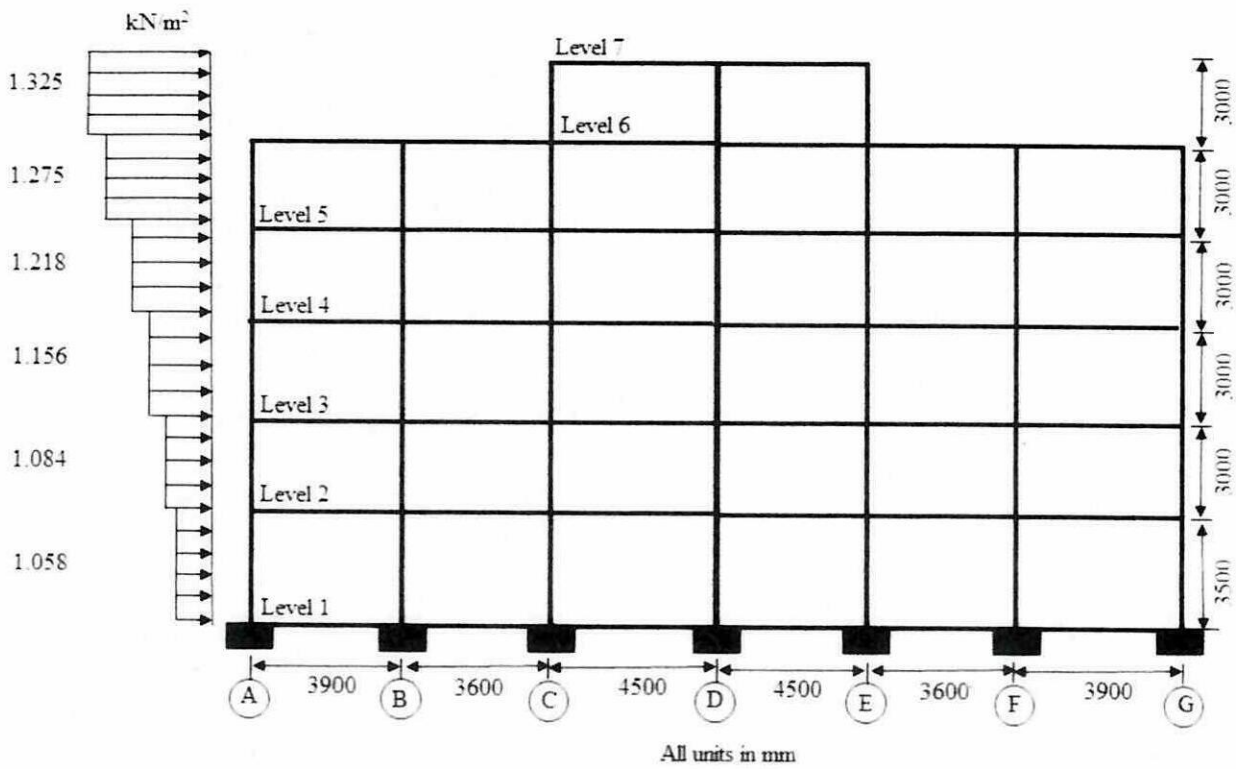
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**Figure Q1**

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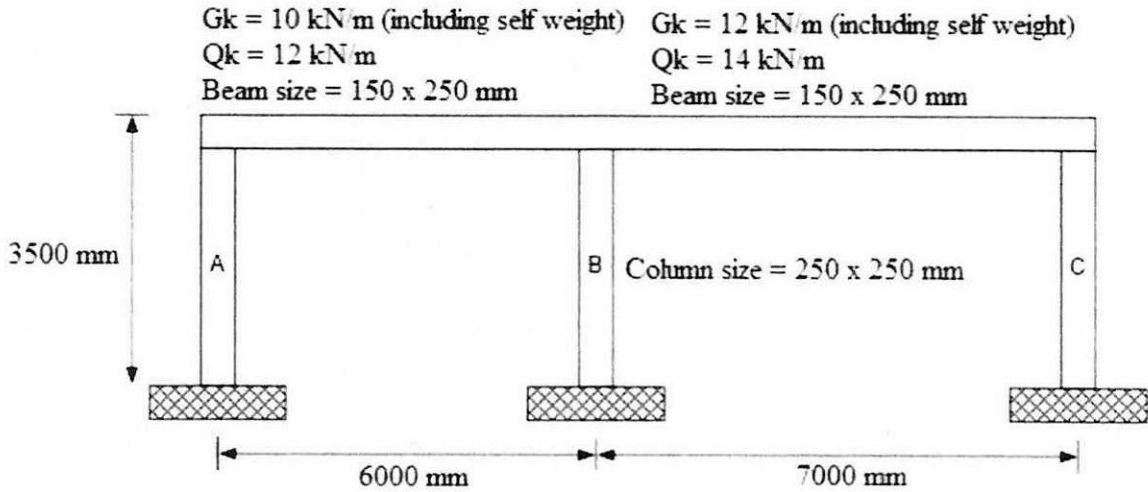


Figure Q2

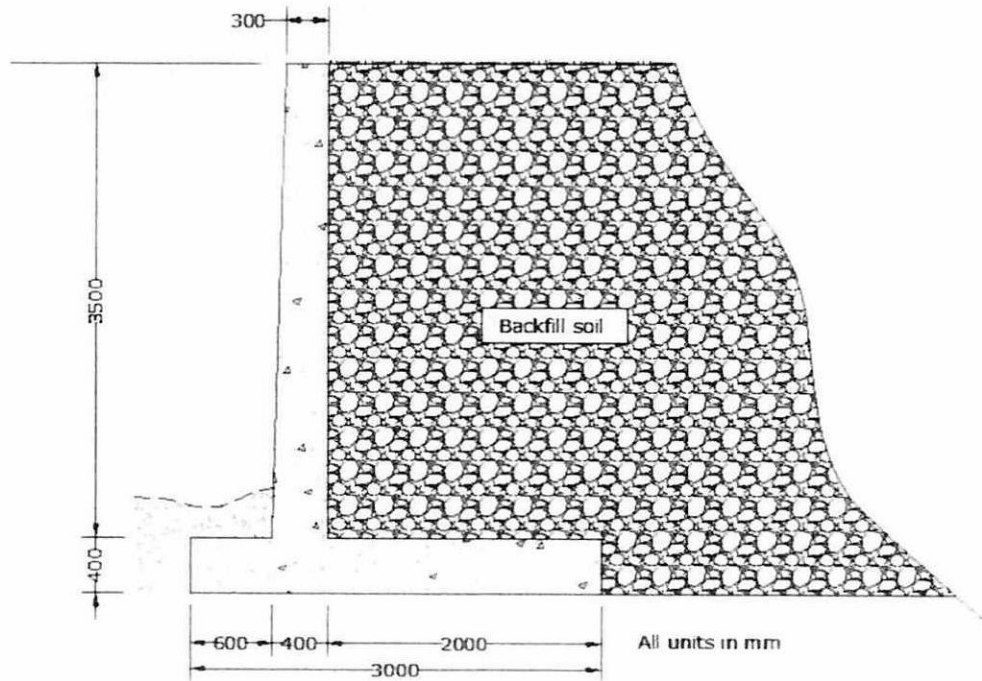


Figure Q4

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