



UNIVERSITY OF JOHANNESBURG
DEPARTMENT OF CIVIL ENGINEERING SCIENCE

COURSE	STRUCTURAL ENGINEERING (REINFORCED CONCRETE DESIGN)
CODE	SUS4A11
EXAM	JUNE 2019
DURATION	THREE (3) HOURS
EXAMINERS	Prof. SO. Ekolu Prof. Akeem Raheem

INSTRUCTIONS: Open Book - Lecture Notes, Design Tables etc. are Allowed

Calculators are Allowed. Computers/laptops, Tablets, Cellphones are Not Allowed

Attempt All four Questions

Take Note of Mark Allocations

AT THE END OF EXAM, STUDENTS ARE <u>REQUIRED</u> TO RETURN THIS PAPER TO THE INVIGILATOR, ALONG WITH ANSWER SCRIPTS
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INFORMATION RELEVANT TO QUESTIONS 1 AND 2

Fig. 1 shows the floor plan and slab of a reinforced concrete warehouse.

Design information

Live loads = 5.0 kN/m^2

Dead load due to finishes, services and partitions = 3.2 kN/m^2

30 MPa concrete

High yield steel strength = 450 N/mm^2

Mild steel strength = 250 N/mm^2

Cover = 35 mm

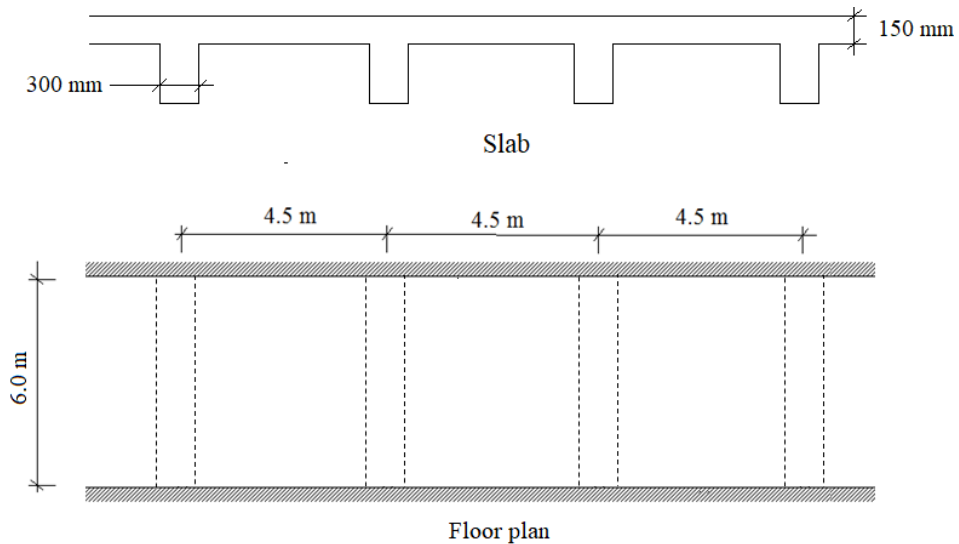


Fig. 1 Floor plan and slab

QUESTION 1. SLABS (ELO 3)

Referring to the design details in Fig.1. The slab reinforcement is to consist of 12 mm bars. Assuming simple supports.

- (i) Determine the type of slab. [2]
- (ii) Design the bending steel reinforcement for the roof slab. [13]
- (iii) Check for shear. [6]
- (iv) Provide a clearly labelled layout sketch of designed reinforcement. [4]

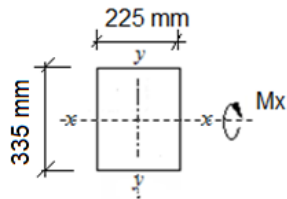
QUESTION 2. BEAMS (ELO 3)

For the RC beam shown in Fig.1, use the details provided and the rule-of-thumb that the beam height is one-tenth of its span. Assume simple supports. The reinforcement is to consist of 8 mm and 16 mm bars high yield steel.

- (i) Sketch the beam's section, giving all its dimensions and calculate the ULS design load. [5]
- (ii) Design the bending reinforcement for the beam. [7]
- (iii) Evaluate shear against code requirements, and if necessary design required reinforcement. [7]
- (iv) Check for deflection [2]
- (v) Give clearly labelled sketch(es) of the designed section and elevation. [4]

QUESTION 3. COLUMNS (ELO 3)

A rectangular column of width 225 mm and depth 335 mm is reinforced with 3Y25 mm bars placed at each face to resist the bending moment about the x-axis. $f_y = 450$ MPa, $f_{cu} = 30$ MPa. Moderate exposure. The reinforcement is to consist of 8 mm and 25 mm bars.



Determine if,

- (i) The load carrying capacity of the column, if the design moment is 55 kN.m [13]
- (ii) The column capacity is adequate to support $N = 1767$ kN, $M_x = 34$ kN.m [12]

QUESTION 4. FOOTINGS [ELO 3]

Design a 3.0 x 1.5 m rectangular footing for a centrally located 300 mm square column carrying a ULS design axial load of 500 kN. Cover 30 mm, $f_{cu} = 25$ N/mm², $f_y = 450$ N/mm². The reinforcement is to consist of 16 mm bars high yield steel. Use rule-of-thumb to estimate footing thickness. Design the longitudinal and transverse tension reinforcements. Provide a clearly labelled sketch of the design. [25]