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**UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER**

PROGRAMME: BSC AGRIC II (LWM)

COURSE CODE: LUM 209

TITLE OF PAPER: FARM BUILDINGS AND STRUCTURES

TIME ALLOWED: TWO (2) HOURS

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO
OTHER QUESTIONS.**

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GRANTED BY THE CHIEF INVIGILATOR**

SECTION I: COMPULSARY**QUESTION ONE**

- A) Figure 1 shows a maize storage building with four (4) identical floor support beams whose ends rest on a plain concrete rectangular pad foundation blocks 250 mm thick. The beams are 1.0 m between centres and span 4.0 m between the concrete pad supports. The building has internal dimensions of 3.0 m x 4.0 m, and together with the support beams weigh 12 kN uniformly distributed. The building will store maize to a uniform depth of 2.0 m.

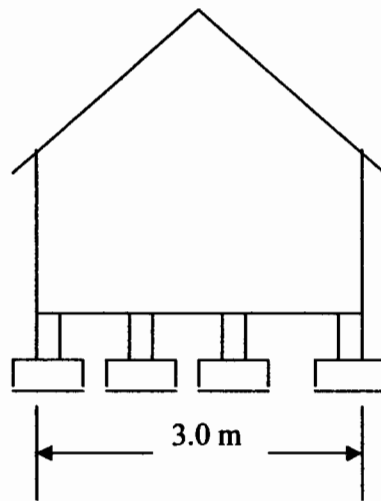


Figure 1. Side elevation of a maize storage building

Given that the density of maize is 800 kg/m^3 , the specific weight of concrete is 23 kN/m^3 , and the allowable bearing capacity of the ground is 140 kN/m^2 , calculate the following:

- i. The dead load of the maize. [5 marks]
 - ii. The actual load carried by the timber beam. [10 marks]
 - iii. The bending moment of the concrete pads. [5 marks]
 - iv. Calculate a suitable size for the concrete pads. [10 marks]
- B) Discuss briefly the role of agricultural structures in food security. [10 marks]

SECTION B: ANSWER ANY TWO QUESTIONS**QUESTION TWO**

- A) Define giving at least one example of the three main types of loads that can be exerted on farm buildings and structures. **[6 marks]**
- B) A concrete ring beam 150 x 150 mm in cross section x 6.0 m in length was designed to secure a maize storage sliding door in a poultry farm. Calculate the dead load of the beam, assuming gravity to be 9.81 m/s^2 and the density of concrete as 5.0 kN/m^3 . **[4 marks]**
- C) Discuss in detail the six main factors that affect the choice of building materials. **[20 marks]**

QUESTION THREE

- A) What are the two main types of stress that are experienced by structural members in farm buildings and structures? **[4 marks]**
- B) A brick pier of $0.7 \times 0.7 \text{ m}$ and 3.0 m high weighs 19 kN/m^3 . It is supporting an axial load from a column of 490 kN . The load is spread uniformly over the top of the pier.
- Calculate the stress in the brickwork immediately under the column. *Show all your work.* **[5 marks]**
 - Calculate the stress at the bottom of the pier. **[6 marks]**
- C) What are the main properties of structural sections that have to be analysed during the design of agricultural buildings and structures? **[6 marks]**
- D) Calculate the second moment of area about the x-x axis for a solid steel cross section that is rectangular, 24 mm wide and 100 mm deep as shown on Figure 2. **[9 marks]**

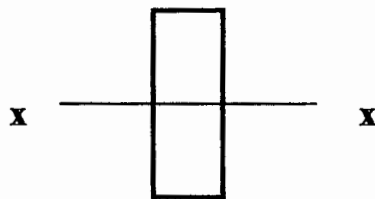


Figure 2. Structural section of a beam.

QUESTION FOUR

- A)
 - i. What are the structural elements that make up agricultural buildings? **[6 marks]**
 - ii. What are the nine types of common roof designs that could be used in the design and construction of agricultural structures? **[9 marks]**

- B) Timber is one of the most common building material used in a number of agricultural structures in Swaziland, but it has one major problem.
 - i. State the structural weakness that timber has as a building material. **[2 marks]**
 - ii. How could such a problem be corrected in order to meet the design specifications of timber structural sections? **[5 marks]**

- C) State with reasons the structural elements for which you can recommend the use of timber for a building that is predominantly concrete and steel as the main structural components. **[8 marks]**