UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE II

COURSE CODE: ABE206/ABE 209

BSc ANIMAL SCIENCE II

BSc ANIMAL SCIENCE (DAIRY) II

BSc ANIMAL SCIENCE (DAIRY) IV

TITLE OF PAPER: FARM BUILDINGS AND STRUCTURES

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: (I) ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS. (II) MARKS WILL BE AWARDED TO LOGICALLY PRESENTED NUMERICAL SOLUTIONS

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SECTION I: COMPULSARY

QUESTION ONE

A) Name the **five (5) categories** of agricultural buildings and structures giving at least one example of each. **(5 marks)**

B) **i.** What are the other **two (2)** structural elements that constitute agricultural buildings other than **walls?** **(2 marks)**

ii. Briefly describe the difference between **load bearing** and **non-load bearing** walls giving examples of the **concrete block wall sizes** that are possible for each category. **(3 marks)**

C) **i.** What are the **three (3) equations** of **static equilibrium?** **(3 marks)**

ii. Calculate the **magnitude** of the forces **R,** and **L** in **Figure 1** and **M and N** in **Figure 2.** **(7 marks)**

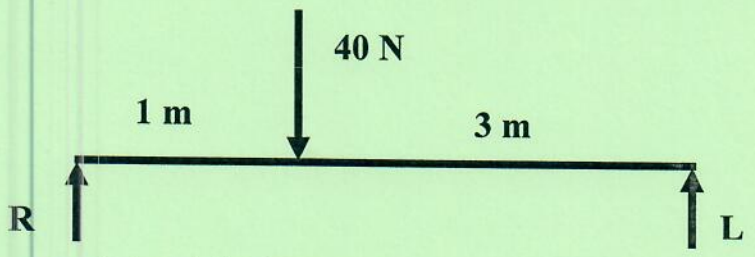

Figure 1. Concrete reinforced ring beam loading.

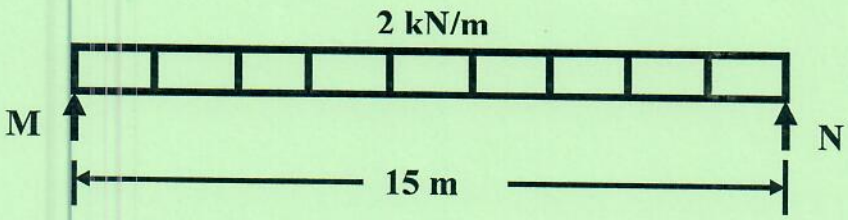

Figure 2. Concrete reinforced ring beam loading.

D) Discuss the **economic importance** of buildings and structures in agricultural production. **(10 marks)**

E) One of the **six main factors** that affect the **choice** of building materials in agricultural buildings and structures is transportation cost to the building site. Prove by calculation that the above statement is correct under the following conditions. A building construction company was building at a site **50 km** away from the nearest building material hardware **(Table 1).**

Table 1. Hardware building materials costs

CONSTRUCTION SITE		**HARDWARE (100 km AWAY)**	
Material	**Cost (E)**	**Material**	**Cost (E)**
PP Cement (OPC)	80.80 per 50 kg bag	Cement (OPC)	80.00 per 50 kg bag
Concrete blocks	14.50 per block	Concrete blocks	14.00 per block
River sand	1000.00/ 5 ton truck	River sand	900.00/ 5 ton truck

i. If the transport cost was **E10.20 / km,** calculate the benefit of using local materials versus using materials **sourced 100 km outside** the construction site. **Please** state all your **assumptions** noting that **(a) 100** x **50 kg** cement bags, **1000** concrete blocks and **(b) 2 x 5** ton river sand truck loads were needed. **(5 marks)**

ii. State the other **five main factors** that affect the **choice** of building materials in agricultural buildings and structures other than **transport.** **(5 marks)**

[40 marks]

SECTION B: ANSWER ANY TWO QUESTIONS

QUESTION TWO

A) i. What are the **three (3)** most important components of concrete? **(3 marks)**

ii. Concrete components **ought** to be **well graded** when making concrete, discuss briefly what this statement means in relation to concrete strength. **(7 marks)**

iii. State the **weakness of concrete** as a building material and **explain** how this weakness could be **rectified** to improve the **weakness.** **(5 marks)**

B) An **axially loaded** concrete column had a uniformly distributed load of **1000 N** and a resultant compressive stress of **33.33 N/m^2**.

i. Calculate the required footing **area** that would **adequately dissipate** the load of the column into the ground. **(5 marks)**

ii. If the footing was designed to be **square in shape**, what were the dimensions i.e. **width and length** supposed to be? **(5 marks)**

C) Bricks and blocks are by-products of concrete, what are the measure differences between the two? **(5 marks)**

[30 marks]

QUESTION THREE

A) Briefly discuss the **significance** of costing **agricultural buildings and structures** before design and construction. **(6 marks)**

B) i. What are the structural elements other than roofs that make up agricultural buildings? **(4 marks)**

ii. Name the **nine (9)** types of roof designs used in agricultural buildings and structures reflected in **Figure 3**. **(9 marks)**

iii. Which type of these roof designs is commonly used by **small holder farmers** in **Southern Africa**? **(2 marks)**

iv. Why is the roof design stated above used the most by small holder farmers in Southern Africa? **(2 marks)**

C) **A 3000 x 2000 concrete hydrant** protection was designed by an irrigation engineer to secure vandalism of her main water supply line. The hydrant protection was to be built using 6-inch concrete blocks that were **300 mm** long, **150 mm** wide and **150 mm** high. If the foundation was **200 mm** deep, with a standard mortar thickness of **15 mm** between blocks, calculate the number of blocks that would be required for the valve protection. **(13 marks)**

[30 marks]

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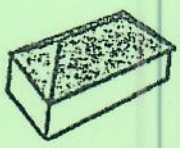

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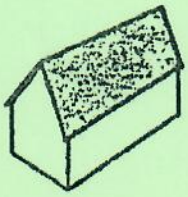

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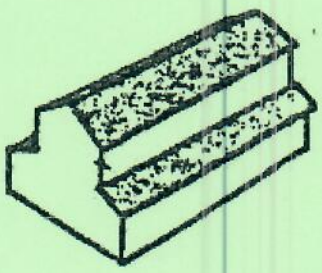

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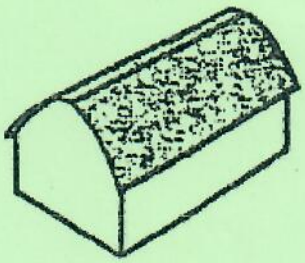

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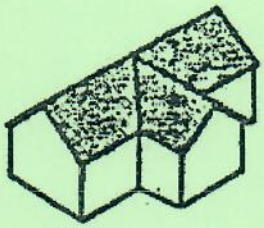

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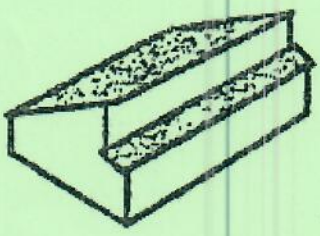

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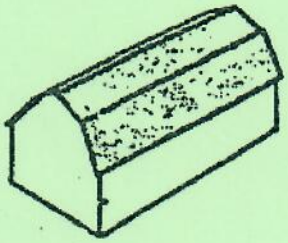

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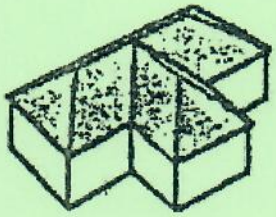

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(9 marks)

Figure 3. Types of building roof designs

QUESTION FOUR

A) State the **three (3) types** of **loads** that can be exerted in agricultural buildings and structures giving at **least one example** of each. **(6 marks)**

I Name the type of normal **stress** shown in **Figure 4a** and **Figure 4b.** **(3 marks)**

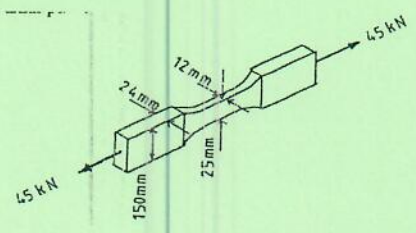

Figure 4a. Normal stress

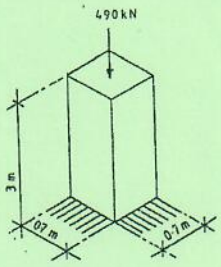

Figure 4b. Normal stress

Figure 4. Normal stresses common in agricultural buildings and structures.

II. The brick pier in **Figure 4 is 0.7 m x 0.7 m x 3 m** high and 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 such that the arrow merely reflects the resultant of the load.

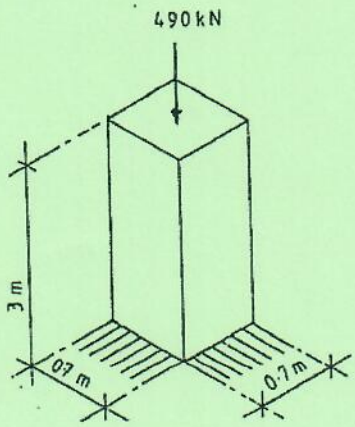

Figure 4. Axially loaded brick pier

i. Calculate the stress in the brickwork immediately under the column. **(3 marks)**

ii. Calculate the stress at the bottom of the pier. **(3 marks)**

iii. Why is **stress** calculation **so important** in the **design** of agricultural buildings and structures? **(4 marks)**

B) A Farm manager intends to construct a **concrete silage silo** with a design life of **20 years**. The depreciation cost is expected to be **5.0%** per year and the initial costs were estimated to be **E45, 000.00**. The bank loan is currently at **15.0%** interest and an insurance of **1.0 %** after construction.

i. Calculate the annual cost of the structure. **(5 marks)**

ii. What would be the value of the structure after the second year of operation? **(5 marks)**

iii. If the returns obtained from silage sales are **E55, 000.00** annually, what advice would you give to the farm director and why? **(1 mark)**

[30 marks]