



**UNIVERSITY OF SWAZILAND  
FINAL EXAMINATION PAPER**

**PROGRAMME: BSC AGRIC II (ABE)**

**COURSE CODE: ABE 209**

**BSC ANIMAL SCIENCE (DAIRY) IV**

**TITLE OF PAPER: FARM BUILDINGS AND STRUCTURES**

**TIME ALLOWED: TWO (2) HOURS**

**SPECIAL REQUIREMENT: A4 DRAWING PAPER**

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

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN  
GRANTED BY THE CHIEF INVIGILATOR**

## SECTION I: COMPULSARY

## QUESTION ONE

- A) What are the five categories of agricultural buildings and structures? (5 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 E15, 000.00. The bank loan is currently at 15.0% interest and an insurance of 1.0 % after construction.
- Calculate the annual cost of the structure. (5 marks)
  - What would be the value of the structure after the second year of operation? (5 marks)
  - If the returns obtained from silage sales are E15, 000.00 annually, what advice would you give to the farm director and why? (5 marks)
- C) i. What are the three (3) equations of static equilibrium? (3 marks)
- Calculate the magnitude of the forces R, and L in Figure 1 and M and N in Figure 2. (7 marks)

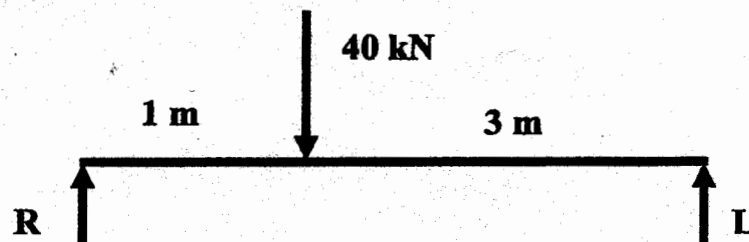


Figure 1 Concrete reinforced ring beam loading.

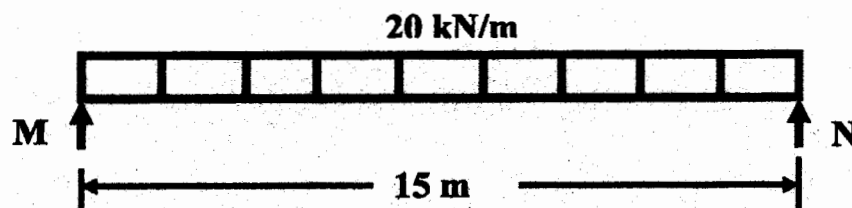


Figure 2. Concrete reinforced ring beam loading.

- D) A small holder farmer intends venturing into broilers raised on deep litter. He was advised to start small with 1000 birds.
- Which type and design of **structural element** was the farmer supposed to use in order to save money? (1 mark)
  - Calculate the **dimensions** i.e. **length** and **width** of the **ground plan** for this proposed farming enterprise given that the space requirement for broilers on deep litter is 6 birds/m<sup>2</sup>. (3 marks)
  - Draw the **ground plan** for the proposed poultry house, showing the **dimensions** and the **title block** with all the **information** that it should have. (6 marks)
- [40 marks]

### SECTION B: ANSWER ANY TWO QUESTIONS

#### QUESTION TWO

- A. The concrete ring beam (2000 x 200 x 150) in Figure 3 failed resulting in structural damage to the building in question.

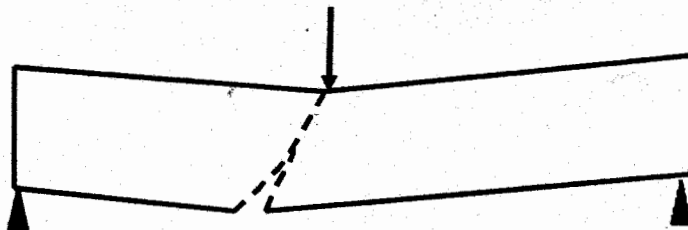


Figure 3. Concrete ring beam failure under load.

- What was the structural problem that caused the **ring beam** to fail? (1 mark)
- What could be done to **correct** the **failure** of the concrete ring beam? (2 marks)
- Provide a design working **drawing** or **sketch** that would reflect a durable concrete beam, which could not fail under the circumstances in Figure 1. Your sketch should indicate the appropriate **dimensions** of the ring beam. (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<sup>2</sup>.**
- 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? (4 marks)**
- C) i. State the two (2) most common categories of agricultural fences giving at least one example of each? (2 marks)**
- ii. What is the fence that could be recommended for the control of small ruminants i.e. sheep and goats in vegetable farms? (1 mark)**
  - iv. What type of fencing posts are utilised in the construction of this type of fence? (2 marks)**
- v. Briefly discuss the functions of fences in agricultural production. (8 marks)**

**QUESTION THREE**

- A) Briefly discuss the significance of costing agricultural buildings and structures before design and construction. (6 marks)**
- B) Discuss the economic importance of agricultural buildings and structures in agricultural production. (10 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. (14 marks)**

**[30 marks]**

**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.** What are the **three most common types of stress** in agricultural buildings and structures? **(3 marks)**
- ii.** A rivet of **10 mm diameter** is connecting two pieces of flat steel in a roof tie. Calculate the shear stress of the rivet when the steel bars are subjected to an axial pull of **6.0 kN**. **(5 marks)**
- ii.** Why is **stress calculation** so important in the design of agricultural buildings and structures? **(4 marks)**
- B)** **i.** What are the **main properties of structural sections** that have to be analysed during the design of agricultural buildings and structures? **(6 marks)**
- ii.** Use equation 1 to 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 4**. **(6 marks)**

$$I_{x-x} = \frac{BD^3}{12} \quad (1)$$

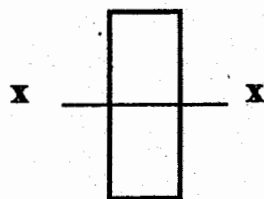


Figure 4. Beam structural section.

**[30 marks]**