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UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER

PROGRAMME: BSc. AGRICULTURAL AND BIOSYSTEMS ENGINEERING YR 2
BSc. ANIMAL SCIENCE (DAIRY) YR 4

COURSE CODE: ABE 209

TITLE OF PAPER: FARM BUILDINGS AND STRUCTURES

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER
QUESTIONS

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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.

   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 **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)

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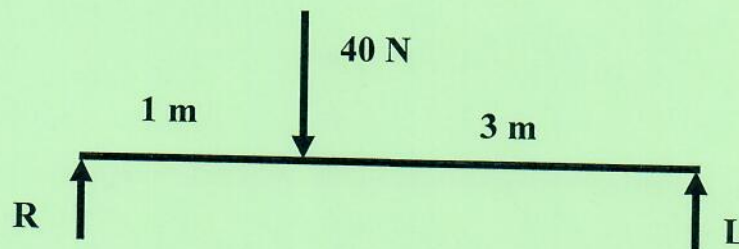
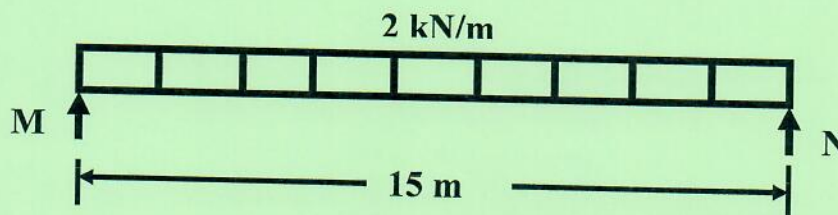

Figure 1. Concrete reinforced ring beam loading.

Figure 2. Concrete reinforced ring beam loading.

D)   Discuss the economic importance of buildings and structures in agricultural production.

   (10 marks)

   [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.
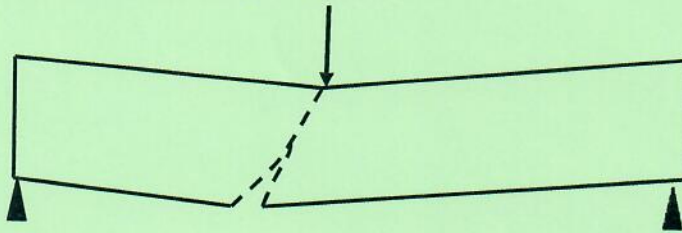

Figure 3. Concrete ring beam failure under load

   i.   What was the structural problem that caused the ring beam to fail?   **(1 mark)**

   ii. What could be done to **correct** the **failure** of the concrete ring beam?   **(2 marks)**

   iii. Provide a design working **drawing or sketch** that would reflect a durable concrete beam, which could no 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/m²**.

   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)**

   iii. What type of **fencing posts** are **utilised** in the **construction** of this type of fence?

   (2 marks)

   iv. Briefly discuss the **functions** of fences in **agricultural production**.   **(8 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.   What are the **nine (9)** types of roof designs that re used in agricultural buildings and structures?

           (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]

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)

         iii.   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.   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**.   **(6 marks)**
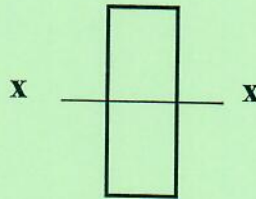
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Figure 2. Beam structural section

[30 marks]