THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF AGRICULTURAL ENGINEERING

2020/21 MID ACADEMIC YEAR TEST

AEN 4131: FARM STRUCTURES

TIME ALLOWED: TWO HOURS

INSTRUCTIONS:

i. THERE ARE FOUR QUESTIONS IN THE PAPER, ATTEMPT ALL QUESTIONS
ii. ALL QUESTIONS CARRY EQUAL MARKS

QUESTION 1

(a) Building materials can be classified either as natural or as manmade. Name TWO natural building materials and TWO manmade building materials. [6 Marks]

(b) List any FOUR factors of a farm building that are influenced by the choice of building materials [6 Marks]

(c) Timber has natural defects and those due to poor handling and seasoning. List any TWO natural defects and any TWO defects due to poor handling and seasoning of timber [6 Marks]

(d) Earth as building material as many advantages that encourage and facilitate self-help and community participation in house building, but it also has disadvantages.

i) List any TWO advantages of soil as a building material [3 Marks]
ii) List any TWO disadvantages of soil as a building material [4 Marks]

QUESTION 2

(a) Concrete is a very common building material. Mention TWO factors that affect the strength of concrete [6 Marks]

(b) A farmer wants to construct a concrete flow for the equipment shed that is 15 m long and 10 m wide. The floor slab is 8 cm thick. If the shed the nominal mix used is 1:2:4. Given that the aggregate used is completely dry and that the Bulk density of sand and stones is 1400 kg/m^3 and 1600 kg/m^3.

If the volume of the concrete is two third (2/3) of the sum of volumes of the individual materials and the concrete use efficiency is 95%, calculate:

i) The maximum size of the coarse aggregate (stones) in mm [1 Mark]

ii) The number of 50 kg bags of cement that are required given cement in a 50 kg bag has a volume of 37 litres. [6 marks]

iii) The number tones of sand that would be bought. [6 Marks]

iv) The number of tones of stones that would be bought. [6 Marks]

QUESTION 3

(a) There are two broad categories of loads that are considered when designing agricultural buildings. Name the TWO categories of loads and for each category, give TWO examples of loads. [6 Marks]

(b) A suspended floor is to be build. The floor is to be supported by 4 equally spaced beams as shown in Fig. Q3. The floor is expected to impose a maximum uniformly distributed surface load Q kN/m^2. The width of the beams is 50 mm. If the maximum equivalent concentrated load to be supported by any of the interior beams (beam B or C) is to be 2000 kN, determine:

i) The maximum uniformly distributed surface load Q. [9 Marks]

ii) The equivalent concentrated load supported by beam one interior beam A. [5 Marks]

iii) The uniformly distributed line load supported by beam A. [5 Marks]

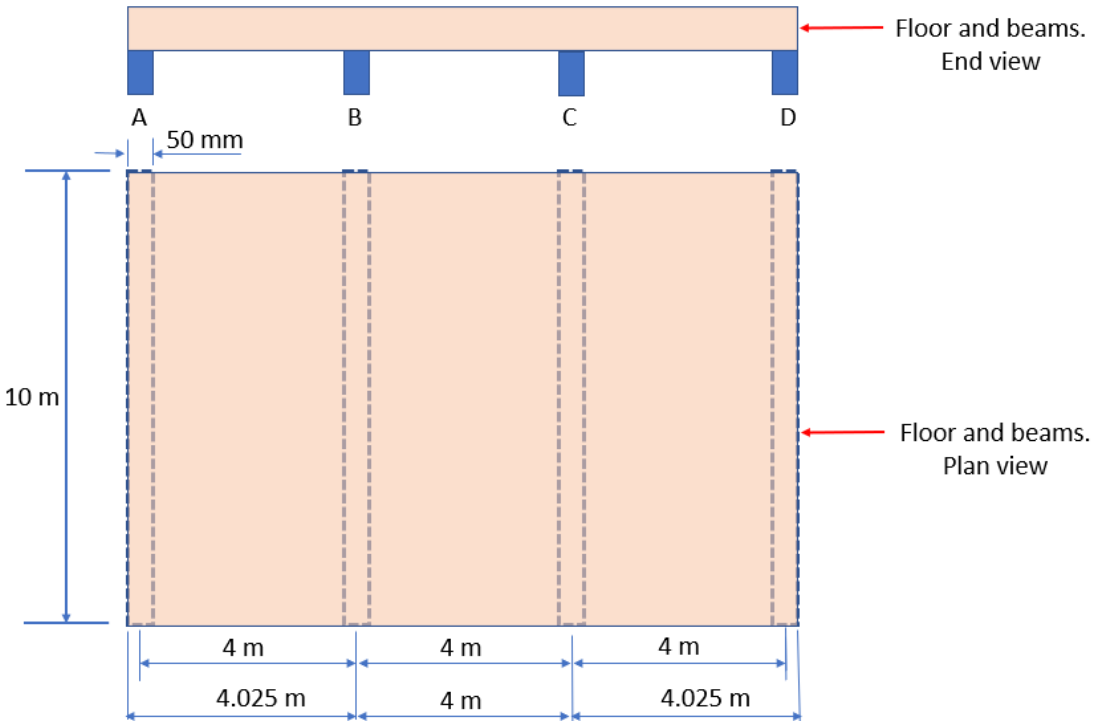

Fig. Q3

QUESTION 4

(a) Farm structures are in static equilibrium because they do not exhibit linear or rotary motion. List conditions that should be met for a structure to be in static equilibrium. [6 Marks]

(b) The beam shown in Fig. Q4, has a pin support at A and a (roller) smooth support at B. Determine:

i) The reaction forces at the supports A and B. [4 Marks]

ii) Draw the shear force diagram (SFD) and bending moment diagram (BMD). [11 Marks]

iii) Give the value of the maximum shear force and state its location. [2 Marks]

iv) Give the value of the maximum bending moment and state its location. [2 Marks]

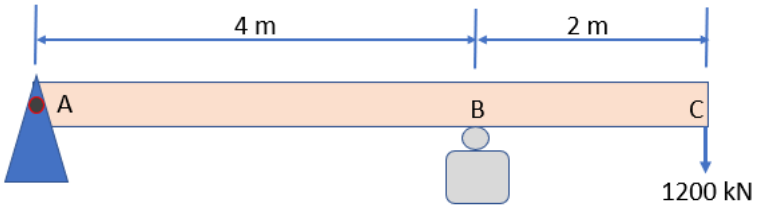

Fig. Q4