



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 208: STRENGTH OF MATERIALS II

DATE: 14/12/2020

TIME: 2.00-4.00 PM

INSTRUCTIONS

- a) This paper contains FIVE (4) questions.
- b) You are required to answer QUESTION (1) and ANY TWO (2) questions.
- c) The marks for each question are as indicated in the brackets.
- d) Illustrate your answers with clear sketches.

QUESTION ONE (30 MARKS) (COMPULSORY)

- a) Define “composite beams” and give three examples (4 marks)
- b) The principal stresses at a point in an elastic material are 100N/mm^2 (tensile), 80N/mm^2 tensile and 50N/mm^2 (compressive). If the stress at the elastic limit in simple tension is 200N/mm^2 , determine whether the failure of material will occur according to maximum principal stress theory. If not, determine the factor of safety (3 marks)
- c) The shearing stress in a solid shaft is not to exceed 40N/mm^2 when the torque transmitted is $20,000\text{Nm}$. Determine the minimum diameter of the shaft (5 marks)
- d) A hollow rectangular column of external depth 1m and external width 0.8m is 10cm thick. Calculate the maximum and minimum stress in the section of the column if a vertical load of 200Kn is acting with an eccentricity of 15cm (10 marks)
- e) State four assumptions made in the Eulers column theory (4 marks) (f) A column of timber section $15\text{cm} \times 20\text{cm}$ is 6m long both ends being fixed. If E for the timber is 17.5Kn/mm^2 , determine;
 - i. Crippling load
 - ii. Safe load for the column if factor of safety is 3 (4 marks)

QUESTION TWO (20 MARKS)

- a) According to the theory of maximum shear stress, determine the diameter of bolt which is subjected to an axial pull of 9Kn together with a transverse shear force of 4.5Kn. elastic limit in tension is 225N/mm². Factor of safety is 3 and poisons ratio is 0.3 (10 marks)
- b) Determine the diameter of a bolt which is subjected to an axial pull of 9Kn together with a transverse shear force of 4.5Kn using
- Maximum principal stress theory
 - Maximum principal strain theory (10 marks)

QUESTION THREE (20 MARKS)

- a) A short column of external diameter 40cm and internal diameter 20cm carries an eccentric load of 80Kn. Find the greatest eccentricity which the load can have without producing tension on the cross section (10 marks)
- b) If in problem (a) above the eccentricity of the point load is given as 150mm, then calculate the maximum and minimum stress in the section (10 marks)

QUESTION FOUR (20 MARKS)

- a) Check the stability of the reinforced concrete retaining wall shown in figure 1. The soil is a silty sand with a horizontal surface and no surcharge. The water table lies below the base. The wall was propped while the backfill was placed using only light compaction. Assume the virtual support face is vertical (15 marks)

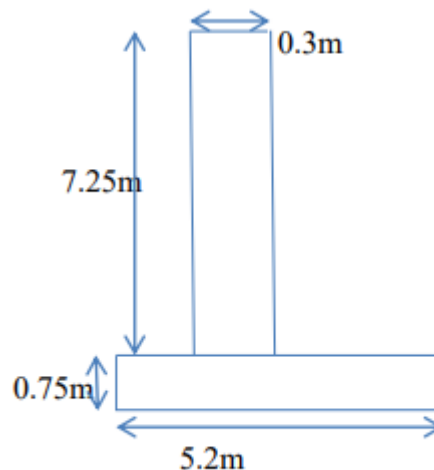


Figure 1

Soil properties $c' = 0$, angle of friction 40° , $\gamma_{\text{soil}} = 20 \text{ Kn/m}^3$ and $\gamma_{\text{concrete}} = 24 \text{ Kn/m}^3$

- b) Calculate the resultant active thrust on a vertical smooth retaining wall of height 5.4m. the water table lies below the base of the wall. Soil properties; angle of friction 30° , $C'=0$ and $\gamma=20\text{Kn/m}^3$

QUESTION FIVE (20 MARKS)

A column of circular section is subjected to a load of 120kn. The load is parallel to the axis but eccentric by an amount of 2.5mm. The external and internal diameters of columns are 60mm and 50mm respectively. If both the ends of the column are hinged and column is 2.1m long, then determine the maximum stress in the column. Take $E=200\text{GN/m}^2$