TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2514: THEORY OF STRUCTURES VII

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2013
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*

This paper consists of **FIVE** questions. Answer question **ONE (Compulsory)** and any **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **TWO** printed pages

Question One (Compulsory)

a) Figure 1 shows a simply supported rectangular slab which is isotropically reinforced with bottom steel such that the yield moment of resistance per unit width of slap is "m" for bending about any axis. Determine the required value of "m" if the slab is to carry a uniformly distributed load of intensity "q"
(10 marks)

b) A rectangular section steel beam 50mm wide and 200mm deep is:

(i) Used as a simply supported beam over a span of 2m with the 20mm dimension vertical. Determine the value of the central concentrated load that will produce initiation of yield at the outer fibres of the beam.
(ii) If the central load is increased by 10% find the depth to which yielding will take place at the centre of the beam spam
(iii) Outer which length of beam will yielding then have taken place?

(iv) What are the maximum deflections for each load case? compressive stress in steel (tension and compression) = 225MN/m^2
Modulus of elasticity E = 206.8GN/m2 **(20 marks)**

Question Two

a) Determine the shape factor of a rectangular section figure 2 shows a loaded cantilever beam and its cross section. **(4 marks)**

b) Determine the shape factor of the cantilever beam section **(7 marks)**

c) Determine the maximum uniformly distributed load that the cantilever can carry if yielding is permitted over the lower part of the web to a depth of 25mm. The yield stress of the material of the cantilever beam is 225MN/m^2 **(9 marks)**

Question Three

a) A circular flat plate of diameter 120mm and thickness 10mm is constructed from steel with modulus of elasticity E = 208 GN/m^2 and $\upsilon = 0.3$. The plate is subjected to a uniform pressure of 5MN/m^2 on one side only. If the plate is clamped at the edges, determine:
(i) The maximum deflection
(ii) The position and magnitude of the maximum radia stress

What percentage change in the results will be obtained if the edge conditions are changed such that the plate can be assumed to be freely supported? **(7 marks)**

b) A circular disc 150mm diameter and 12mm thickness is clamped around the periphery and built into a piston of diameter 60mm at the centre. Assuming that the piston remains rigid, determine the maximum deflection of the disc when the piston carries a load of 5KN. The material of the disc has a modulus of elasticity. E = 208GN/m^2 and $\upsilon = 0.3$ **(13 marks)**

Question Four

a) A square slab with built-in edges is isotropically reinforced with top and bottom steel. Determine the intensity $"\omega"$ of the uniformly distributed load that will cause collapse of the slab. Use the yield-line method of analysis. **(8 marks)**

b) A rectangular slab whose length and width is 10m and 5m respectively is isotropically reinforced with top and bottom reinforcement such that the yield moment of resistance m per metre width of slab both for positive and negative bending about any axis. The slab is simply supported along three edges and fully fixed along the fourth edge. By considering a reasonable yield line pattern such as shown in figure 4(b) determine the intensity " ω " of the uniformly distributed load that will cause collapse. **(12 marks)**

Question Five

a) Design a rectangular slab 7.5m x 5m simply supported on all edges. The imposed load is 6KN/m^2. The load factors are 1.5 and 2.2 for dead and imposed loads respectively. The estimate moment in the longer dimensions is half of the shorter side:

$$\tau_s = 240N/mm^2$$

$$\tau_c = 20N/m^2$$

Take =

Finishes = 1KN/m^2

Unit weight of concrete = 24KN/m^3 **(20 marks)**