TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN CIVIL ENGINEERING (BSCE)

ECE 2407: STRUCTURAL DESIGN I

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

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
- *Answer Booklet*
- *Mathematical table/Pocket calculator*

This paper consists of **FIVE** questions.
 Answer question **ONE (COMPULSORY)** in section **A** and any other **TWO** questions from section **B**
Maximum marks for each part of a question are as shown
This paper consists of **FIVE** printed pages

SECTION A

Question One (Compulsory)

a) Figure 1a below is a laterally restrained steel beam restrained at the ends and points of application of the loads. For the given loads, determine the size of grade 43 section required.

C

Load specifications. (unfactored loads)

(i)   W1
   - Dead Load   =   30KN
   - Imposed Load =   50KN
(ii)   W2
   - Dead Load   =   20KN
   - Imposed Load   =   30KN

(iii)   Self-weight   =   1KN/m   **(20 marks)**

b) The arrangement in figure 1b is a system of formwork to support a 125mm thick reinforced concrete slab. The following data is given:
   - Load due to reinforced concrete = $24KN/m^3$
   - Load due to self weight of timber sheeting = $1KN/m^2$
   - Load due to self weight of joists == $0.12KN/m^2$
   - Imposed load due to construction work = $1.5KN/m$
   - The timber class is SC3 (Kenyan cypress)

   Design a typical support joist spanning 2.5m at 450mm centres and check for deflection. NB. Use K3 (Load duration factor) for formwork = 1.4

SECTION B (Attempt any TWO questions)

Question Two

a) Outline **FOUR** requirements of cased columns.   **(2 marks)**

b) Figure 2b shows a bracket of an I –section connected to the flange of a vertical column. The bracket carries a load of 150KN at an eccentricity of 150mm. Determine the thickness of the weld required for the bracket if the permissible stress of the weld is $100N/mm^2$.   **(10 marks)**

c) An internal stanchion in a multi storey building is of actual length 4.5m centre to centre of floor beams. The steel section is to convey an axial load of 750KN when cased in accordance with requirements of BS 449. Choose a suitable universal column section in grade 43 and make all the necessary checks. **(8 marks)**

Question Three

a) Figure 3 a shows angle sections bolted as shown. Determine the safe load P for the bolted section.

Take: F_s = $95N/mm^2$

   F_t = $155N/mm^2$

   F_{br} = $300N/mm^2$

Note: All bolts are 19mm in diameter, turned and of strength designation 4.6. **(10 marks)**

b) Figure 3b shows a roof plan of a conference hall measuring 30mm x 12m. The roof consists of 125mm thick reinforced concrete slab supported on universal beams spaced at 2.5m centres. The roof finish together with water proof layer has a thickness of 80mm and an average unit weight $20KN/m^3$. If the imposed load is $0.75KN/m^2$, design the steel beams using grade 43steel, given that:
   - Density of concrete   = $2400kg/m^3$
   - E   = $210KN/mm^2$
   - Assume any other relevant information

NB. Perform all the necessary checks

Question Four

a) State SIX factors that govern holding power of nails.   **(3 marks)**

b) Differentiate between visual and machine grading of timber.   **(2 marks)**

c) Figure 4c shows the plan and section through a timber floor for a domestic dwelling. Design a timber joist of strength class SC2 given the following information.
   - Joists are spaced at 400mm centres and their depths are limited to 200mm
   - Self weight of T & G board = 0.1KN/m^2
   - Self weight of plaster board ceiling = 0.2KN/m^2
   - Imposed loading on floor = 1.5KN/m^2
   - Take self wt of joists = 0.13KN/m^2 **(15 marks)**

Question Five

An SS5 grade Kenyan Blue gum 3.0mm in height supports a very short term load of 80KN applied 50mm eccentric to X-X axis as shown in figure 5a. The column is used in an external environment restrained at both ends in position and one end in direction check the adequacy of 150 x 300mm timber. Performs ALL the necessary checks. **(17 marks)**

c) List **SIX** advantages of welded connections. **(3 marks)**