2305/303
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2308/303
STRUCTURES
Oct./Nov. 2010
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN HIGHWAY ENGINEERING

STRUCTURES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/pocket calculator.
*Answer any **FIVE** of the following **EIGHT** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
All relevant design tables are included.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

1. (a) Using Macaulay's method, determine in terms of EI, the deflection at points C and D in the beam loaded as shown in Figure 1. (12½ marks)

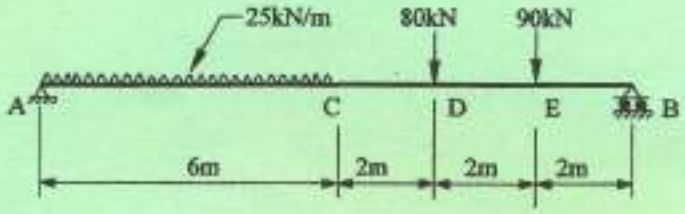


Fig 1

(b) Show that the maximum shearing stress in a rectangular beam section is given by

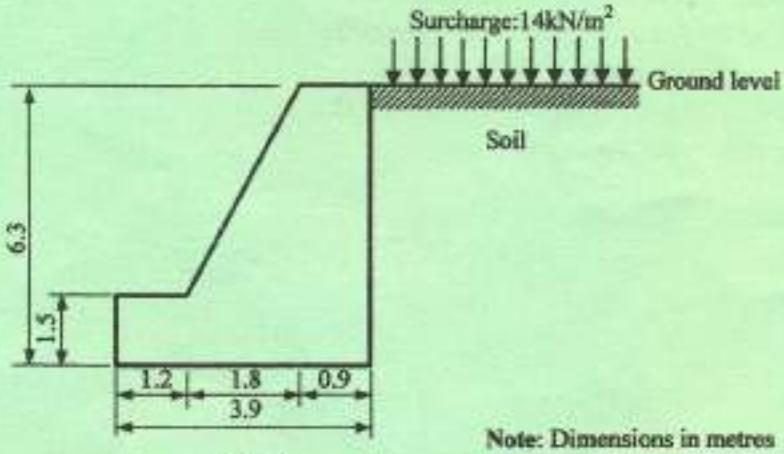
$$\frac{1.5Q}{bd}$$

where: Q = maximum shear force
b = breadth of section
d = depth of section. (7½ marks)

2. Figure 2 shows a retaining wall with a surcharge of 14 kN/m^2. Using the data below determine:

(i) whether tension occurs in the base;
(ii) the maximum and minimum pressure under the base;
(iii) the factor of safety against sliding.

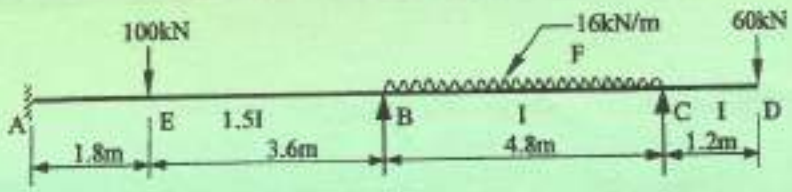
Data: Density of soil = 1900 kg/m^3
Density of concrete = 2400 kg/m^3
Angle of shearing resistance = 29°
Angle of wall friction = 29°. (20 marks)



Note: Dimensions in metres

Fig 2

3. Using the moment distribution method analyse the beam shown in Figure 3 and hence sketch the bending moment diagram indicating the critical values.



(20 marks)

Fig 3

4. Using the three-moment theorem analyse the beam shown in Figure 4 and hence draw the shear force and bending moment diagrams indicating all critical values.

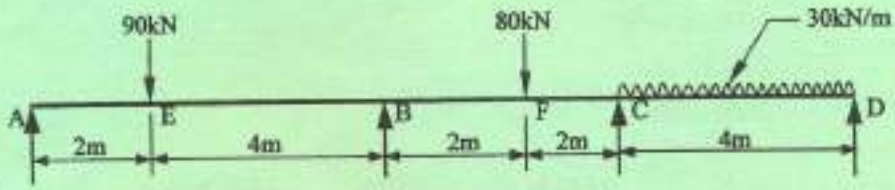


Fig 4

(20 marks)

5. Design and detail the plan and section of a reinforced concrete roof slab of effective spans 3.0m x 18.0m to carry a superimposed load of 2.51 kN/m^2. The surfacing and screed weight is 0.6 kN/m^2. Take m = 15; P_{st} = 210 N/mm^2; P_{cb} = 7N/mm^2 and concrete density as 24kN/m^3.

(20 marks)

6. Using the data below, design and detail the elevation and section of a reinforced concrete rectangular beam.

Data:
- Effective span = 8.0m
- Breadth of beam = 250mm
- P_{cb} = 8.5N/mm^2
- P_{st} = 230 N/mm^2
- Imposed load = 7.5kN/m
- Unit weight of concrete = 24kN/m^3
- P_q = 0.8 N/mm^2

(20 marks)

7. (a) A continuous principal rafter of a truss is 3m long between intermediate connections. It carries a thrust of 190 kN. Assuming that it is effectively held in position at both ends and restrained in direction at both ends determine a suitable steel angle section for the rafter. (5 marks)

(b) Select a suitable universal beam section to support the loading system shown in Figure 5.

Take live load = 75% of the point loads.
$Pq = 100N/mm^2$; $E = 210\ kN/mm^2$; $F = 165\ N/mm^2$. (15 marks)

Given:

Live load = 75% of point loads;
$Pq = 100N/mm^2$;
$E = 210\ kN/mm^2$;
$f = 165N/mm^2$.

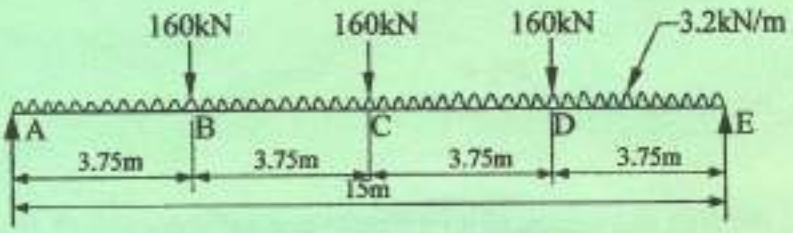


Fig 5

8. (a) Design the weld for the direct shear connection for the angle shown in Figure 6. The load acts on the centroidal axis of the angle. Use 6mm fillet weld of strength 483 N/mm. (11 marks)

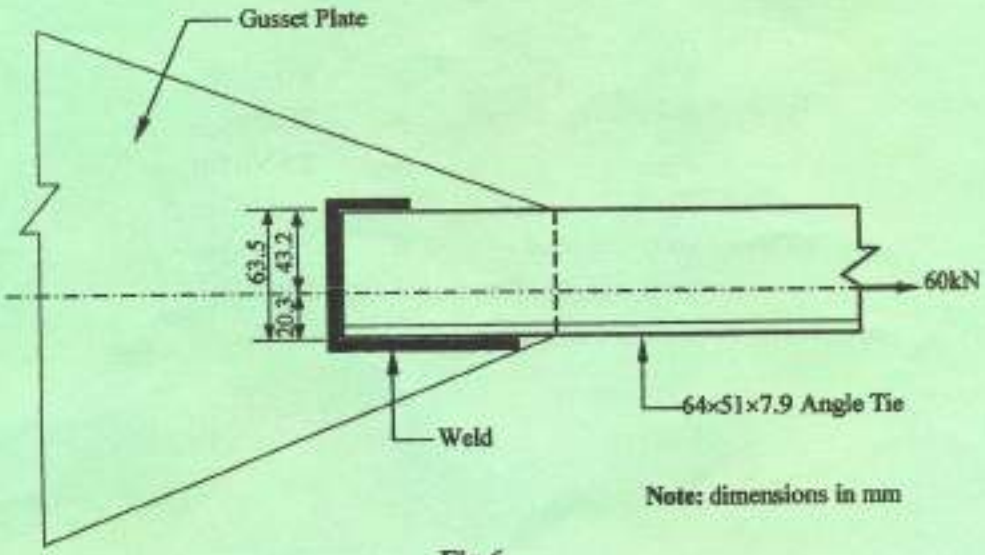


Fig 6

(b) A timber beam of clear span 5.5m is simply supported on 250mm bearing walls at each end and carries a uniformly distributed load of 12 kN/m over its entire length. Design the beam using the given data:

Permissible deflection = $\frac{\text{span}}{300}$

- permissible bending stress = 9 N/mm^2
- permissible shear stress = 1.2 N/mm^2
- Depth of section is twice the breadth.
- Young's modulus of elasticity = 8 kN/mm^2

(9 marks)