

2707/302

STRUCTURES III

June/July 2021

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN CIVIL ENGINEERING
MODULE III**

STRUCTURES III

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

answer booklet;

scientific calculator;

drawing instruments.

This paper consists of EIGHT questions.

Answer FIVE questions.

Maximum marks for each part of a question are as indicated.

All relevant tables for this examination are provided.

Candidates should answer the questions in English.

This paper consists of 10 printed pages.

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

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Turn over

1. Using the method of three moment theorem, analyze the beam shown in figure 1 and hence sketch the bending moment diagram indicating values of critical points. (20 marks)
 $EI = \text{Constant}$

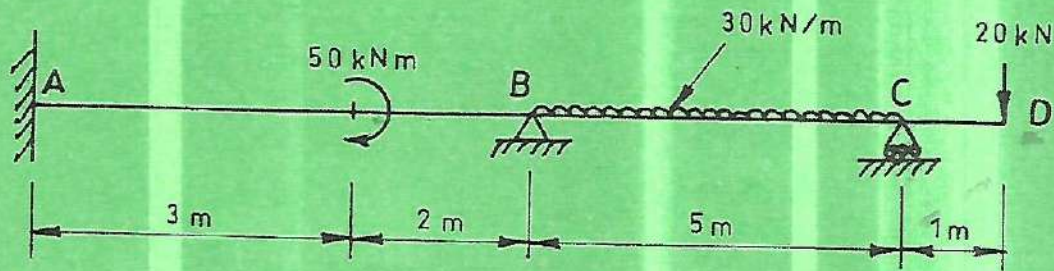


Fig. 1

2. Figure 2 shows a cross-section of an eccentrically loaded column. Determine the extreme fibre stresses at point A, B, C and D. (20 marks)

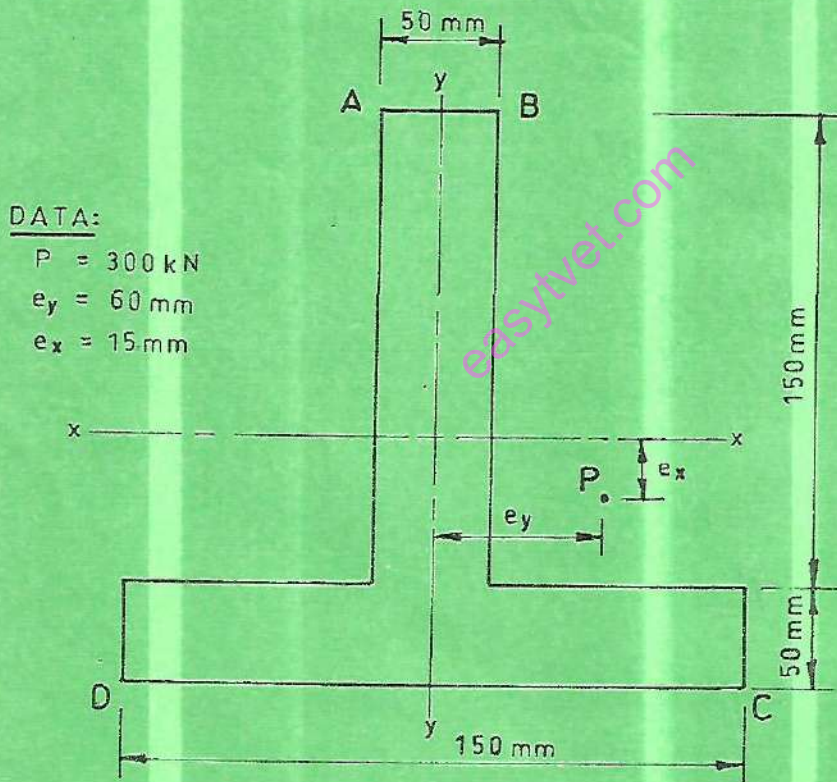
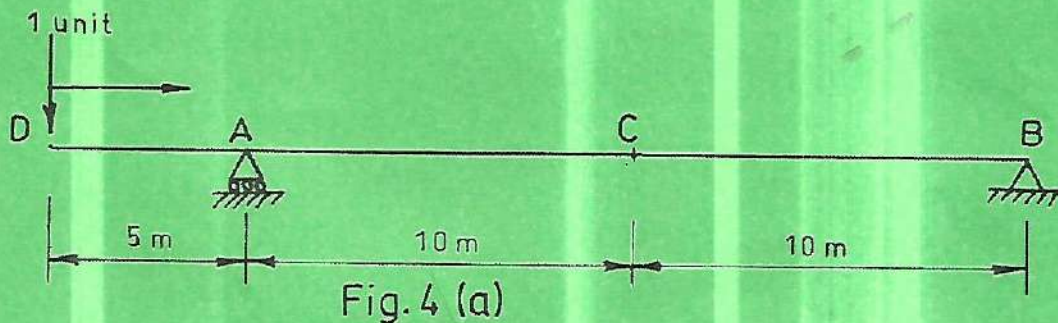


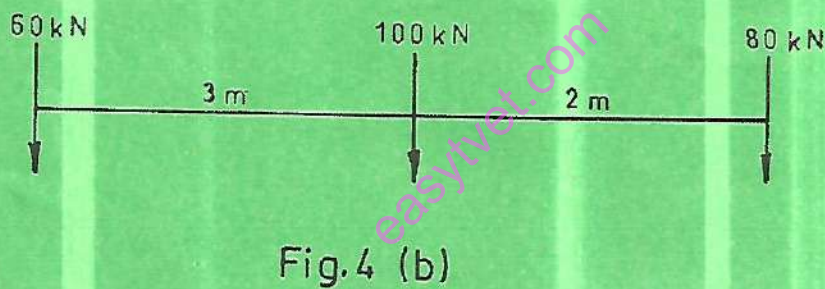
Fig.2

5. (a) **Figure 4 (a)** shows a beam supported at A and B. Sketch the influence line diagram for:
- the reaction at A;
 - the reaction at B;
 - the reaction at C.

(10 marks)



- (b) Determine the maximum bending moment at point C, in figure 4 (a) when the beam is loaded with moving point loads as shown in **figure 4 (b)**. The beam crosses from D to B. (10 marks)



6. **Figure 5** shows an eccentrically loaded bolted connection for a stanchion in grade S275 steel.

Determine:

- Load carried by the furthest bolt 'A'.
- The shear strength of one bolt.
- The bearing capacity of one bolt.
- The bearing capacity of the plate.

Take:

p_s	=	160 N/mm ²
p_{bb}	=	460 N/mm ²
bolt diameter	=	20 mm
hole diameter	=	22 mm

(20 marks)

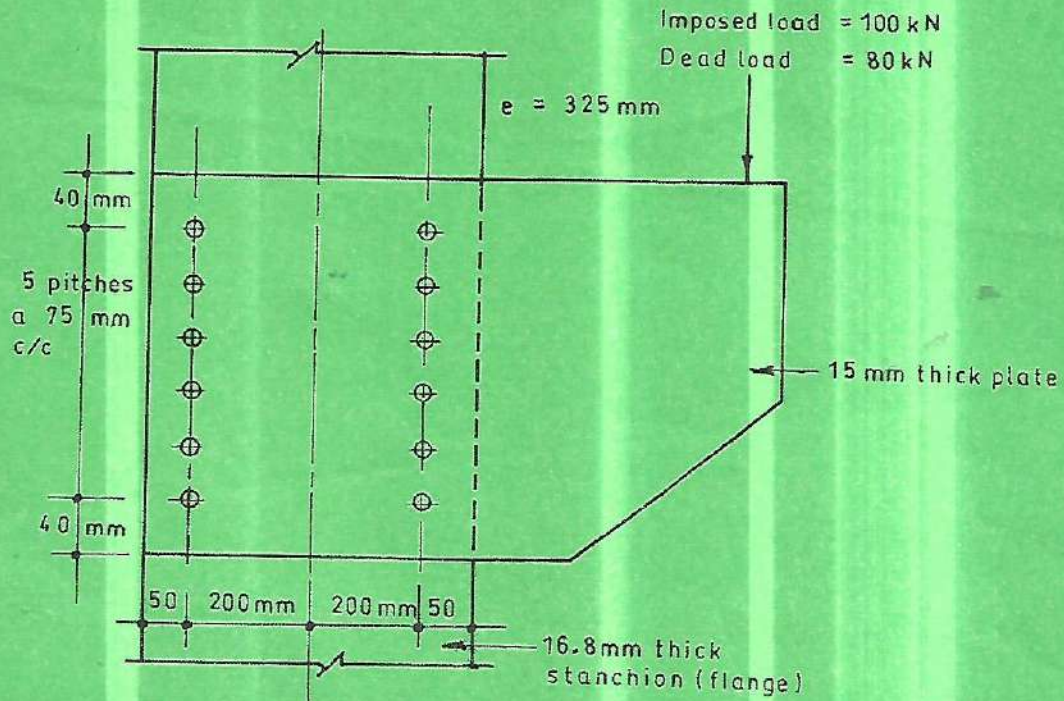


Fig. 5

7. (a) **Figure 6** shows a welded connection for an angle using 6 mm fillet weld of strength 483 N/mm^2 . Design the weld for direct shear. The load is acting through the centroidal axis of the angle as shown. (4 marks)

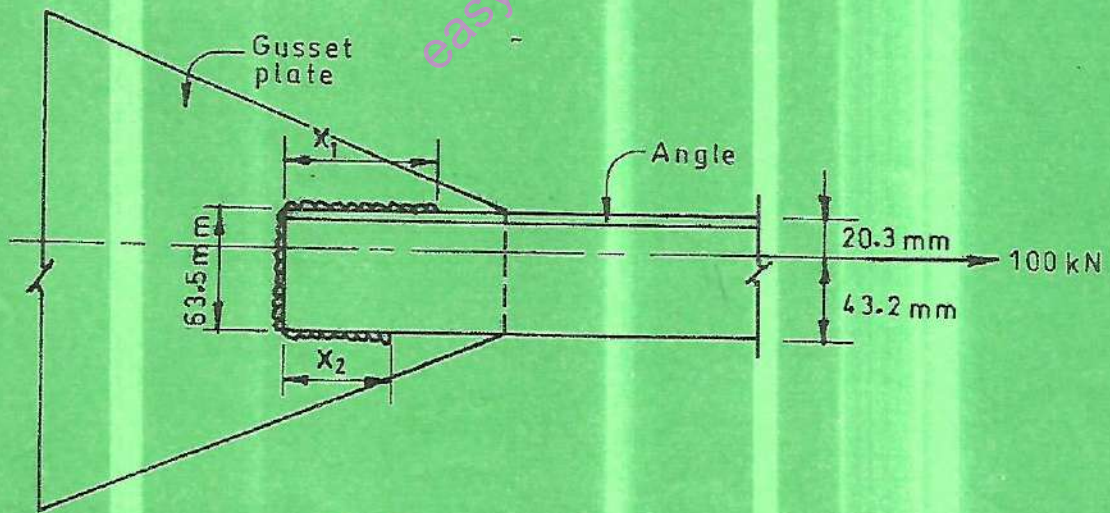


Fig. 6

- (b). Universal beams (UB) of effective length 6 m and spaced at 1 m centre to centre supports a suspended reinforced concrete floor slab 125 mm thick. Select a suitable section for an internal beam in grade S275 steel and check for shear, bending and deflection using the following data:

Unit weight of concrete	=	24 kN/m ³
Imposed load	=	3 kN/m ²
Finishes	=	1.2 kN/m ²
P_y	=	275 N/mm ²
Young's modulus of elasticity	=	205 kN/mm ²
Permissible deflection	=	$\frac{\text{Span}}{360}$

(16 marks)

8. (a) List five reasons for casing stanchions.

(5 marks)

- (b) Figure 7 shows the loading condition on a stanchion of actual length 8.0 m, which is fixed at one end and pinned at the other end. Check the adequacy of 305 × 305 × 118 kg/m UC in grade S 275 steel.

(15 marks)

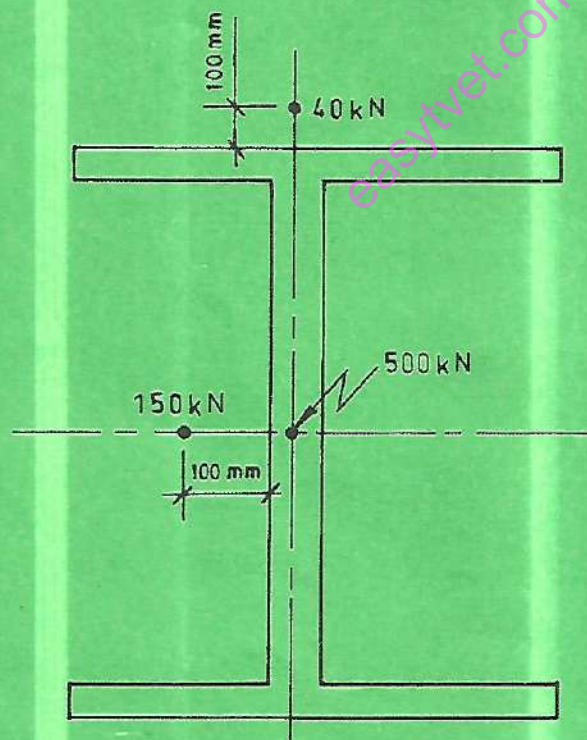


Fig. 7