SCAN

Name:_____ Index No:_____/_____

2305/303
2307/303
2308/303
STRUCTURES
Oct./Nov. 2013
Time: 3 hours

Candidate's Signature: _____

Date:_____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN HIGHWAY ENGINEERING

STRUCTURES

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have mathematical tables/scientific calculator and drawing instruments for this examination.
*Answer any **FIVE** of the **EIGHT** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
Answers should be written in the spaces provided in this question paper.
Relevant design tables are attached.
*Do **NOT** remove any pages from this question paper.*
Candidates should answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 20 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. Using the three moments theorem, analyse the beam shown in figure 1 and hence sketch the shear force and bending moment diagrams indicating the values at all critical points. (20 marks)

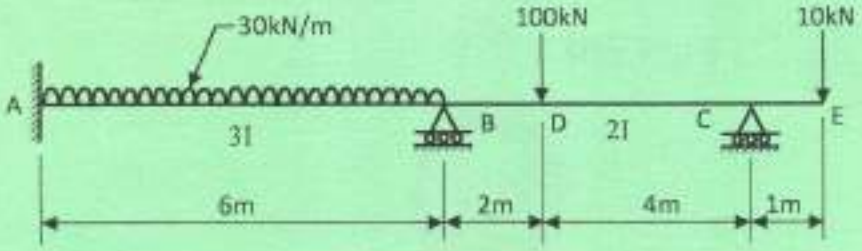

Figure 1

2. (a) A slab simply supported on four sides on 200 mm thick walls is 6.8 m x 4.8 m internal dimensions. Using the load factor method, the following information and table 2, design the slab:

Loading	- Imposed load	=	3 kN/m²
	Finishes	=	0.8 kN/m²
Pst	= 230 N/mm²		
Pcb	= 7 N/mm²		
Unit weight of concrete		=	24 kN/m³

(16 marks)

(b) Detail the plan and section of the slab designed in 2(a) above showing the reinforcement details. (4 marks)

3. Using the moment distribution method, analyse the frame shown in figure 2, and hence sketch the bending moment diagram indicating the values at critical points. (20 marks)

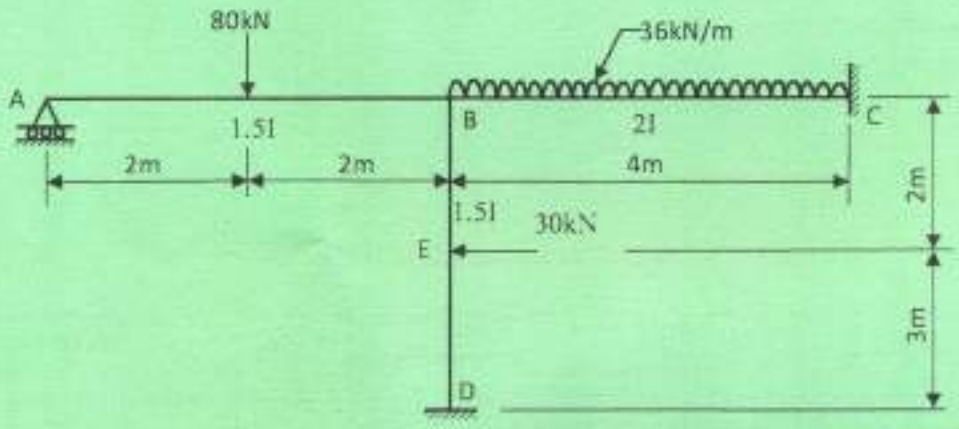

Figure 2

4. Reinforced T-beams in a suspended floor are of effective span 6 m spaced at 3m c/c. Using the load factors method, design the beams given the following information and table 3:

overall depth	=	550 mm
slab thickness	=	150 mm
breadth of rib	=	350 mm
Pst	=	230 N/mm^2
Pcb	=	7 N/mm^2
Permissible shear stress	=	0.7 N/mm^2
Permissible stress in local bond	=	1.25 N/mm^2
Unit weight of concrete	=	24 KN/m^3
Loading: Imposed load	=	2.5 kN/m^2
Partitions	=	1.2 kN/m^2
Finishes	=	0.8 kN/m^2

(20 marks)

5. For the beam shown in figure 3:

(a) Plot the influence line diagram for the:

(i) reaction at A;
(ii) reaction at B;
(iii) bending moment at D.

(13½ marks)

(b) Determine the maximum positive bending moment at D when a uniformly distributed load of 20 kN/m and 4.5 m long crosses the beam from C to B. (6½ marks)

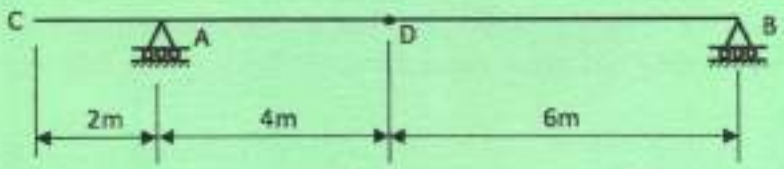

Figure 3

6. (a) (i) State **four** advantages and **two** disadvantages of welded connections.

(ii) State **four** reasons for casing steel columns.

(5 marks)

(b) Determine the size of the fillet weld required for the eccentric welded connection shown in figure 4, given the information in table 4.

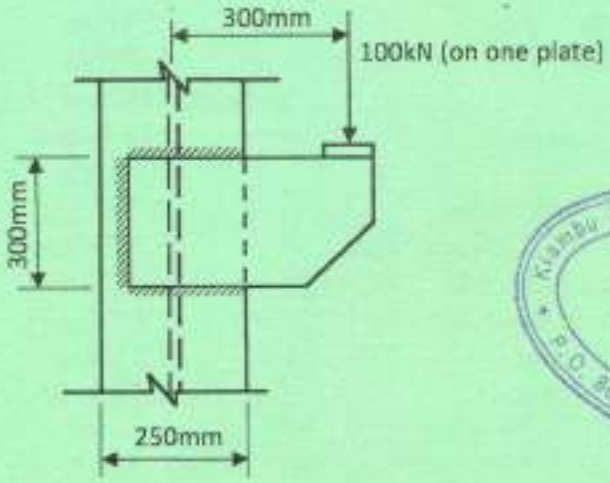

Figure 4

(15 marks)

7. (a) Define the following terms as applied to structural timber:

(i) grade stress;
(ii) modification factors;
(iii) strength class;
(iv) dry stress.

(4 marks)

(b) A suspended timber floor is supported on timber joists of effective length 4.0 m spaced at 500 mm c/c. Using the following data and the information in table 5, design the joists for bending and hence check for shear, bearing and deflection.

Data:

- grade stresses

- bending parallel to grain = 75 N/mm^2
- shear parallel to grain = 0.71 N/mm^2
- compression perpendicular to grain = 1.9 N/mm^2

- load sharing modification factor = 1.1
- bearing length at supports = 100 mm
- depth /breadth ratio = 3
- loading : dead load = 1 kN/m^2
  imposed load = 2 kN/m^2
- permissible deflection = 0.003 x span
- Youngs modulus E = 9.9 kN/mm^2

Assume medium term loading.

(16 marks)

8. (a) Figure 5 shows a truss loaded in such a way that the upper reaction is horizontal.

Using the graphical method, determine the:

(a) magnitude of the reactions;

(b) magnitude and nature of forces in the members.

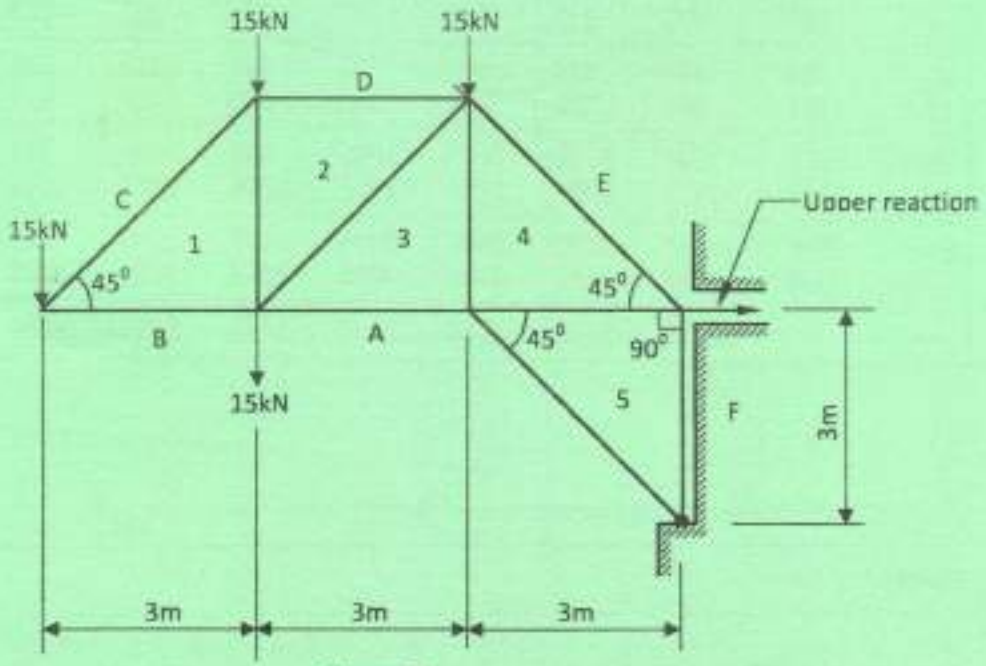

Figure 5

(20 marks)

Table 1

Reinforcement-bar areas (mm^2) per metre width for various bar spacings

Bar diam. (mm)	*Bar spacing (mm)*									
	75	*100*	*125*	*150*	*175*	*200*	*225*	*250*	*275*	*300*
6	377	283	226	189	162	142	126	113	103	94
8	671	503	402	335	287	252	223	201	183	168
10	1047	785	628	523	449	393	349	314	286	262
12	1508	1131	905	754	646	566	503	452	411	377
16	2681	2011	1608	1340	1149	1005	894	804	731	670
20	4189	3142	2513	2094	1795	1571	1396	1257	1142	1047
25	6545	4909	3927	3272	2805	2454	2182	1963	1785	1636
32	—	8042	6434	5362	4596	4021	3574	3217	2925	2681
40	—	—	10050	8378	7181	6283	5585	5027	4570	4189

Areas of groups of reinforcement bars (mm^2)

Bar diam. (mm)	*Number of bars*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
6	28	57	85	113	141	170	198	226	254	283
8	50	101	151	201	251	302	352	402	452	503
10	79	157	236	314	393	471	550	628	707	785
12	113	226	339	452	565	679	792	905	1017	1131
16	201	402	603	804	1005	1206	1407	1608	1809	2011
20	314	628	942	1257	1571	1885	2199	2513	2827	3142
25	491	982	1473	1963	2454	2945	3436	3927	4418	4909
32	804	1608	2412	3216	4021	4825	5629	6433	7237	8042
40	1256	2513	3769	5026	6283	7539	8796	10050	11310	12570

Table 2

Bending moment coefficients for slabs spanning in two directions at right angles simply supported on four sides

ly/lx	1·0	1·1	1·2	1·3	1·4	1·5	1·75	2·0	2·5	3·0
fx	0·062	0·074	0·084	0·093	0·099	0·104	0·113	0·118	0·122	0·124
fy	0·062	0·061	0·059	0·055	0·051	0·046	0·037	0·029	0·020	0·014

Table 3

VALUES OF γ FOR COMPUTING MOMENT OF RESISTANCE BASED ON THE STRENGTH OF THE CONCRETE IN COMPRESSION

b/b_r	Values of γ for d_1/d_s					
	2 or less	3	4	5	6	∞
1	0·25	0·250	0·250	0·250	0·250	0·250
2	0·25	0·220	0·200	0·185	0·175	0·125
4	0·25	0·200	0·170	0·150	0·140	0·062
6	0·25	0·195	0·165	0·140	0·125	0·042
8	0·25	0·190	0·160	0·135	0·120	0·031
∞	0·25	0·185	0·145	0·120	0·100	0

Table 4

STRENGTH OF WELDS

Leg length (size) (mm)	**Strength N/mm**
3	242
4	322
5	402
6	483
8	644
10	805

Table 5

Modification factor K_3 for duration loading

Duration of loading	Values of K_3
Long term (eg. dead + permanent imposed)	1·00
Medium term (e.g dead + snow dead + temporary imposed)	1·25
Short term (e.g. dead + imposed + wind, dead + imposed + snow + wind)	1·5
Very short term (e.g. dead + imposed + wind)	1·75