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2705/202 2709/202
2707/202 2710/202
STRUCTURES II, GEOTECHNOLOGY II
AND CONCRETE TECHNOLOGY II
June/July 2019
Time: 3 hours

13 SEP 2019

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE

MODULE II

STRUCTURE II, GEOTECHNOLOGY II AND CONCRETE TECHNOLOGY II

3 hours

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INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Drawing instruments;
Graph paper;
Scientific calculator.
*This paper consists of **EIGHT** questions in **THREE** sections; **A**, **B** and **C**.*
*Answer **TWO** questions from section **A**, **TWO** questions from section **B** and **ONE** question from section **C**.*
Relevant tables are included in this paper.
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Use the tables provided in the question paper.
Candidates should answer the questions in English.

This paper consists of 9 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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SECTION A: STRUCTURES II

*Answer **TWO** questions from this section.*

1. (a) Using Mohr's theorem, calculate the slope and deflection at free end of the cantilever beam shown in **figure 1**.

Take $E = 205\ kN/m^2$
$I = 47.3 \times 10^6\ mm^4$

(10 marks)

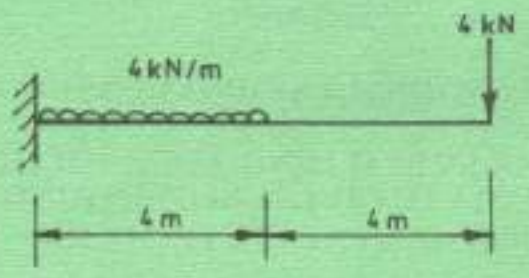

Fig. 1

(b) A trapezoidal reinforced concrete wall retains water on its vertical back as shown in **figure 2**. Calculate the maximum and minimum stresses at the base of the wall when the reservoir is half full.

Unit weight of reinforced concrete $= 24\ kN/m^3$
Unit weight of water $= 10\ kN/m^3$

(10 marks)

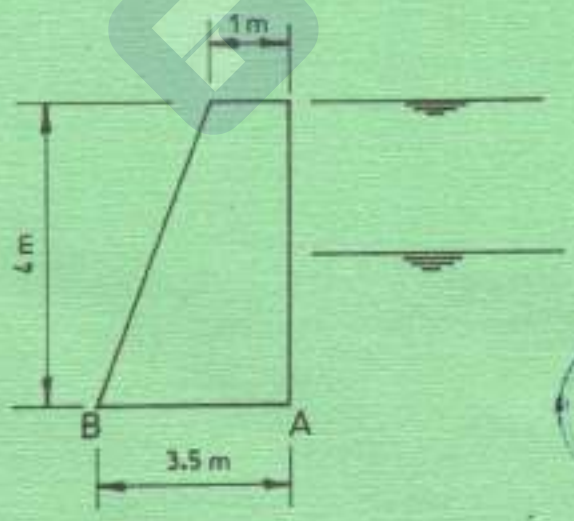

Fig. 2

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2. (a) A rectangular column of cross section 400×200 mm carri[illegible] as shown in **figure 3**. Calculate the stresses at corners B and D. (10 marks)

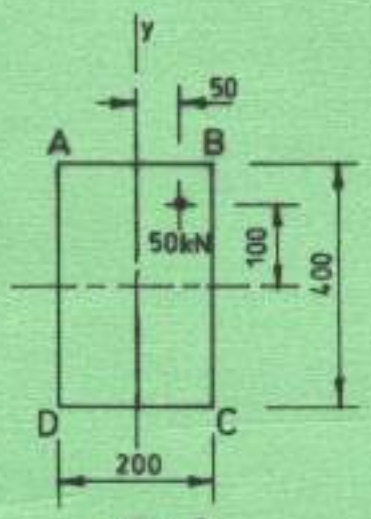

Fig. 3

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(b) A masonry wall of length 4 m, height 2.5 m and thickness 250 mm is subjected to a uniformly distributed horizontal wind pressure of 0.2 kN/m^2 acting over the entire height of the wall.

Determine the maximum and minimum stresses at the base of the wall.

Unit weight of masonry = 16 kN/m^3.

Consider 1 m length of wall. (10 marks)

3. (a) A braced square reinforced concrete column of effective height 3.6 m is required to support a factored axial load of 900 kN.

Design the column given by the following data:

f_{cu} = 25 N/mm^2;
f_y = 460 N/mm^2;
Steel ratio = 2%

(10 marks)

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(b) **Figure 4** shows the plan and section of a reinforced concrete stair slab which spans longitudinally along simple supports.

Design the stairs given the following data:

Finishes	= 0.5 kN/m^2
Imposed load	= 2 kN/m^2
f_{cu}	= 20 N/mm^2
f_y	= 40 N/mm^2
Tread	= 300 mm
Riser	= 150 mm
Waist	= 150 mm
Cover	= 20 mm
Unit weight of concrete	= 24 kN/m^3

(10 marks)

Clause 3.4.4.5

Effective Span 3.0x1000 = 3000

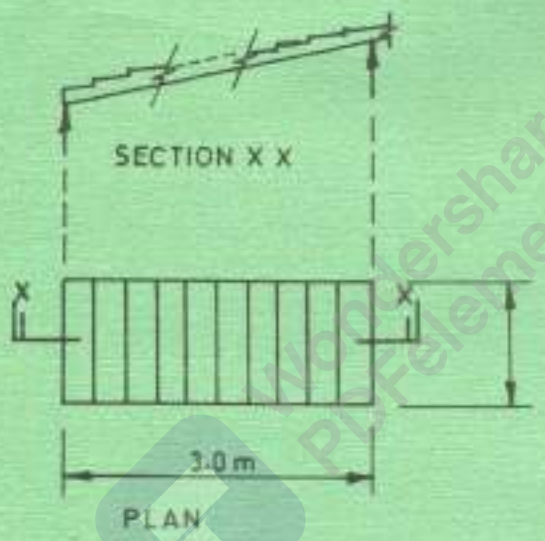

Fig. 4

prestressed Prec.

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SECTION B: GEOTECHNOLOGY II

*Answer **TWO** questions from this section.*

4. (a) (i) Distinguish between physical and chemical weathering of rocks.

(ii) Explain **two** effects of transportation on rock particles during weathering. (6 marks)

(b) With the aid of sketches, describe the following types of folds:

(i) symmetrical fold;

(ii) asymmetrical fold;

(iii) overturned fold. (9 marks)

(c) (i) State **two** types of quarries.

(ii) Describe **two** methods of excavation used in quarries. (5 marks)

5. (a) State **four** uses of transportation tunnels. (4 marks)

(b) Explain **two** measures taken when a fault zone is encountered during tunneling. (4 marks)

(c) (i) State **three** measures taken to protect earth dams against effects of earthquakes.

(ii) With the aid of labelled sketches, describe the following methods of controlling seepage in earth dams:

(I) vertical and horizontal drains;

(II) cut off trenches. (12 marks)

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6. (a) State **four** uses of geological maps.

(b) (i) Define the term 'outcrop'.

(ii) Sketch **two** types of outcrop. (5 marks)

(c) **Diagram No. 1** shows a geological map.

(i) Draw and label the strike lines.

(ii) Draw a topographical section along plane XY.

(iii) Draw a geological section along plane XY.

(iv) Determine the dip and strike.

(11 marks)

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SECTION C: CONCRETE TECHNOLOGY II

*Answer **ONE** question from this section.*

7. (a) State **five** factors that influence the choice of a concrete mixing plant. (5 marks)

(b) With the aid of a labelled sketch, outline the tremie method of casting concrete. (10 marks)

(c) Sketch and label a section through a construction joint in the wall of a reinforced concrete water tank. (5 marks)

8. (a) (i) Define the term 'prestressing'.

(ii) Describe the following methods of pre-stressing concrete :

(I) pre-tensioning;

(II) post-tensioning. (8 marks)

(b) State **three** advantages of prestressed concrete. (3 marks)

(c) (i) State **four** advantages of precast concrete units.

(ii) Outline the procedure of fixing a suspended precast concrete slab. (9 marks)

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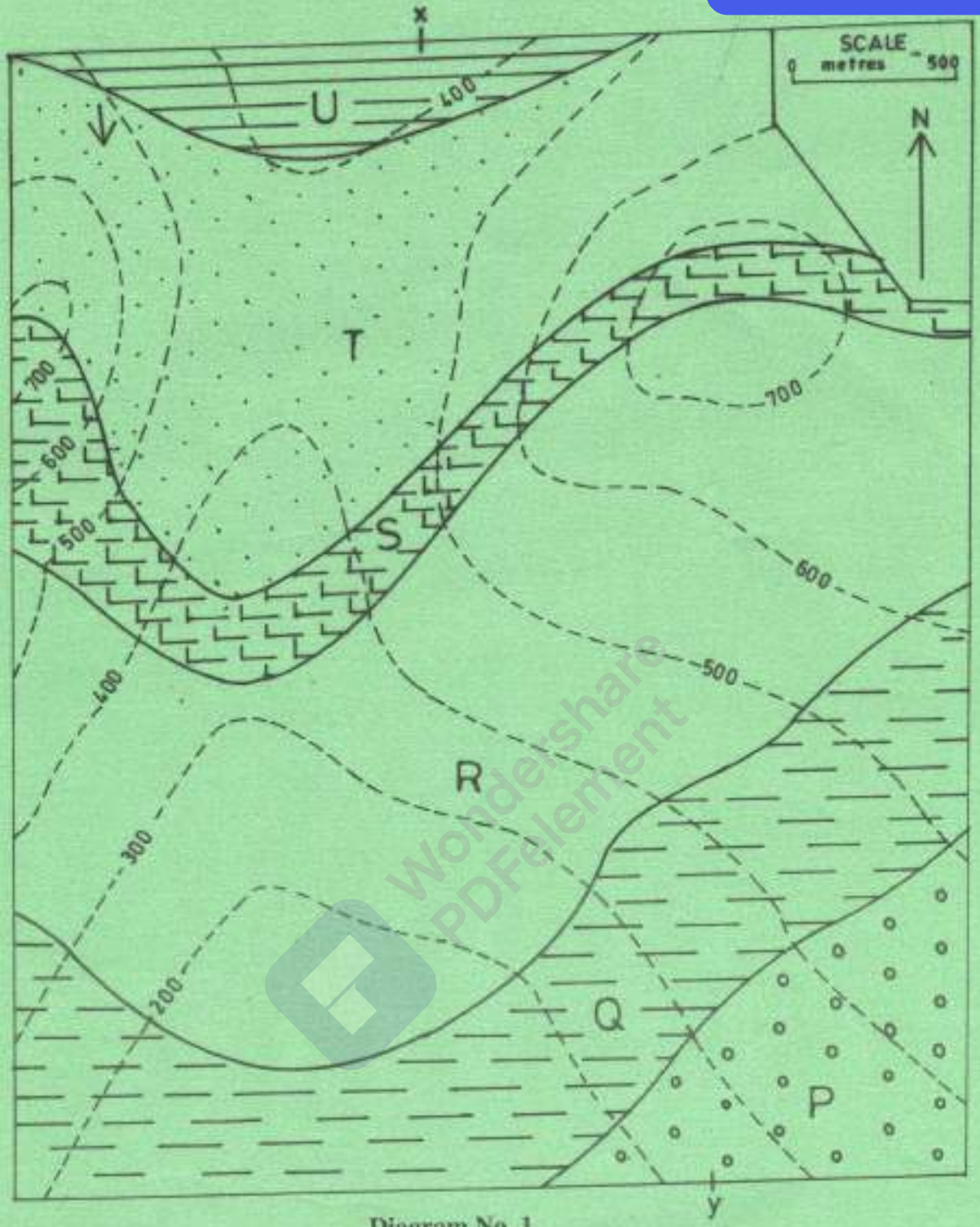

Diagram No. 1

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Bar areas number

number	Sectional area (mm²) Size									
	6	8	10	12	16	20	25	32	40	50
1	28	50	79	113	201	314	491	804	1257	1963
2	57	101	157	226	402	628	982	1606	2513	3927
3	85	151	236	339	603	942	1473	2413	3770	5890
4	113	201	314	452	804	1257	1963	3217	5027	7854
5	141	251	393	565	1005	1571	2454	4021	6283	9817
6	170	302	471	679	1206	1885	2945	4825	7540	11781
7	198	352	550	792	1407	2199	3436	5630	8796	13744
8	226	402	628	905	1608	2513	3927	6434	10053	15708
9	254	452	707	1018	1810	2827	4418	7238	11310	17671
10	283	503	785	1131	2011	3142	4909	8042	12566	19635
11	311	553	864	1244	2212	3456	5400	8847	13823	21598
12	339	603	942	1357	2413	3770	5890	9651	15080	23562
Perimeter (mm)	18.85	25.13	31.42	37.70	50.27	62.83	78.54	100.53	125.66	157.08
Weight (kg/m)	0.222	0.395	0.616	0.888	1.579	2.466	3.854	6.313	9.864	15.413
Number	6	8	10	12	16	20	25	32	40	50

Bar areas pitch

pitch (mm)	Sectional area (mm²) Size									
	6	8	10	12	16	20	25	32	40	50
50	565	1005	1571	2262	4021	-	-	-	-	-
75	377	670	1047	1508	2681	4189	6545	-	-	-
100	283	503	785	1131	2011	3142	4909	8042	-	-
125	226	402	628	905	1608	2513	3927	6434	10053	-
150	188	335	524	754	1340	2094	3272	5362	8378	13090
175	162	287	449	646	1149	1795	2805	4596	7181	11220
200	141	251	393	565	1005	1571	2454	4021	6283	9817
250	113	201	314	452	804	1257	1963	3217	5027	7854
300	94	168	262	377	670	1047	1636	2681	4189	6545
	6	8	10	12	16	20	25	32	40	50

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Table 3.25 — Minimum percentages of reinforcement

Situation	Definition of percentage	Minimum percentage	
		f_y = 250 N/mm² %	f_y = 460 N/mm² %
Tension reinforcement			
Sections subjected mainly to pure tension	$100A_s/A_c$	0.8	0.45
Sections subjected to flexure:			
a) flanged beams, web in tension:			
1) $b_w/b < 0.4$	$100A_s/b_wh$	0.32	0.18
2) b_w/b 0.4	$100A_s/b_wh$	0.24	0.13
b) flanged beams, flange in tension:			
1) T-beam	$100A_s/b_wh$	0.48	0.26
2) L-beam	$100A_s/b_wh$	0.36	0.20
c) rectangular section (in solid slabs this minimum should be provided in both directions)	$100A_s/A_c$	0.24	0.13
Compression reinforcement (where such reinforcement is required for the ultimate limit state)	$100A_{sc}/A_{cc}$	0.4	0.4
General rule	$100A_{sc}/A_c$	0.4	0.4
Simplified rules for particular cases:			
a) rectangular column or wall	$100A_{sc}/bh_f$	0.4	0.4
b) flanged beam:	$100A_{sc}/b_wh$	0.2	0.2
1) flange in compression	$100A_{sc}/A_c$	0.2	0.2
2) web in compression			
c) rectangular beam			
Transverse reinforcement in flanges or flanged beams (provided over full effective flange width near top surface to resist horizontal shear)	$100A_{sl}/h_fl$	0.15	0.15

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