TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

Department of BUILDING AND Civil engineering

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN CIVIL ENGINEERING

DCE 2303: DESIGN OF CONCRETE STRUCTURES

SPECIAL /SUPPLIMENTARY EXAMINATIONS

SERIES: JULY 2025

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

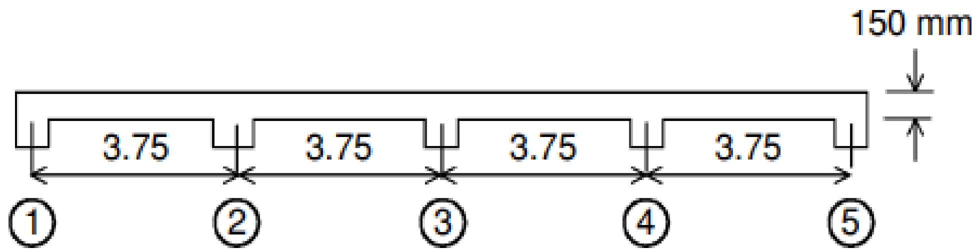
This paper consists of **five** questions. Attempt any THREE questions.

Do not write on the question paper.

QUESTION ONE (20 Marks)

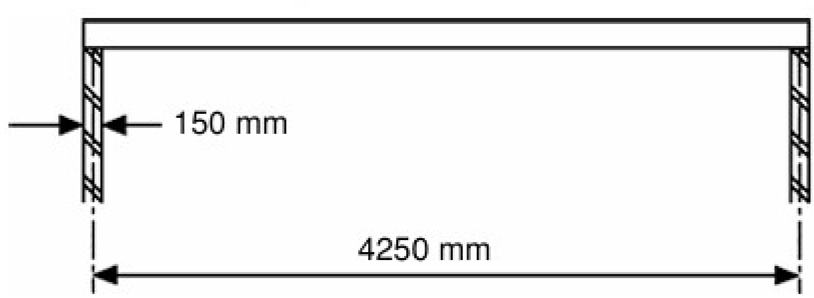
(a) List the factors that will determine the choice of a slab in design (4 Marks)

(b) Design the continuous one-way spanning slab in Example 3.10 assuming the cover to the reinforcement is 25 mm (Fig. 1). (16 Marks)



QUESTION TWO (20 Marks)

A reinforced concrete floor subject to an imposed load of 4 kNm^{-2} spans between brick walls as shown below. Design the floor for exposure class XC1 assuming the following material strengths: f_{cu} = 35 Nmm^{-2} f_y = 500 Nmm^{-2}. (20 Marks)

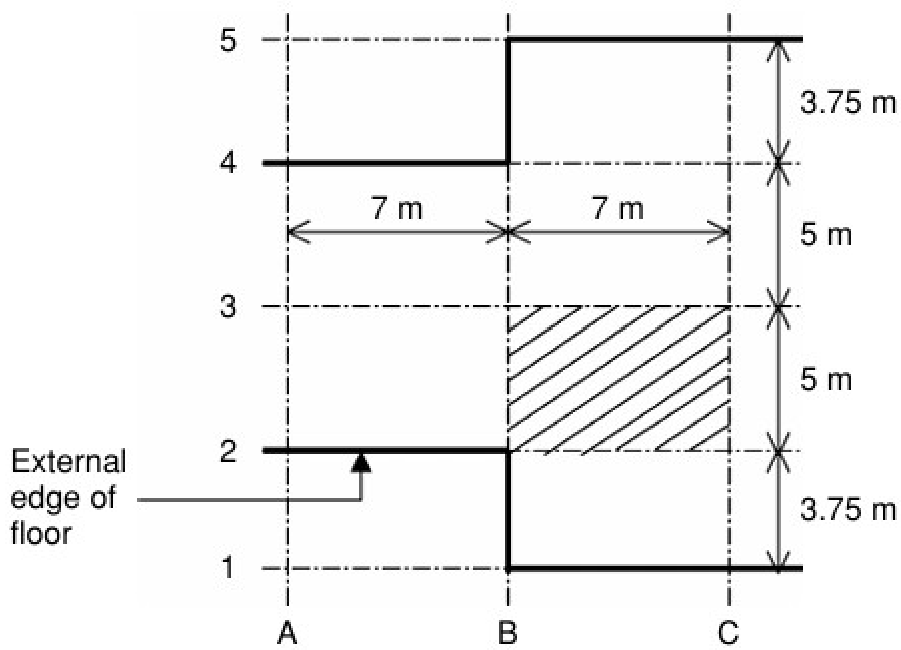


QUESTION THREE (20 Marks)

Fig. shows a part plan of an office floor supported by monolithic concrete beams (not detailed), with individualslab panels continuous over two or more supports. The floor is to be designed to support an imposed load of 4 kNm−2 and finishes plus ceiling loads of 1.25 kNm−2. The characteristic strength of the concrete is 30 Nmm−2 and the steel reinforcement is 500 Nmm−2. The cover to steel reinforcement is 25 mm.

(a) Calculate the mid-span moments for panels AB2/3 and BC1/2 assuming the thickness of the floor is 180 mm. (10 Marks)

(b) Design the steel reinforcement for panel BC2/3 (shown hatched) and check the adequacy of the slab in terms of shear resistance and deflection. Illustrate the reinforcement details on plan and elevation views of the panel. (10 Marks)



QUESTION FOUR (20 Marks)

(a) State THREE conditions that define Beams in reinforced concrete structures. (3 Marks)

(b) A short-braced column in which f_{cu} = 30 Nmm^{-2} and f_y = 500 Nmm^{-2} is required to support an ultimate axial load of 2000 kN. Determine a suitable section for the column assuming that the area of longitudinal steel, A_{sc} , is of the order of 3 per cent of the gross cross-sectional area of column, A_{col} . (17 Marks)

QUESTION FIVE (20 Marks)

(a) State the two principal categories of limit states normally considered in design and describe what each state entails. (7 Marks)

(b) Design the longitudinal steel and links for a 350 mm square, short-braced column which supports the following axial loads: G_k = 1000 kN Q_k = 1000 kN Assume f_{cu} = 40 Nmm^{-2} and f_y & f_{yv} = 500 Nmm^{-1} (13 Marks)

Table 3.13 Values of A_{sv}/s_v

Diameter (mm)	*Spacing of links* (mm)										
	85	*90*	*100*	*125*	*150*	*175*	*200*	*225*	*250*	*275*	*300*
8	1.183	1.118	1.006	0.805	0.671	0.575	0.503	0.447	0.402	0.366	0.335
10	1.847	1.744	1.57	1.256	1.047	0.897	0.785	0.698	0.628	0.571	0.523
12	2.659	2.511	2.26	1.808	1.507	1.291	1.13	1.004	0.904	0.822	0.753
16	4.729	4.467	4.02	3.216	2.68	2.297	2.01	1.787	1.608	1.462	1.34

Table 3.18 Form and area of shear reinforcement in solid slabs (Table 3.16, BS 8110)

Values of υ *(N/mm²)*	*Area of shear reinforcement to be provided*
$\upsilon < v_c$	None required
$\upsilon_c < \upsilon < (\upsilon_c + 0.4)$	Minimum links in areas where $\upsilon > \upsilon_c$ $A_{sv} \geq 0.4bs_v/0.87f_{yv}$
$(\upsilon_c + 0.4) < \upsilon < 0.8\sqrt{f_{cu}}$ or 5 N/mm²	Design links $A_{sv} \geq bs_v(\upsilon - \upsilon_c)/0.87f_{yv}$

Table 3.22 Cross-sectional area per metre width for various bar spacing (mm²)

Bar size (mm)	*Spacing of bars*								
	50	*75*	*100*	*125*	*150*	*175*	*200*	*250*	*300*
6	566	377	283	226	189	162	142	113	94.3
8	1010	671	503	402	335	287	252	201	168
10	1570	1050	785	628	523	449	393	314	262
12	2260	1510	1130	905	754	646	566	452	377
16	4020	2680	2010	1610	1340	1150	1010	804	670
20	6280	4190	3140	2510	2090	1800	1570	1260	1050
25	9820	6550	4910	3930	3270	2810	2450	1960	1640
32	16100	10700	8040	6430	5360	4600	4020	3220	2680
40	25100	16800	12600	10100	8380	7180	6280	5030	4190

Table 3.10 Cross-sectional areas of groups of bars (mm^2)

Bar size (mm)	*Number of bars*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
6	28.3	56.6	84.9	113	142	170	198	226	255	283
8	50.3	101	151	201	252	302	352	402	453	503
10	78.5	157	236	314	393	471	550	628	707	785
12	113	226	339	452	566	679	792	905	1020	1130
16	201	402	603	804	1010	1210	1410	1610	1810	2010
20	314	628	943	1260	1570	1890	2200	2510	2830	3140
25	491	982	1470	1960	2450	2950	3440	3930	4420	4910
32	804	1610	2410	3220	4020	4830	5630	6430	7240	8040
40	1260	2510	3770	5030	6280	7540	8800	10100	11300	12600

Table 3.11 Values of design concrete shear stress, υ_c (N/mm^2) for $f_{cu} = 25\ N/mm^2$ concrete (Table 3.8, BS 8110)

$\frac{100A_s}{bd}$	*Effective depth (d) mm*							
	125	*150*	*175*	*200*	*225*	*250*	*300*	*≥ 400*
≤ 0.15	0.45	0.43	0.41	0.40	0.39	0.38	0.36	0.34
0.25	0.53	0.51	0.49	0.47	0.46	0.45	0.43	0.40
0.50	0.57	0.64	0.62	0.60	0.58	0.56	0.54	0.50
0.75	0.77	0.73	0.71	0.68	0.66	0.65	0.62	0.57
1.00	0.84	0.81	0.78	0.75	0.73	0.71	0.68	0.63
1.50	0.97	0.92	0.89	0.86	0.83	0.81	0.78	0.72
2.00	1.06	1.02	0.98	0.95	0.92	0.89	0.86	0.80
≥ 3.00	1.22	1.16	1.12	1.08	1.05	1.02	0.98	0.91