NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

DESIGN OF STRUCTURES II

ECW3212

Special Examination Paper

May 2024

This examination paper consists of 4 pages

Time Allowed: 4 hours

Total Marks: 100

Special Requirements: OPEN BOOK

Examiner's Name: Eng. K Mushunje

INSTRUCTIONS

1. Answer ALL questions
2. Each question carries marks as shown
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**15**
3.	**30**
4.	**30**
TOTAL	**100**

QUESTION 1

a) STATE five durability considerations that must be made in reinforced concrete design. Explain how each affects concrete durability. [10]

b) A 4m high column 400 mm×400 mm carries a dead load of 800 kN and an imposed load of 300kN. The safe bearing pressure is 200 kN/m^2. Design a square base to resist the loads. The concrete is grade C35 and the reinforcement grade 460. The condition of exposure is non aggressive soil. [15]

QUESTION 2

A cavity wall supporting an ultimate axial load of 150kN/m shared equally by both leaves (Figure 2.1). Determine the appropriate bricks and mortar if both manufacturing and construction control are normal. [15]

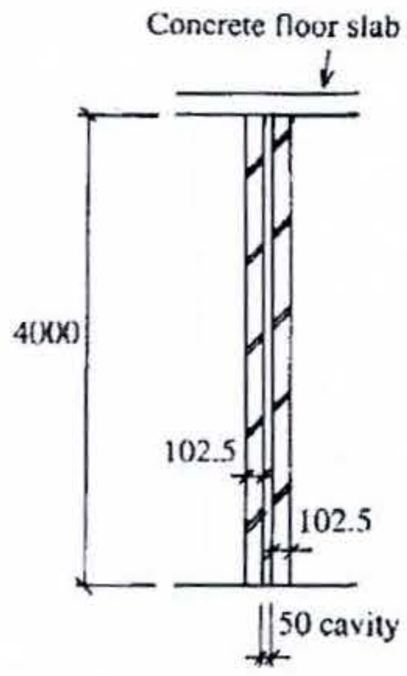

Figure 2.1

QUESTION 3

a) Design a one way spanning slab spanning 4.5m on 230mm walls to carry a live load of 3.0kN/m^2, plus floor finishes and ceiling loads of 1.0 kN/m^2 as shown in Figure 3.1.
Characteristic material strengths: f_y = 460 MPa, f_{cu} = 30 MPa
Unit weight of concrete = 24 kN/m^3

Provide a sketch of reinforcement and bending schedule. [30]

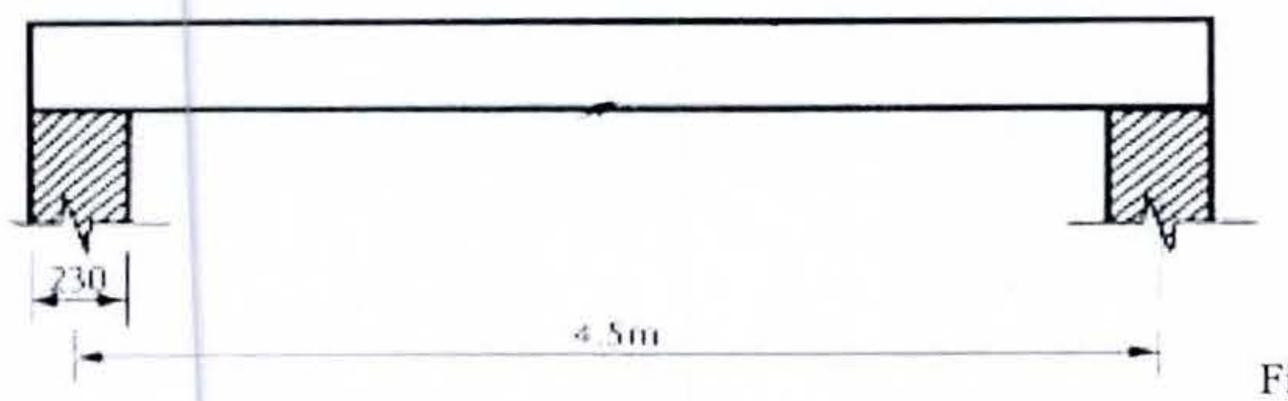

Figure 3.1

QUESTION 4

Design a reinforced concrete beam 400 mm deep × 230 mm wide shown in Figure 4.1 for the following conditions:

Nominal maximum aggregate size (h_{agg})	20 mm
Minimum required fire resistance	1.0 hours
Characteristic dead load (g_k)	0.35 kN/m
Characteristic imposed load (q_k)	1.15 kN/m
Characteristic dead load ($\gamma_{concrete}$)	24.0 kN/m^3
Material Strength	$f_{cu} = 40$ N/mm^2, $f_y = f_{yv} = 460$ N/mm^2 and the exposure class is mild.

Design for the highest mid-span moment and highest support moment by considering all the load cases. Show reinforcement details and the bending schedule. [30]

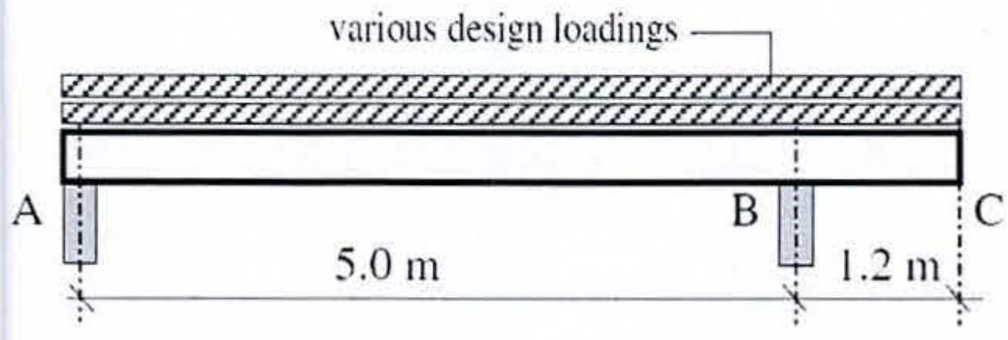

Figure 4.1

SECTIONAL AREAS OF GROUPS OF BARS [mm²]										
Bar size [mm]	Number of bars									
	1	2	3	4	5	6	7	8	9	10
6	28 3	56 5	84 8	113	141	170	198	226	254	283
8	50.3	101	151	201	251	302	352	402	452	503
10	78 5	157	236	314	393	471	550	628	707	785
12	113	226	339	452	565	679	792	905	1020	1130
16	201	402	603	804	1010	1210	1410	1610	1810	2010
20	314	628	942	1260	1570	1880	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

SECTIONAL AREAS PER METRE WIDTH FOR VARIOUS BAR SPACINGS [mm²]										
Bar size [mm]	Bars spacing [mm]									
	75	100	125	150	175	200	225	250	275	300
6	377	283	226	188	162	141	126	113	103	94
8	670	503	402	335	287	251	223	201	183	168
10	1050	785	628	524	449	393	349	314	286	262
12	1510	1130	905	754	646	565	503	452	411	377
16	2680	2010	1610	1340	1150	1010	894	804	731	670
20	4190	3140	2510	2090	1800	1570	1400	1260	1140	1050
25	6540	4910	3930	3270	2800	2450	2180	1960	1780	1640
32	10700	8040	6430	5360	4600	4020	3570	3220	2920	2680
40	16800	12600	10100	8380	7180	6280	5590	5030	4570	4190