TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

KIBIT EXAMINATIONS FOR:

HIGHER DIPLOMA IN BUILDING AND CIVIL ENGINEERING

(BUILDING ECONOMICS OPTION)

EBC 32XT: CONCRETE AND TIMBER TECHNOLOGY

YEAR 2 SEMESTER I

SERIES: DECEMBER 2017

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination
-Answer Booklet, examination pass and student ID
-Pocket calculator
This paper consists of **FIVE** questions. Attempt **any THREE questions**
Do not write on the question paper.
Mobile Phones are NOT allowed inside the examination room.

QUESTION ONE

(a) Define the following terms as used in structural design giving two examples for each:

(i) Dead load.

(ii) Live load (4 marks)

(b) A simply supported slab clear dimensions 3.0x3.4 is supported by 200 mm thick block wall all round. It is loaded with 2.5 Kn/m^2 live load, assume 50 mm thick screed on the top side and 20 mm plaster on the underside. Using the following material strength,

F_{cu} =25 N/mm^2

Fy= 425 N/mm^2

Cover to main reinforcements= 20 mm

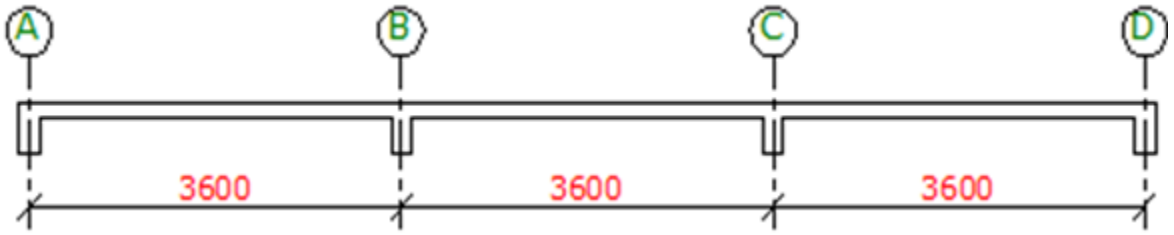
(i) Design the slab reinforcement and check for shear.

(ii) Sketch the reinforcement details (16 marks)

QUESTION TWO

The continuous slab shown below carries characteristic imposed load load, qk=3.0 Kn/m^2 and has overall depth, h=150 mm. Design the slab using the following material strength.

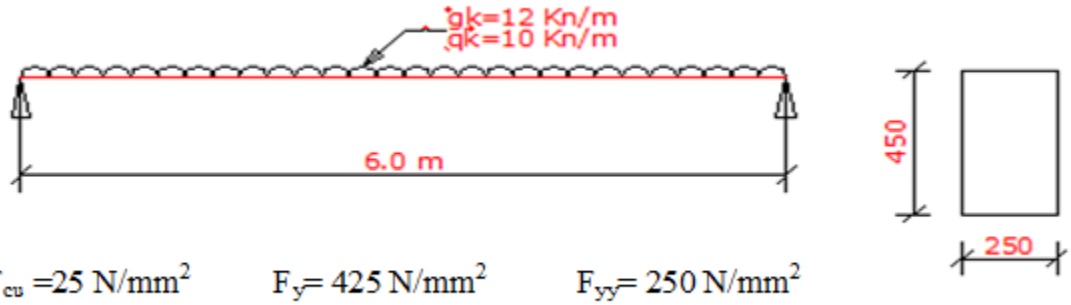
F_{cu} =20 N/mm^2 (20 marks)



Fy= 425 N/mm2

QUESTION THREE

The reinforced concrete beam shown below has an effective span of 6.0 m and carries characteristic dead (including self-weight) and imposed loadof 12 Kn/m and 10 Kn/m respectively. Design for bending and shear at all critical points. (20 marks)



F_{cu} =25 N/mm^2 F_y= 425 N/mm^2 F_{yy}= 250 N/mm^2

Cover to main reinforcements= 26 mm

QUESTION FOUR

(a) An internal column of a multi-storey building support axial characteristic dead and imposed load of 400 Kn and 250 Kn respectively from a symmetrical arrangement of beams. The column is held in position and direction at the top and bottom, is square, short and braced.

Take F_{cu} =30 N/mm^2 F_y= 425 N/mm^2

Design the following:

(i) A suitable cross section of the column.

(ii) The size of longitudinal reinforcement.

(iii) The size and spacing of links. (12 Marks)

(b) Compare the properties of the constituent materials of reinforced concrete. (8 Marks)

QUESTION FIVE

Check the adequacy of 47x225 timber floor joist in strength grade C18 using figure 1 and given that:-

(i) The joists are spaced at 450 mm crs.

(ii) The floor is tongue and groove barding with self-weight of 0.1 Kn/m2

(iii) The ceiling is plasterboard with self-weight of 0.2 kn/m2

(iv) The floor has an effective span of 4.0 m crs (20 marks)

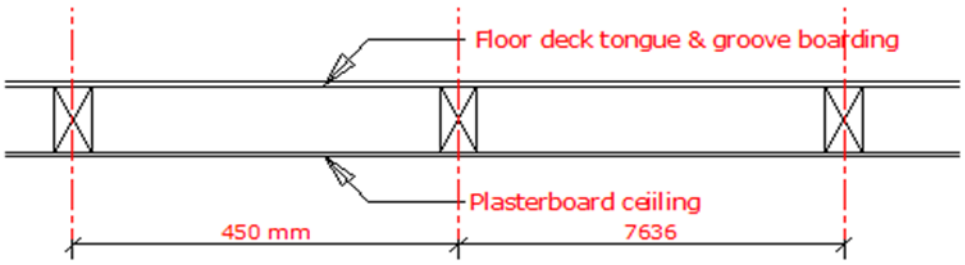


Fig.1

Table 1: Values of A_{sv}/S_v

Diameter of links (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	0.336	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 2: Cross-sectional area per metre width for various bar spacing (mm^2)

Bar Size (mm)	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: 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 6.3 Grade stresses and moduli of elasticity for various strength classes: for service classes 1 and 2 (based on Tables 8 and 9, BS 5268)

Strength class	*Bending parallel to grain* ($\sigma_{m,\beta,||}$) *N/mm²*	*Tension parallel to grain* *N/mm²*	*Compression parallel to grain* ($\sigma_{c,\beta,||}$) *N/mm²*	*Compression perpendicular to grain*[1] ($\sigma_{c,\beta,\perp}$) *N/mm²*	*N/mm²*	*Shear parallel to grain* (τ_β) *N/mm²*	*Modulus of elasticity* E_{mean} *N/mm²*	E_{min} *N/mm²*	*Characteristic density*[2] ρ_k *kg/m³*	*Average density*[2] ρ_{mean} *kg/m³*
C14	4.1	2.5	5.2	2.1	1.6	0.60	6 800	4 600	290	350
C16	5.3	3.2	6.8	2.2	1.7	0.67	8 800	5 800	310	370
C18	5.8	3.5	7.1	2.2	1.7	0.67	9 100	6 000	320	380
C22	6.8	4.1	7.5	2.3	1.7	0.71	9 700	6 500	340	410
C24	7.5	4.5	7.9	2.4	1.9	0.71	10 800	7 200	350	420
TR26	10.0	6.0	8.2	2.5	2.0	1.10	11 000	7 400	370	450
C27	10.0	6.0	8.2	2.5	2.0	1.10	12 300	8 200	370	450
C30	11.0	6.6	8.6	2.7	2.2	1.20	12 300	8 200	380	460
C35	12.0	7.2	8.7	2.9	2.4	1.30	13 400	9 000	400	480
C40	13.0	7.8	8.7	3.0	2.6	1.40	14 500	10 000	420	500
D30	9.0	5.4	8.1	2.8	2.2	1.40	9 500	6 000	530	640
D35	11.0	6.6	8.6	3.4	2.6	1.70	10 000	6 500	560	670
D40	12.5	7.5	12.6	3.9	3.0	2.00	10 800	7 500	590	700
D50	16.0	9.6	15.2	4.5	3.5	2.20	15 000	12 600	650	780
D60	18.0	10.8	18.0	5.2	4.0	2.40	18 500	15 600	700	840
D70	23.0	13.8	23.0	6.0	4.6	2.60	21 000	18 000	900	1 080

[1] When the specification specifically prohibits wane at bearing areas, the higher values may be used.
[2] For the calculation of dead load, the average density should be used.

Table 6.8 (*cont'd*)

*Customary target size**	*Area*	*Section Modulus*		*Second moment of area*		*Radius of gyration*	
mm	$10^3 mm^2$	*About x–x* $10^3 mm^3$	*About y–y* $10^3 mm^3$	*About x–x* $10^6 mm^4$	*About y–y* $10^6 mm^4$	*About x–x* *mm*	*About y–y* *mm*
75 × 100	7.50	125	93.8	6.25	3.52	28.9	21.7
75 × 150	11.3	281	141	21.1	5.27	43.3	21.7
75 × 175	13.1	383	164	33.5	6.15	50.5	21.7
75 × 200	15.0	500	188	50.0	7.03	57.7	21.7
75 × 225	16.9	633	211	71.2	7.91	65.0	21.7
75 × 250	18.8	781	234	97.7	8.79	72.2	21.7
75 × 300	22.5	1130	281	169	10.5	86.6	21.7
100 × 100	10.0	167	167	8.33	8.33	28.9	28.9
100 × 150	15.0	375	250	28.1	12.5	43.3	28.9
100 × 200	20.0	667	333	66.7	16.7	57.7	28.9
100 × 225	22.5	844	375	94.9	18.8	65.0	28.9
100 × 250	25.0	1010	417	130	20.8	72.2	28.9
100 × 300	30.0	1500	500	225	25.0	86.6	28.9
150 × 150	20.0	563	563	42.2	42.2	43.3	43.3
150 × 300	30.0	2250	1130	338	84.4	86.6	43.3
300 × 300	90.0	4500	4500	675	675	86.6	86.6

Note. * Desired size of timber measured at 20% moisture content

Table 6.9 Bending and shear deflections assuming $G = E/16$

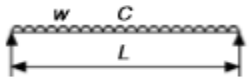
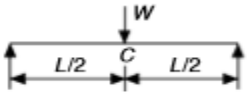
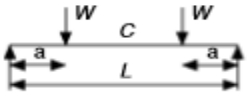
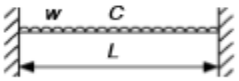
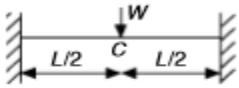
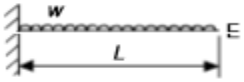
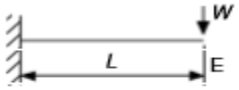
Load distribution and supports	*Deflection at Centre C or end E*	
	Bending	*Shear*
	$\frac{5}{384} \times \frac{wL^4}{EI}$	$\frac{12}{5} \times \frac{wL^2}{EA}$
	$\frac{WL^3}{48EI}$	$\frac{24}{5} \times \frac{WL}{EA}$
	$\frac{Wa}{EI}\left[\frac{L^2}{8} - \frac{a^2}{6}\right]$	$\frac{96}{5} \times \frac{Wa}{EA}$
	$\frac{wL^4}{384EI}$	$\frac{12}{5} \times \frac{wL^2}{EA}$
	$\frac{WL^3}{192EI}$	$\frac{24}{5} \times \frac{WL}{EA}$
	$\frac{wL^4}{8EI}$	$\frac{48}{5} \times \frac{wL^2}{EA}$
	$\frac{WL^3}{3EI}$	$\frac{96}{5} \times \frac{WL}{EA}$

Table 6.10 Maximum depth to breadth ratios (Table 19, BS 5268)

Degree of lateral support	*Maximum depth to breadth ratio*
No lateral support	2
Ends held in position	3
Ends held in position and member held in line, as by purlins or tie-rods at centres not more than 30 times the breadth of the member	4
Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists	5
Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding six times the depth	6
Ends held in position and both edges held firmly in line	7