MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY(MMUST)

UNIVERSITY EXAMINATIONS
2013/2014 ACADEMIC YEAR
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FOURTH YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 414

COURSE TITLE: STRUCTURAL CONCRETE DESIGN

DATE:

DURATION: 3HOURS

INSTRUCTIONS TO CANDIDATES:

Answer any **FOUR** of the five questions. Marks for each question are indicated in the parenthesis.
Standard codes and tables relevant to the subject are allowed.
The usual notations apply.

1a) Outline general procedures adopted for the design of pad footings. (3 marks)

b) A reinforced concrete beam is 350mm wide and 700mm deep is required to span 8m between the centres of supporting piers 300mm wide. The beam beam carries dead and imposed loads of $22\,{}^{kN}\!/_{m}$ and $17\,{}^{kN}\!/_{m}$ respectively as shown in figure 1.

Assuming $f_{cu} = 30\,{}^{N}\!/_{mm^2}$, $f_y = 460\,{}^{N}\!/_{mm^2}$, $f_{yv} = 250\,{}^{N}\!/_{mm^2}$ and the exposure condition is mild, design the beam in respect to:

- Main Steel
- Shear Reinforcement
- Deflection
- Reinforcement Detail

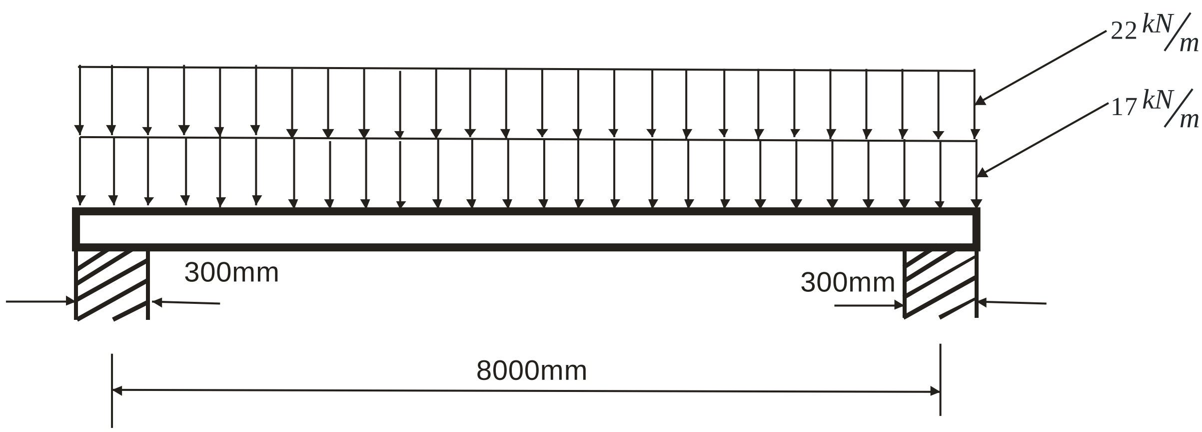

Fig. 1

(17 marks)

2. a) Explain the following types of retaining wall using sketches:
   - Gravity walls
   - Cantilever walls
   - Counterfort walls

(7.5 marks)

b) A one way reinforced concrete floor subject to an imposed load of $3.8\,{}^{kN}\!/_{m^2}$ spans between block walls as shown in figure 2. Design the floor for mild exposure conditions assuming the following material strength:

- $f_{cu} = 30\,{}^{N}\!/_{mm^2}$,
- $f_y = 460\,{}^{N}\!/_{mm^2}$

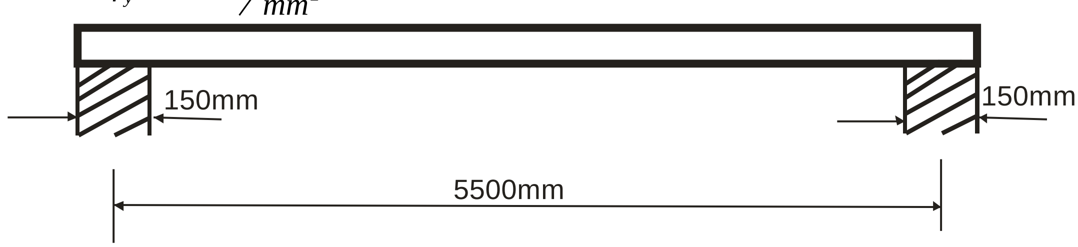

Fig.2

(12.5 marks)

3. Figure shows a part plan of Dean of engineering's office floor supported by monolithic concrete beams, with individual slab panels continuous over two or more supports in the upcoming engineering complex at MMUST. The floor is to be designed to support an imposed load of $3kN/m^2$ and finishes plus ceiling loads of $1.28kN/m^2$. The characteristic strength of the concrete is $30N/mm^2$ and the steel reinforcement is $460N/mm^2$. The cover to steel reinforcement is 25 mm.

(a) Calculate the mid-span moments for panels AB2/3 and $BC$1/2 assuming the thickness of the floor is 200 mm.

(b) Design the steel reinforcement for panel $BC$2/3 (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.

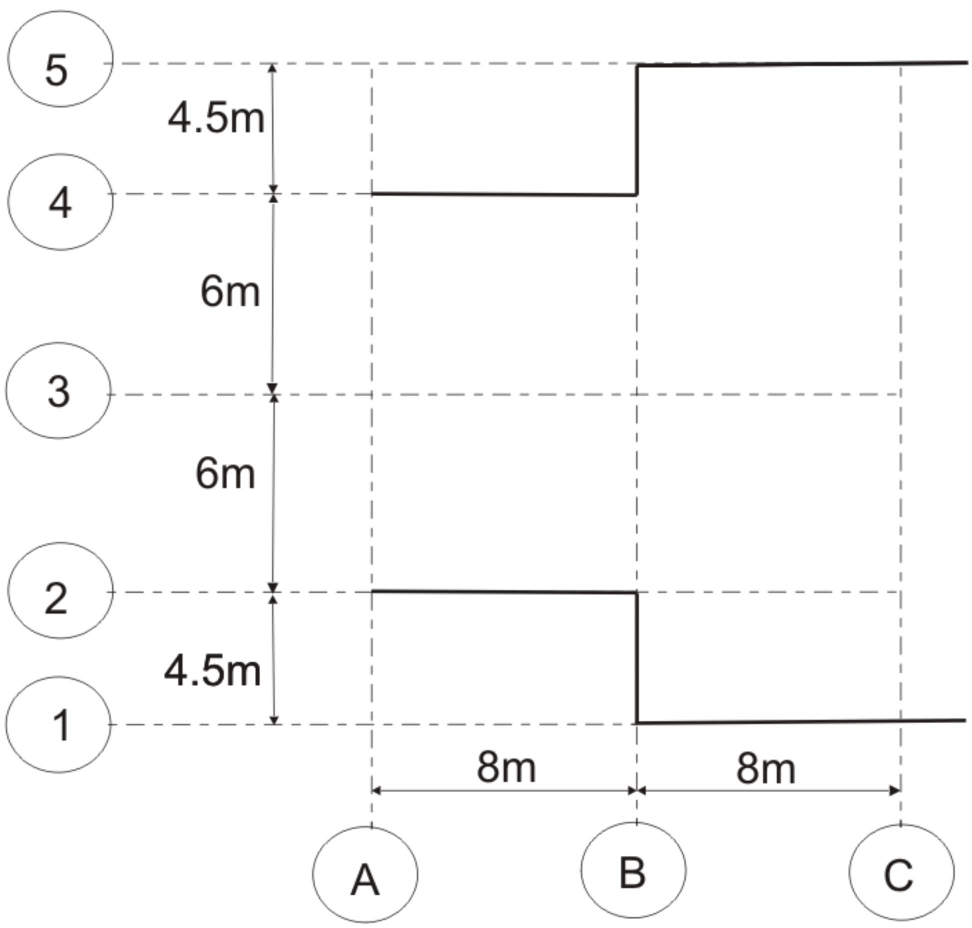

Fig. 3

3. a) Differentiate between:
    - short and slender columns;

- braced and unbraced columns.

(6 marks)

b) A 500mm square column axially carries a dead load G_k of 1000kN and imposed load Q_k of 350kN. Assuming that the safe bearing capacity of the soil is $150\,kN/m^2$. Design and detail a square pad footing to resist loads assuming the following materials:

- $f_{cu} = 40\,N/mm^2$
- $f_y = 460\,N/mm^2$

(14 marks)

4. a) Differentiate between one way and two way slabs. (2 marks)

b) Masinde Muliro University of Science and Technology is planning to build a dam to mitigate on the perennial water shortage. The engineer is recommending the use of cantilever retailing wall shown in figure 3 and is to be backfilled with granular material a unit weight, $19\,kN/m^3$ and an angle of friction, $\phi = 30^o$. Assuming that the allowable bearing pressure of the soil is $150\,kN/m^2$, the coefficient of friction is 0.5 and unit weight of reinforced concrete is $24\,kN/m^3$.

(i) Determine the factor of safety against sliding and overturning.

(ii) Calculate the ground bearing pressure.

(iii) Determine the bending reinforcement of the wall. Assuming $f_{cu} = 35\,N/mm^2$, $f_y = 460\,N/mm^2$ and cover is 40mm.

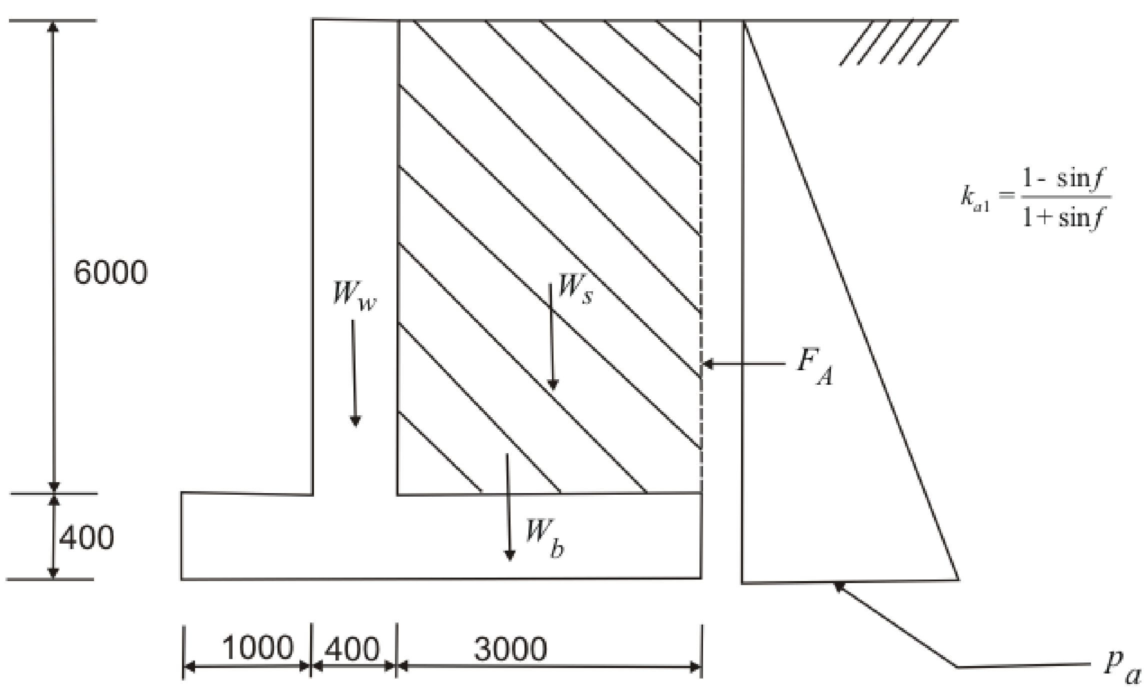

Fig.3

(18 marks)

5. a) Explain what you understand by the term 'under-reinforced' and why concrete beams are normally designed in this way.

(4 marks)

b) Design the longitudinal and shear reinforcement for a 300mm square, short-braced column which supports either:

(i) An ultimate axial load of 1300kN and a moment of 64kNm about the x-x axis

(ii) An ultimate axial load of 1300kN and a moment of 62.5kNm about the x-x axis and 45kNm about the y-y axis

Assume $f_y = 460 \, {N}/{mm^2}$, $f_{cu} = 30 \, {N}/{mm^2}$

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(16 marks)

Appendices

Appendix 1

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

Appendix 2

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

Appendix 3

Cross-sectional area per metre width for various bar spacing (mm^2)

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 3.11 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