Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	STRUCTURAL DESIGN
COURSE CODE	:	BPD 30802
PROGRAMME	:	3BPC
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	2 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS
		B) ANSWER **TWO (2)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

SECTION A

Q1 (a) Discuss **THREE (3)** main assumptions used in the design and theory of reinforced concrete.

(9 marks)

(b) A rectangular reinforced concrete beam has to support a design moment of 195kNm. The beam rectangular section dimension is 250 x 500 mm (b x d) as shown in Figure **Q1**. Characteristic concrete strength of beam, $f_{ck} = 25N/mm^2$; and high yield steel reinforcement characteristic strength, $f_{yk} = 500N/mm^2$.

Calculate the area of steel reinforcement required.

(16 marks)

Q2 (a) Explain the aim of designing an under-reinforced concrete structural component.

(4 marks)

(b) Illustrate with explanation the behaviour of a loaded continuous beam in bending.

(5 marks)

(c) A 4m span simply supported slab with effective depth d = 150 mm is to carry an ultimate design load of 15kN/m per m width. The steel reinforcement at the tension side consists of H10-200 bar which are continued to support.

Analyse the outcome to verify shear of the simply supported slab, assuming f_{ck} = $25N/mm^2$, and reinforcement steel strength, f_{yk} = $500N/mm^2$.

(16 marks)

SECTION B

Q3 A rectangular reinforced concrete slab is simply supported on two masonry walls 250mm thick and 5m apart (clear distance). The slab carries a distributed permanent action of 1.0 kN/m^2 (excluding slab self-weight) and a variable action of 2.0 kN/m^2. Characteristic concrete strength of slab, f_{ck} = 30N/mm^2, the high yield steel reinforcement characteristic strength, f_{yk} = 500N/mm^2, and unit weight of reinforced concrete is 25kN/m^3. It is assumed that the diameter of steel reinforcement bar = 12mm with slab thickness, h = 175mm and nominal concrete cover for durability, fire and bond requirements being 30mm.

(a) Calculate the design moment M_{Ed} .

(6 marks)

(b) Calculate the area of steel reinforcement required in the design of this one-way spanning slab without having to verify for shear, deflection and cracking.

(10 marks)

(c) Describe the purpose of introducing control joints in slab construction.

(5 marks)

(d) Discuss **ONE (1)** advantage and **ONE (1)** disadvantage of slab-on-grade.

(4 marks)

Q4 (a) Describe the fundamental principle of prestressing that is used to produce prestressed concrete.

(4 marks)

(b) Illustrate with explanation **TWO (2)** methods used for prestressing of concrete members.

(8 marks)

(c) Examine the cost-benefit analysis of using prestressed concrete.

(5 marks)

(d) Describe the **FOUR (4)** methods of design in the use of Limit State Design of Structural Steelwork.

(8 marks)

Q5 A universal steel beam is restrained at points A, B, C and D as shown in Figure **Q5**. The unfactored actions consists of 9kN/m permanent action that is unifromly distributed load (UDL), G_{k1}; and 10kN/m temporary action UDL , G_{k2}.

(a) (i) Calculate the maximum applied bending moment of the beam M_c, and sketch the bending moment and shear force diagrams.

(8 marks)

(ii) Using 533 x 210 x 109 UB with a design strength of f_y = 265N/mm^2 and section classification confirmed as being plastic, verify if the shear capacity and moment capacity of the steel beam are sufficient.

(6 marks)

(b) Illustrate the stress-strain relationship of structural steel.

(4 marks)

(c) Describe with the aid of a diagram the behaviour of a steel beam in bending with increasing moment.

(4 marks)

(d) Explain the action of torsional restraints, such as secondary load-carrying beams or tie beams at intervals along the beam span.

(3 marks)

- END OF QUESTION -

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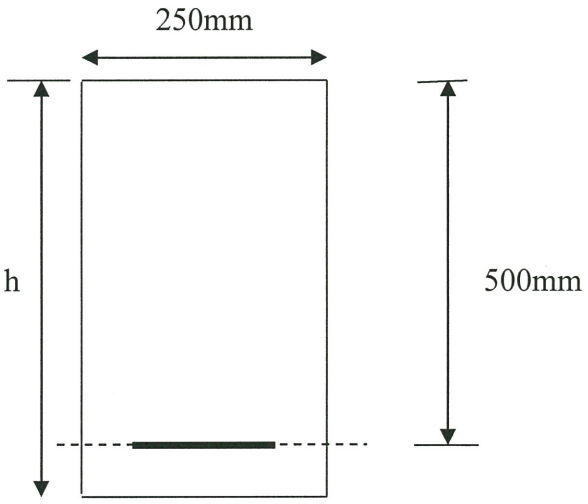

FIGURE Q1

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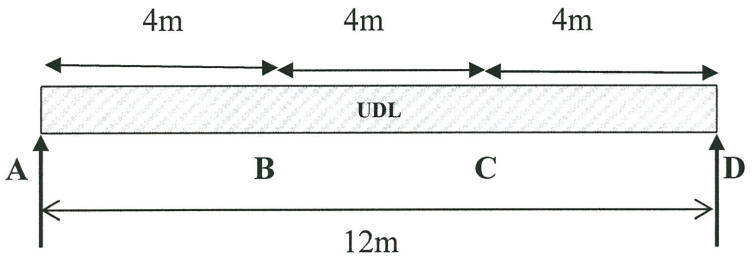

FIGURE Q5

Cross Sectional Area of Reinforcement

Table 1: Cross Sectional Area (mm^2) according to Size and Numbers of Bar

Bar Size (mm)	Number of bar								Perimeter (mm)
	1	2	3	4	5	6	7	8	
6	28.3	56.6	84.9	113	141	170	198	226	18.9
8	50.3	101	151	201	251	302	352	402	25.1
10	78.6	157	236	314	393	471	550	629	31.4
12	113	226	339	453	566	679	792	905	37.7
16	201	402	603	805	1006	1207	1408	1609	50.3
20	314	629	943	1257	1571	1886	2200	2514	62.9
25	491	982	1473	1964	2455	2946	3438	3929	78.6
32	805	1609	2414	3218	4023	4827	5632	6437	100.6
40	1257	2514	3771	5029	6286	7543	8800	10057	125.7

Table 2: Cross Sectional Area (mm^2) for every meter width at distance between bar

Bar Size (mm)	Distance between Bar (mm)								
	50	75	100	125	150	175	200	250	300
6	566	377	283	226	189	162	141	113	94
8	1006	670	503	402	335	287	251	201	168
10	1571	1048	786	629	524	449	393	314	262
12	2263	1509	1131	905	754	647	566	453	377
16	4023	2682	2011	1609	1341	1149	1006	805	670
20	6286	4190	3143	2514	2095	1796	1571	1257	1048
25	9821	6548	4911	3929	3274	2806	2455	1964	1637
32	16091	10728	8046	6437	5364	4598	4023	3218	2682
40	25143	16762	12571	10057	8381	7184	6286	5029	4190