UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2009/2010

SUBJECT NAME	:	STRUCTURAL DESIGN
CODE SUBJECT	:	BPD 3082
COURSE	:	3 BPC
EXAMINATION DATE	:	NOVEMBER 2009
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	PART A ANSWER **ALL** QUESTIONS PART B ANSWER **TWO (2)** QUESTIONS ONLY OUT OF THREE (3) QUESTIONS. ALL CALCULATIONS MUST BE BASED ON STANDARD BS8110: 1997; BS 5950: PART 1: 2000 AND MS 544

THIS PAPER CONTAINS OF 5 PAGES

PART A (50 marks)

Q1 (a) Reinforced concrete is one of the main materials used in structural design and many civil engineering applications.

Describe **four (4)** properties of reinforced concrete.

(10 marks)

(b) Define stress-strain relationship of reinforced concrete structures.

(3 marks)

(c) There are three (3) design concepts that have been developed and used in reinforced concrete design. Explain any **two (2)** of the design concepts:

(i) Permissible stress design
(ii) Load factor design
(iii) Limit state design

(6 marks)

(d) Mode of failure of a beam will depend upon whether the section is under-reinforced or over-reinforced. With the aid of sketches, explain both mode of failure.

(6 marks)

Q2 (a) With the aid of sketches, explain any **three (3)** of the following topics:

(i) Local buckling of steel structures
(ii) Lateral torsional buckling of steel structures
(iii) Shear buckling
(iv) Shear load and Moment capacity
(v) Stress-strain relations of steel structures

(12 marks)

(b) Describe the difference between compression parallel to grain and compression perpendicular to grain in timber.

(6 marks)

(c) Propose some possible ways of increasing the structural use of timber in Malaysia.

(7 marks)

PART B (50 marks)

Q3 Figure Q3 shows a simply supported rectangular beam of 9 m carries the characteristics of dead loads (excluding s/w) and imposed loads of 25kN/m and 10kN/m respectively. Use the given data as follows:

Characteristic strength of concrete, f_{cu}	= 30 N/mm^2
Characteristic strength of main reinforcement, f_y	= 460 N/mm^2
Characteristic strength of links, f_{yv}	= 250 N/mm^2
Beam size, (b x h)	= 350 mm X 600 mm
Concrete cover	= 30 mm
Density of concrete	= 24 kN/m^3
Diameter of main bar	= 20 mm
Diameter of link	= 10 mm

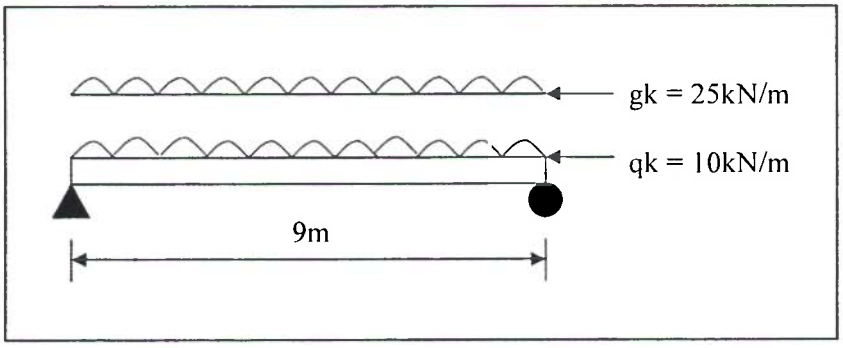


Figure Q3: Simply supported reinforced concrete beam

(a) Determine the maximum shear force and bending moment.

(4 marks)

(b) Calculate the reinforcement for the beam.

(12 marks)

(c) Calculate the shear and deflection checks.

(9 marks)

Q4 (a) Explain the differences between short and slender columns.

(4 marks)

(b) Figure Q4 shows an internal column in a braced two-storey building supporting an approximately symmetrical arrangement of beams (350 mm x 600 mm) results in characteristic dead and imposed load each of 1050 kN being applied to the column. Assuming that the pad footing is not design to resist any moment. Use the given data as follow:

Characteristic strength of concrete, f_{cu}	= 40 N/mm^2
Characteristic strength of main reinforcement, f_y	= 460 N/mm^2
Characteristic strength of links, f_{yv}	= 250 N/mm^2
Column size, (b x h)	= 350 mm X 350 mm
Concrete cover	= 35 mm
Clear height, ℓ_o	= 4.5 m
Beam size, (b x h)	= 350 mm X 650 mm
Diameter of main bar	= 20 mm
Diameter of link	= 10 mm

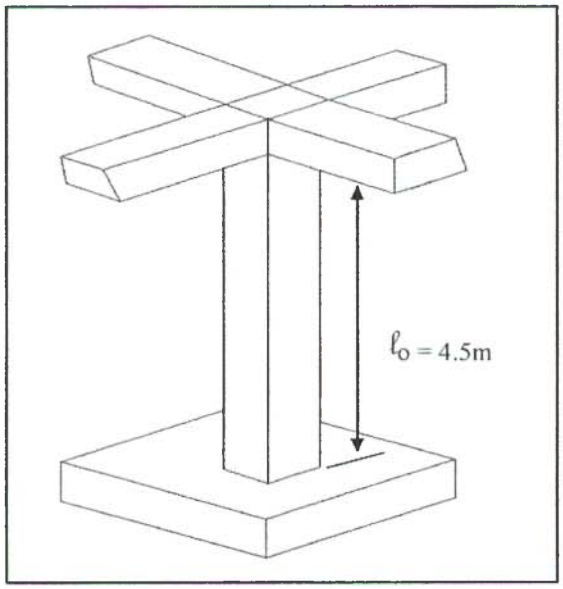


Figure Q4: Internal reinforced concrete braced column

(i) Determine if the column is short or slender.

(4 marks)

(ii) Calculate the ultimate axial load capacity of the column.

(4 marks)

(iii) Calculate the reinforcement for the column.

(10 marks)

(iv) Calculate the links and spacing.

(3 marks)

Q5 A simply supported steel beam shown in Figure Q5 supports uniformly distributed characteristic dead and imposed loads of 5 kN/m each as well as a characteristic imposed point load of 20 kN at mid span. The beam is fully restrained along its length. Use the given data as follow:

Beam size	= 406 X 178 X 60 kg/m UB S275
Beam length	= 10 m
Modulus of elasticity, E	= 205 x 10^6 kN/m^2

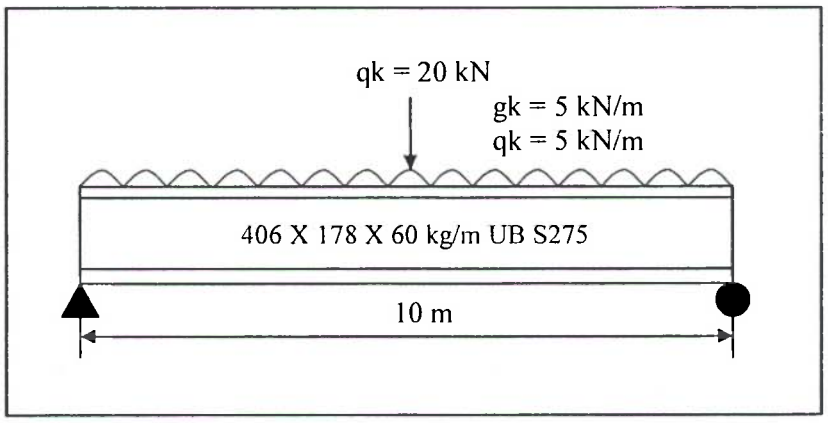


Figure Q5: Simply supported steel beam

Calculate:

(a) Maximum shear force and bending moment.

(6 marks)

(b) Strength and section classification.

(5 marks)

(c) Shear capacity.

(5 marks)

(d) Moment capacity.

(5 marks)

(e) Deflection checks.

(4 marks)

END OF QUESTION PAPER

Appendix I

Table 1 : Sectional areas per metre width for various bar spacings (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	943
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

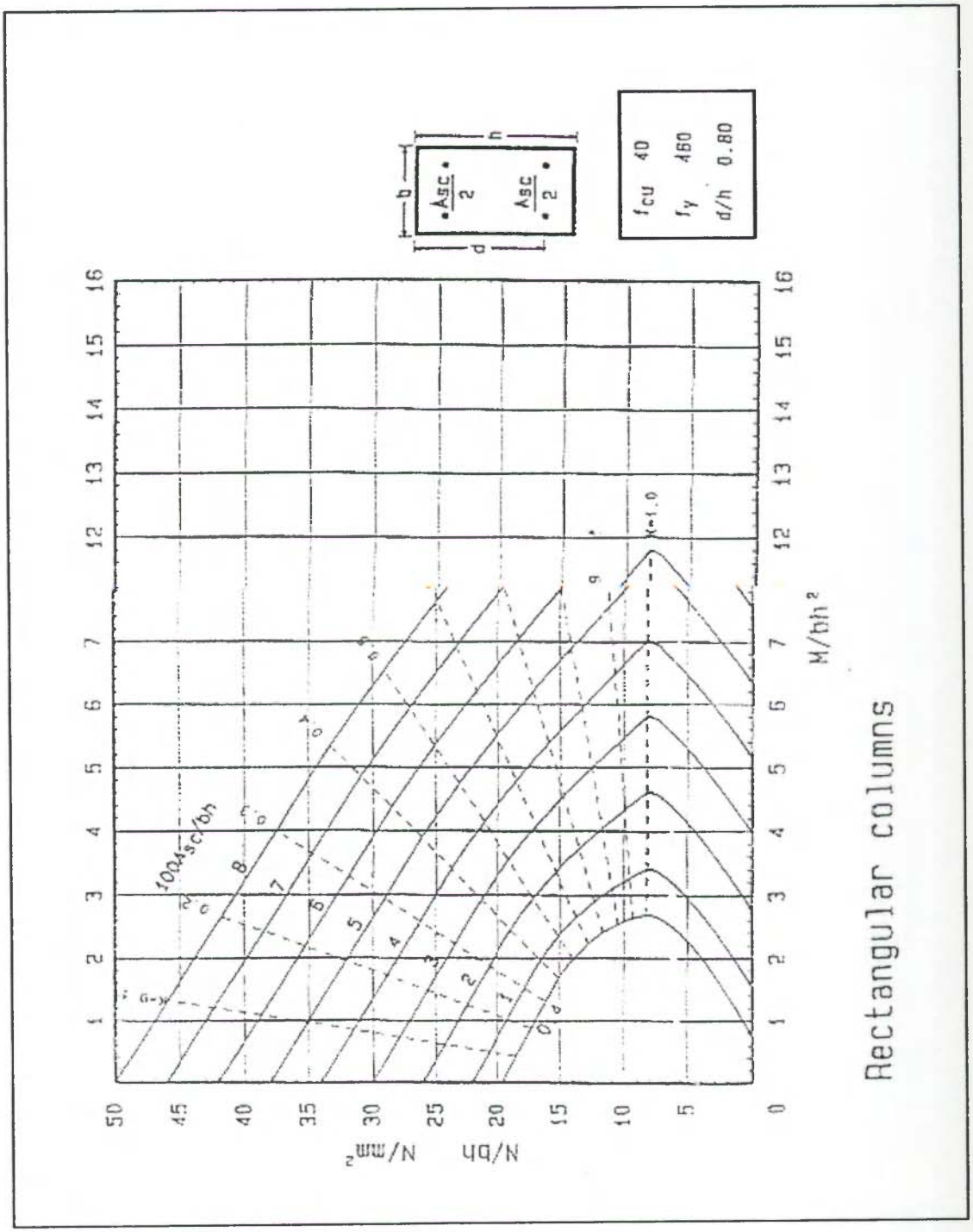
Table 2 . A_{sv}/S_v for varying stirrup diameter and spacing

Bar size (mm)	Stirrup spacing (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	1.570	1.256	1.047	0.897	0.785	0.698	0.628	0.571	0.523
12	2.659	2.511	2.260	1.808	1.507	1.291	1.130	1.004	0.904	0.822	0.753
16	4.729	4.467	4.020	3.216	2.680	2.297	2.010	1.787	1.608	1.462	1.340

Table 3 : 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	3400	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 II


Rectangular columns
f_{cu} 40
f_y 460
d/h 0.80
$\frac{A_{sc}}{2}$
$\frac{A_{sc}}{2}$
b
h
d
M/bh²
N/bh
N/mm²
100Asc/bh