UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

SUBJECT NAME	:	CONSTRUCTION MATERIALS & TESTING
SUBJECT CODE	:	BPD 3093
COURSE	:	3 BPC
EXAMINATION DATE	:	NOVEMBER/DISEMBER 2010
DURATION	:	3 HOURS
INSTRUCTION	:	PART A ANSWER **ALL** QUESTIONS PART B ANSWER **THREE (3)** QUESTION ONLY FROM SIX (6) QUESTION. ATTACH THE DOE FORM FOR **Q1** TOGETHER WITH YOUR ANSWER SCRIPT

THIS QUESTION PAPER CONSISTS OF 7 PAGES

PART A (25 marks)

Q1 Good concrete practice involves mix design to ensure quality, productivity and economy. Concrete produced must be workable, strong and durable.

(a) Write formula and sketch graph showing the relationship between target mean strength, characteristic strength and margin for the mix design of concrete. State the typical values of probability factors and standard deviation used in the mix design.

(10 marks)

(b) Complete the concrete mix design form provided according to the DOE method, given the following data:

i. Characteristic compressive strength, 35 N/mm^2 at 28 days with a 5% defective rate (k = 1.64)
ii. Portland cement class 42.5
iii. Slump required, 60 – 180 mm
iv. Maximum crushed aggregate size, 20mm,
v. Density of crushed aggregate, 2700 kg/m^3
vi. Maximum free-water/ cement ratio 0.55
vii. Percentage passing 600μm sieve is 55%

(15 marks)

PART B (75 marks)

Q2 Quality control of masonry work involves testing of bricks and blocks according to established standards.

(a) Determine the percentage of water absorption of blocks based on the data below:

Weight of air-dried specimen = 8.65 kg
Weight of saturated specimen = 9.80 kg

(10 marks)

(b) Explain the method to produce foamed concrete block with the use of a flow chart. State the mix proportions and tests for density, dimensional stability, water absorption and compressive strength.

(15 marks)

Q3 Structural use of timber requires understanding of its engineering properties and methods of construction and testing.

(a) Explain the stress grading of timber.

(10 marks)

(b) Describe seasoning and preservation of timber in the tropics.

(15 marks)

Q4 Steel structures are often used in industrial buildings. Good practice requires understanding of the engineering properties of steel and methods of testing according to established standards.

(a) Sketch and label the typical stress-strain curve of mild steel.

(10 marks)

(b) Explain the selection and innovative applications of steel and alloy in construction.

(15 marks)

Q5 Bituminous materials are often used in road pavement. Durability and ease of applications have considerable bearing on its popularity.

(a) Sketch and label elements of road pavement.

(10 marks)

(b) Discuss the potential use of rubber crumbs as wearing course for plantation roads.

(15 marks)

Q6 Polymers have secured a place in construction with engineering properties very different from metals and ceramics.

(a) Sketch and label the typical stress-strain curve of polymer materials.

(10 marks)

(b) Explain the applications of polymers for sustainable construction.

(15 marks)

PLEASE ATTACH WITH ANSWER SCRIP FOR Q1

NAME : _____

STUDENT ID. NO : _____ I/C NO or PASSPORT NO. : _____

LECTURER NAME : _____

SECTION NO. : _____

Stage	Item		Reference or calculation	Values
1	1.1	Characteristic strength	Specified	..... N/mm² at ..... days Proportion defective ..... %
	1.2	Standard deviation	Fig 3	..... N/mm² or no data ..... N/mm²
	1.3	Margin	C1 or Specified	(k = ...) ..... × ..... = ... N/mm² ..... N/mm²
	1.4	Target mean strength	C2	..... + ... = ... N/mm²
	1.5	Cement strength class	Specified	42.5/52.5
	1.6	Aggregate type: coarse Aggregate type: fine		Crushed/uncrushed Crushed/uncrushed
	1.7	Free-water/cement ratio	Table 2, Fig 4	..... Use the lower value [ ]
	1.8	*Maximum free-water/ cement ratio*	*Specified*	.....
2	2.1	Slump or Vebe time	Specified	Slump ..... mm or Vebe time ..... s
	2.2	Maximum aggregate size	Specified	..... mm
	2.3	Free-water content	Table 3	..... [ ] kg/m³
3	3.1	Cement content	C3	..... + ... = ... kg/m³
	3.2	*Maximum cement content*	*Specified*	..... kg/m³
	3.3	*Minimum cement content*	*Specified*	..... kg/m³
				use 3.1 if ≤ 3.2 use 3.3 if > 3.1 [ ] kg/m³
	3.4	Modified free-water/cement ratio		..... [ ]
4	4.1	Relative density of aggregate (SSD)		..... known/assumed
	4.2	Concrete density	Fig 5	..... kg/m³
	4.3	Total aggregate content	C4	..... − ..... − ..... = ... kg/m³
5	5.1	Grading of fine aggregate	Percentage passing 600 µm sieve	..... %
	5.2	Proportion of fine aggregate	Fig 6	..... %
	5.3	Fine aggregate content	C5	..... × ..... = [ ] kg/m³
	5.4	Coarse aggregate content		..... − ..... = [ ] kg/m³

Quantities	Cement (kg)	Water (kg or litres)	Fine aggregate (kg)	Coarse aggregate (kg) 10 mm	20 mm	40 mm
per m³ (to nearest 5 kg)	.....	.....	.....	.....	.....	.....
per trial mix of ..... m³	.....	.....	.....	.....	.....	.....

Items in italics are optional limiting values that may be specified (see Section 7).

Concrete strength is expressed in the units N/mm². 1 N/mm² = 1 MN/m² = 1 MPa. (N = newton; Pa = pascal.)

The internationally known term 'relative density' used here is synonymous with 'specific gravity' and is the ratio of the mass of a given volume of substance to the mass of an equal volume of water.

SSD = based on the saturated surface-dry condition.

Table 2 Approximate compressive strengths (N/mm^2) of concrete mixes made with a free-water/cement ratio of 0.5					
Cement strength class	**Type of coarse aggregate**	**Compressive strengths (N/mm^2) Age (days) 3**	**7**	**28**	**91**
42.5	Uncrushed	22	30	42	49
	Crushed	27	36	49	56
52.5	Uncrushed	29	37	48	54
	Crushed	34	43	55	61

Throughout this publication concrete strength is expressed in the units N/mm^2.
$1\ N/mm^2 = 1\ MN/m^2 = 1\ MPa$. (N = newton; Pa = pascal.)

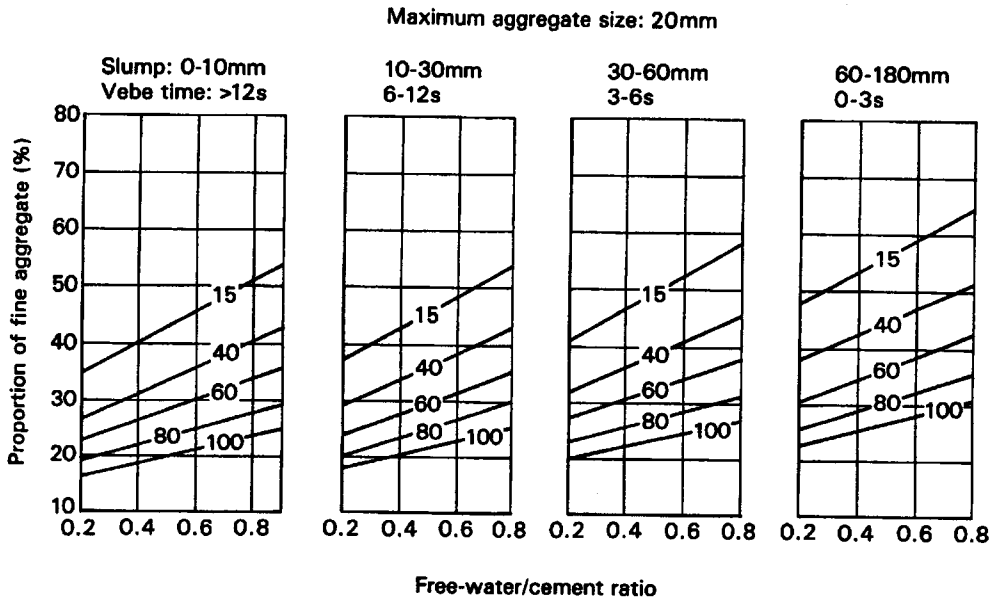

Table 3 Approximate free-water contents (kg/m^3) required to give various levels of workability					
Slump (mm)		**0–10**	**10–30**	**30–60**	**60–180**
Vebe time (s)		**>12**	**6–12**	**3–6**	**0–3**
Maximum size of aggregate (mm)	**Type of aggregate**				
10	Uncrushed	150	180	205	225
	Crushed	180	205	230	250
20	Uncrushed	135	160	180	195
	Crushed	170	190	210	225
40	Uncrushed	115	140	160	175
	Crushed	155	175	190	205

Note: When coarse and fine aggregates of different types are used, the free-water content is estimated by the expression:

$$\tfrac{2}{3} W_f + \tfrac{1}{3} W_c$$

where W_f = free-water content appropriate to type of fine aggregate
and W_c = free-water content approporiate to type of coarse aggregate.

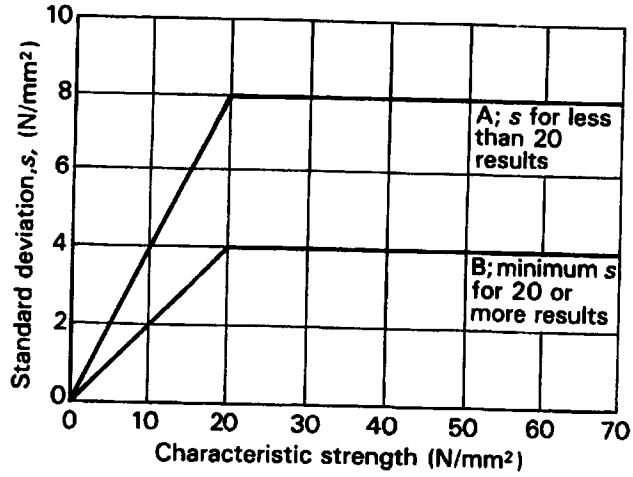

Figure 3
Relationship between standard deviation and characteristic strength

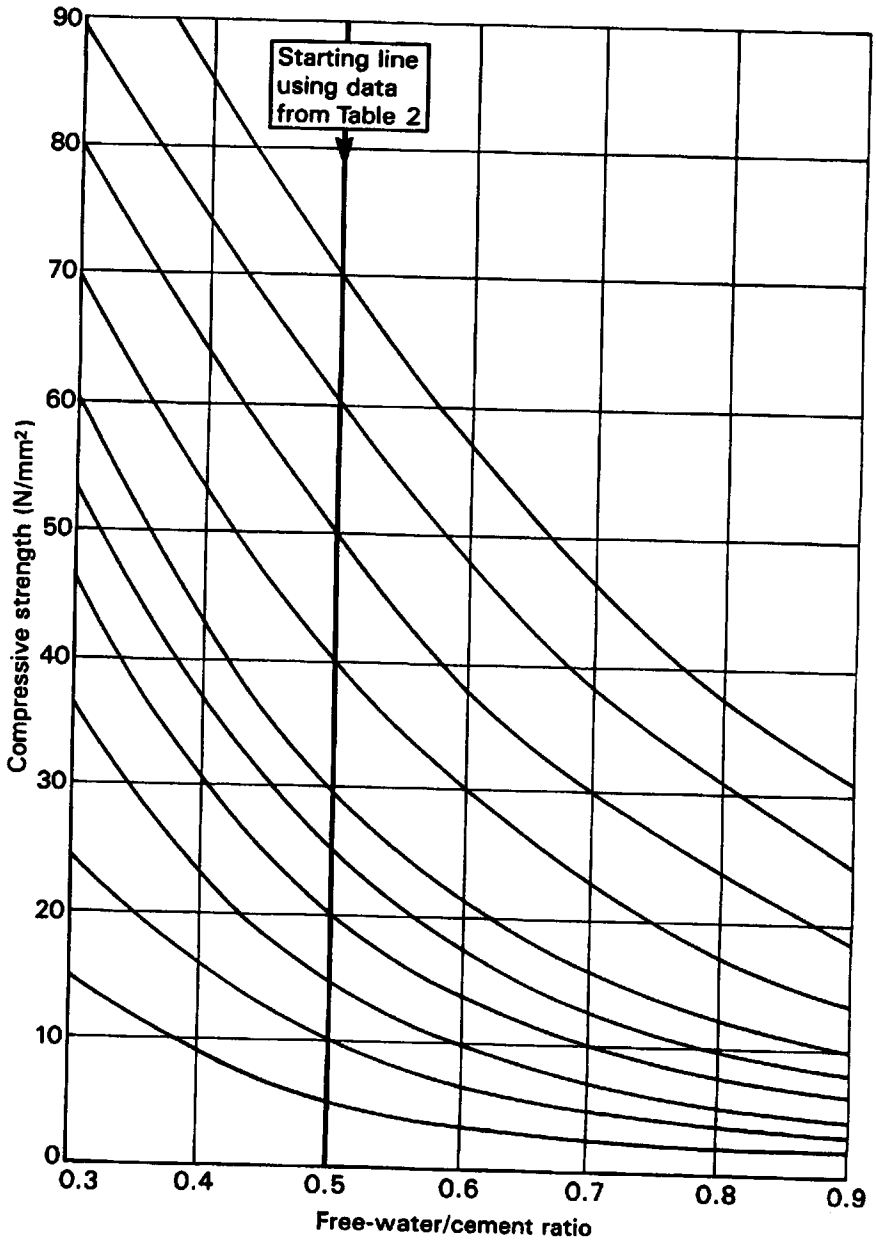

Figure 4
Relationship between compressive strength and free-water/cement ratio

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