KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR SEMESTER II SESI 2004/2005

NAMA MATA PELAJARAN : TEKNOLOGI KONKRIT

KOD MATA PELAJARAN : BTA 4223

KURSUS : 4BTA, 4BTC

TARIKH PEPERIKSAAN : MAC 2005

JANGKA MASA : 2 JAM 30 MINIT

ARAHAN : JAWAB SOALAN **S1** DAN TIGA (**3**) SOALAN LAIN

KERTAS INI MENGANDUNGI 7 MUKA SURAT BERCETAK

S 1 Satu projek berkumpulan yang bertujuan menghasilkan satu nomograf rekabentuk bancuhan konkrit sedang dilaksanakan.

(a) Lukis nomograf pada kertas graf *semi-log* yang disediakan.

(10 markah)

(b) Lakar sistem ujian kebolehtelapan air pada permukaan konkrit menurut deraf standard ISO/DIS 7031. Tulis formula dan tunjukkan contoh pengiraan berdasarkan data berikut:

Tekanan, P = 1 bar
Tebal gasket = 15 mm
Diameter gasket = 50 mm
Diameter pin mikrometer = 10 mm
Masa untuk pin mikrometer bergerak 5 mm = 30 minit
Kandungan simen = 25 %

(15 markah)

S 2 Kawalan nisbah air/simen dalam proses bancuhan konkrit dan pengawetan di tapak bina ialah keperluan penting untuk menjamin kualiti konkrit.

(a) Nyatakan tiga (**3**) kaedah rekabentuk bancuhan konkrit. Tunjukkan contoh pengiraan untuk menghasilkan konkrit gred 60. Andaikan *margin* 10 N/mm^2 dan kebolehkerjaan sangat rendah. Granit hancur bersaiz 20 mm maksimum dan ketumpatan bandingan 2.68. Ketumpatan bandingan agregat halus 2.60 adalah 25% daripada agregat keseluruhan. Nyatakan andaian lain jika berkenaan.

(10 markah)

(b) Tunjukkan satu contoh pengiraan pelarasan kandungan air pada agregat dalam bancuhan konkrit. Andaikan agregat halus mengandungi 5 % air bebas dan agregat kasar menyerap 1 % air.

(15 markah)

S 3 Konkrit agregat ringan kerap digunakan dalam pembinaan bangunan tinggi. Satu projek yang bertujuan menghasilkan satu nomograf rekabentuk bancuhan konkrit agregat ringan sedang dilaksanakan.

(a) Sediakan carta alir pemprosesan *micronised silica* yang berpotensi dibangunkan sebagai bahan tambah untuk agregat ringan.

(10 markah)

(b) Lakarkan nomograf rekabentuk bancuhan konkrit agregat ringan dan tunjukkan contoh penggunaannya untuk menentukan kandungan simen dan nisbah air/simen pada bancuhan konkrit. Nyatakan kekuatan mampatan konkrit agregat ringan berketumpatan 1600kg/m^3 yang mengandungi *Aglite* dan *Lytag*.

(15 markah)

S 4 Projek pembuatan kayak konkrit adalah bertujuan meningkatkan daya cipta dan kebolehan pelajar bekerja berpasukan.

(a) Tulis nota ringkas mengenai penggunaan gentian dalam konkrit bagi meningkatkan kekuatan lenturnya.

(10 markah)

(b) Lakar dan terangkan dengan ringkas sistem ujian menurut ASTM C1018 bagi menentukan kekuatan lentur sampel konkrit.

(15 markah)

S 5 Ubahbentuk konkrit ringan sering diuji untuk mengawal kualiti pembinaan.

(a) Sediakan modul penggunaan alat DEMEC untuk mengukur ubahbentuk konkrit. Lakar graf yang berkaitan.

(10 markah)

(b) Tentukan ubahbentuk konkrit yang disebabkan perubahan suhu dan pengembangan sekiranya pekali ubahbentuk konkrit, $\alpha = 11 \times 10^{-6}/^{o}C$, kenaikan suhu $10^{o}C$, terikan konkrit, $\varepsilon = 200 \times 10^{-6}$, panjang anggota konkrit, $l = 5$ m. Cadangkan kaedah untuk menampung kesan tersebut.

(15 markah)

S 6 Ujian tanpa musnah memainkan peranan penting dalam penilaian dan peningkatan kualiti struktur konkrit bertetulang.

(a) Terangkan dengan ringkas mengenai kaedah halaju denyutan ultrabunyi sebagai ujian tanpa musnah konkrit.

(10 markah)

(b) Dengan bantuan carta alir, terangkan prosidur penilaian struktur konkrit yang dilanda kebakaran.

(15 markah)

S 1 A group project is aimed at producing a concrete mix design nomograph.

(a) Draw the nomograph on the *semi-log* graph paper provided.

(10 marks)

(b) Sketch the water permeability test system according to the draft ISO/DIS 7031 standard. Write the formula and show sample calculation based on the following data:

Pressure, P = 1 bar
Thickness of gasket = 15 mm
Diameter of gasket = 50 mm
Diameter of micrometer pin = 10 mm
Time for micrometer pin to move 5 mm = 30 minutes
Cement content = 25 %

(15 marks)

S 2 The control of water/cement ratio in the concrete mix process and curing at the construction site are important requirements for quality control.

(a) State three (3) concrete mix design methods. Show sample calculation to produce grade 60 concrete. Assume margin of 10 N/mm^2 and very low workability. Crushed granite of maximum size 20 mm, relative density of 2.68. Fine aggregate of relative density 2.60 is approximately 25% of the total aggregate content. State other assumptions where necessary.

(10 marks)

(b) Show a sample calculation of field adjustment for free water content of fine aggregate in concrete mix design. Assume that the fine aggregate contains 5 % free water and the coarse aggregate absorbs 1 % water.

(15 marks)

S 3 Lightweight aggregate concrete is often used in the construction of high rise buildings. A project is aimed at producing a mix design nomograph for lightweight aggregate concrete.

(a) Prepare a process flow chart of *micronised silica* for use as admixture for lightweight aggregate.

(10 marks)

(b) Sketch a mix design nomograph for lightweight aggregate concrete containing *Aglite* and *Lytag*. Show its application for the determination of cement content, water/cement ratio and compressive strength for density of 1600 kg/m^3.

(15 marks)

S 4 A concrete canoe project is aimed at enhancing creativity and to promote team work among students.

(a) Describe briefly the use of fibre in concrete to increase its flexural strength.

(10 marks)

(b) Sketch and explain a test system according to ASTM C1018 for the determination post peak flexural strength of concrete specimen.

(15 marks)

S 5 The deformation of lightweight concrete is monitored to ensure its compliance to specification.

(a) Prepare a module for the use of DEMEC gauge to measure the deformation of lightweight concrete. Sketch relevant graph where necessary.

(10 marks)

(b) Determine the deformation of concrete due to temperature variation and expansion. Assume the coefficient of expansion, $\alpha = 11 \times 10^{-6}/^{\circ}C$, temperature increase of $10^{\circ}C$, concrete strain, $\varepsilon = 200 \times 10^{-6}$, concrete length, $l = 5$ m. Propose a method to accommodate the deformation.

(15 marks)

S 6 Non destructive test is playing an important role to enhance quality control during concrete construction.

(a) Describe briefly the ultrasonic pulse velocity method.

(10 marks)

(b) Explain the procedure for structural appraisal of fire damaged concrete buildings with the aid of a flow chart.

(15 marks)

KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

FAKULTI KEJURUTERAAN AWAM
DAN ALAM SEKITAR

PANDUAN REKABENTUK BANCUHAN KONKRIT

TIA Concrete Mix Design Nomograph

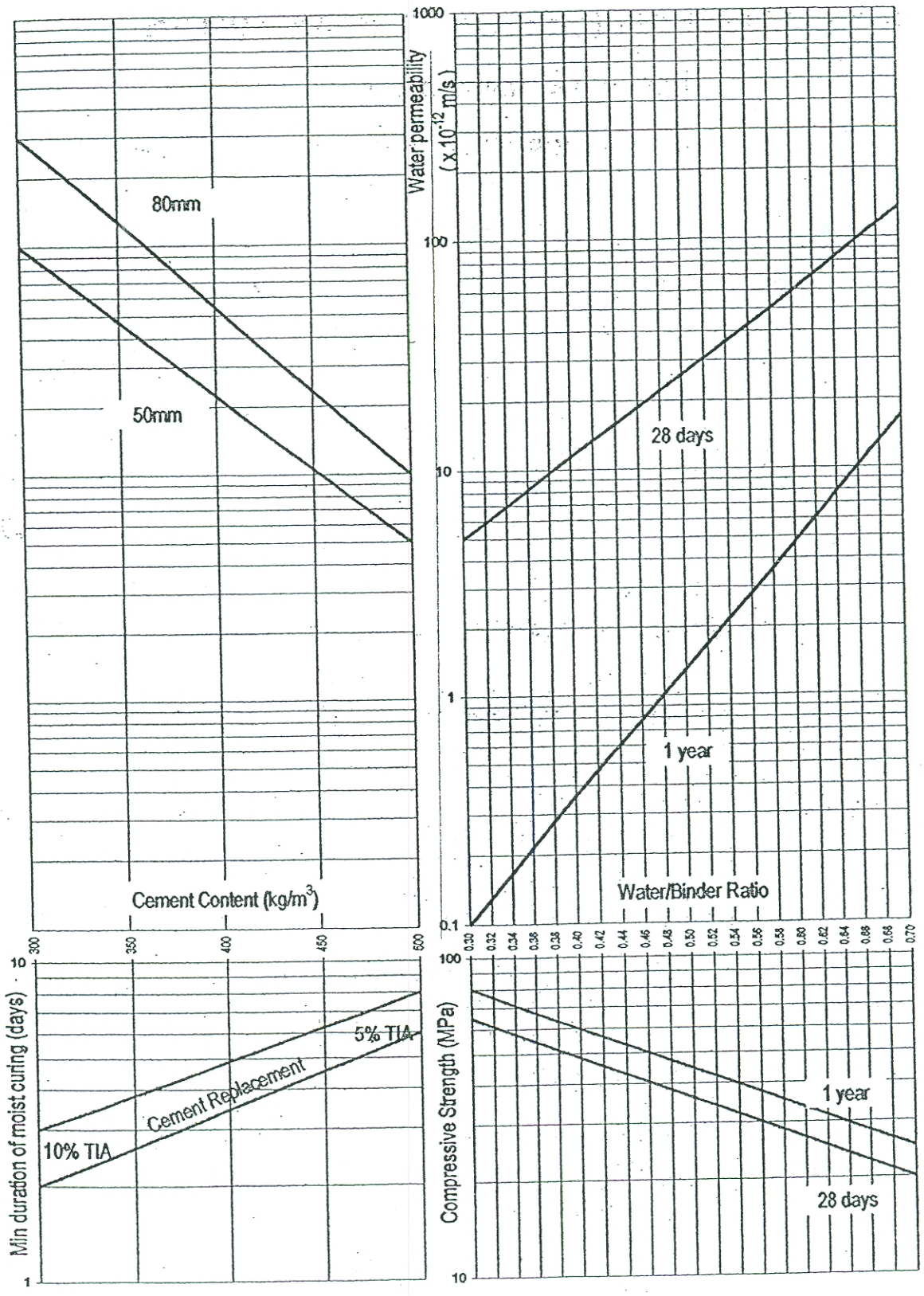

Table 10.16 (a) Relative mixing water requirements for different consistencies of concrete

Description	Consistence				Relative water content
	Slump		Vebe	Compacting factor	
	Millimeters	*Inches*	*s*		*(%)*
Extremely dry	-	-	32 - 18	-	78
Very stiff	-	-	18 - 10	0.70	83
Stiff	0 - 30	0 - 1	10 - 5	0.75	88
Stiff plastic	30 - 80	1 - 3	5 - 3	0.85	92
Plastic (reference)	80 - 130	3 - 5	3 - 0	0.91	100
Fluid	130 - 180	5 - 7	-	0.95	106

Table 10.16 (b) Approximate mixing water content for the reference (plastic) mix of Table 10.16(a) for different maximum sizes of aggregate

Maximum size of aggregate		Non-air-entrained water content		Entrapped water content (%)	Air-entrained* water content	
Millimeters	*Inches*	kg/m^3	lb/yd^3		kg/m^3	lb/yd^3
10.0	0.375	225	385	3.0	200	340
12.5	0.500	215	365	2.5	190	325
20.0	0.750	200	340	2.0	180	305
25.0	1.000	195	325	2.5	175	295
40.0	1.500	175	300	1.0	160	275
50.0	2.000	170	285	0.5	155	265
70.0	3.000	160	265	0.3	150	250
150.0	6.000	140	230	0.2	135	220

Table 10.17 Bulk volume of coarse aggregate per unit volume of concrete

Maximum size of aggregate		Bulk volume of rodded coarse aggregate per unit volume of concrete for fineness modulus of sand			
Millimeters	*Inches*	*2.40*	*2.60*	*2.80*	*3.00*
10.0	0.375	0.50	0.48	0.46	0.44
12.5	0.500	0.59	0.57	0.55	0.53
20.0	0.750	0.66	0.64	0.62	0.60
25.0	1.000	0.71	0.69	0.67	0.65
40.0	1.500	0.75	0.73	0.71	0.69
50.0	2.000	0.78	0.76	0.74	0.72
70.0	3.000	0.82	0.80	0.78	0.76
150.0	6.000	0.87	0.85	0.83	0.81

Table 10.8 (a) Relation between water/cement ratio & compressive strength according to ACI Standard 211.3-75

Compressive strength at 28 days		Water/Cement ratio (by weight)	
MPa	*psi*	Non-air-entrained concrete	Air-entrained concrete
48	7000	0.33	-
41	6000	0.41	0.32
34	5000	0.48	0.4
28	4000	0.57	0.48
21	3000	0.68	0.59
14	2000	0.82	0.74

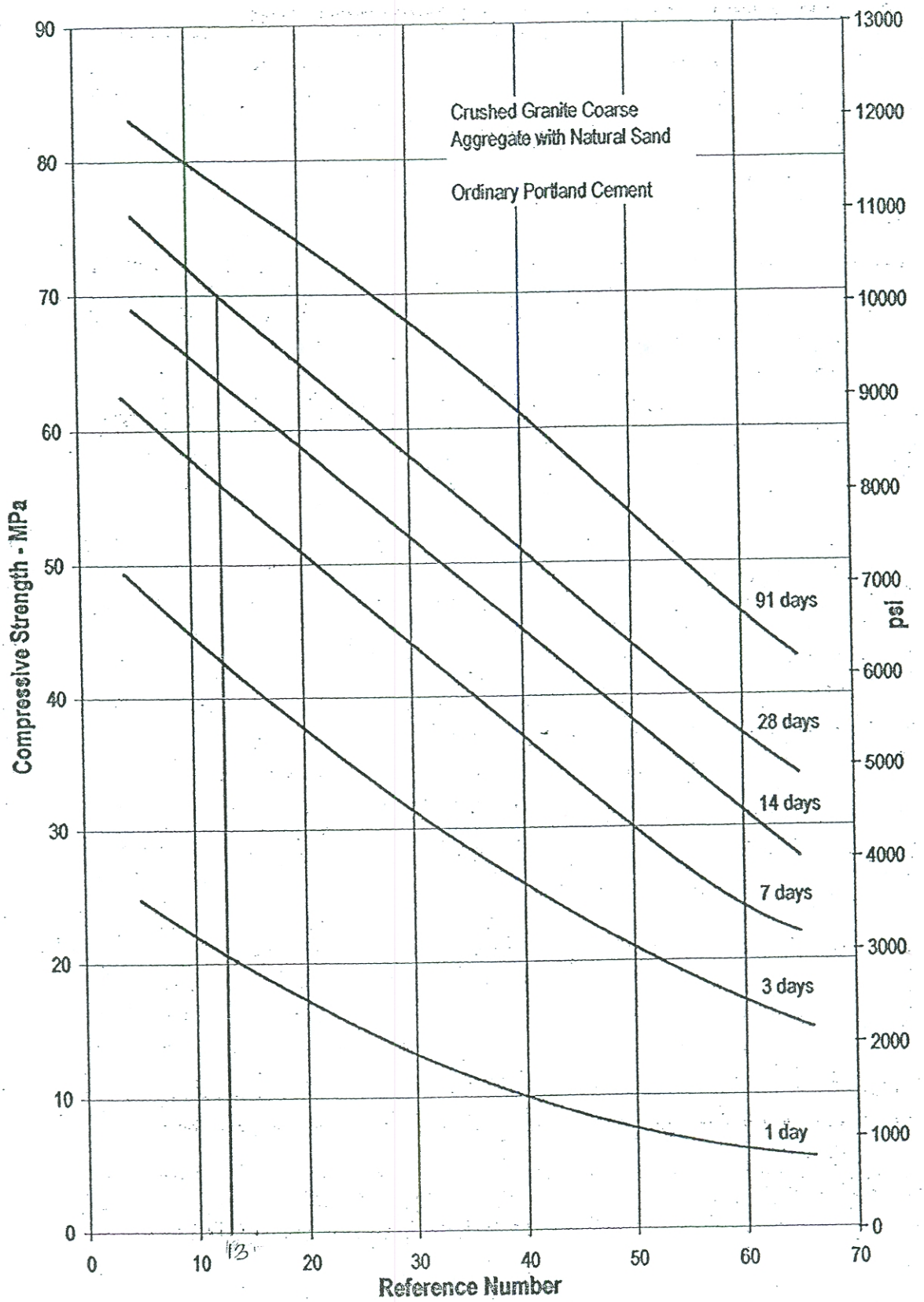

Fig. 10.12 Relation between compressive strength and "reference number" for mixes containing crushed granite coarse aggregate, natural sand and ordinary portland cement[10.10]

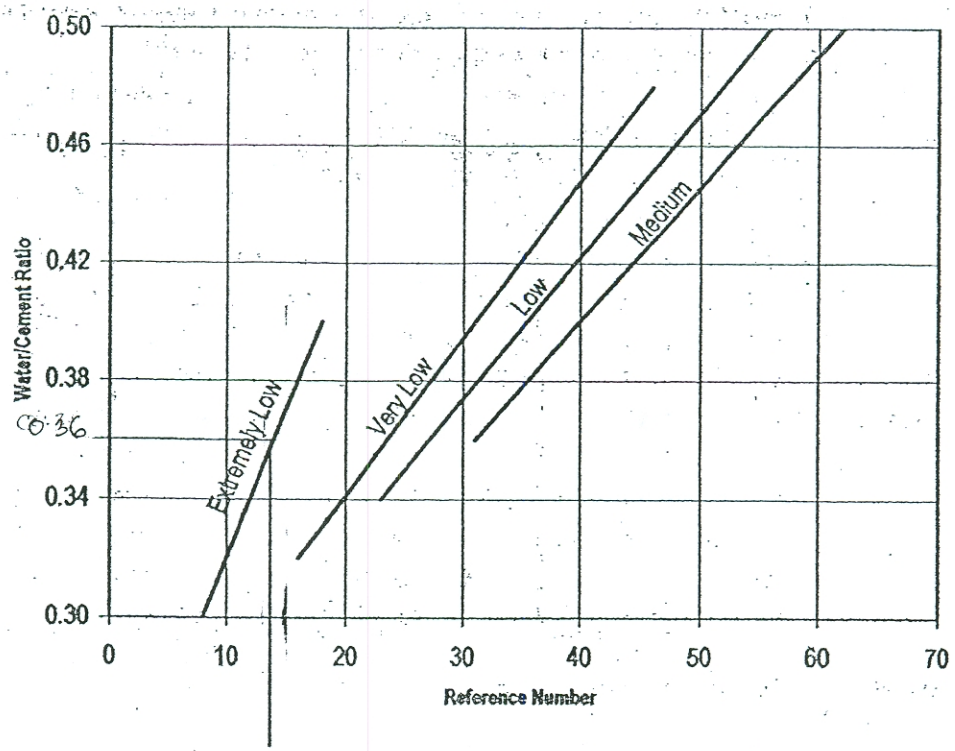

Fig. 10.15 Relation between water/cement ratio and "reference number" for 19.05mm (3/4 in.) maximum size aggregate[10.10]

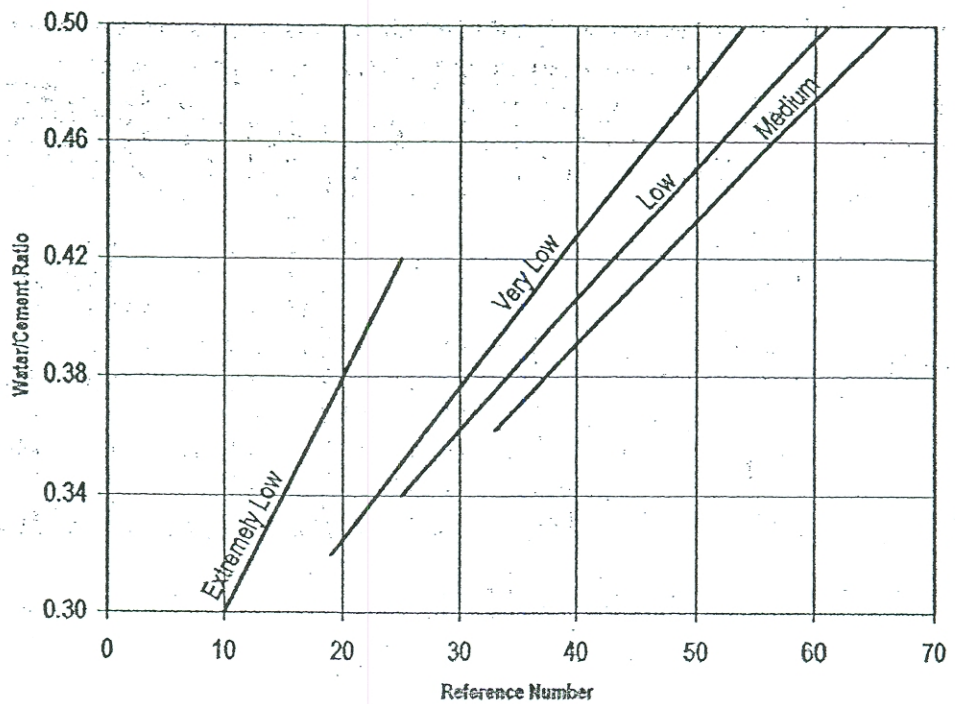

Fig. 10.16 Relation between water/cement ratio and "reference number" for 9.52mm (3/8 in.) maximum size aggregate[10.10]

Table 10.13 Aggregate/Cement ratio (by weight) required to give four degrees of workability with different Water/Cement ratios using Ordinary Portland Cement[10.19]

Type of coarse aggregate*		Irregular gravel								Crushed granite							
Maximum size of aggregate		19.05 mm (3/4 in.)				9.52 mm (3/8 in.)				19.05 mm (3/4 in.)				9.52 mm (3/8 in.)			
Degree of workability †		EL	VL	L	M	EL	VL	L	M	EL	VL	L	M	EL	VL	L	M
Water/cement ratio by weight	0.30	3.0	-	-	-	2.4	-	-	-	3.3	-	-	-	2.9	-	-	-
	0.32	3.8	2.5	-	-	3.2	-	-	-	4.0	2.6	-	-	3.6	2.3	-	-
	0.34	4.5	3.0	2.5	-	3.9	2.6	-	-	4.6	3.2	2.6	-	4.2	2.8	2.3	-
	0.36	5.2	3.5	3.0	2.5	4.6	3.1	2.6	-	5.2	3.6	3.1	2.6	4.7	3.2	2.7	2.3
	0.38	-	4.0	3.4	2.9	5.2	3.5	3.0	2.5	-	4.1	3.5	0.3	5.2	3.6	3.0	2.6
	0.40	-	4.4	3.8	3.2	-	3.9	3.3	2.7	-	4.5	3.8	3.2	-	4.0	3.3	2.9
	0.42	-	4.9	4.1	3.5	-	4.3	3.6	3.0	-	4.9	4.2	3.5	-	4.4	3.6	3.1
	0.44	-	5.3	4.5	3.8	-	4.7	3.9	3.3	-	5.3	4.5	3.7	-	4.8	3.9	3.3
	0.46	-	-	4.8	4.1	-	5.1	4.2	3.6	-	-	4.8	4.0	-	5.1	4.2	3.6
	0.48	-	-	5.2	4.4	-	5.4	4.5	3.8	-	-	5.1	4.2	-	5.5	4.5	3.8
	0.50	-	-	5.5	4.7	-	-	4.8	4.1	-	-	5.4	4.5	-	-	4.7	4.0

* Natural sand used in combination with both types of coarse aggregate

† EL = Extremely Low
VL = Very Low
L = Low
M = Medium

Table 10.14 Aggregate/Cement ratio (by weight) required to give four degrees of workability with different Water/Cement ratios using Rapid-hardening Portland Cement[10.19]

Type of coarse aggregate*		Irregular gravel								Crushed granite							
Maximum size of aggregate		19.05 mm (3/4 in.)				9.52 mm (3/8 in.)				19.05 mm (3/4 in.)				9.52 mm (3/8 in.)			
Degree of workability †		EL	VL	L	M	EL	VL	L	M	EL	VL	L	M	EL	VL	L	M
Water/cement ratio by weight	0.32	2.6	-	-	-	-	-	-	-	2.9	-	-	-	2.5	-	-	-
	0.34	3.4	2.2	-	-	2.8	-	-	-	3.6	2.4	-	-	3.2	-	-	-
	0.36	4.1	2.7	2.3	-	3.5	2.4	-	-	4.3	2.9	2.4	-	3.9	2.5	-	-
	0.38	4.8	3.2	2.8	2.3	4.2	2.9	2.4	-	4.9	3.4	2.9	2.4	4.5	3.0	2.5	-
	0.40	5.5	3.7	3.2	2.7	4.9	3.3	2.8	2.3	5.5	3.9	3.3	2.7	5.0	3.4	2.9	2.4
	0.42	-	4.2	3.6	3.0	-	3.7	3.1	2.6	-	4.2	3.6	3.0	5.5	3.8	3.2	2.7
	0.44	-	4.6	4.0	3.4	-	4.1	3.5	2.9	-	4.7	4.0	3.3	-	4.2	3.5	3.0
	0.46	-	5.0	4.3	3.7	-	4.5	3.8	3.2	-	5.1	4.3	3.6	-	4.6	3.8	3.2
	0.48	-	5.5	4.7	4.0	-	4.9	4.1	3.5	-	5.5	4.6	3.9	-	5.0	4.1	3.4
	0.50	-	-	5.0	4.3	-	5.2	4.4	3.7	-	-	4.9	4.1	-	5.3	4.4	3.7

* Natural sand used in combination with both types of coarse aggregat

† EL = Extremely Low
VL = Very Low
L = Low
M = Medium

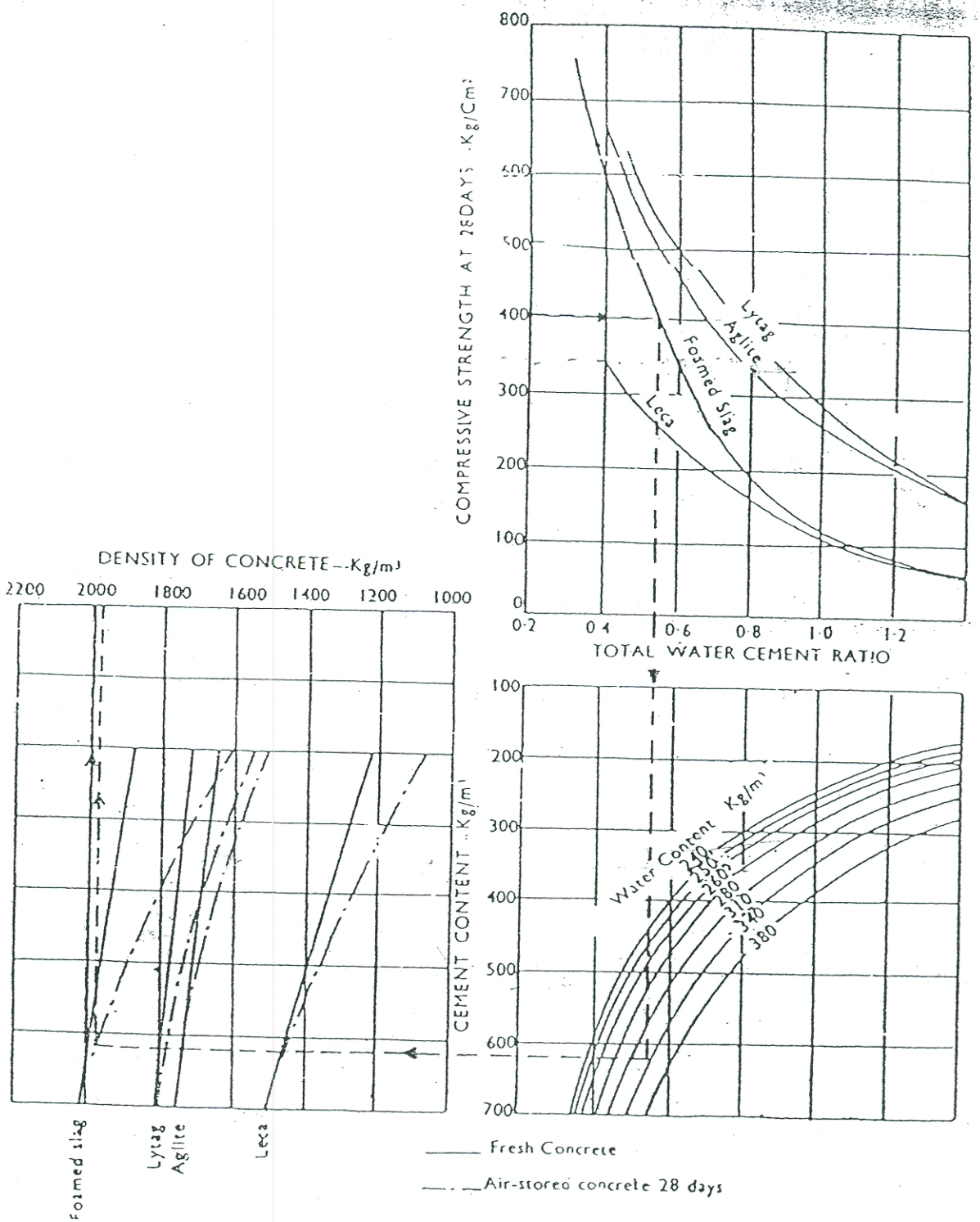

Fig. 12·2. Mix Design for Light-Weight Agrregate Concrete[12.3].

	W/C	OPC (kg/m³)	ρ (kg/m³)
Leca	0·4	700	1500
Foamed slag	0·6	480	1850
Aglite	0·8	350	1600
Lytag	0·85	330	1650