UNIVERSITY OF JOHANNESBURG

PROGRAMME	:	BTECH: ENGINEERING: CIVIL
SUBJECT	:	CONCRETE TECHNOLGY 4
CODE	:	TBJ421
DATE	:	SUMMER SSA EXAMINATION 2015 7 DECEMBER 2015
DURATION	:	(SESSION 1) 08:00 - 11:00
WEIGHT	:	40:60
TOTAL MARKS	:	100%

ASSESSOR	:	DR SALIM RW
MODERATOR	:	DR WEKESA BW
NUMBER OF PAGES	:	7 PAGES

INSTRUCTIONS	:	ONLY ONE ANY TYPE CALCULATOR PER CANDIDATE MAY BE USED.
REQUIREMENTS	:	NONE.

INSTRUCTIONS TO STUDENTS

1. PLEASE ANSWER ALL QUESTIONS
2. FIGURE 1 AND TABLES 2 TO 6 MAY BE USED WHEN NEED ARISES

QUESTION ONE **(20 Marks)**

Gill Owens (2012) has stated that "Concrete is the most commonly used building material on the planet and most of the infrastructure for modern civilization has been built using concrete in some form or other. Because of this extensive use, concrete has a relatively large environmental footprint and therefore has to be considered carefully and rationally when sustainability is discussed". With support of diagrams discuss what you understand by the term "sustainability" with respect to infrastructure/building project that utilizes concrete as a construction material. In your discussion state and clearly indicate how concrete in such project affect sustainable development. (The minimum number of words to be used is 800 words while the maximum should be 1000 words).

Gill Owens, 2012, *Fundamentals of concrete* Cement and concrete Institute, South Africa

Total Marks for Question 1 **(20 Marks)**

BACKGROUND INFORMATION FOR ANSWERING QUESTIONS TWO TO FIVE

Gibraltar is a British enclave of about 6 km^2 and is situated on the southern tip of the Liberian Peninsula.

It was recently decided to build a bus lane on Sir Herbert Miles Road between Catalan Bay and Sandy Bay. The pavement of the bus lane will be built with concrete.

The Government of Gibraltar will pay for the construction of the bus lane.

MATERIALS

- Characteristics of the fine and coarse aggregate to be used for production of the concrete:

□ Stone:	Size:	19.0mm
	Compacted Bulk Density (CBD):	1550kg/m^3
	Relative Density (RD):	2.7
	Loose Bulky Density (LBD):	1470kg/m^3
	Moisture Content:	2.8%
□ Sand:	Fine Modulus (FM):	2.3
	Relative Density (RD):	2.65
	Loose Bulky Density (LBD):	1450 kg/m^3
	Moisture Content:	3.8%

- Delft Dealers will supply the cement (CEM I 32.5) for the construction of the crossing.

From the background information given and your knowledge of concrete technology answer questions two to five.

QUESTION TWO **(20 Marks)**

Concrete can be attacked by acids and sulphates.

a) Explain the factors that will influence the rate of acids and sulphates on concrete.

(5 Marks)

b) Explain the difference between the attack of acids and sulphates on concrete.

(10 Marks)

c) At chainage 6.0Km the concrete bus lane crosses a concrete canal of the Catalan River. The headwater of the river is the Catalan Spring in the Rock of Gibraltar. This spring water is the most pure water in Gibraltar. The water is bottled by Gibraltar Bottling Company and is very expensive.

At the location where the bus lane crosses the concrete canal, it will be permanent be covered with about 50mm water.

During the last site meeting the Governor mentioned that the strength of the concrete of the canal will always be increasing in its life span. His motivation for this statement was that the concrete is submerged for life and therefore, the hydration of the cement will be ongoing.

Was he correct?

Support you answer by providing objective reasons or explanation. (5 Marks)

Total Marks for Question 2 **(20 Marks)**

QUESTION THREE **(20 Marks)**

The bus stop next to the bus lane will be plastered. Good workability is essential for the successful application of the plaster.

a) Explain step by step how the workability of mortar for plastering can be assessed.

(10 Marks)

b) Explain three things that can be used or added to the plaster to improve its workability. (10 Marks)

Total Marks for Question 3 **(20 Marks)**

QUESTION FOUR **(20 Marks)**

Table 1 contains the cube strength results of the pavement of the bus lane.

Will you accept the results of the cube strength?

Support you answer by providing the following:

- The acceptance criteria as stated in SABS 01000-2:1992. Code of practice for structural use of concrete Part 2: Materials and execution of work.
- The average of the results per set
- The minimum result per set

Support your answer by providing objective reasons and motivations. Also provide the necessary calculations.

QUESTION 5 **(20 Marks)**

a) Concrete can be compacted by hand tamping, poker vibrator or beam vibrator.

Which type of compaction will you prefer?

Support your answer by providing objective reasons and motivations. Also refer to the uses of the other type of compactions. (7 Marks)

b) Concrete can be re-vibrated

Is this statement true?

Explain your answer. Also refer to the effect that re-vibration has on concrete. (13 Marks)

Total Marks for Question 5 **(20 Marks)**

Total Marks for the examination paper **(100 Marks)**

TABLE 1: Cube strength results

CUBE STRENGTH RESULTS			
Set	Cube strength results		
A	26	20	21
B	24	28	22
C	29	22	23

$$Mass\ of\ sand\ (for\ 1\ m^3\ of\ concrete) = \left\{1000 - \left[\frac{Cement}{RD_c} + \frac{Stone}{RD_{st}} + Volum\ water\right]\right\} x RD_{sand}$$

$$S = \sqrt{\frac{\sum x^2 - n\ x\ mean^2}{n-1}}$$

DESIGN TABLES

TABLE 2: Water requirement of concrete mixes (19.0mm stone and 75mm slump)

Sand quality	Water content, ℓ/m^3	
	Natural	Crusher
Very poor	240	235
Poor	225	225
Average	210	215
Good	195	205
Excellent	180	195

TABLE 3: Adjustment to water content to compensate for stone sizes other than 19.0mm

Maximum size of stone, mm	9,5	13,2	19,0	26,5	37,5
Correction, ℓ/m^3	+20	+10	0	-10	-20

TABLE 4: Increase of stone when using Fly Ash

FA content as % by mass of total cementitious material	Percentage additional stone
15	3
25	4
30	5
40	6
50	7

TABLE 5: Values of *k* for determining of stone

Approximate slump range, mm	Placing requirement	K				
		Maximum size of stone, mm				
		9,5	13,2	19,0	26,5	37,5
75 - 150	Hand compaction	0,75	0,84	0,94	1,00	1,05
25 - 100	Moderate vibration	0,80	0,90	1,00	1,06	1,10
0 - 25	Heavy vibration	1,00	1,05	1,08	1,10	1,15
60 - 125	Pumped	-	0,83	0,86	0,87	-
25 - 50	Concrete roads*	-	-	-	-	1,2

* Calculated on CBD of 37,5-mm stone when using a blend of 37,5- and 19-mm stone

TABLE 6: Particle Relative Densities of cementetious materials

Material	Particle relative density
CEM I	3,14
GGBS	2,9
FA	2,3
CSF	2,1

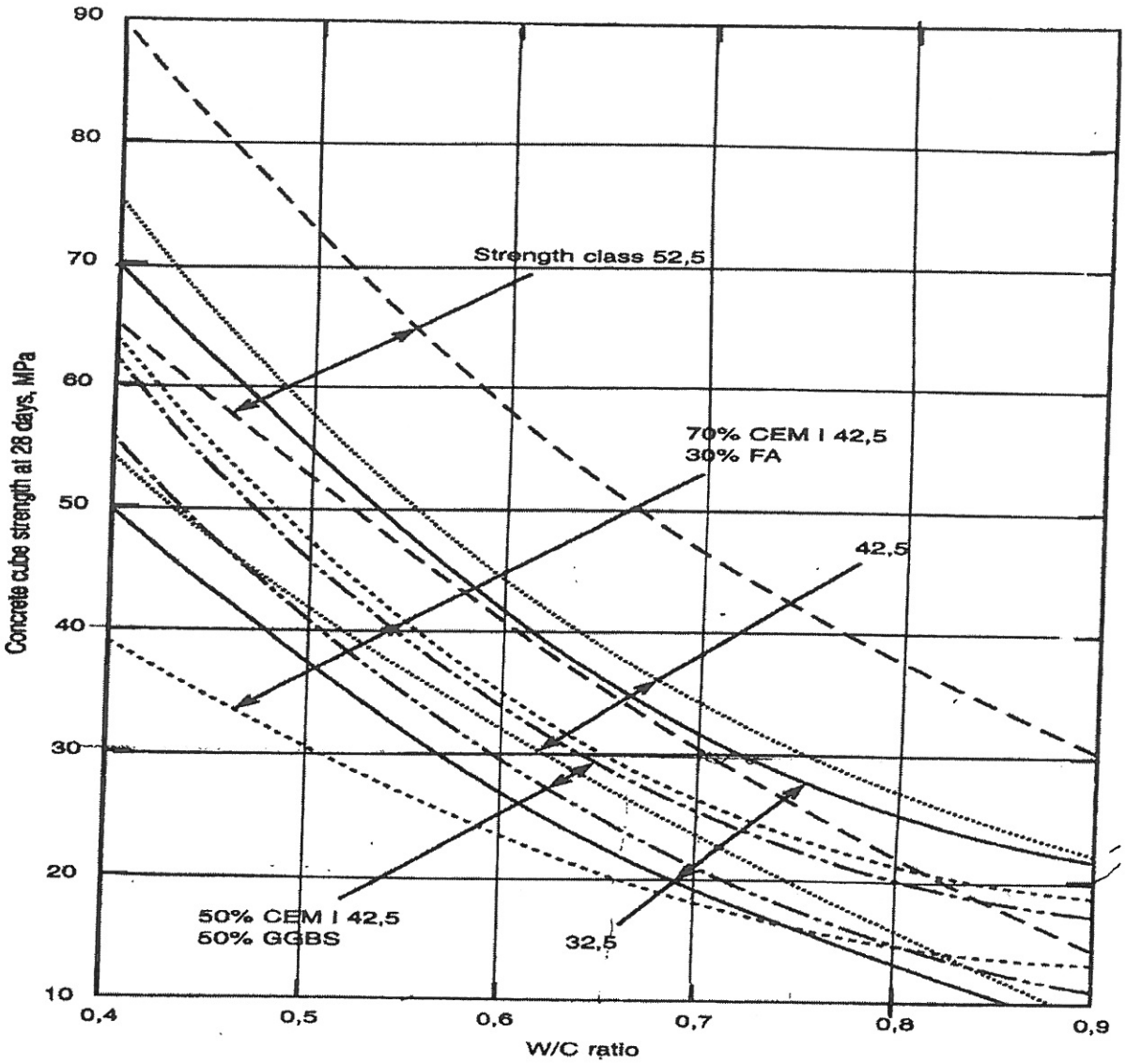

Figure 1: Ranges of compressive strength performance of South African cements used in concrete