(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: BTB 231

COURSE TITLE: CONCRETE TECHNOLOGY

DATE: MONDAY 8TH FEBRUARY 2021 TIME: 9.00 – 11.00 AM

INSTRUCTIONS:

1. This paper consists of **FOUR** questions.
2. **ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS**.
3. Marks for each question are indicated in the parenthesis.

MMUST observes ZERO tolerance to examination cheating

Question ONE (30 Marks)

a) Define the following terms as used in concrete technology:
   i. Aggregates
   ii. Cement
   iii. Admixtures
   iv. Concrete **[4 Marks]**

b) What is a structural material? Briefly explain why concrete is regarded as a structural material. **[2 Marks]**

c) Describe any **THREE** types of concrete classification, giving one example in each and usage. **[6 Marks]**

d) Describe any FOUR qualities of a good concrete. **[2 Marks]**

e) Highlight **FOUR** types of impurities in sand. **[2 Marks]**

f) Briefly describe the bulking phenomenon in sand and state **THREE** effects of bulking of sand on concrete. **[3 Marks]**

g) Highlight any FOUR properties of a good cement for use in concrete production. **[2 Marks]**

h) Design a concrete mix using the following data:
   28 days mean characteristic strength = 30 MPa, Risk factor K = 1.64, Standard deviation S = 8 N/mm^2 , The maximum size of coarse aggregate = 20mm, Aggregate type = **crushed** 60% Fine aggregate passes through the 600-micron sieve, Slump range 60-180, 25 mm cover to reinforcement, specific gravity of aggregate = 2.65, ordinary Portland cement of 42.5 MPa and exposed to a moderate environmental condition. **[9 Marks]**

   NB: Use the tables, curves and figures attached at the end of the question paper.

Question TWO (20 marks)

a) Describe the TWO classes/types of aggregates, giving one example in each case. **[3 Marks]**

b) Briefly describe the following properties of coarse aggregates:
   i. Size
   ii. Shape
   iii. Surface texture
   iv. Specific gravity
   v. Soundness **[5 Marks]**

c) Highlight **THREE** factors that affect the bulk density of coarse aggregates. **[4.5 Marks]**

d) Highlight any THREE precautionary measures to be undertaken in storing of cement. **[3 Marks]**

e) Highlight THREE reasons why accelerator admixtures would be added to concrete to enhance the early strength development. **[3 Marks]**

f) State THREE quality requirements of aggregates. **[1.5 Marks]**

Question THREE (20 marks)

a) What is Fresh concrete? What is the importance of plastic state of fresh concrete during construction period? **[3 Marks]**

b) Briefly describe the process of determining the concrete slump (Slump – Test) **[7 Marks]**

c) What is workability of concrete? State TWO ways of increasing workability without compromising the strength of the concrete. **[3 Marks]**

d) Describe how the following factors affect workability of concrete. **[3 Marks]**

i. Water content
ii. Cement content
iii. Aggregate size

e) Highlight FOUR main requirements which form the basis of selection and proportioning of mix ingredients during the mix design of concrete. **[4 Marks]**

Question FOUR (20 Marks)

a) What is hardened concrete? **[1 Marks]**

b) Briefly **describe** the following properties of hardened concrete: **[3 Marks]**

i. Compressive strength
ii. Durability
iii. Shrinkage

c) What is formwork? **[1 Marks]**

d) Highlight **FIVE** qualities of a good formwork **[5 Marks]**

e) Highlight **FOUR** basic requirements of formwork. **[4 Marks]**

f) Describe **THREE** factors that determines the removal time of formwork. **[3 Marks]**

g) Describe **THREE** classes/types of loads that are being supported by formwork. **[3 Marks]**

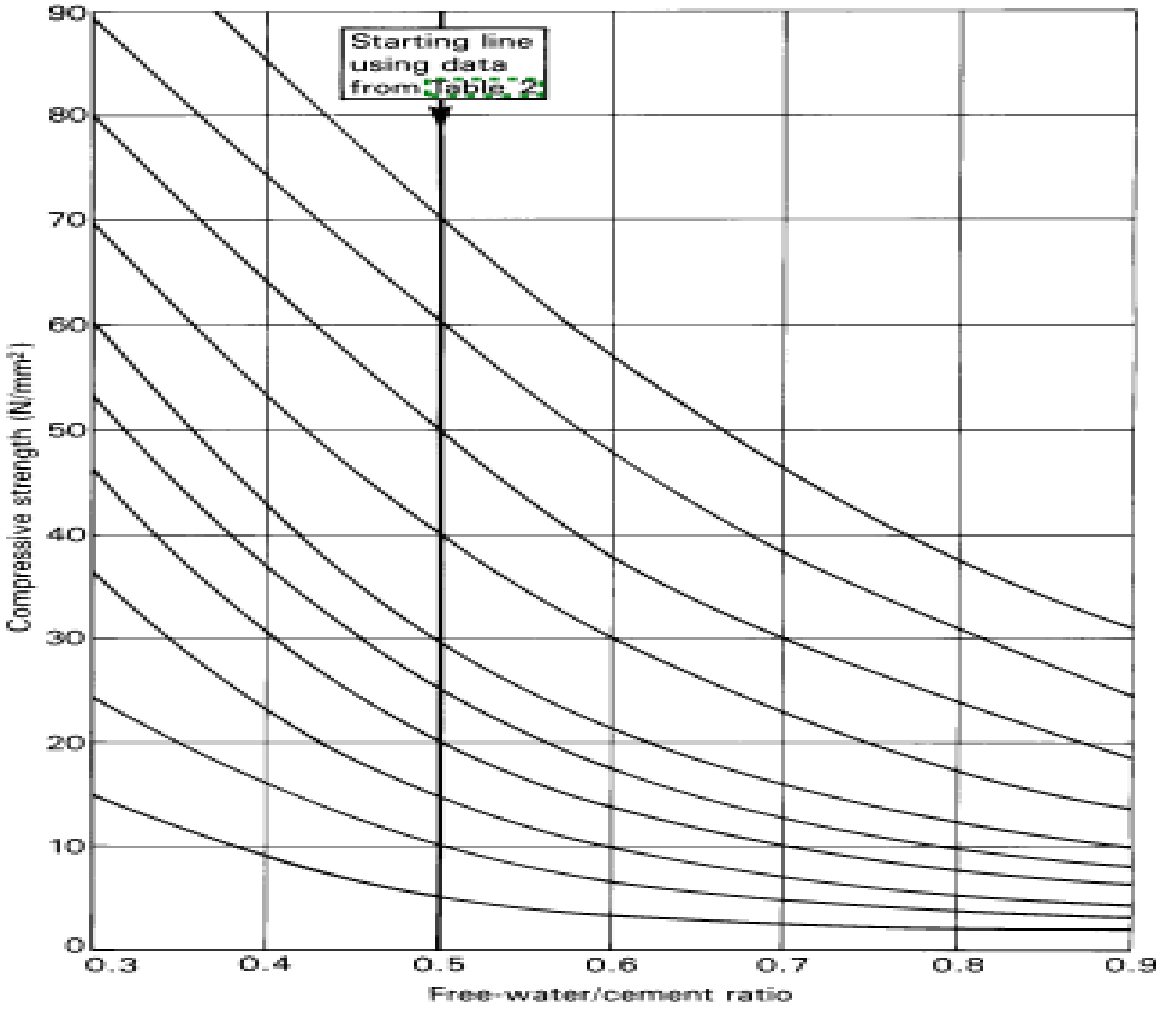

Figure 4: Relationship between compressive strength and free water/cement ratio

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:

$$^2/_3\ W_f + {}^1/_3\ W_c$$

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

Table 4: Minimum cement content (kg/m^3) for various exposure conditions of concrete.

Concrete structure exposure	Reinforced concrete Minimum aggregate size (mm)			Non-reinforced concrete Maximum aggregate size (mm)		
	40	20	10	40	20	10
Mildly-protected from the heat and exposed to little rain, except for short periods of time while under construction.	220	250	290	200	220	270
Intermediate-sheltered from the rain and mid-water reservoir for long periods of time. Concrete used for structures immersed in the water.	260	290	340	220	250	300
Aggressive-exposure to sea water, rain and direct sun and so forth interchangeably.	320	360	410	270	310	360

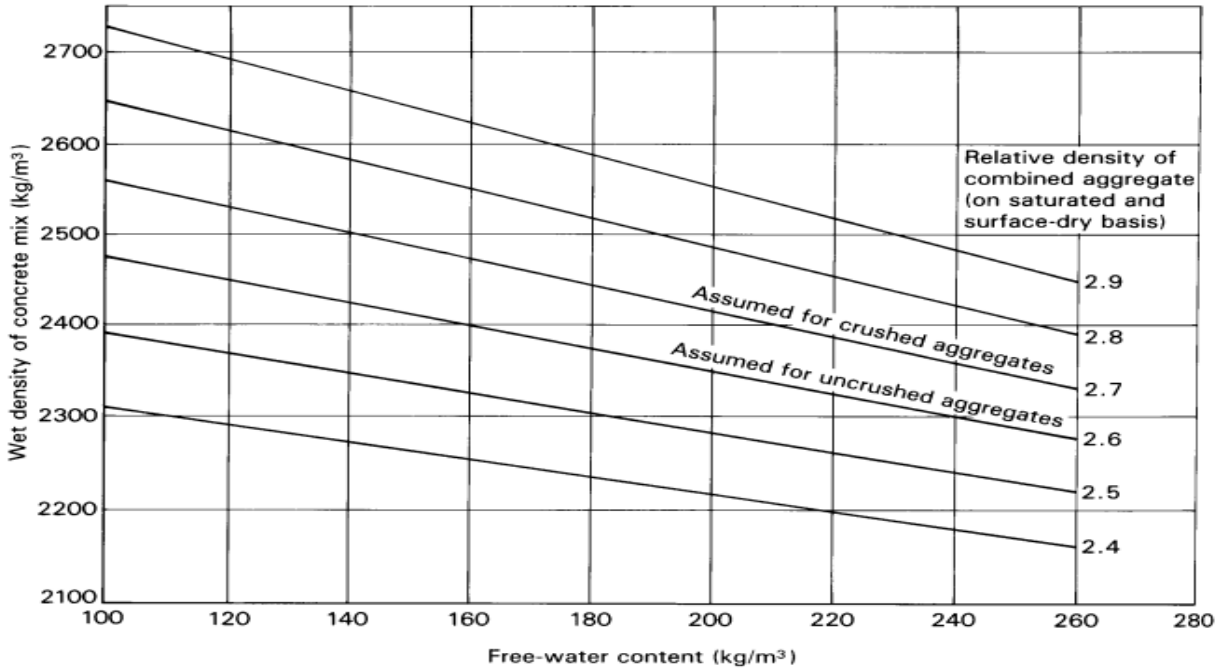

Figure 5 Estimated wet density of fully compacted concrete

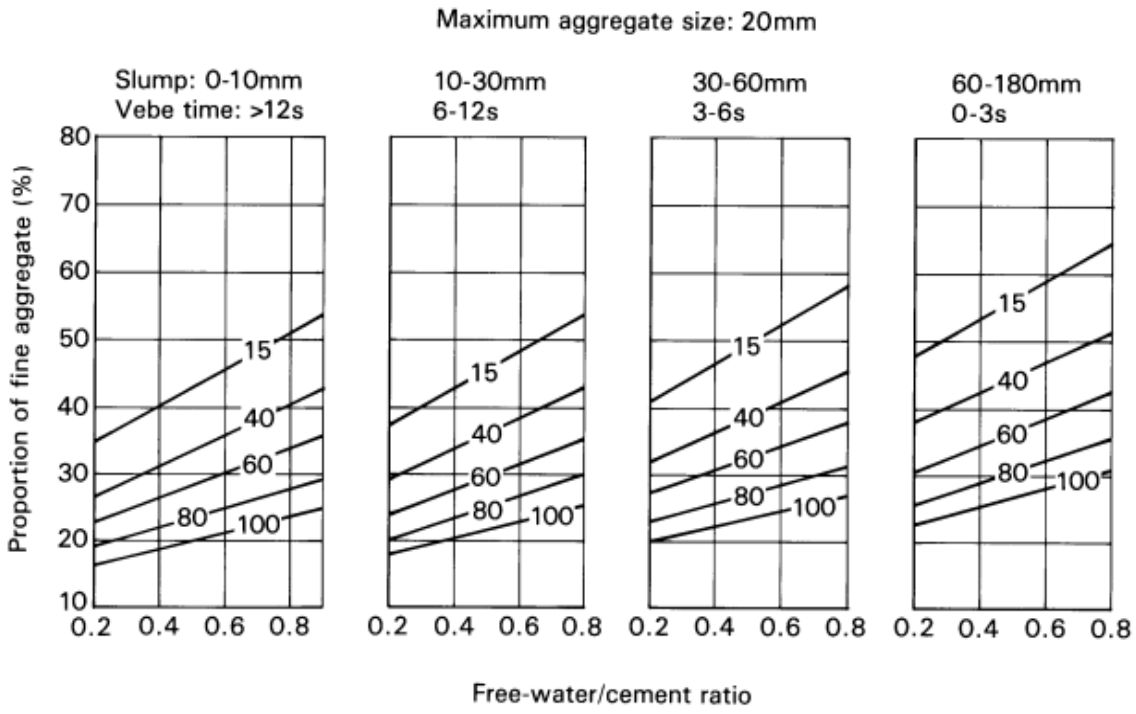

Figure 6 (continued)