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BBA in TM, 3rd Sem. **05 December, 2023 (Morning)**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM	: FINAL EXAMINATION	WINTER SEMESTER	: 2022-2023
COURSE NO	: CEE 4361	TIME	: 3 Hours
COURSE TITLE	: Civil and Environmental Technology I	FULL MARKS	: 150

There are 7 (SEVEN) questions in this question paper. <u>QUESTION 1 AND QUESTION 2 ARE COMPULSORY</u>. Answer any 4 (FOUR) from Question 3 to Question 7.

Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks, CO, and PO. The symbols have their usual meaning.

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1 Concrete mix design is required for a building project based on the following data: CO3 PO3 (60)

Volume ratio of sand to total aggregate = 0.40
FM of fine aggregate = 2.6
FM of coarse aggregate = 6.6
Location of the Project : IUT
Specific gravity of cement = 2.9 (CEM Type II-B/M)
Specific gravity of sand = 2.5
Specific gravity of coarse aggregate = 2.6
Compressive strength (28 days) = 5700 psi
Minimum required slump = 175 mm
Maximum aggregate size = ¾ inch, Coarse aggregate type = Stone chips
Air content in concrete = 2%
Unit weights of cement, sand, and coarse aggregate with void are 1300 kg/m^3, 1350 kg/m^3 and 1450 kg/m^3, respectively.

(assume reasonable data if any information is missing)

The following graphs are provided :

- Variation of compressive strength (28 days) with W/C (Fig. 1),
- Variation of cement content with compressive strength (28 days) for different aggregate size and slump value (Fig. 2).

(i) Calculate the unit contents of cement, sand, coarse aggregate, and water in concrete (in kg/m^3).
(ii) Prepare a mixture proportion table. Typical form of mixture proportion table is attached (Table 1).
(iii) Calculate the unit weight of concrete.
(iv) Calculate the volume ratio of the mix.

(v) Calculate the cost of concrete for one cubic meter. Assume the cost of 50 kg of cement is Tk. 500, cost of 1 m^3 of sand is Tk. 1767, cost of 1 m^3 of stone chips is Tk. 8834, and cost of 100 kg of water is 10 Tk.

(vi) Determine the volume fractions that will be occupied by cement, water, sand, and coarse aggregate in one cubic meter of concrete.

(vii) Calculate the compaction factor of the mix. What does it signify?

(viii) What changes in the mix design would you recommend if the target compressive strength is not achieved with the mix? (Answer in words, calculation is not necessary.)

(ix) In summer, the slump is found to be 80 mm during a trial of the proposed mix. Mention two measures that can be taken during mixing to achieve the minimum required slump without compromising the long-term strength requirement.

2 Two sand samples were collected for a construction project from the local market. The sieve analysis data of the samples are summarized below: CO2 PO2 (10)

ASTM Sieve	Amount Retained (g)	
	Sand 1	Sand 2
3 inch	0	0
1.5 inch	0	0
1.06 inch	0	0
¾ inch	0	0
½ inch	0	0
3/8 inch	0	0
#4	0	0
#8	160	30
#12	170	45
#16	5	100
#30	5	70
#40	5	70
#50	40	80
#100	40	70
#200	45	10
Pan	40	20

(i) Calculate the FM for the samples,

(ii) Draw the grading curves for the samples,

(iii) Make a brief discussion on the FM and grading curves of the samples based on technical perspective.

Questions 3–7 are mapped with CO1 and PO1 (Answer any four).

3 (a) Explain with figures how yield strength can be determined for relatively low-grade steel (e.g, $f_y \leq 60$ ksi) and high-grade steel (e.g, $f_y \geq 75$ ksi). (8)

(b) Compare flash setting and false setting. How can these types of setting be controlled? (4)

(c) Write down three advantages of Hoffman's kiln burning process over clamp burning. (4)

(d) Compare briefly among Third Class brick, Picked Jhama brick, and Jhama brick. (4)

4 (a) Metal B has more modulus of toughness than metal A, but has less modulus of resilience than A. Draw qualitative stress-strain curves for A and B in a single figure. (4)

(b) Why is drying required prior to the burning process during brick production? (4)

(c) What are the four major minerals present in cement clinker? Which one do you think is the major contributor to the early strength of concrete/ mortar, and why? (4)

(d) Write down three benefits of using mineral admixtures in cement. Give an example of a mineral admixture with pozzolanic property. (4)

(e) Compare between self-compacting concrete and roller compacted concrete, and between retarder and accelerator. (4)

5 (a) Briefly discuss about the chloride induced corrosion and carbonation induced corrosion of steel in concrete. Write down the corrosion reactions (including cathodic and anodic). (8)

(b) "Bond strength between concrete and steel is less for the top steel bars compared to the bottom steel bars." – Why? (4)

(c) Compare drying shrinkage and autogenous shrinkage. How does rate of hydration influence autogenous shrinkage and drying shrinkage? (4)

(d) Mention two measures that can be taken to mitigate each of the following problems: (4)

(i) Bleeding in fresh concrete,
(ii) Fast setting of concrete in hot weather.

6 (a) Discuss the importance of seasoning of timber. How does moisture content influence the strength and elastic modulus of timber? (4)

(b) Compare briefly among plywood, laminated board, and fiber board. (4)

(c) Discuss the manufacturing process of natural rubber. What is vulcanization of rubber? (4)

(d) Briefly discuss the applications of rubber stopper and carbon fiber-reinforced polymer (CFRP). (4)

(e) Compare between thermo-setting plastic and thermo-plastic. (4)

7 (a) Briefly compare among whitewash, emulsion paint, and weather coat. Which one will provide better resistance against penetration of water? Why? (4)

(b) What are the roles of vehicles in paint and driers in varnish? (4)

(c) Briefly discuss the electroplating process with a diagram. Why is it better than hot dipping? (4)

(d) Explain with figure how water molecules are bonded together with hydrogen bond. (4)

(e) Calculate atomic packing factor for face centered cubic unit cell. (4)

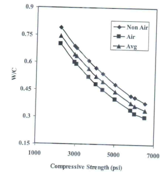

Fig. 1 W/C versus Compressive Strength (aggregate type = stone chips)

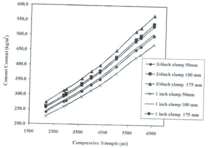

Fig. 2 Cement Content versus Compressive Strength (aggregate type = stone chips)

Table 1. Mixture Proportion of Concrete

W/C	s/a	Maximum Aggregate Size	Slump	Air Content	Unit Contents (kg/m^3)			
%	%	mm	cm	%	C	W	FA	CA

Table 2. Sieve Sizes

Traditional American and British Sieve Sizes

Aperture mm or μm	Approximate Imperial equivalent in.	Previous designation of nearest size BS	ASTM
125 mm	5	—	5 in.
106 mm	4.24	4 in.	4.24 in.
90 mm	3.5	$3\frac{1}{2}$ in.	$3\frac{1}{2}$ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	$2\frac{1}{2}$ in.	$2\frac{1}{2}$ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.
37.5 mm	1.50	$1\frac{1}{2}$ in.	$1\frac{1}{2}$ in.
31.5 mm	1.25	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	$\frac{7}{8}$ in.	$\frac{7}{8}$ in.
19.0 mm	0.750	$\frac{3}{4}$ in.	$\frac{3}{4}$ in.
16.0 mm	0.625	$\frac{5}{8}$ in.	$\frac{5}{8}$ in.
13.2 mm	0.530	$\frac{1}{2}$ in.	0.530 in.
11.2 mm	0.438	—	$\frac{7}{16}$ in.
9.5 mm	0.375	$\frac{3}{8}$ in.	$\frac{3}{8}$ in.
8.0 mm	0.312	$\frac{5}{16}$ in.	$\frac{5}{16}$ in.
6.7 mm	0.265	$\frac{1}{4}$ in.	0.265 in.
5.6 mm	0.223	—	No. $3\frac{1}{2}$
4.75 mm	0.187	$\frac{3}{16}$ in.	No. 4
4.00 mm	0.157	—	No. 5
3.35 mm	0.132	No. 5	No. 6
2.80 mm	0.111	No. 6	No. 7
2.36 mm	0.0937	No. 7	No. 8
2.00 mm	0.0787	No. 8	No. 10
1.70 mm	0.0661	No. 10	No. 12
1.40 mm	0.0555	No. 12	No. 14
1.18 mm	0.0469	No. 14	No. 16
1.00 mm	0.0394	No. 16	No. 18
850 μm	0.0331	No. 18	No. 20
710 μm	0.0278	No. 22	No. 25
600 μm	0.0234	No. 25	No. 30
500 μm	0.0197	No. 30	No. 35
425 μm	0.0165	No. 36	No. 40
355 μm	0.0139	No. 44	No. 45
300 μm	0.0117	No. 52	No. 50
250 μm	0.0098	No. 60	No. 60
212 μm	0.0083	No. 72	No. 70
180 μm	0.0070	No. 85	No. 80
150 μm	0.0059	No. 100	No. 100
125 μm	0.0049	No. 120	No. 120
106 μm	0.0041	No. 150	No. 140
90 μm	0.0035	No. 170	No. 170
75 μm	0.0029	No. 200	No. 200
63 μm	0.0025	No. 240	No. 230
53 μm	0.0021	No. 300	No. 270
45 μm	0.0017	No. 350	No. 325
38 μm	0.0015	—	No. 400
32 μm	0.0012	—	No. 450