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B. Sc. Engg. (CEE)/ 4th Sem. 22 February, 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM : MID SEMESTER EXAMINATION SUMMER SEMESTER: 2021-2022
COURSE NO. : CEE 4411 TIME : 1.5 Hours
COURSE TITLE : Engineering Materials and Concrete Technology FULL MARKS: 100

There are 3 (Three) questions. Answer all questions. 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. The sieve analysis data of a sand sample and stone aggregate sample for a construction work are given below: **(36)** (CO2) (PO2)

ASTM Sieve	Sand Material Retained (g)	Stone aggregate Material Retained (g)
3 inch	0	0
1.5 inch	0	0
¾ inch	0	200
3/8 inch	0	950
#4	0	2500
#8	80	900
#12	75	0
#16	0	0
#30	60	0
#40	50	0
#50	60	0
#100	40	0
#200	10	0
Pan	70	50

(i) Calculate the fineness modulus (FM) for the sand and stone aggregate samples,
(ii) Draw the grading curves for the samples in one graph,
(iii) Make a brief discussion on the FM and grading curves,
(iv) If the recommended FM is 2.5 for sand and 6.6 for stone chips, what measures are necessary to improve the grading of the samples?
(v) In what ratio the sand sample is to be mixed with another sand sample of FM = 3.0 to maintain the required FM of 2.5?
(vi) Refer to the following data related to a sample of brick aggregate:

Weight of OD sample = 1250 g; Weight of SSD sample = 1380 g; Weight of the SSD sample in water = 700 g; Unit weight of OD sample = 1250 kg/m^3

Calculate the following:

a) Absorption capacity (in %),
b) Bulk specific gravity (SSD basis),
c) Void (in %) in the sample.

2. Mixture proportion of mortar is necessary for plastering work of a brick wall of 25 ft long and 10 ft height. The following data are provided: **(32)** (CO3) (PO3)

S/C (weight ratio) = 2.5:1; W/C (weight ratio) = 1:2; Specific gravity of cement = 3.0; Specific gravity of sand = 2.5; Air content = 1.5%; Mortar thickness = 1 inch.

(i) Calculate the unit contents of sand, cement, and water,
(ii) Calculate the cost of materials for 1 cubic meter of mortar (assume cost for 1 cft of sand = 50 TK, cost for 1 bag of cement = 500 TK, cost for 100 liters of water = 10 TK),
(iii) Calculate the unit weight of mortar,
(iv) Estimate the amount of each ingredient of mortar necessary for the plastering work of both surfaces of the wall. Assume 10% extra volume of material is necessary due to the loss of mortar during application on the wall,
(v) If there is 5% (by weight) surplus amount of water (in addition to SSD) in sand, how it should be adjusted with the mixing water of mortar?
(vi) Calculate the volumetric ratio of cement to sand. Assume unit weight of cement = 1400 kg/m^3 and unit weight of sand = 1350 kg/m^3,
(vii) Calculate compaction factor,
(viii) Discuss some defects that may appear on the plaster work if sea sand and sand with excessive dust particles are used for the preparation of mortar,
(ix) If the cement contains significant amount of free lime, what kind of defect you may see on the plaster work? Why?
(x) Propose three measures that can be taken to increase the compressive strength of the mortar.

3. **(a)** Why is the apparent specific gravity of a material typically greater than its bulk specific gravity? Aggregates X and Y have same void (%), but the unit weight of Y is higher than that of X. Are the specific gravities of X and Y same? If not, which one has higher specific gravity? **(5)** (CO1) (PO1)

(b) Draw qualitative stress-strain curves for low-alloy steel bar with relatively low strength grade (i.e., $f_y \leq 60$ ksi) and carbon-steel bar with relatively high strength grade (i.e., $f_y \geq 75$ ksi). Comment briefly on the ductility, yield plateau, **(8)** (CO1) (PO1) ultimate strength, weldability and corrosion resistance of these two types of steel.

(c) "Around 1 lb of CO_2 is produced during 1 lb of Portland cement production" – justify. (4) (CO1) (PO1)

(d) What is unsoundness of cement? How can high contents of MgO and $CaSO_4.2H_20$ cause unsoundness? (5) (CO1) (PO1)

(e) Why are alkalis and iron pyrites not desirable in the clay used to produce brick? (6) (CO1) (PO1)

(f) Compare briefly among CEM I, CEM II/B-M and CEM V/B. Which type of cement is more environmentally friendly? (4) (CO1) (PO1)

Tabl 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