Key มกค 60.

King Mongkut's University of Technology Thonburi

Midterm Examination

Semester 1 Academic Year 2017

CVE 335 Cement and Concrete Materials — 3rd Year International Program
Date of Examination: October 2nd, 2017 — Time 9.00-12.00 AM.

Instruction:

1. There are 5 questions in 13 pages (including this page). Full mark is 100 marks.
2. Write your name at all pages and answer all questions in the examination paper. If the provided space is not enough, use the back side of the paper.
3. The use of calculator is allowed but the student is NOT allowed to bring any book or note into the examination room (close-book exam).

Examiners : Dr. Raktipong Sahamitmongkol
Tel. 02-470-9312

This examination paper has been approved by the Department of Civil Engineering

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Assoc. Prof. Dr. Sutat Leelataviwat
Head of the Civil Engineering Department

Student Name:_____**ID. Number**_____

Student Name: _____ **ID. Number:** _____

Question 1: Ingredient for Concrete Production

1.1 Describe differences between Portland cement type I, type III, and type IV. Also state the suitable application for each of them (10 marks)

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1.2 The table shown below presents chemical compositions of five cements; **A, B, C, D, and E.** Identify **Portland cement type I, type IV, and white cement** from these cements. The reasons of selection must be also provided. (10 marks)

CEMENT	Chemical Composition (%)				Blaine Fineness (cm^2/g)
	C_3S	C_2S	C_3A	C_4AF	
A	49	25	12	8	3,000
B	56	15	12	8	4,500
C	25	50	5	12	3,000
D	30	46	5	13	3000
E	51	26	11	1	3,000

Portland Cement Type I is _____.
Reasons:

Portland Cement Type IV is _____.
Reasons:

White Cement is _____.
Reasons:

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1.3 Describe effects of following materials on the properties of concrete.

a) Superplasticizers (5 marks)

b) Sugar (5 marks)

c) Unsound particles (5 marks)

d) Fine aggregates (5 marks)

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Question 2: Flow of mortar

State four factors which influence the flow of mortars and discuss how each of these factors affects the flow of mortar (10 marks).

Factor #1:

Factor #2:

Factor #3:

Factor #4:

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Question 3: True or False

Indicate whether the following statements are "True" or "False" (20 Marks)
For each statement, the score is "+1" if the answer is correct, "-1" if the answer is incorrect, and "0" if no answer is provided. The maximum score is thus "+20" and the minimum is "-20".

_____ 1. Mandatory ingredients to make concrete includes; cement, water, aggregates, and admixtures.

_____ 2. Portland is the name of the most important hydration products when the cement mixes with water.

_____ 3. Presence of silt and clay on the aggregate can improve the properties of concrete

_____ 4. Admixtures are added to the concrete mixture immediately before or during mixing and can affect properties of concrete, accelerate or retard the cement paste.

_____ 5. Workability is the property that determines the ease with which freshly mixed concrete can be placed and finished without segregation. Angular and rough aggregates reduce the workability of the concrete. Large size aggregates increase the workability due to lesser surface area

_____ 6. For a given water content, workability decreases if the concrete aggregates contain an excess of thin particles, flat particles, elongated particles, or flaky particles

_____ 7. Workability of concrete is measured by slump test. It increases by adding, air-entraining agent, superplasticizer, plasticizer or by increasing water-cement ratio.

_____ 8. Decreasing water-cement ratio has adverse effect on durability, freeze/thaw resistance, wear resistance, and strength of the concrete

_____ 9. The hydraulic cement hardens under water, comprises of silicates (SiO_2) aluminates (Al_2O_3) of lime.

_____ 10. Pozzolanic cement is produced from active silica (SiO_2) and alumina (Al_2O_3) in the volcanic ash and the tiles combined with the lime

_____ 11. Portland cement is made of calcareous material, such as limestone or chalk, and from alumina and silica such as clay or shale

_____ 12. To obtain cement dry powder, lime stones and shales or their slurry is burnt in a rotary kiln at a temperature around 1400 0C to form clinkers, then before cooling the clinker, gypsum is added to adjust the setting time of cement.

_____ 13. Four major compounds of the cement include: Tricalcium Silicate ($3CaO.SiO_2$) or C_3S, Dicalcium Silicate ($2CaO.SiO_2$) or C_2S, Tricalcium Aluminate ($3CaO.Al_2O_3$) or C_3A and gypsum ($CaSO_4.2H_2O$)

_____ 14. Tetracalcium Aluminoferrite C_4AF is normally present in the largest amounts (45-55%), occurs as small equidimensional colourless grains. C_4AF reacts with water and forms calcium silicate hydrate C-S-H.

_____ 15. Rapid hardening Portland cement (or high early strength cement) develops strength more rapidly than ordinary Portland cement by decreasing the setting time in comparison to the ordinary Portland cement.

_____ 16. White Portland cement is made from raw materials containing a high amount of iron oxide and manganese oxide. It is not liable to cause staining since it has a low content of soluble alkalis. The strength of white Portland cement is usually higher than ordinary Portland cement.

_____ 17. The hydration of cement compounds is exothermic and the main products of hydration are $C_3S_2H_3$, $Ca(OH)_2$ and C_3AH_6 .

_____ 18. The particle size for the sand, silt and clay including sand: 0.07 mm to 4.75 mm, Silt: 0.002 mm to 0.06 mm, and clay particles smaller than 0.002 mm.

_____ 19. Calcium chloride ($CaCl_2$) can accelerate the hydration of the calcium silicates but it is not suggested to be used in reinforced concrete because of the presence of chloride ions in the vicinity of steel reinforcement can cause corrosion on the reinforcement.

_____ 20. Retarders are useful in concreting in hot weather, when the normal setting time is shortened by the higher temperature, and in preventing the formation of cold joints

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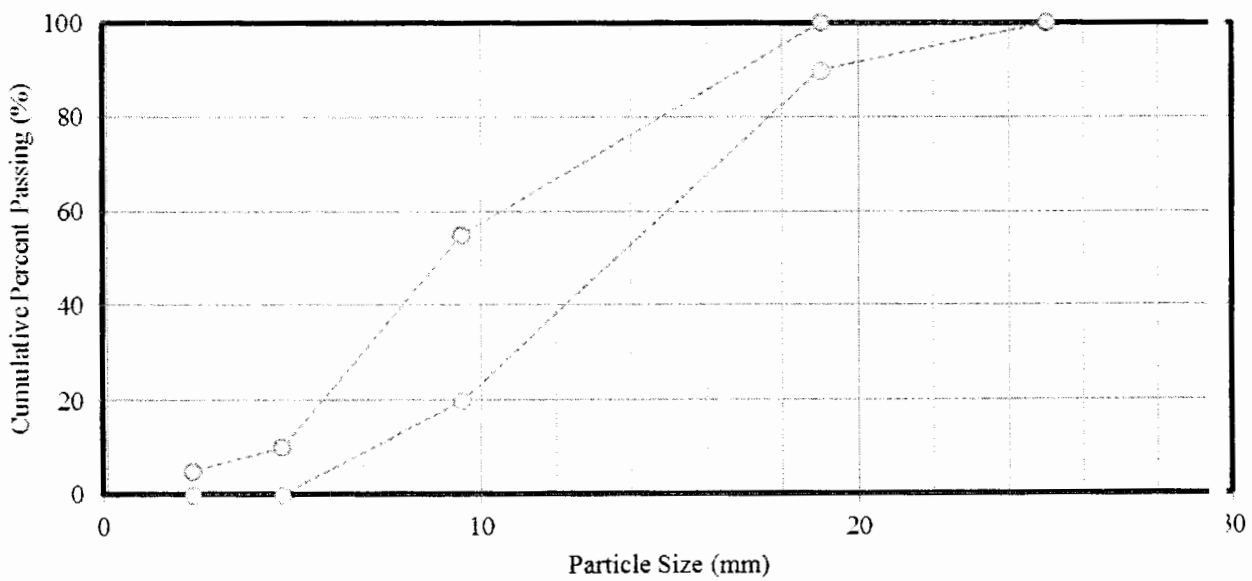
Question 4: Sieve Analysis

The sample of coarse aggregate was tested according to ASTM C136 (Sieve Analysis). The experimental data is given below.

1) Fill the value in the data table below and determine the fineness modulus of the aggregate. (5 marks)
2) Determine if the aggregate complies with the standard grading of coarse aggregate by comparing grading curve with the standard grading in the graph below. (5 marks)

Sieve No.	Sieve Opening (mm)	Weight of Sieve (g)	Weight of Sieve and Aggregate. (g)	Weight of Retained Aggregate. (g)	Percent Retained (%)	Cumulative Percent Retained (%)	Percent Passing (%)
1"	25.000	210	210				
3/4"	19.000	210	690				
3/8"	9.500	210	2670				
#4	4.750	213	2973				
#8	2.360	215	515				
#16	1.180	220	220				
#30	0.600	215	215				
#50	0.300	220	220				
#100	0.150	236	236				
Pan	-	249	249				
Weight Summation of Retained Aggregate (g):				6000			
Original Weight of Aggregate Sample (g):				6000	**Fineness Modulus** =		



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Question #5: Mix Design of Concrete (20 marks)

Design the mix proportion (by ACI method) of concrete for use in reinforced concrete structure of a new KMUTT dormitory located at Ratchaburi campus (20 Points)

The specification of concrete are as follows :

- Compressive strength of concrete at 28 days of 30 MPa
- Slump of fresh concrete between 20 – 80 mm.

The properties of the materials used in the concrete mixture are as follows :

- Portland cement type I with specific gravity of 3.14
- Coarse aggregate with maximum size of 20 mm, specific gravity (SSD) of 2.71, water absorption of 0.52%, dry compacted weight of 1600 kg/m^3, and water content of 2%.
- Fine aggregate with fineness modulus of 2.60, specific gravity of 2.55 (SSD), water absorption of 1.0%, and water content of 6%.

Table 1 – Slump of concrete for construction work

Type of Work	Slump (mm)
Reinforced Concrete Foundation	20-80
Plain Concrete Foundation, Caisson, Retaining Wall	20-80
Beam and Reinforced Concrete Wall	20-100
Column	20-100
Slab and Road slab	20-80
Mass Concrete	20-80

Table 2 – Water content, air content for specified slump and maximum coarse aggregate.

Workability and Air Content	Water (kg/m^3)							
	Maximum size of coarse aggregate (mm)							
	10	12.5	20	25	40	50	75	150
Slump (mm)	Concrete without air entraining agent							
30-50	205	200	185	180	160	155	145	125
80-100	225	215	200	195	175	170	160	140
150-180	240	230	210	205	185	180	170	-
Air Content (%)	3.0	2.5	2.0	1.5	1.0	0.5	0.3	0.2
Slump (mm)	Concrete with air entraining agent							
30-50	180	175	165	160	145	140	135	120
80-100	200	190	180	175	160	155	150	135
150-180	215	205	190	185	170	165	160	-
Air Content (%) for exposure of								
- Not severe	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
- Moderate	6.0	5.5	5.0	4.5	4.5	4.0	3.5	3.0
- Severe	7.5	7.0	6.0	6.0	5.5	5.0	4.5	4.0

Table 3 – Relationship between water to cementing material ratio and compressive strength of concrete (using standard cylinder)

Compressive Strength at 28 Days (MPa)	Water to Cement (by Weight)	
	Concrete without Air Entrainment	Concrete with Air Entrainment
45	0.38	-
40	0.43	-
35	0.48	0.40
30	0.55	0.46
25	0.62	0.53
20	0.70	0.61
15	0.80	0.71

Table 4 – Maximum W/C for concrete in sulfate environment

Type of Structures	Wet concrete and Freezing and Thawing^{+}	Concrete in marine environment or in sulfate*
Thin structure and the concrete covering is less than 25 mm	0.45	0.40*
Other Structures	0.50	0.45*

Note : + For concrete with air entrainment agent
* For Portland cement type II or V, the W/C can be increased 0.05.

Table 5 – The ratio of coarse aggregate to total volume of concrete

Maximum Size (mm)	Volume of coarse aggregate in dry condition with fully compacted For sand which have different fineness modulus			
	F.M. = 2.40	F.M. = 2.60	F.M. = 2.80	F.M. = 3.00
10	0.50	0.48	0.46	0.44
12.5	0.59	0.57	0.55	0.53
20	0.66	0.64	0.62	0.60
25	0.71	0.69	0.67	0.65
40	0.75	0.73	0.71	0.69
50	0.78	0.76	0.74	0.72
75	0.82	0.80	0.78	0.76
150	0.87	0.85	0.83	0.81