CONCRETE TECHNOLOGY LABORATORY

DEPARTMENT OF CIVIL ENGINEERING
CHULALONGKORN UNIVERSITY

Tested by ..... ID No. .....
Date ..... Graded by .....

TEST No. C-5

PROPERTIES OF FRESH CONCRETE (II)

Part A Unit Weight and Air Content (Gravimetric) of Fresh Concrete

Objective — To determine the unit weight and amount of air content of freshly mixed concrete by weight analysis.

Material — Freshly mixed concrete at least 2 different mixes (The mix design condition may be given by the instructor).

References — ASTM Designation : C 138
BS (British Standard) 1881
JIS (Japan Industrial Standard) A 1116

Apparatus — (1) Concrete container : metal cylinder with appropriate size, watertight and adequate strength.
(2) Balance with appropriate sensibility
(3) Tamping Rod
(4) Vibrator

Nominal Size of Coarse Aggregate		Capacity of Measure	
In	mm	ft^3	Litre
1	25.0	0.2	6
1.5	37.5	0.4	11
2	50.0	0.5	14
3	75.0	1.0	28
4.5	112.0	2.5	70
6	150.0	3.5	100

Procedures

1. Determine the capacity of the container, V_c by accurately weighing the weight of water required for filling the container. Pour water until it overflows a little, then put a polished glass on the container to remove excessive water. At this time no bubbles shall be seen under the glass plate. The capacity of the container shall be calculated by dividing the weight of water by the density of water.

2. Place the sample in the container to a depth approximately one third of the depth. Evenly plunge the tamping rod into the sample by the appropriate number of time[1]. Then tap the outside of the container 10 to 15 times with a wooden hammer.

3. Add the sample to the depth approximately two-third, and repeat the compaction procedure[2]. Lastly place the sample to the extend it overflows a little, repeat the compaction and level the surface by removing excessive sample with a metal rule.

4. Remove the adhered to the outside of the container, then determine the weight of the sample in the container, W_c.

5. If the vibrator is used for the compaction process, fill the container with two layers of concrete sample. Each layer have to be vibrated until the large bubbles is disappear. After finishing the compaction of the upper layer, level the surface by removing excessive sample with a metal rule.

6. The unit weight of concrete, W_u and the amount of air content, A (%) can be calculated as follows:

$$W_u = \frac{W_c}{V_c}$$

$$A = \frac{(\frac{W}{V}) - W_u}{(\frac{W}{V})} * 100$$

where W is total weight of concrete material per 1 m^3 (kg) and V is the total absolute volume of concrete material per 1 m^3 which can be obtained by dividing their respective weight (kg) by their respective specific gravity (Test No. C-1, C-2 and C-3) multiplied by 1000.

[1] 10 times for the container with inside diameter of 14 cm.
25 times for the container with inside diameter of 24 cm. 50 times for the container with inside diameter of 35 cm.

[2] The depth of plunging the tamping rod into the sample shall approximately be the thickness of each layer of the sample.

Part B Bleeding of Concrete

Objective — To determine the relative quantity of mixing water that will bleed from a sample of freshly mixed concrete.

Material — Freshly mixed concrete.

References — ASTM Designation : C 232
JIS (Japan Industrial Standard) A 1123

Apparatus —
(1) Container : A metal container of approximately ½ ft^3 capacity having an inside diameter of 10 ± ¼ in (254 ± 6.4 mm) and an inside height of 11 ± ¼ in (279 ± 6.4 mm)
(2) Balance which sufficient capacity to determine the mass of the load required with an accuracy of 0.5%
(3) Glass Graduate approximately 100 ml capacity.
(4) Pipet
(5) Tamping Rod

Significance and Use

1. This test method provides procedures to be used for determining the effect of variables of composition, treatment, environment or other factors in the bleeding of concrete. It may also be used to determine the conformance of a product or treatment with a requirement relating to its effect on bleeding of concrete.

2. For a sample consolidated by rodding only and tested without further disturbance, thus simulating conditions in which the concrete, after placement, is not subjected to intermittent vibration.

3. For a sample consolidated by vibration and tested without further intermittent period of vibration, thus simulating conditions in which the concrete, after being placed, is subjected to intermittent vibration.

Procedures

1. Place the sample in the container to a depth approximately one third of the depth. Evenly plunge the tamping rod into the sample by 25 times. Then tap the outside of the container 10 to 15 times with a wooden hammer.

2. Add the sample to the depth approximately two-third, and repeat the compaction procedure. Lastly place the sample to the top layer, repeat the compaction. Level the top surface to a reasonably smooth surface by a minimum amount of troweling. The top surface should be 3 ± 0.3 cm below the edge of the container when leveled.

3. Immediately after troweling, record the time and ambient temperature. Determine the mass of the container and its content. Place the specimen on a level platform or floor free of vibration and cover the container to prevent evaporation of the bleed water.

4. Draw of the water that has accumulated on the surface by pipet at 10 min intervals for the first 40 min and at 30 min intervals thereafter until cessation of bleeding. To Facilitate the

collection of bleeding water, tilt the specimen carefully by placing a block approximately 2 in (50 mm) thick under one side of the container 2 min prior to each time the water is withdrawn.

5. After each withdrawal, transfer the water to glass graduate through the filter paper in order to exclude the material present other than water. Record the accumulated quantity and the weight of water after each transfer.

6. Calculate the volume of bleeding water per unit area of surface, V as follows:

$$V = \frac{V_b}{A}$$

where V_b is volume of bleeding water measured during the selected time interval, ml and A is the area of exposed concrete.

7. Calculate the accumulated bleeding water, expressed as a percentage of the net mixing water contained within the test specimen as follows:

$$\text{Bleeding} = \frac{WD}{wS} * 100$$

where W is total weight of the batch (kg), D is weight of bleeding water (g), w is net mixing water (kg) and S weight of the sample (g)

Part C Time of Setting of Concrete Mixtures by Penetration Resistance

Objective — To determine the time of setting of concrete with slump greater than zero by means of penetration resistance.

Material — Freshly mixed concrete.

Reference — ASTM Designation : C 403

Apparatus —
(1) Container for mortar specimens : The minimum lateral dimension shall be 6 in (152 mm) and the height at least 6 in.
(2) Penetration Resistance Apparatus[3]
(3) Tamping Rod
(4) Pipet

[3] Spring reaction-type or hydraulic reaction-type with removable needles of 645, 323, 161, 65, 32 and 16 mm^2. Each needle shank shall be scribe peripherally at a distance 1 in (25 mm) above the bearing face.

Significance and Use

1. Since the setting time of concrete is a gradual process, any definition of time of setting must necessarily be arbitrary. In this test method, the times required for the mortar to reach specificed values of resistance to penetration are used to define times of setting.

2. This test method can be used to determine the effects of variables, such as brand, type and content of cementatious material, water content, and admixtures, upon the time of setting of concrete. This test method may also be used to determine compliance with specified time of setting requirements.

3. This test method may also be applied to prepared mortars and grouts. However, when the setting time of concrete is desired, the test shall be performed on mortar sieved from the concrete mixture and not on a prepared mortar intended to simulate the mortar fraction of the concrete; it has been shown that the initial and final setting times may be increased when using the prepared mortar.

Procedures

1. Obtain the representative sample of fresh concrete with sufficient volume of mortar to fill the test container to the depth at least 5½ in[4]. Determine and record the slump. The ambient temperature and humidity should also be recorded.

2. Remove essentially all of the mortar from the sample of concrete by sieving it through a No.4 (4.75 mm) sieve onto a nonabsorbent surface.

3. Thoroughly remix the mortar by hand. Place the mortar into the container by using a single layer. Consolidate the mortar to eliminate air pockets in the specimen by rod the mortar once for each 1 in^2 (645 mm^2) of top surface area of the specimen and distribute the strokes uniformly over the cross section of the specimen and level the top surface. The mortar surface shall be at least ½ in (13 mm) below the top edge of the container.

4. Remove the bleeding water from the surface of the mortar specimen prior to make a penetration test by means of pipet or suitable instrument.

5. Insert a needle of appropriate size, depending upon the degree of setting of the mortar, in the penetration resistance apparatus and bring the bearing surface of the needle into contact with the mortar surface.

6. Gradually and uniformly apply a vertical force downward on the apparatus until the needle penetrates the mortar to a depth of 1 in (25 ± 1.5 mm) as indicated by the scribe mark with in 10 ± 2 sec. Record the force required.

7. Calculate the penetration resistance by dividing the recorded force by the bearing area of the needle. In subsequent tests take care to avoid areas where the mortar has been disturbed by previous tests. The clear distance between needle impressions shall be at least two diameters of the needle being used, but not less than ½ in (13 mm). The clear distance between any needle impression and the side of the container shall be not less than 1 in (25 mm).

8. Prepare a graph of penetration resistance as the ordinate versus elapsed time as abscissa. The graph may be prepared by either normal scale or log-log scale. By fitting a smooth curve, determine the initial setting and final setting. The time of initial setting and final setting

[4] At least one specimen for each mix proportion.

are defined as the time when the penetration resistance reach 500 psi (3.5 MPa) and 4000 psi (27.6 MPa) respectively.

9. Not less than six penetration resistance determinations shall be made in each time of setting test and the time interval between penetration resistance determinations shall be such as to give a satisfactory curve of penetration resistance versus elapsed time.

Sketch all necessary figures about the test

Experimental Data and Results

Specific gravity of cement	
Specific gravity of coarse aggregate	
Specific gravity of fine aggregate	
Volume of concrete container	

Weight (kg/m^3)	Mix No. 1	Mix No. 2	Mix No. 3
Coarse aggregate			
Fine aggregate			
Cement			
Water			
S/A			
w/c			
Admixture			

Part A Unit Weight and Air Content (Gravimetric) of Fresh Concrete

Weight	Mix No.1		Mix No.2		Mix No.3	
	1	2	1	2	1	2
Container						
Concrete + container						
Concrete						
Concrete material, W						
Absolute volume, V						
Unit weight, W_u						
Air content (%)						
Average unit weight						
Average air content						

Part B Bleeding of Concrete

Mix No. 1					Mix No. 2					Mix No. 3				
Weight of sample (g)					Weight of sample (g)					Weight of sample (g)				
Ambient temperature (^{o}C)					Ambient temperature (^{o}C)					Ambient temperature (^{o}C)				
Time (min)	Volume (ml)	Weight (g)	V (ml/cm^2)	Bleeding (%)	Time (min)	Volume (ml)	Weight (g)	V (ml/cm^2)	Bleeding (%)	Time (min)	Volume (ml)	Weight (g)	V (ml/cm^2)	Bleeding (%)
Bleeding water per unit surface area (ml/cm^2)					Bleeding water per unit surface area (ml/cm^2)					Bleeding water per unit surface area (ml/cm^2)				
Bleeding (%)					Bleeding (%)					Bleeding (%)				

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Part C Time of Setting of Concrete Mixtures by Penetration Resistance

Mix No. 1				Mix No. 2				Mix No. 3			
Weight of sample (g)				Weight of sample (g)				Weight of sample (g)			
Relative humidity (%)				Relative hunidity (%)				Relative humidity			
Ambient temperature (^{o}C)				Ambient temperature (^{o}C)				Ambient temperature (^{o}C)			
Time (min)	Force (N)	Bearing area (mm^2)	Resistance (MPa)	Time (min)	Force (N)	Bearing area (mm^2)	Resistance (MPa)	Time (min)	Force (N)	Bearing area (mm^2)	Resistance (MPa)
Time of initial setting (min)				Time of initial setting (min)				Time of initial setting (min)			
Time of final setting (min)				Time of final setting (min)				Time of final setting (min)			

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Discussion and Conclusion

Summary of Results

	Mix No. 1	Mix No. 2	Mix No. 3
Unit weight (kg/m^3)			
Air content (%)			
Bleeding water per unit surface area (ml/cm^2)			
Bleeding (%)			
Time of initial settimg (min)			
Time of final setting (min)			