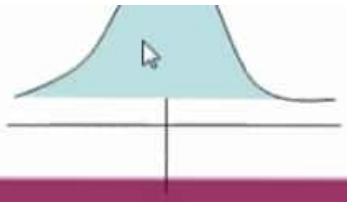
Experiment No.	13	ACI	211

TITLE	
	Concrete Mix Design

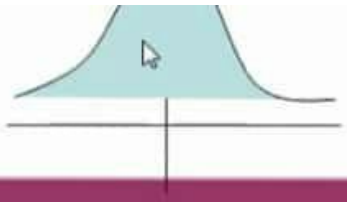
Design Data		
Minimum Compr. Strength	200 Kg/cm^2 at 28 days	Assumed for required work
Standard Deviation	20 Kg/cm^2	Assumed
S.G. of CA	2.68	Previous Experiment
Dry rodded density	1600 Kg/cm^2	Previous Experiment
G_{max}	25 mm	Previous Experiment
S.G. of FA	2.64	Previous Experiment
FM of FA	2.80	Previous Experiment
Slump	50 mm	Previous Experiment
Cement used	OPC	Assumed

CALCULATION



$S_{av} = S_{min} + K\sigma$ If 1% result is allowed to fall below below minimum K = 2.33	T-11.3
w/c ratio [regards to strength] w/c ratio [regards to durability] Minimum of above two	F-11.3 T-11.5
Based on slump & G_{max} Water = Entrapped air = Cement = Water/w/c ratio	T-11.8
Based on G_{max} & FM of FA Bulk volume of CA per unit volume = Weight of CA = Dry rodded density x Bulk volume	T-11.4

CALCULATION



$S_{av} = S_{min} + K\sigma$ If 1% result is allowed to fall below below minimum K =	T-11.3
w/c ratio [regards to strength] w/c ratio [regards to durability] Minimum of above two slab	F-11.3 T-11.5
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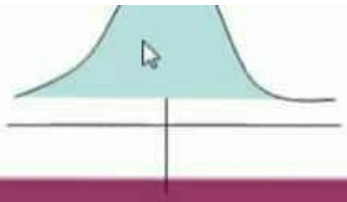
CALCULATION



$S_{av} = S_{min} + K\sigma$ If 1% result is allowed to fall below below minimum K = 1.65	T-11.3
w/c ratio [regards to strength] w/c ratio [regards to durability] Minimum of above two slab	F-11.3 T-11.5
Based on slump & G_{max} Water = Entrapped air = Cement = Water/w/c ratio	T-11.8
Based on G_{max} & FM of FA Bulk volume of CA per unit volume = Weight of CA = Dry rodded density x Bulk volume	T-11.4

CALCULATION

Volume except FA			
C	----kg	----x10^3/3.15	----cm^3
W	----kg	----x10^3/1	----cm^3
CA	----kg	----x10^3/s.g.	----cm^3
Air	----%	----x10^6/100	----cm^3
		Total	----cm^3

Volume of FA	100x100x100 - Total	----cm^3
Weight of FA	---- x s.g./10^3	----kg

CALCULATION

Let surface moisture of FA = 3%		
Free water contribution from FA	(3/100) x wt. of FA	----kg
Actual Water	Weight of W – free water	----kg
Actual FA	Weight of FA + free water	----kg

Final Batch	
Cement	----kg
Fine Aggregate	----kg
Coarse Aggregate	----kg
Water	----kg
Density	----kg/m^3

ASTM	C 192

Making & Curing of test specimen

APPARATUS

- Cylindrical mold [C-31- 6" by 12"]
- Tamping rod
- Vibrator
- Small tools [shovel, trowel, straight edge, scoop, ruler, rubber glove, metal mixing bowl, mallet]
- Slump Apparatus
- Sampling & mixing pan
- Air content Apparatus
- Temperature measuring device
- Concrete mixer

APPARATUS

Cylindrical Mould

Tamping Rod

Vibrator

Shovel

Trowel

Scoop

Mallet

Air Content Apparatus

Concrete Mixer

PREPARATION OF MATERIALS

Temperature

Bring the concrete materials to room temperature 20^0C to 30^0C

Cement

Store in dry place, in moisture proof container. It shall be pass through a 850 µm (# 20) or finer sieve to remove all lumps, remixed on a plastic sheet and returned to sample container

Aggregate

Separate into individual size fractions and for each batch recombine in proper proportions to produce desired grading.
Determine S.G. and Absorption of aggregates.
Aggregates may be brought to and maintained in a SSD condition.
Surface moisture must be determined

PROCEDURE

1. Mixing

Mix concrete of such size as to leave about 10% excess after molding the test specimens

a) Add CA, disperse the admixture in mixing water, add some of the solution
b) Start mixer
c) Add cement, FA and water with mixer running
d) Mix for 3 mins., after all the ingredients are in the mixer
e) 3 mins. rest
f) Again 2 mins. mixing
g) Cover the top or open end to prevent evaporation
h) Deposit mixed concrete in the clean, damp mixing pan and remix by shovel until it appears uniform

PROCEDURE

2. Checking

a) Slump [C143]
b) Air content [C173 or C231]
c) Temperature [C1064]

PROCEDURE

3. Making specimens

a) Mold the specimens as near as possible to the place where they are to be stored
b) Place molds on rigid surface, free from vibration and disturbances
c) Avoid striking, tilting
d) Place the concrete in molds using scoop or shovel with symmetrical distribution

PROCEDURE

4. Consolidation

a) It is done by rodding or external/internal vibration based on slump
b) Place concrete in **3** layers
c) Rod each layer **25** times
d) Distribute the strokes uniformly over the cross section
e) For each upper layer allow the rod to penetrate the layer being rodded approximately **1"**
f) Tap the outsides of the molds lightly **10** to **15** times with mallet [to close the holes left and to release large air bubbles that may have been trapped]

PROCEDURE

5. Finishing

a) Strike off the surface of concrete and trowel it
b) No depressions or projections larger than 3 mm are allowed

Curing of test specimen

Protection

Cover specimen with nonabsorptive, nonreactive plate or sheet of tough, durable and impervious plastic

Removal

Remove the specimens from molds **24±4** hrs. after casting

Environment

a) Unless otherwise specified, specimens shall be cured at **23±2^{0}C** from time to molding until the moment of test
b) Keep the specimens in water storage tank or in a moist room in accordance with **C511**
c) Water should be saturated with **$Ca(OH)_2$**
d) Avoid running water

ASTM	C 143

Standard test method for slump of hydraulic cement mortar

APPARATUS

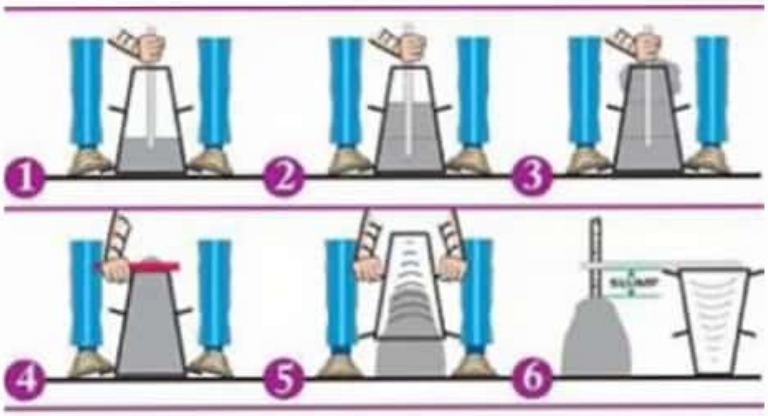
Mould

Metal mould shall not be thinner than **1.5** mm, lateral surface of frustum of cone at base is **200** mm in dia, the top 100 mm in dia, and the height shall be **300** mm

Tamping rod

Round, straight steel rod with 16 mm dia, 600 mm length, having the tamping end or both ends rounded to a hemispherical tip

Slump Test



PROCEDURE

a) Dampen the mould and place it on a flat, moist, non absorbent, rigid surface
b) It shall be held firmly while filling by operator standing on the two foot pieces
c) Immediately fill the mold in **3** layers
d) Rod each layer with **25** strokes uniformly
e) For bottom layer, incline the rod slightly and make half of the strokes near perimeter and then progressively with vertical strokes spirally toward the centre
f) Rod bottom layer for full depth
g) For second and top layer, rod just to penetrate into the underlying layer
h) Strike off the surface of the concrete by rolling motion of tamping rod

PROCEDURE

i) Remove the mold immediately by raising it in vertical direction

j) Raise a distance of 12" in 5±2 sec., by a steady upward lift with no lateral or torsional motion

k) Complete whole task from filling to removal of mold within 2½ min

l) Measure slump by determining the vertical distance between the top of mold and the displaced original centre of the top surface of the specimen

ASTM	C 39

Compressive strength of cylindrical concrete specimens

TESTING MACHINE

The machine must be power operated and must apply load continuously rather than intermittently and without shock

PROCEDURE

a) Compressive test shall be carried as soon as after the specimen is removed from the moist storage
b) Clean the blocks of testing machine and the test specimen
c) Place specimen on lower block
d) Carefully align the axis of specimen with the centre of thrust
e) Adjust the load indicator to zero
f) Apply load continuously without shock
g) Apply load until specimen fails
h) Record maximum load and type of failure

Table 13.1: Stress Calculation

Curing [days]	Sample No.	Load [N]	Area [mm^2]	Stress [MPa]	Average Stress [MPa]	Failure Photo
7	1	????	????	????	Stress = 0.9*Ave. to 1.1*Ave. Then Average or Not Averaged	????
7	2	????	????	????		????
7	3	????	????	????		????