1

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23-04-19

1(A)-Day

MSI

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Aggregate

The inert materials used in the concrete are all as aggregate. It occupies 70-80% in volume of concrete.

Types of aggregate —

2017 1) Fine aggregate :

Sand and suroki are commonly used as fine aggregate. Stone screenings, burnt clays, fly ash are sometimes used as substitute for sand

< 3/16" / 4.76 mm / ASTM #4

American Society for testing materials

→ numbering করে number 4 sip #4

ii) ~~Force~~ মোটা দানা

2017 ii) Coarse aggregate : in Brick wall, ~~Bro~~ Khoa, Brooken stone, ~~gra~~ gravel, ~~bble~~ pebble are used as coarse aggregate.

$\frac{3}{16}''$ < Gravel

$\frac{3}{16}'' \sim 2''$ commonly used = 20 mm

G_{max}

↙

maximum size of aggregate.

size → $(\frac{3}{16}'' - 2'')$ can be more than 2"

Maximum size of coarse aggregate/Gravel,

G_{max} = 20 mm

19.5 mm

$\frac{4}{5}''$

28-04-19

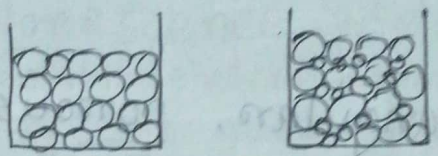
1(D) - Day

2014 * define grading of aggregate

2015 Principal of ~~relation~~ gradation

The principal is that the smaller particles will fill up the empty ~~coarse~~ pores in between lager particles.

Expected



नत

2014
2018 A suitable grading is required for the combined aggregate in ~~the~~ concrete mix due to

i) Secure workability

ii) Economy in cement use

iii) Higher density gather

2014 * What is the purpose of grading sand? How is it carried out?

* ~~What~~ Give specification of good sand
i) It should be passed through 4.76 mm sieve
ii) Fineness Modulus should be 2.50 to 3.50
iii) Silt contents should not be more than 4%
iv) Coarse sand should be either pit sand or river sand or combination of two.

Sand: It is an engineering material ~~me~~ named as fine aggregate. It may be sharp~~ed~~, angular or rounded.

2074 Classification based on source

i) Pit sand
a) sharp, angular, porous
b) free from salts
c) It may contain clay or other impurities
d) Light brown or yellowish ~~yeel y~~ in color
e) suitable for mortar work

ii) River sand
a) Fine, round and polished
b) It contains earthy impurities like gravel, pebble etc.
c) Whitish in color
d) Suitable for plastering work

2017 * Why do we avoid using sea sand in construction?

2014 2015 * Sea sand is not suitable for construction of concrete member with reinforcement - explain

iii) Sea sand

a) fine, round and polished

b) It is the worst among all ~~three~~ these 3 kinds of sand which contains sea salt and absorb moisture from atmosphere, causing permanent dampness and efflorescence. Thereby the work gradually disintigrates. It also contains shells and organic matters which decompose in the body of mortars. Plaster and concrete also reduce their life and strength.

2017 2014 2012 According to size Uses

i) Fine Sand — $< 1/16''$ (#16) — suitable for plastering

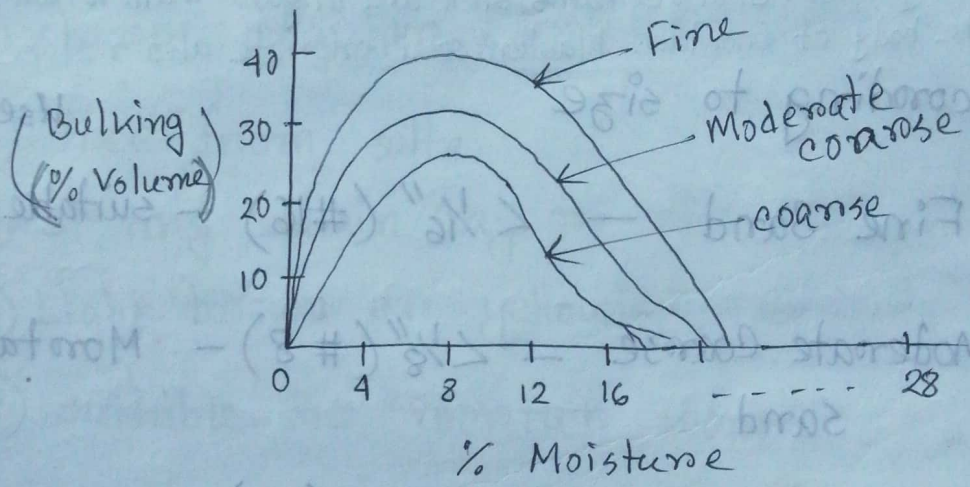
ii) Moderate Coarse sand — $< 1/8''$ (#8) — Mortar

iii) Coarse sand — $< 3/16''$ (#4) — Concrete

2014 Bulking of Sand: The presence of moisture in sand increase its volume. This is due to the fact that a thin film of water is formed around the ~~sun~~ sand ~~goe~~ grains. resulting increase in the volume. This

2015
2014
* Why does fine sand shows higher bulking than that of coarse sand

phenomenon is called bulking of sand. (5 to 8)% of moisture by weight of sand increase ~~about 20~~ the volume about (20 – 30)%



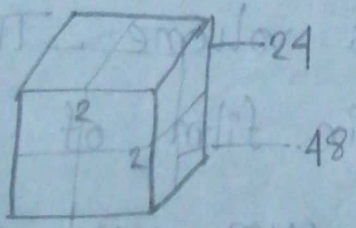
bulking

$$b = \frac{V_m}{V_s} \times 100$$

V_m = Volume of moist sand

V_s = " " fully saturated sand.

b = bulking in percentage.



* Smaller the size of aggregate larger the surface area.

30-04-19

2(A)-Day

2015 * Write down some uses of low FM sand with higher F.M

Numeric value যা বোঝে বোঝানো যায় বস্তু চিকন না বোঝে

2013 Imp.

Fineness Modulus: (FM): Fineness is modulus is an ~~imperical~~ empirical formula obtained by taking the sum of cumulative percentages of weight retained on the standard sieves (3", 1.5", ----, #50, #100) and dividing by 100. The value should be betn 2 to 3.

$$F_{com} = \frac{m_1F_1 + m_2F_2 + \cdots}{m_1 + m_2 + \cdots}$$

$m_1, m_2, \cdots$ = amount of sample 1, 2, 3, ---

$F_1, F_2, \cdots$ = FM of sample 1, 2, ---

F_{com} = Combined Fineness Modulus.

$$R = \frac{F_1 - F_{com}}{F_{com} - F_2}$$ [When compared between 2]

R → Ratio of variety of sand to be mixed with one another

2011 * Explain its significance in sand grading (FM)

Prob The following is the result of sieve analysis of two different sample 1 and 2, 1200 gm each;

Sieve size	wt. retained (1)	wt. retained (2)
3"	0	0
$1\frac{1}{2}$"	0	0
$\frac{3}{4}$"	0	0
$\frac{3}{8}$"	0	0
#4	0	20
#8	50	80
#16	140	220
#50	360	310
#100	650	570

Low FM of sand high absorb moisture

Its ability to absorb the moisture highly

small size large surface area and to increase bulking volume.

Cumulative wt. retained (1)	Cumulative wt. retained (2)	% cumulative wt. retained (1)	% cumulative wt. retained (2)
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	20	0	1.6
0	100	4.17 $\frac{50}{1200}\times 100$	8.83
50	320	15.83 $\frac{190}{1200}\times 100$	26.67
190	630	45.83 $\frac{550}{1200}\times 100$	52.5
550	1200	100	100
1200		165.83	189.6

$$FM(1) = \frac{165.83}{100} = 1.66$$

$$FM(2) = \frac{189.6}{100} = 1.90$$

$$F_{com} = \frac{1.66 \times 1200 + 1.90 \times 1200}{1200 + 1200} = 1.78$$

2012

Surki : It is made by grinding fresh and well burnt bricks.

i) It should be perfectly clean.

ii) Free from foreign matter

iii) Sufficiently fine to pass through #8 sieve.

Uses:

i) Lime mortar

ii) Lime plaster

iii) Lime concrete

2014

Alkali aggregate reaction : Alkali Silica Reaction (ASR): concrete acidic এর (এরজন্য) Alkali

Alkali in concrete + Reactive aggregate → Reacted product

Reacted product + water → Expansion, Crack

↓

~~জল~~ water এর সাথে বিক্রিয়ার ফলাফল না থাকলে ফলাফল হবে।

" " " থাকলে Crack হবে।

~~Water concrete এর কোন বন্ধু আমার প্রবন্ধ~~

Problem :

i) Map Cracking

ii) Strength Reduction

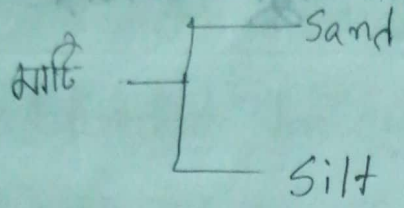
iii) Poor durability

iv) Poor water tightness

durability problem এর জন্য project failure হয়

17-06-19

2(D)-Day



আর্দ্রতা ইটের ওজন = 6 lb

Cft → Cubic fit → $feet^3$

Volume of one brick = $\frac{9.5 \times 4.5 \times 2.75}{12 \times 12 \times 12}$

= 0.06803 ~~cft~~ cft

VolumRoom = $10' \times \frac{10}{12}' \times 30'$

= 250 cft

ইট লাগবে = $\frac{250}{0.06803}$ = 3674.849 টি

1 cft এ ইট সাজায় বাথরুম লাগে ~~২৫~~ ২৫ টে ইট

" " " cement দিয়ে " " ৩২ " "

19-06-19

3(A) - Day

2008

Countermeasure:

New Structure

Alkali in concrete + Reactive aggregate = Reacted product

↑ use of

Low alkali cement

Use of Admixture (GBFS, FA)

↑

Use of non reactive aggregate

Chemical method
Mortar Bar method

} used to reduce reactivity.

GBFS → Granulated Blast ~~Furness~~ Furnace Slag

FA → Fly Ash

Existing Structure

Reacted product + water = Expansion

↑

H_2O

Coating Material

Concrete

Cement

Portland Cement ; 1824 সালে Joseph Aspdin

Portland cement is a hydraulic cement that react and harden chemically with the addition of water. It contains limestone and clay and iron ore blended and heated to a temperature of 1200 - 1500 °C. The resulting clinker (কঠিন ছাই) is ground to the consistancy of powder and gypsum is added.

Calcareous Material → Calcium → 2/3 → ~~CaCO3~~ limestone ($CaCO_3$)

Silica → Clay — $SiO_2 + Al_2O_3 + Fe_2O_3 + H_2O$

↗ 1/3

~~Arge~~ Angillaceous Material

2009 Cement is a binding material and crystalline compound of calcium silicate and other calcium compound having hydraulic properties.

Nisha

Suitability of cement over lime

Manufacturing step

1) Mixing and crushing of raw materials
   a) Dry process
   b) Wet process
2) Burning
3) Grinding
4) Storage and packing

2009
2007

Suitability of Cement over lime

i) Construction of structure in wet place or under water

ii) Heavy strength ~~is require~~ and durability is required.

iii) Mortar and plaster has to set quiculy and attained its strength

iv) Used in water ~~tig~~ tight structure

v) Decorative, ornamental and pointing works

vi) ~~Long~~ Hard surface is required against weathering action.

Oxide composition of ordinary cement:

Oxide	Composition (%)
CaO	60-67%
SiO_2	17-25%
Al_2O_3	3-8%
Fe_2O_3	0.5-6%
MgO	0.1-4%
Alkali (K_2O, Na_2O)	0.4-1.3%
SO_3	1-3%

The above oxides present in the raw material when subjected to clinkering temperature combined one ~~in~~ with another to form a complex compound ~~or~~ called bt bogue's compound

24-06-19 3(E)-Day

Short form	Formula	Amount	Color
C_3S	Ca_3SiO_5	54.1%	Red
C_2S	Ca_2SiO_4	16.6%	Aqua
C_3A	$Ca_3Al_2O_6$	10.8%	Green
C_4AF	$Ca_4Al_2Fe_2O_{10}$	9.1%	Yellow

Bogue's Four compound

Functions of various components of Cement:

2018 2015 2000

1) **Lime (CaO):** It plays important role on the quality as it occupies most of the places.
   i) Deficiency causes strength reduction.
   ii) Lack of CaO results quick setting.
   iii) Excess will make the cement unsound.
   iv) Excess causes expansion and disintigration.

2) **Magnesia (MgO):**
   i) It imparts hardness
   ii) It helps to form colour.

2015 * functions of gypsum

iii) Excess makes the cement unsound.

3) Silica (SiO_2):

i) It helps to gain ~~strain~~ strength.

ii) Setting time increases

2007 2005 4) Alumina (Al_2O_3):

i) It imparts quick setting property.

ii) Excess weakens the cement.

2005 5) Calcium sulfate ($CaSO_4$):

i) It is present in the forom of gypsum ($CaSO_4.2H_2O$)

i) It increases initial setting time of cement

ii) It stabilizes the heat of hydration.

বিস্তারিত ব্যাখ্যা

6) Alkali

i) Excess causes ~~alkali~~ efflorescence

iii)

Property of Cement:

i) It gives strength to the masonry. brick work

ii) Excellent binding material

iii) Easily workable.

iv) Good resistance to the moisture.

v) It causes good plasticity

6) It sets ~~ah~~ and harden's easily.

2012

Site selection for the cement factory:

Following key factors are to be paid attention by selecting the site for the cement fatory.

i) Climatic conditions: The site should be such that the area climate is favourable for the manufacturing process.

ii) labour: a) Easily available labour
b) Economy in labour charge.

26-06-19

4(A) - Day

iii) Market: The factory should be closed to the market that will reduce the transport cost.

iv) Power:
a) Availability of the power
b) Low cost fuel.

v) Raw materials:
a) Easily available around the factory.
b) Continuous supply of the raw material.

vi) Transport facility: The transport facility should be smooth to carry the raw materials and finished products.

2014 *What are the harmful constituents of cement
Alkali Oxides (K_2O, Na_2O) → 1% এর বেশি হলে failure of cement concrete
MgO → 5% এর বেশি হলে causes cracks after mortar on concrete hardens

Uses of Cement:

i) Cement mortar for the masonry, plastering, pointing works

ii) Manufacturing of concrete, used for different structure

iii) Making joints for pipe, drain etc.

iv) Preferation ~~of~~ of foundation, water tight flow, footpath etc.

v) Use as coating material

কোন type cement কোন কাজে use হয়
2013 qstn 5(b)

Types of cement:

1) Ordinary portland cement (OPC)

2) Acid resistant cement — 2014 short note

3) Blast furnace cement

4) Expansive cement

5) High Alumina cement

6) Low heat cement

2011[1(c)]
* Ordinary portland

7) Pozzolana cement
8) Quick setting cement
9) Rapid hardening cement
10) Sulfate resisting cement — 2011 advantage disadvantage
11) White cement

ASTM अनुसार Classification

1) TYPE -I -IA
II - IIA
III - III A
IV -
V -

→ ordinary portland cement (generate)

TYPE-I: a) It is the general purpose cement used in concrete for making floor, building, bridge etc.

b) It is for all uses where special properties of other cement types are not required

(moderate sulfate)

TYPE -II cement: a) It is used where precaution against moderate ~~surface~~ sulfate attack is important.
sulphate

b) It contains not more than ~~20~~ 8% of C_3A

b) It generates less heat of hydration and may be used as mass concrete.

c) It is prefer in the hot weather concreting

TYPE - III : → Rapid hardening cement

a) It is chemically and physically similar to that of TYPE -I excepts the particles have been ground finer

b) It provides high early strength

c) It is prefered in the cold weather country

TYPE - IV :

a) It is used where the rate an amount of heat generation from hydration must be minimized.

b) It is the most suitable cement to be used in the mass concrete / massive concrete structure.

TYPE - V :

a) It is used only in the concrete exposed to severe sulfate action.

b) It is not resistant to the acid and other corrosive substances.

IA, IIA, IIIA :

i) These cements are similar to that of Type - I, II, III respectively except that small quantity of air entraining material

2011

Ordinary portland cement. Give specification of OPC with respect to the follows:

Sun Mon Tue Wed Thu Fri Sat

Date :

a) <u>setting time</u> : Initial → not less than 45 min

Final — not more than 10 hours

b) <u>Fineness :</u> The rate of hydration depends on the fineness of the cement particles, and for a rapid developments of strength, high fineness is necessary. Finer cement leads to stronger reaction and greater strength.

c) <u>Soundness :</u> It is essential that a cement paste once set, does not undergo a large change in volume. Some changes in volume may take place due to delayed in the hardened, namely free lime (CaO), MgO and $CaSO_4$

d) <u>strength :</u> The strength of mortar, plaster or concrete depends on the cohesion of cement paste.

are inter ground with the clinker at the time of manufacture.

07-10 4(D)-Day

Expansive Cement: The cement which suffers no overall change in the volume on drying is known as expansive cement. (8-20) parts of sulpho Aluminate clinker are mixed with 100 parts of portland cement.

Advantage:

i) It works against drying shrinkage

2018 Usese:

i) It is used in the water retain structure.
ধরে রাখা

ii) In the repairing works

High Alumina Cement:

2017

Advantage:

1) The initial setting time of cement is more than 3 and half hours thus it allows more time for mixing and placing operations.

2) It can stand high temperature.

3) It can resist action of acid.

4) It sets quickly and attains higher ultimate strength in short time.

5) It is not affected by CO_2 dissolved in pure water and is therefore suitable for manufacturing of pipes.

Disadvantage:

1) It can not be used in mass concrete.

2) It is costly

→ secondary cementicious material

Pozzolona Cement:

Pozzolona → it is a ~~silious~~ siliceous material which, while in itself possessing no cementicious properties, will in finely divided form and in the presence of water react with calcium hydroxide ($Ca(OH)_2$), to form a compound possessing cementicious properties.

Characteristics:

1) The pozzolona constituent shall not be less than 10% and not more than 25% by weight of portland cement.

2) The specific surface area of pozzolanic cement shall not be less than 3000 cm^2/gm.

3) Compressive strength of the cement shall ~~should~~ not be less than 220 kg/cm^2 at 7 days and shall not be less than 310 kg/cm^2 at 28 days

Advantage

1) It attains compressive strength with the age.
2) It resists action of sulphate sulfate.
3) It involves less heat during setting
4) High water tightness
5) It is cheap.

Disadvantage

1) Compressive strength in the early age is less
2) Less resistant to the erossion and weathering action

used → to prepare mass concrete,
used in sewage works
→ laying concrete under water

2014

Rapid hardening cement	Quick setting cement
i) Initial setting time – not less than 45 minutes	i) Initial setting time – 7 minutes
ii) Final setting time – not more than 10 hours	ii) Final setting time – Only 30 minutes
iii) Aluminium sulphate is not added	iii) Aluminium sulphate is added
iv) Suitable for cold weather concreting	iv) Suitable for laying concrete under static water or running water

2014

Short note on Acid-resistant cement :

Acid resistant cement is composed by acid-resistant aggregates, additives and aqueous solution of sodium silicate or soluble glass. Acid-resistant cement is used for acid-resistant and heat-resistant coatings of installations of chemical industry. It is not water-resistant and it fails when attacked by water or weak acids.

2011

Sulphate resisting cement:

Advantages:

i) It is used for hydraulic structures in alkaline water and for canal lining, culverts etc.

ii) It increases the resisting power against severe sulphate action

Disadvantages

i) It is not resistant to the acid and other corrosive substances.

03-07-19

5(A)- Day

2019 diff betn RHC and quick setting cement

Rapid hardening cement: (RHC)

2018 It is used under the following recomanded condition.

i) In the free fabricated ~~contact~~ concrete construction
নির্মাণ কাজ

ii) Where the formwork (shattering - ছাঁচ) is required to be removed early and reuse else where.

iii) Road reparing works

iv) In cold weather concreting.

2017 2015 **Advantage:**

i) Construction work is speedy

ii) Formwork canbe used frequently.

iii) It requires short period of curing.

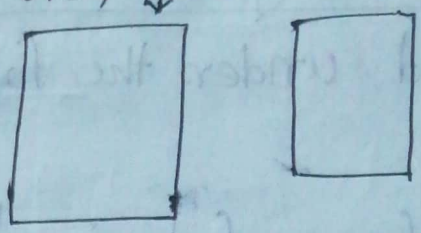
iv) It allows higher permissible stress. Thus it ~~v)~~ is economical

Disadvantage:

i) It is costly.

$\uparrow S = \frac{P}{A\downarrow}$

OPC, $s\downarrow$ $A\uparrow$ RHC $S\uparrow$ $A\downarrow$



Testing of Cement:

a) Field test

b) Laboratory test

Field test

1) In a cement bag there should not be any visible lumps.

ii) The color should be greenish gray

iii) If thrust your hand into a cement bag, it must be give a cool feeling.

iv) Feel a pinch of cement in between fingers.

v) It should not give a gritty feeling.

vi) Take a hand full of cement and

2014 Short note → Acid-resistance cement

~~through~~ throw it on a bucket full of water. It should flow sometimes before sinks.

2013 **Laboratory test:**

a) Fineness test

b) Setting time test

c) Strength test

2014 Short note d) Soundness test

e) Heat of hydration test

f) Chemical composition test.

প্রাকটি- practical regular test

academic

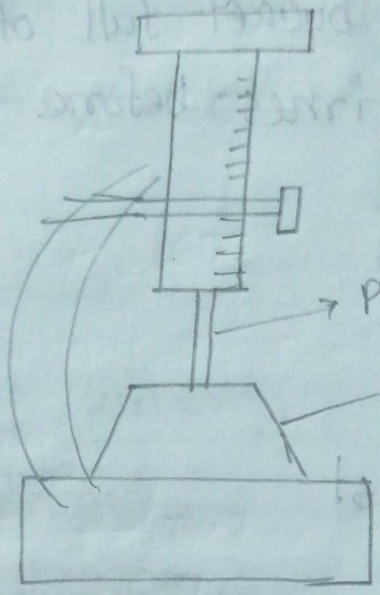
→ mega project এ করা হয়।

2018 **Standard consistency** : / Normal consistency

Standard consistency ~~is~~ of a cement test is defined as that consistency which will permit a vicat apparatus plunger having 10 mm diameter and ~~fift~~ 50 mm length to penetrate to a depth of (10 ± 1) mm depth from the top of the mould.

2015 2017 2018 * diff bet^n initial and final

2018 * Write down procedure and precaution in necessary setting time of cement in laboratory



Initial Setting time: It is regarded as the time elapsed between the moment the water is added to the cement to the time that the paste start loosing its plasticity.

During the test it is specified as the period elasped between the time ~~workers~~ water is added to the cement and the time at which vicat apparatus needle penetrates the test block 25mm from the top of the mould

vicat apparatus plunger → dia 10mm
needle → dia 1mm

2014 diff betn normal consistency and initial setting
293

Final setting time: The time elasped between the ~~w~~ moment ~~add~~ ~~to~~ water is added to the cement and the time when cement paste has completely lost it's plasticity and attains sufficient hardness to resist certain pressure. During the test it is specified as the period elasped from the time water is added to the cement to the time when vicate ~~oper~~ apparatus needle does not penetrate more than 0.5mm

Initial	Final
i) Cement paste has started loosing its plasticity	i) has completely lost its plasticity
ii) Penetrates 25mm from the top of the mould	ii) does not penetrate more than 0.5mm
iii) start to attain hardness	iii) Attains sufficient hardness.
iv) For OPC not less than ~~45~~ 30 min	iv) For OPC not more than 10 hours

03-07-19 5(D)-Day 2015 2017 diff bet^n False and Flash

	OPC	RHC	LHC (Low heat cement)
Initial (min)	30	30	60
Final (min)	600	600	600

10hrs ~~30 min~~ এর বেশি হওয়া যাবে না,

2009 False setting:

It is the ~~no~~ name that indicates abnormal premature stiffening of cement within a few minutes of mixing with water, without ~~involving~~ evolving any heat.

Causes: (abnormal stiffening)

1) Dehydration of gypsum when interground with too hot clinker

$CaSO_4 \cdot 2H_2O$

↓

(Semi hydrate) $CaSO_4 \cdot \frac{1}{2}H_2O$

↓

(An hydrate) $CaSO_4$

2. Excess alkali present in cement when carbonated and precipitated induce rigidity.

3. Activation C_3S by aeration at high humidity

2007
2006

Chemical requirements of Cement: Composition

1. Ratio of % of lime to the % of silica, alumina and iron oxide when calculated by the formula $\frac{CaO - 0.7\,SO_3}{2.8\,SiO_2 - 1.2Al_2O_3 - 0.65\,Fe_2O_3}$	not greater than 1.02 and not less than 0.66
2. Ratio of % of alumina to that of ~~oxide~~ iron oxide	not less than 0.66
3. Weight of insoluble residue	not more than 2%
4. Weight of magnesia	not more than 6%

5. Total sulfate content	a) not more than 2.75% when C_3A is 7% or less b) not more than 3% when C_3A is greater than 7%
6. Total loss on ignition (ans, heat)	not more than 5%

Hydration of cement:

2012
07, 05

Hydration is ~~the~~ a general term ~~to~~ used to describe ~~betw~~ the chemical reaction between cement powder and water.

C_3A and C_4AF react instantaneously when mix with water. C_3S is the next to react with water, which is responsible for early strength gain. C_2S reacts most slowly and it gathers progressive strength.

250 calar ... stronger

$2C_3S + 6H \longrightarrow C-S-H + 3CH$ (120 cal/gm)

$2C_2S + 4H \longrightarrow C-S-H + CH$ (62 cal/gm)

$C_3A + 3CSH_2 + 26H \longrightarrow C_6AS_3H_{32}$ (300 cal/gm)

$2C_3A + C_6AS_3H_{32} + 4H \longrightarrow 3C_4ASH_{12}$

$C_4AF + 10H + 2CH \longrightarrow C_6AFH_{12}$

$C_3S_2H_3$ (C-S-H gell)

$C_6AS_3H_{32}$ (Ettringite)

C_4ASH_{12} (Monosulfate)

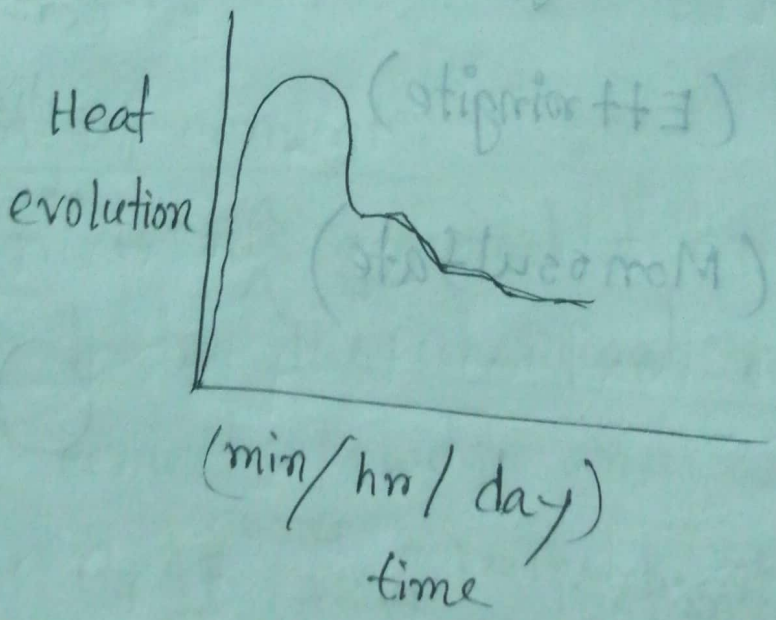
cement ... particle ... size ... micrometer

hydration ... zig-zag ... contact

250 hydration ... 250- C-S-H ... stronger cement

heat kJ/kg

Compound	heat (kJ/kg)
i) C_3S	517
ii) C_2S	262
iii) C_3A	1144
iv) C_4AF	418



15-07-19

6(D)-Day

2017 *diff betn setting and hardening

Flash setting: The reaction between C_3A and H_2O is very quick and leads to immediate stiffening of the paste. is known as flash setting.

Gypsum addition

Gypsum addition amount is 2.5% when C_3A content is not more than 7%, 3% when C_3A exceeds 7% but not more than 10%.

Gypsum

Advantage:

i) It stabilizes heat of hydration

ii) It retards (minimize) the hydration of C_3A.

iii) It prevents flash setting

Disadvantage:

i) Excess gypsum causes expansion and disruption of cement paste.

ii) Excess leads to delayed initial setting time.

2012

Mean Means of Determination of Hydration progress:

i) The amount of calcium hydroxide $Ca(OH)_2$ in the paste

ii) The heat evolved by the hydration

iii) The specific gravity of the paste.

iv) Amount of chemically combind water.

v) Amount of unhydrated cement paste.

vi) Gn directly from the strength of cement paste.

weight go respect a- important parameate (meant)

Prob Water : cement (w/c) ratio = ~~0.36~~ 0.6

relative density of unhydrated cement = 3.14

constant

Relative density of hydrated cement gell = 1.75

Cement = 100 cc

The cement combines chemically 23% of its own weight with water.

Find the volume of void after 50% hydration

Soln

~~Degree of~~ Degree of hydration

D.H. = 0%

$W = \rho V$

$V = \frac{W}{\rho}$

∴ Volume of unhydrate cement = 100cc

Weight of unhydrated cement = 100 × 3.14

= 314 gm

" " Water $\frac{W}{C} = 0.63 \Rightarrow W = 0.63C$

= 314 × 0.6

= 188.68 gm

Volume of unhydrated water = 188.6 cc

Total volume, $V_T = 100 + 188.6 = 288.6$ cc

DH = 50%

Volume of unhydrated cement = 100 × 0.5

= 50 cc

" " hydrated product = $\frac{0.5(314 + 0.23 \times 314)}{1.76}$

" " void = ~~109.72 cc~~

$V_4 = 288.6 - [504 - 191.72]$

Corrosion

2013

2018

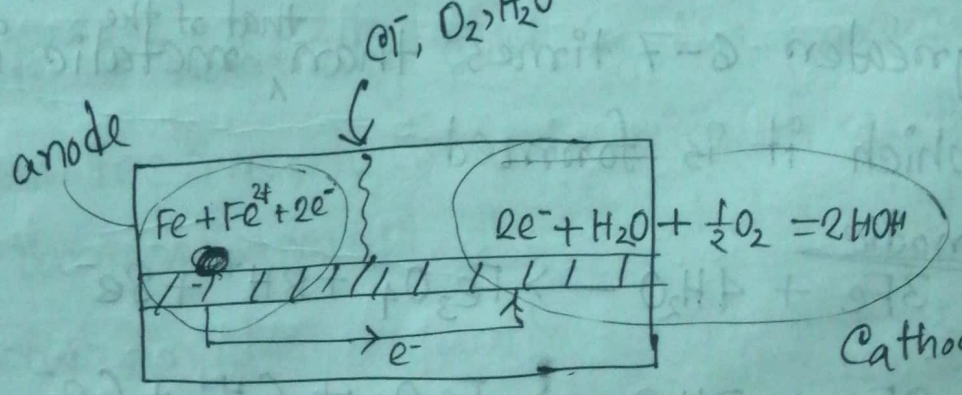
The process produces a new and less desirable material from the original metal and can result in a loss of function of the component or the system.

ASTM Terminology ~~(G)~~ (G 15) defines corrosion as "The chemical ~~elec~~ and electrochemical reaction between a material, usually metal, and its ~~en~~ ~~b~~ environment that produces a deterioration of the material and its properties.

2013 Mechanism of corrosion in R.C.C

2018
2013

Corrosion cell: The surface of the embedded steel ~~and~~ in concrete acts a mixed electrod consis of anode and cathode. Electricall connected through the body of the ~~and~~ steel ~~itself~~ concrete pour water functions as an aqueous medium that is electrolyte thus rainforcement corrosion cell is formed.



Macro corrosion → anode cathode distance বেশি হলে

Micro corrosion → কম হলে।

17-07-19

7(A)-Day

Basic corrosion electrochemistry:

The transfer of electron involves reduction of oxygen to hydroxil. To dissolve 10 kg of iron approximately 3.2 kg of oxygen is reduced to hydroxil ion. The ion dissolution is named as anodic reaction. The electrochemical oxygen reduction is named as cathodic reaction. The red-brown rust which is formed on the surface of the embedded steel in concrete as volume greater 6-7 times than that of the metalic iron from which it is formed.

Anodic

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 8H^+ + 8e^-$$

$$2Fe + 3H_2O \longrightarrow Fe_2O_4 + 6H^+ + 6e^-$$

$$Fe + 2H_2O \longrightarrow HFeO_2 + 3H^+ + 3e^-$$

$$Fe \longrightarrow Fe^{2+} + 2e^-$$

Cathodic

$$2H_2O + O_2 + 4e^- \longrightarrow 4OH^-$$

$$2Fe + 2H_2O + O_2 \longrightarrow 2Fe(OH)_2$$

$$4Fe(OH)_2 + O_2 + 2H_2O \longrightarrow 4Fe(OH)_3$$

$$2Fe(OH)_3 \longrightarrow Fe_2O_3 \cdot H_2O + 2H_2O$$

Hy Hydrated Ferric Oxide
বাদামি রঙের rust যার corrosion Product

Passivity of the steel:

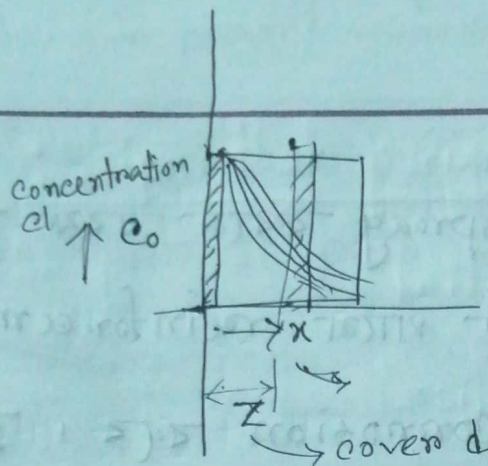
Passivity is normally cost by the production of thin, protective, hydrated oxide film that acts as a barrier against the dissolution of ~~the~~ steel by anodic reaction. ~~It stiffne~~ Its thickness may vary 1-10 manometer.

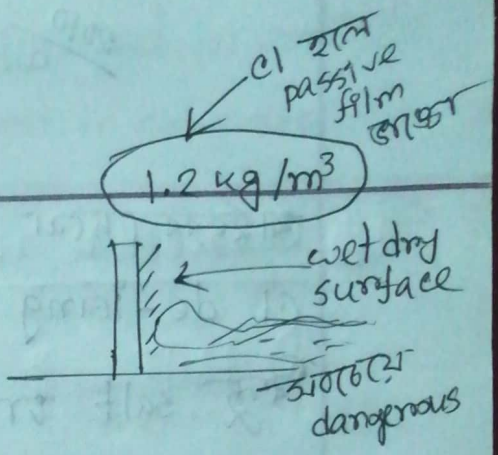
Types of corrosion:

1) Pitting corrosion (70% of the failure):

i) eto Chloride ions either present initially or by diffusion from the external environment can initiate pitting corrosion. The present chloride can prevent or slow down the formation of passive film on repassivation reaction. When present at the pre existing passive film, break down of the film may occure. ~~when~~ ~~Both the presences~~

Both the processes result in pitting corrosion. When the coating breaks down the exposed metal gives up electrons easily and the reaction initiates ~~tymy~~ tiny pits.





concentration of cl

$$\frac{dc}{dt} = D\frac{d^2x}{dt^2}$$ → Fick's law → crank solution

$$c(x,t) = C_o\left(1 - erf\frac{x}{2\sqrt{x}}\right)$$

c(x,t): concentration of cl; x: space; t: time; C_o: surface chloride; erf: error function

Cl দুরকমের → passive film ও যেমন passive film ভেঙ্গে যায় →

$D = 12 \times 10^{-8}\ m^2/s$ → $D = 12 \times 10^{-7}\ m^2/s$ হলে 3 1 decimal বাড়লে/কমলে corrosion start time অনেক year আগে পরে হয়। life cycle এ huge difference হয়।

2010 diff betn dry corrosion and wet corrosion

বাইরের দেশে
de-icing salt spray করলে বরফ চলে যায়।
কিন্তু salt ঢুকে আসে পাশে reinforcement
a affect করে corrosion করে। ব্রাস্তায়-
rod/steel নাই। কিন্তু bridge এ problem
করে।

22-07-19 7(D)-Day

2018 Uniform corrosion (30% of the failure)

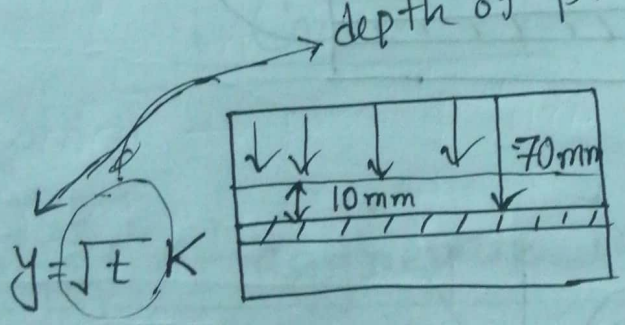
Uniform corrosion, as the name indicates, occurs over the majority of the surface of steel at a steady and often predictable rate.

This type of corrosion occurs when the alkalinity of the surrounding concrete is reduced by the carbonation. After

2013 * Mension the causes of corrosion of steel in concrete

2011 How can prevent corrosion of steel in concrete

the pH of the pore solution decreases to less than 11, passive film breaks down and destrooyed. Normal carbonation results decrease of the porosity making the carbonated paste stronger. Therefore carbonation is advantagious to non reinforced concrete.



· squre root foromula

$\sqrt{\text{time}}$

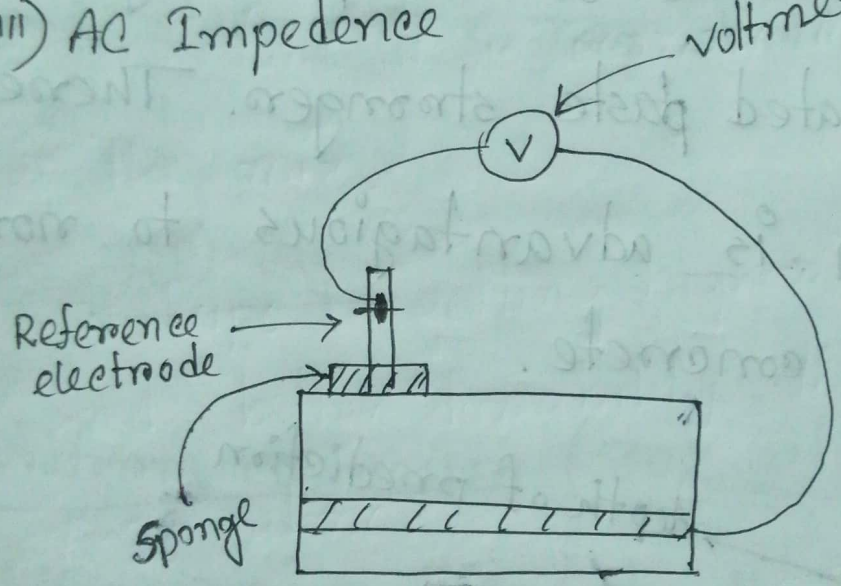
যেসব পদার্থের use করে color change হয়ে corrosion detect করা যায়।

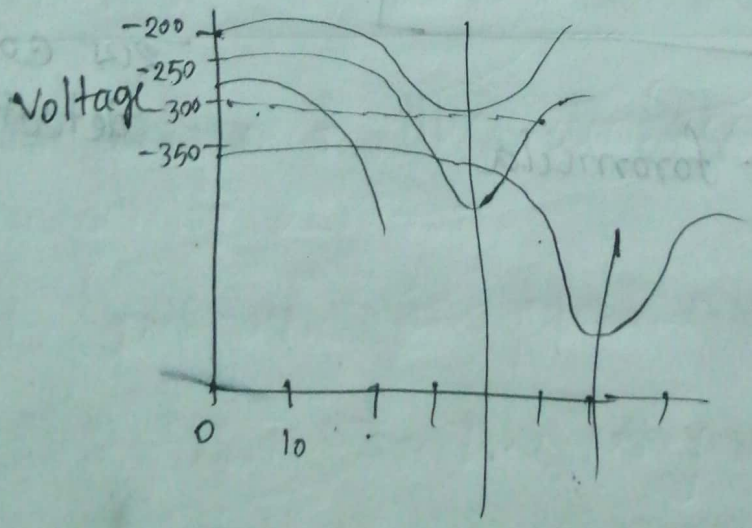
Corrosion monitoring technique:

i) Half cell potential → specify standards for HCP 2018

ii) Linear polarization

iii) AC Impedence





HCP		
Vs. $CuSO_4$	Vs AgCl	Corrosion
> -200	> -86	No (90%)
-200 > HCP > -350	-86 > HCP > -236	Uncertain
< -350	< -236	Yes (90%)

Concrete

Concrete:

Function of aggregate in concrete:

Aggregates are important constituents of concrete. There impacts on various characteristics and properties is undoubtedly considerable.

i) They give body or volume to the concrete

ii) Reduce shrinkage.

iii) Aggregates are cheaper than cement and

iv) Therefore it is economical to ~~the~~ be used in the mix.

v) It helps in getting higher volume stability and better durability than the cement paste alone.

Functions of water in concrete:

i) To ~~weig~~ wet the surface of aggregate to develop adhesion.

ii) To prepare a plastic mixture

iii) To impart workability of the concrete to facilitate the placing at the desire position.

iv) It is needed for hydration to set and hard during the curing.

Segregation : (আলগা হওয়া)

It is defined as the separation of the consitituent materials of the concrete.

Such concrete is not only going to be weak, lack of homogeneity (অসমসত্ত্বতা) is also going to induce (ঘটা) undesirable properties in the harden concrete.

2015
2018 * How do you measure segregation?

24-07-19
~~24~~-07-19 ~~7(E) D~~ 8(A)-Day

Means of Segregation:

2015
2018

It is difficult to measure quantitatively but it can easily be observed at the time of concreting operation. The pattern of subsidence in the slump test on the pattern of spread in the flow test gives a fair idea on the quality of concrete with respect to segregation.

Types of segregation:

i) Coarse aggregate seperating out or settling down from the rest of the matrix.

ii) Matrix seperating out from the coarse aggregate.

iii) Water seperating out from the rest of the material.

2015
2014

Causes:

i) Badly proportioned concrete where sufficient matrix is not there to ~~buying~~ bind and contain aggregate

ii) Insufficient mix concrete ~~in~~ e with excess water.

iii) Drooping of concrete from heights.

iv) When concrete is discharged from a badly designed mixer: on from a mixer with worn-out blades

v) ~~Convien~~ Conveyance of concrete by conveyor belt, wheel ~~bar~~ barrow, long distance haul by dumper, long lift by skip and hoist promote segregation.

air bubble বের করা উচিৎ না। তাড়াতাড়ি প্রবেশ করাতে হবে আস্তে
vibration এর মূল উদ্দেশ্য conpasion হওয়া) আস্তে বের করতে হবে।

vi) Too ~~weight~~ wet mix if excessively vibrated.

vii) If the vibration is done continuously ~~b~~ for a long time

viii) While finishing the concrete flow on pavement, a mason works too much with trowel, fload, temping immediately on placed concrete.

6' ~~উপর~~ এর বেশি উপর থেকে ঢালাই করে concrete ফেলা যাবে না।
column 6' করা হলো, তারপর আবার উপরে করা হয়। 10' এর column এ।

2011

Remedy of segregation :

i) Correct proportion of the mix, proper handling, transporting, placing, compacting and finishing

ii) Remixing for a short time improves homogenity

iii) Use of workability agent and pozzolanic material.

iv) Use of air entraining agent.

29-07-19 / 2017

8(D)- Day

* How does bleeding affect permeability and bond loss in concrete

Bleeding; It is a particular form of segregation in which water comes up to the surface and accumulates at the top, being of the lowest specific gravity among all the ingredients of concrete. It is observed when the mix is highly wet, badly proportioned and in case of insufficient mix. Thin members like roof, slab and road slab when cast in the sunny weather excessive bleeding is observed. In the case of bleeding along with water, certain amount of cement also comes up to the surface. When the surface is worked up with trowel and float aggregate goes down and ~~wat~~ cement with water comes up to the surface. The formation

of this cement paste at the surface is known as Laitance.

Disadvantage

i) This produces dust in the summer and mud in the rainy season.

ii) It developes higher shrinkage, cracks.

iii) A plane of weakness is formed. This forms a continuous channel and flow path and causes higher permeability.
ব্যাপ্তিযোগ্যতা

iv) While proceed (বিগত হওয়া) bleeding it may be intercepted (বাধা) by aggregate and steel. and causes bond loss. among the aggregate, steel and matrix.

shear transfer এর জন্য bond very very important

2015 *What do you suggest if you find bleeding over concrete in the field?
*How does bleeding affect bond loss?
2014 → and permeability

2011 **Remedy of bleeding:**

1. By delayed finishing operation
2. Proper proportioning
3. Use of fine pozzolanic material.
4. Use of air entraining agent
5. Uniform and complete mixing
6. Finally re-vibration

Properties of concrete:

1. Strength
2. Elastic properties
3. Fatigue
4. Durability
5. Impermeabity

} Hard concrete এর property

6. Workability. } Fresh concrete এর property

1. Strength: The strength of concrete is commonly consider as its most valuable property. which gives the overall picture of the quality of concrete.

1. Compressive strength
2. Tensile strength
3. Flexural strength
4. Shear strength

Fl

31-07-19 9(A)-Day

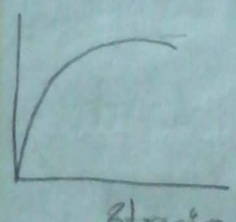
2. Elastic property: The elastic properties of concrete are of important not only because of their bearing upon the deformation of concrete under load, But also for the design of reinforced concrete. Concrete is not perfectly elastic of any range of loading and deformation is not proportional to the stress at any stage of loading. Elastic property varies with—

1) The richness of the mixture → 25 cement ratar 100 rich concrete richness ratar

2) Intensity of loading

3) The age of concrete

relavent property $n = \frac{E_s}{E_c}$ — modulus of elasticity of steel / of concrete



3. Fatigue of concrete: Plain concrete when subjected to flexa, exhibits fatigue. The flexa resisting ability of a concrete of a given quality is indicated by an endurance limit whose value depends on the number of repeatation of stress

4. Durability of concrete: The concrete should with stand the condition for which has been designed, without deterioration over a period of years such concrete is said to be durable.

a) External causes:

i) Weathering

ii) Extreme temperature change

iii) Abrasion

iv) Electrolytic action

v) Attack of natural and industrial liquid and gas.

b) Internal causes :

i) Alkali aggregate reaction

ii) Volume change

iii) Differences in thermal properties between aggregate and paste

iv) Permeability.

5. Impermeability of concrete: Penitration into concrete may adversely affect its durability and its penetration depends on the permeability of concrete. It is of important in respect of

i) Acid attact

ii) Moisture movement

iii) Heat and temperature movement

iv) water types

6. Workability of concrete: Workability is the ease (আরাম) of transporotation, placing and finishing operations. It is the physical property which is the amount of usefull extarnal and internal energy requirees to produce compaction of concrete on the workability

21-08-19 9(D)-Day

Factors affecting properties of concrete:

2017 1) Grading of aggregate: The term grading indicates the art of combining various sizes of particle to produce a dense and economic concrete using minimum amount of cement per unit volume for a desire strength.

2018 2012 Effect of maximum size of aggregate:

Larger the particle higher is the strength. This is due to the fact that larger the aggregate lower is the surface area and hence less amount of water is required for a given workability. However later it was found that the use of larger aggregate did not contribute higher strength as expected

1) Larger aggregate gives lower surface

area to give low gel bonds.

2) Bigger size causes more heterogeneity to prevent uniform distribution of load when stressed.

Lean mixed larger aggregate gives higher strength. Rich mixed high strength concrete is adversely (বিরূপ) affected by the larger aggregate.

Combine F.M of fine aggregate (F_f = 2.85) and coarse aggregate (F_c = 6.77) was found to be 5.30 if 8.46 ~~sieve~~ cft of combine and well packed aggregate is required. Determine the volume of fine and coarse aggregate mixed initially. Shrinkage factor to be 0.75.

Solve: $R = \frac{F_1 - F_{com}}{F_{com} - F_2} = \frac{6.77 - 5.30}{5.30 - 2.85} = 0.6 = 60\%$

Initial Volume $= \frac{8.46}{0.75} = \cancel{11.13}\ 11.28$ cft

Volume of fine agg. $V_f = \frac{60}{160} \times 11.28 = 4.23$ cft

" " Coarse " $V_c = \frac{100}{160} \times 11.28 = 7.05$ cft

2) Moisture content of aggregate: Bulking of sand is very high ~~for~~ fine aggregate and is of great ~~less~~ importance. Concrete mix is designed on the basis of dry volume of aggregate is known as real mix ratio but in the field the aggregate is wet particularly when they are washed. connection must be given to the volumetic measurement is known

as field mix ratio.

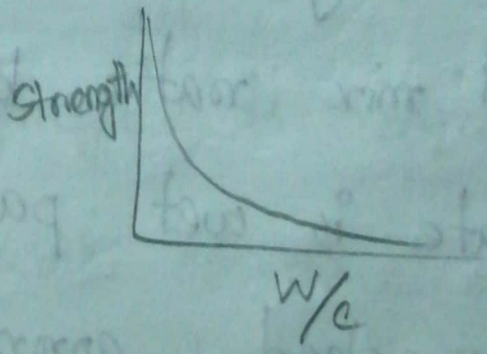
3) Water: Cement (W/C) Ratio: The proportion between amount of water and cement is known as water cement ratio.

i) To wet the surface of area.

ii) To impart workability

iii) To combine chemicaly with cement.

Strength is inversely proportional to the water cement ratio when the concrete is fully compact



4) Proportioning of ingredients of concrete :

The object is to obtain a strong and durable concrete to ~~mix~~ meet all the ~~ingred~~ requirements

i) Arbitrary method

ii) Minimum void method

iii) Sieve analysis method

iv) Trial mix method

5) Method of mixing of concrete: The object is to coat the surface of aggregate with the cement paste test and to blend all the materials of concrete into a uniform mass.

a) Hand mixing

b) Machine mixing

25-08-19 10(A)-Day

6) Placing and compaction: the Concrete must be transported from the place of mixing to the place of final placement as quicly as possible by the method that prevent ~~segret~~ segregation. The placing must be done continuously to avoid jonts. The Concrete should be deposited and not ~~throughr~~ throwon or dumped from a distance. It should be ~~conta~~ compacted to eliminate the entrapped air. It is done by standiard steel rod forcing the concrete round the corners and edges to enable the space between the reinforcement bars to be completely ~~the~~ ~~fitten~~ filled up.

2018 * What are the effects of improper curing of concrete — Explain / Explain

Curing: It is described as the process of maintaining a satisfactory moisture content and favourable temperature in concrete during the period immediately following the placement, so that hydration of cement may continue until all the desire properties are developed to a sufficient degree to meet the requirement of service.

concrete surfaces are kept wet for a certain period after placing of concrete so as to promote the hardening of cement.

Methods:

Top class → a) Water curing
- i) Immersion ডুবানো
- ii) Ponding — Ponding with water
- iii) Spraying — sprinkling of water
- iv) Wet covering — covering with wet Jutebags

b) Membrane curing

c) Application of heat

d) Miscellaneous
বিবিধ / বিভিন্ন
chemical formation

2014 * Types of curing

2013 * What method is popular in Bd. why

Strength of concrete: Compressive strength is one of the most important and useful properties of concrete in most structural applications concrete is employed primarily to resist compressive ~~strength~~ stress. In case where the tension and shear are important, compressive strength to measure these properties.

Classical law

1918 Abrams

$$S = \frac{A}{B^x} \qquad x = W/C \text{ by volume}$$

$A = 14000 psi$, $B = 7$ } At 28 days

Feret :-

1897

$$S = K\left(\frac{c}{c+e+a}\right)^2$$

K = Constant, depends on degree of compaction & w/c ratio

c, e, a = Volume of cement, water, air

Gel/Space ratio : — alternative Classical Law

Instead of relating the strength to W/C ratio the strength can more correctly be related to the solid product of hydration of cement to the space available for the formation of this product

Powers and Brownyard,

For full hydration :-

$$\text{Gel/space}, x = \frac{\text{Volume of gel}}{\text{Volume of space}}$$

$$x = \frac{C \times V_c \times 2.06}{C \times V_c + W_o}$$

C = weight of cement in gm

V_c = Specific volume of cement = 0.319 mL/gm

W_o = Volume of water in mL.

Assuming 1mL of cement will produce 2.06mL of gel on hydration

~~If x be the~~

If α be the fraction of hydration :

$$x = \frac{\alpha C V_c \times 2.06}{\alpha C V_c + W_o}$$

Strength, $S = 2400\, x^3$ kg/cm^2

Math Calculate gel:space ratio and theoretical strength of 500 gm of cement with 0.5 W/c ratio for full and 60% hydration.

For full hydration,

$$x_{100} = \frac{C \times V_c \times 2.06}{C \times V_c + W_o}$$

$$= \frac{500 \times 0.319 \times 2.06}{500 \times 0.319 + 250}$$

$$= 0.8$$

$\frac{W}{C} = 0.5$

$\Rightarrow \frac{W}{500} = 0.5$

$\Rightarrow W = 250$ gm

$S_{100} = 2400(x_{100})^3 = 1228.8$ kg/cm^2

$$x_{60} = \frac{0.6 \times 500 \times 0.319 \times 2.06}{0.6 \times 500 \times 0.319 + 250} = 0.57$$

$$S_{60} = 2400 (x_{60})^3 = 444.46 \text{ kg/cm}^2$$

28-08-19 10 (D) - Day

Maturity of concrete: Strength is a function of summation of the product of time and temperature.

2018 what is

$$\text{Maturity} = \sum (\text{time} \times \text{temperature})$$

$$\% \text{ strength} = A + B \log_{10} \frac{M}{1000}$$

Strength at 28 days 18°C-28°C (kg/cm²)	A	B
< 175	10	67
175 - 350	21	61
350 - 525	32	54
525 - 700	42	46.5

Prob Strength of fully matured concrete is 400 kg/cm². Find the strength of an identical concrete at an age of 10 days when cured at an avg. temperature 20°C during ~~they~~ day and 10°C during night.

Soln: $M_{10} = 10 \times 12 [20 - (-11)] + 10 \times 12 \times [10 - (-11)]$

(first day 12 hours; night 12 hours)

$= 6240^{\circ}C\,h$ (h — hour; °C — degree centigrade)

% Strength $= 32 + 54 \log_{10} \frac{6240}{1000} = 74.94$

$$S_{10} = 400 \times \frac{74.94}{100} = 299.76 \text{ kg/cm}^2$$

if 10 days strength এর 310 হয় তাহলে 299.76 কে shattering করলে খারাপ হবে না।

(Workability is the ease of transportation, placing and finishing operations.

Workability: The property of concrete which determines the amount of useful internal work necessary to produce full compaction. It is defined as the ease (সহজ) with which the concrete can be compacted 100%) having regard to the mode of compaction and place of deposition.

2014
2011

Factors affecting workability:

2018
2011

1) **Water content:** The higher the water content per unit volume of concrete higher will be the fluidity which is one of the important factors affecting workability. In case all other steps to improve workability fails, only as a last resource addition of water can be recommended. ~~The more~~ More water can be added provided higher

quantity of cement is also added to keep the w/c ratio constant.

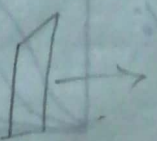
2) Mix proportion: The higher the aggregate/cement ratio leaner is the concrete. In lean concrete less quantity of cement paste is available for providing lubrication per unit surface area of aggregate and thus mobility of the aggregate is restricted. On the other hand in case of rich concrete with lower aggregate/cement ratio more cement paste is available to make the mix cohessive to proovide bettero workability.

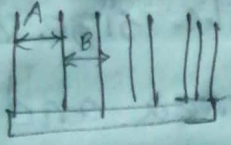
2015
2017
2018

3) Size of aggregate: Bigger the size of aggregate less is the surface area and less amount of water is required to wet the surface of aggregate and less amount of water is requined to lubricate the aggregate to reduce the internal friction and hence higher will be the workability.

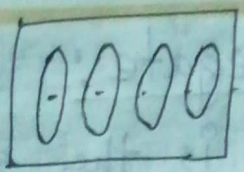
2015
2018
2012

4) Shape of aggregate: Rounded and cubical shaped aggregate contributes to better workability than that of angular, elongated, flaky aggregate due to the fact that it has less surface area and less voids. That is why river sand and gravel give a better workability than that of crushed sand and ~~ag gravel~~ aggregate





Elongated



Flaky

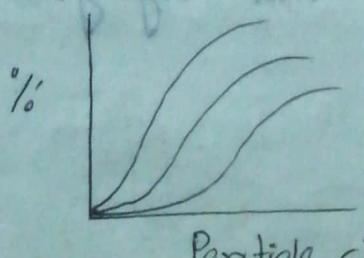
02-09-19

11(A) - Day

5 2015

Surface texture: Rough textured aggregate has more surface area and contributes less workability for the same volume. and round, smooth textured aggregate offers reduced inter particle frictional resistance and contributes higher workability.

6) **Grading of aggregate:** The better the grading less is the void. Excess paste is available for better lubrication and hence higher is the workability.



same volume এর মধ্যে good gradation এর void কম

বিভিন্ন Particle এর বিভিন্ন gradation.

2017 7. Use of admixture: Air entraining agent reduces internal friction between particles being acted as a ball bearing and provides better mobility. Similarly, fine pozzolanic material, though increase surface area, offers better lubricating effect provides better workability.

pozzolanic material → size খুব ছোট → কিন্তু খুব বেশি ছোট হলে lubrication → সমস্যা, ক্রিয়া

Measurement: → How to measure workability

i) Slump test — used most
ii) Compacting factor test
iii) Flow test
iv) Kelly ball test
v) Vee Bee consistometer test.

methods of measuring workability

2014 Procedure to measure slump value of concrete

2013 step

2017 2012 Slump test: The apparatus consists of a metalic mould in the form of frustum of a cone having the dimensions : bottom dia = 20cm, top dia = 10cm, height = 30cm, thickness ≥ 1.6 mm. For tamping the concrete a steel tamping rod : 16mm dia, 65mm long with the bullet end is used.

1. i) Intern surface should be thoroughly cleared
2. ii) The mould is placed on a smooth, horizontal, rigid and non absorbent surface.
3. iii) The mould is filled in three layers
4. iv) Each layer is tamped 25 times evenly distributed on the whole surface.
5. v) After the top layer is tamped the concrete is struck off with the trowel.

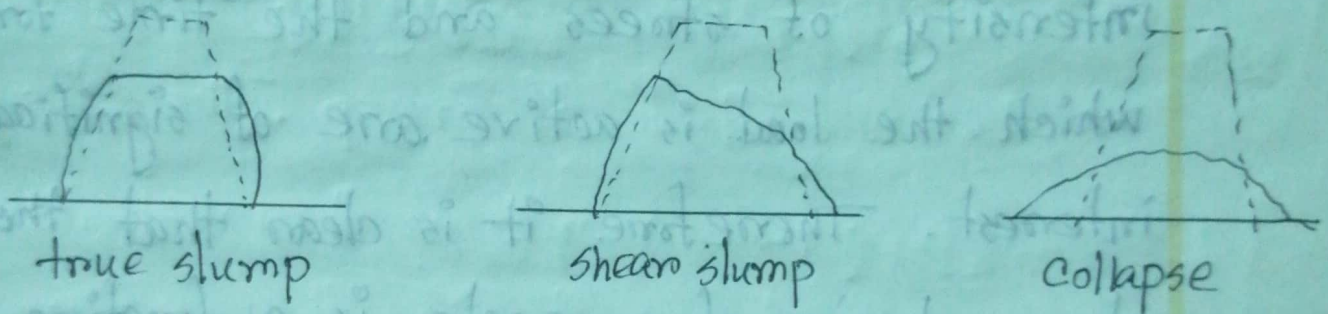
2013 * what slump value is important to concrete engineer

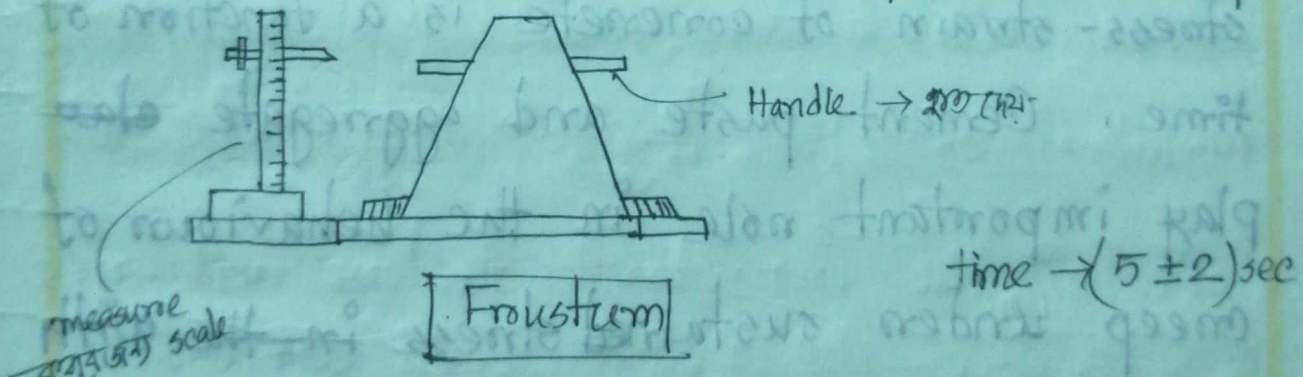
2011 * Advantage of slump test

* short note → Formwork of concrete

6. vi) The mould is raised carefully and slowly in the vertical direction.

The subsidence after lifting up the mould is known as slump of concrete.



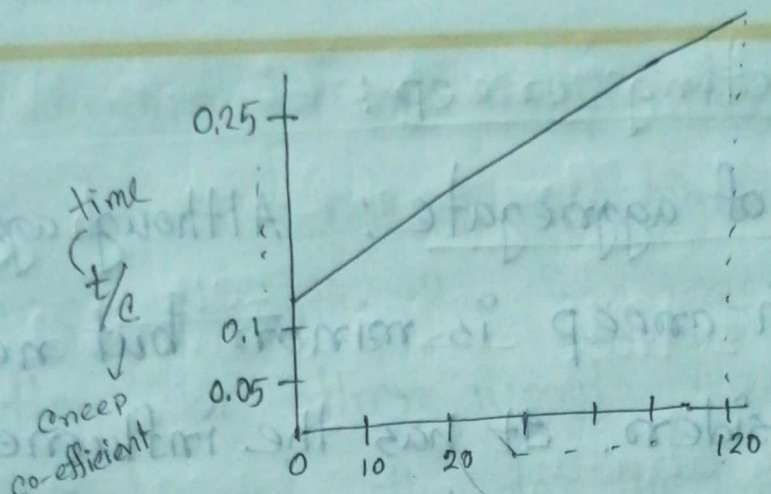


2017 cause 2018 *Why does creep take place in concrete

2015 internal cause

Creep of concrete: Creep can be defined as time dependent part of the strain resulting for stress. The degree of curvature of stress-strain curve depends upon many factors amongst ~~wit~~ which the intensity of stress and the time for which the load is active are of significant interest. Therefore it is clear that the stress-strain of concrete is a function of time. Cement paste and aggregate ~~play~~ play important role in the behaviour of creep. Under sustained stress ~~in the~~ with time, the gel, the absorbed water layer, the water held in the gel, pore and capillary, pore ~~force~~ yields, flows and readjust themselves, ~~and~~ which behaviour is known as creep.

2013 short note → construction joint



2017

Ross expression, $C = \frac{t}{a+bt}$

time

Creep Co-efficient

Constant

are

07-09-19

11 (D)-Day

2015 * How does maturity affect creep of concrete

Factors affecting creep:

1) Influence of aggregate: Although aggregates influence on creep is minor but need to be consider. It has the influence ~~to~~ its through its restraining effect (নিরোধক / বাধা দেওয়া) on the magnitude of creep. The stronger the aggregates more is the restraining effect and hence less is the creep. Modulus of elasticity of aggregate is one of the important factors influence in creep. If Light weight aggregate shows higher creep than normal weight aggregate.

2) Influence of mix proportion: A poorer paste structure undergoes higher creep. Creep increases with the increase in water/cement ratio. In other words creep is inversely proportional ~~the~~ to the strength of concrete. and thus all the factors affecting ~~to the strength~~ also affects creep.

3) Influence of age: The age at which the concrete member is loaded will have a ~~pre~~ predominate effect on creep. The Quality of ~~young~~ gell improves with time. such gell creeps less. The young gel ~~on~~ under load being not so stronger and creeps more.

2012 * Carbonation is advantageous to non-reinforced concrete explain

2011 * Why mild steels are used as reinforced concrete

Chemical attack of concrete:

i) Leaching act (efflorescence)

ii) Action of sulfate → How to control 2015

iii) Sea water attack

iv) Acid attack — কিভাবে attack হয় 2011/2014

2012 What measures should be taken

2011 which concrete Attack হয়

1. Efflorescence: A change on the surface to a powdery substance upon the exposer in air as a crystaline material through a loss of water. 2017 2015

Required conditions:

i) There must be water soluble salts present inside concrete. ($CaCO_3$, $CaSO_4$)

2) There must be sufficient moisture present in concrete. to renders the salts into a soluable solution.

2011 *Discuss various types of shrinkage and their respective effects on concrete structure.
* What is light weight concrete? Advantage and disadvatg over ordinary plain concrt

3) There must be a path present for the soluable salts to migrate through to the surface.

2009 2017 Causes:

2015 1) Constituents

a) Cement: pigments use in the colored cement and other admixtures contributes to the efflorescence.

b) Aggregates: Sand contaminated with salt is a major factor. Aggregates containing sulfate solutions has the obvious risk.

c) W/c ratio: Higher w/c ratio results pouno porous blocks becoming interconnected give rise to the potential to efflorescence.

09-09-19 12(A)-Day

2)

2) ~~Poor~~ structure:

a) ~~Poor~~

2) Quality

a) ~~Coar~~ Pore ~~Poor~~ structure: Permeability and porosity of the concrete are both related to the internal pore structure. Greater permeability results the ~~in~~ water more readily penetrating into concrete., When humidity of the sorrounding drops, water comes to the surface ~~bringing soluble~~ soluable salts to the concrete pores.

b) Variability: পরিবর্তনশীলতা Variability of the quality of concrete causes localized occurance of efflorescence due to differencing in compaction and curing

3) Factor related to curing

Relative Humidity.

a) Humidity: Curing in the dry air, RH is less then 65% increase the risk of efflorescence.

b) Temperature: Temperature affect the efflorescence through the effect on the rate of evaporation. Slow rate of evaporation increase the risk.

c) CO_2: Curing in the CO_2 environment having concentration greater than 5% was found to have remarkable effect.

2014 Removal of efflorescence:

1. Stiff bristled brushing
2. Brush off materials should be totally removed by vaccum cleaning
3. If dry brushing is not effective, washing with

water in conjunction with further brushing may be tried

4. High pressure water jet.

5. Light sand dusting

Sp. Gravity, $G_1 = \frac{\gamma}{\gamma_w}$ — unit weight

— density " "

$4000 - 3500 = 500$

2015

8) c)

4000	0.5	800	0.1
3200	0.6	∴ 1	$\frac{0.1}{800}$
$4000 - 3200 = 800$	→ 0.1	∴ 500	$\frac{0.1 \times 500}{800} = 0.06$

For 3500 psi strength 0.5 +

W/C ratio $= 0.5 + 0.06 = 0.56$ is taken

$\frac{\text{Water}}{\text{cement}} = \frac{190}{\text{cement}} = 0.56 \Rightarrow$ cement $= 339.3\ kg/m^3$

Weight of CA = ρV

= dry rodded density × bulk volume

$= 105\ lb/ft^3 \times 0.69$

$= 72.45\ \frac{lb}{ft^3} = \frac{72.45 \times 0.45}{(0.3)^3}\ kg/m^3$

$W = V\gamma$

$= 1207.5\ kg/m^3$

Volume of cement, $V = \frac{W}{\gamma} = \frac{\text{weight of cement}}{\text{sp. gravity} \times \gamma_w}$

$= \frac{339.3}{3.15 \times 1000\ kg/m^3}$

$= \frac{339.3 \times 100 \times 100 \times 100}{3.15 \times 1000}\ cm^3$

$= 107.71 \times 10^3$

Volume of water $= \frac{190 \times 100^3}{1000} = 190 \times 10^3\ cm^3$

Volume of ~~fine~~ CA $= \frac{1207.5 \times 100^3}{2.68 \times 1000} = 450.56 \times 10^3\ cm^3$

air = 2% of 1 m^3 of concrete

$= \frac{2}{100} \times 10^6 \ cm^3 = 20 \times 10^3 \ cm^3$

total volume = $768.27 \times 10^3 \ cm^3$

volume of FA = $(1000 - 768.27) 10^3 \ cm^3$

$= 231.73 \times 10^3 \ cm^3$

$W = V\rho$
$= V \cdot sp\gamma_w$

Weight of FA = $\frac{231.73 \times 10^3}{100 \times 100 \times 100} \times 2.61 \times (1000) \ kg/m^3$

$= 604.82 \ kg$

Cement : FA : FA : water = 339.3 : 1207.5 : 604:82 : 190

=

Adjustment of field condition

surface moisture of FA = 2%

total free surface moistane = $604.82 \times \frac{2}{100}$

$= 12.09 \ kg/m^3$

Actual weight of FA = 604.82 + 12.09 =

Net water content = 190 - 12.09 =

Cement

Class prob

W/C = 0.63

Volume of cement = 100 cc

Relative density of unhydrated cement = 3.14

" " " hydrated " gell = 1.74

The cement combines chemically 23% of its own weight with water. Find the volume of void after 50% hydration.

Soln

$W = pV$

Degree of hydration at 0%

Volume of unhydrated cement = 100 cc

Weight of " " $= (100 \times 3.14)$ gm

$= 314$ gm

$\frac{W}{C} = 0.63 \Rightarrow W = (0.63 \times 314)$ gm

$= 197.82$ gm

$\rho_w = 1$ gm/cc

Volume of ~~unhydrated~~ water = 197.82 cc

Total volume $V_{T\,0\%} = (100 + 197.82)$ cc

$= 297.82$ cc

Degree of hydration of at 50%

Volume of unhydrated cement = $100 \times 50\%$

$= 100 \times 0.5 = 50\ cc$

Volume of hydrated product = $\frac{0.5[314 + 314 \times 23\%]}{1.74}$

$= 110.98\ cc$

Total volume $V_{T\,50\%}$ = $(50 + 110.98)\ cc$

$= 160.98\ cc$

Total volume of voids = $V_{T\,0\%} - V_{T\,50\%}$

$= (297.82 - 160.98)\ cc$

$= 136.84\ cc$

CT

5) $W_c = 500\,gm$

$W/c = 0.55$

Relative density of ~~cement~~ unhydrated cement = 3.15

" " " hydrated " = 1.76

Cement combines ~~27~~ 23% of its own weight

Find the volume of voids after full hydration

Soln For,

Degree of hydration at 0%

Weight of cement = 500 gm

$\frac{W}{c} = 0.55 \Rightarrow W = (500 \times 0.55)\,gm$

$= 275\,gm$

Volume of water = 275 cc $\quad W = \rho V$

Volume of unhydrated cement = $\frac{500}{3.15}$

$= 158.73\,cc$

$V_{T\,0\%} = 158.73 + 275 = 433.73\,cc$

For DH at 100%

Volume of unhydrated cement = ~~158.73~~ 158.73 ~~500~~ × 0%

= 0 ~~gm~~ cc

Volume of hydrated product = $\frac{1[500 + 500 \times 0.23]}{1.76}$

= 349.43 cc

$V_{T\ 100\%}$ = 0 + 349.43 = 349.43 cc

Volume of ~~total~~ voids = $V_{T\ 0\%} - V_{T\ 100\%}$

= 433.73 − 349.43

= 84.3 cc

2012

~~7b)~~

7)d.) $V_{uc} = ?$

Volume of void = 140 cm^3 after 50% hydration is completed

Let,

Weight of cement = x gm

DH at 0%

Volume of unhydrated cement = $\frac{x}{3.14}$ cc

$\frac{W}{C} = 0.63$

~~$\Rightarrow W = 0.63 \times \frac{x}{3.14} = 0.2x$~~

$\Rightarrow W = 0.63x$ gm

Volume of water = $\frac{0.63x}{1} = 0.63x$ cc

V_T 0% = $\frac{x}{3.14} + 0.63x = 0.948x$

DH at 50%

Volume of unhydrated cement = $\frac{x}{3.14} \times 0.5$

= 0.1

DH at 50%

Volume of unhydrated cement $= 0.5x \times \frac{x}{3.14}$

$= 0.16x$ cc

Volume of hydrated product $= \frac{0.5[x + 0.23x]}{1.74}$

$= 0.35x$ cc

$V_{T\,50\%} = 0.16x + 0.35x = 0.51x$

$V_v = V_{T0\%} - V_{T\,50\%}$

$\Rightarrow 140 = 0.948x - 0.51x$

$\Rightarrow 140 = 0.438x$

$\Rightarrow x = 319.63$ gm

$\therefore V_{uc} = \frac{x}{3.14} = \frac{319.63}{3.14} = 101.79$ cc

$\therefore V_{uc} = 0.16x = 0.16 \times 319.63 = 51.14$ cc

2017
8.c) $20L = 0.02 m^3$

Amount of water = $150 kg/m^3$

for $0.02m^3$, water = 3 kg

$\frac{W}{C} = 0.46$

$\Rightarrow$ Cement = $\frac{150}{0.46} = 326.08 kg/m^3$

for $0.02m^3$, cement = 6.52 kg

W=ρV

Weight of CA = $100 lb/ft^3 \times 0.66$

$= \frac{100 \times 0.45}{(0.3)^3} \times 0.66$

$= 1100 kg/m^3$

for $0.02m^3$, CA = 22 kg

Vol of cement = $\frac{6.52}{3.15 \times 1000}$

$= 0.0021 m^3$

Vol of water = $\frac{3}{1000}$ = 0.003 m^3

Vol of CA = $\frac{22}{2.70 \times 1000}$ = 0.008 m^3

air = 2.5% of 0.02 m^3 of concrete

= $\frac{2.5}{100} \times 0.02$ = 0.0005 m^3

V_T =

2017

8)b) W/C = 500 gm

$\frac{W}{C} = 0.55 \Rightarrow W = 275$ gm

Gel/space, $x_{60} = \frac{\alpha C V_c \times 2.06}{\alpha C V_c + W_0}$

$= \frac{0.6 \times 500 \times 0.319 \times 2.06}{0.6 \times 500 \times 0.319 + 275}$

$= 0.53$

Strength $= 2400 x^3$

$= 2400 (0.53)^3 = 357.3$ kg/cm^2

2017

6)d) At 10 days,

$M_{10} = 10 \times 12 \times [20 - (-11)] + 10 \times 12 \times [10 - (-11)]$

$= 6240$ °Ch

$\%$ strength $= A + B \log \frac{M}{1000}$

$= 32 + 54 \log \frac{6240}{1000}$

$= 74.94$

$S_{10} = 300 \times \frac{74.94}{100} = 224.82$ kg/cm^2

At 5 days

$$M_5 = 5 \times 12 \left[25 - (-11)\right] + 5 \times 12 \left[5 - (-11)\right]$$

$$= 3120 \text{ °Ch}$$

$$\% \text{ strength} = 32 + 54 \log \frac{3120}{1000}$$

$$= 58.68$$

$$S_5 = 300 \times \frac{58.68}{100} = 176.04 \text{ kg/cm}^2$$

At 5 days

$$M_5 = 5 \times 12 \times \left[25 - (-11)\right] + 5 \times 12 \times \left[10 - (-11)\right]$$

$$= 3420 \text{ °Ch}$$

$$\% \text{ strength} = 32 + 54 \log \frac{3420}{1000}$$

$$= 114.84$$

$$S_5 = 300 \times \frac{114.84}{100} = 344.52 \text{ kg/cm}^2$$

y, Ranga bala

$W = Vp$

2018

8.b) volume of cement $= 200\,cc = \frac{200}{100\times100\times100} = 0.0002\ m^3$

Weight of cement $= 0.0002 \times 3.15 \times 1000 = 0.63\ kg$

$= 630\ gm$

$\frac{W}{C} = 0.6 \Rightarrow W = 0.6 \times 630 = 378\ gm$

$$x_{100} = \frac{C V_c \times 2.06}{C V_c + W_o}$$

$$= \frac{630 \times 0.319 \times 2.06}{630 \times 0.319 + 378}$$

$$\doteq 0.7$$

$$S_{100} = 2400\,(0.7)^3 = 823.2\ kg/cm^2$$

CT(1) → 17

CE 2103-CT1 [17 Series]

Full Marks: 20 Time: 20 min

1. Sea sand is suitable for construction, if not, explain why. 03
2. Define bulking of sand. Bulking of fine sand is higher than that of coarse sand, explain. 04
3. Define F.M. of aggregate. What is the principle of grading curve? 04
4. Explain importance of grading curve. 03
5. Three different types of sand A, B, C were mixed in the ratio of 1:3:6 and their fineness modulus were 2.40, 'x', and 2.70, respectively. Calculate the value of 'x' if the combined fineness modulus is 2.56. 06

Nisha
1700082

CE 2103-CT2 [17 Series]

Full Marks: 20 Time: 20 min

1/ Differentiate between False and Flash setting of cement. 03

2/ Explain why carbonation is advantageous to non reinforced concrete. 03

3/ Where do you recommend to use high alumina cement and where you do not? Where to use Type III cement? 04

4/ State the characteristics of pozzolona, Why does rapid hardening cement be economical? 05

5/ A work contains 500 gm. of cement and required w/c ratio was 0.55. Find out volume of voids after full hydration is completed. Assume relative density of unhydrated cement and hydrated cement are 3.15 and 1.76, respectively. Cement combines chemically 23% of its own weight with water. 05