Introduction to Fresh Concrete :

The production of good concrete mix is important for quality construction. the desirable characteristics of good fresh concrete mix is

1. Possibility of Easy Transport & placing.
2. Resistance to Bleeding & Segregation Reactions

The overview of the concrete production process is systematically Explain by the following flow chart

Stages of production of concrete :

Batching of the Ingridients

↓

Mixing of the Ingredients in proper propoitions

↓

To obtain the fresh concrete from above 2 stages

↓

To Transpoit the fresh concrete to constructions spot

↓

Test the sample concrete mix

↓

place the concrete mix where it is required

↓

After that compacting the concrete mix without air voids

↓

Curing is done properly for req days i.e 7 days (or) 14days

↓

Proper Finishings is done

↓

Hardened concrete is obtained

Batching of concrete ingredients :

In this process of Batching in concrete production work two ways to done :

1. Volumetric Batching
2. Weigh Batching

Volumetric Batching :

→ In this volumetric Batching we are using box guages (or) volumetric vessels to measure the Ingradient volume

→ It is an approximate method. No skilled Labour is not required in volumetric Batching

→ the production of concrete by volumetric batching require more materials because of its improper propotions of mix

→ Generally, this type of Batching is used in unimpotant concrete works

* Compute the volume of constituent materials for the Batch of 1 bag cement. the concrete mix propations 0.45 : 1 : 1.861 : 3.583 (water : cement : Fine Agg : Coarse Agg) the Bulk Density of Fine. Agg is 1500 Kg/m³. The Bulk Density of coarse Agg is 1450 Kg/m³.

Al-

Given data,

1 Bag = 50 Kgs

Bulk Density of cement = 1440 Kg/m³ (standard value)

Cement = 1 , water = 0.45

Fine = 1.861

Coarse = 3.583

(8)

Weight of Cement = 50 Kg

Weight of Fine Agg = 50 × 1.861
= 93.05 Kg

Weight of Coarse Agg = 50 × 3.583
= 179.15 Kg

Weight of water = 0.45 × 50
= 22.5 Kg

Assume,

Density of water = 1000 Kg/m³

Vol of Cement for 1 bag = $\frac{50}{1440}$

= 0.0349 m³

= 0.0349 × 1000 lit

= 34.9 lit

Vol. of ~~Cement~~ fine Agg = $\frac{93.05}{1500}$

= 0.0620 m³

Vol of Coarse Agg = $\frac{179.15}{1450}$

= 0.1235 m³

Vol of water = $\frac{22.5}{1000}$ = 0.0225 m³

= 22.5 lit

Compute the

0.48 : 1 : 2.962 : 4.19 . Bulk Density of fine Agg 1510 Kg/m³

Bulk Density of coarse Agg is 1480 Kg/m³

Weight of cement = 50 Kg

Weight of Fine Agg = 50 × 2.962
= 118.1

Weight of coarse Agg = 50 × 4.19
= 20.95

Weight of water = 0.48 x 50
= 24

Assume, Density of water = 1000 kg/m³

Vol of cement = $\frac{50}{1440}$ = 0.0347 m³
= 34.7 lit

Vol of Fine Agg = $\frac{118.1}{1510}$ = 0.078 m³

Vol of coarse Agg = 0.0141 m³ = $\frac{20.95}{1480}$

Vol of water = $\frac{24}{1000}$ = 0.024 m³
= 24 lit

Way Batching :—

The Batching of constituent materials by weights provides better accuracy & reliability.

In this Batching procedure the weights of materials are taking into consider

Computer control & automatic waying systems are used in large Batching plants (Redimix plant)

The Weight Batching systems are calibrated frequently to maintain uniformity in quality of concrete

Generally in Bulk production works the way Batching system is used

A skilled Labour is required for good operation of mix proportions. and also the loss of materials is very less when compared to volumetric Batching

Due to Wacy Batching we are acheiving good quality of fresh concrete

Mixing :

Mixing is the process of dispersing the constituent materials uniformly in fresh concrete mix. The mixing is continue until the fresh mass becomes Homogenous and uniform colour.

Mixing process is classified into 2 major types

1. Hand mixing
   Ba → Batch
2. Machine mixing

Batch mixing → Continous mixing

a) Tilting Drum mixer
b) Non Tilting Drum mixer
c) Pan Type mixer
d) Dual Drum mixer

Hand Mixing :

* Hand mixing is used in small scale & unimportant construction works
* In Hand mixing process the quality of fresh concrete is Effected by the workmanship.
* The cement & Fine Aggregate are initially mixed properly in dry condition
* The coarse Aggregate is spread over the cement Sand mixture in Alternative layers
* The Dry mix is turned 2 - 3 times to acheive Homoginity.
* In this Hand mixing process Initially 75 % of Water is added to the dry concrete mix and mixed thoroughly.
* After that remaining 25 % of water is sprinkled over the concrete mix to acheive Homoginity and Uniformity in colour
* In this Hand mixing process we require non absorbing platforms (or) steel plates during the time of mixing.

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FRESH CONCRETE

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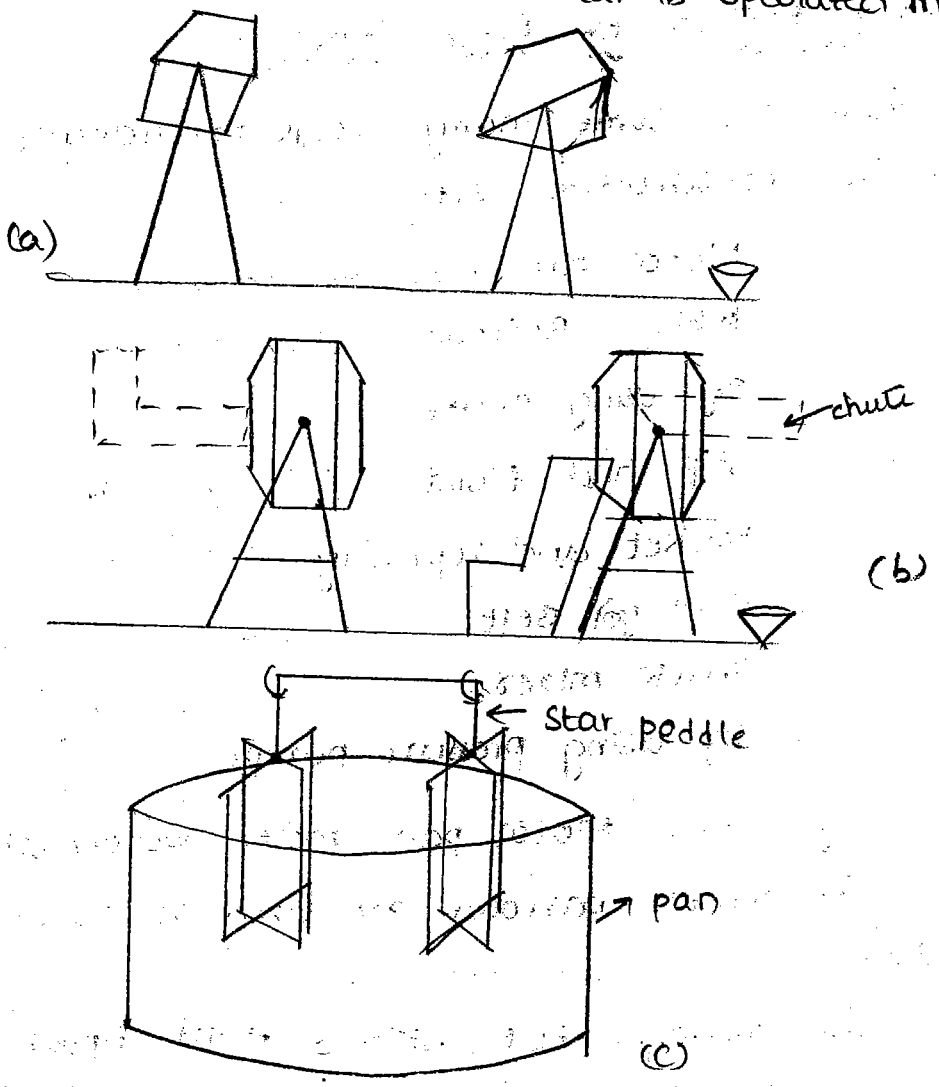
Machine mixing :—

→ The machine mixing operatos consists sharp blades to mix the concrete ingredients properly.

→ Generally this concrete mixing operatos are worked by using fuel (or) Electricity.

→ Both Batching and continuous mixers are done in this type of mixing.

→ This Tilting-type machine mixer (a) is operated manually



In this type a mixer having a problem with inconvinence in sharp blades & drum axis and other mechanical properties Generally all the ingredients of concrete is added to the drum 50·1. of water content is charged and thoroughly mixed sometime. After that 30·1. of water is charged into the drum & do continous mixing until the Homogenity and unifomity in colour is occured.

→ Remaining 20·1· of water is added before the removal of concrete mix from the machine mixer. At that time we are also adding the chemical addmixture to the concrete mix.

→ the pan type machine mixers are used for the mixing the cohesive concrete in less water content.

→ Generally these type of mixer are used in Bricks manufacturing Industry.

Transportation of fresh concrete :

There are some many ways to Transport the fresh concrete to the construction site.

- Motor pan
- Wheel Barrows
- By using chute
- Skip and Hoist
- Bouket and ropeway
- Conveyor Belt
- Truck mixer
- By using pressure pumps.

→ By using Motor pan more workmenship is required.

→ the wheel barrows are used in Road construction works

→ the conveyor belt, skip & Hoist Apparatus are generally used in multi storing Building construction

→ the chute Apparatus are used in Transporting the fresh concrete from higher level to lower levels

→ Bucket and ropeway system is used in water island works. Because the construction spot is present in water body that's way we are Transporting the fresh concrete through Bucket & rope way.

→ The truck mixer are used in Batching plants
→ Generally these ready mix trucks are used in long way to transport the fresh concrete.
→ The concrete is mixed in this ready mix trucks during the travelling time.

Tests on Fresh Concrete :

1. Consistency of concrete
2. Firmness
3. Stiffness
4. Solidity
5. Stability of concrete
6. Thickness of concrete
7. Flowing ability
8. Fluidity
9. Filling Ability
10. Passing Ability

Factors Influencing workability of concrete ; —

Factors

- Quantity of Ingridients used
  - → Cement
  - → Water
  - → Aggregate
  - → Fine & Coarse Agg ratio in concrete mix
  - → Add mixture percentage
- Properties of Aggs
  - → Size
  - → shape
  - → Surface Texture
  - → grading of Agg
  - → Type of Agg i.e light, Normal & Heavy wt Agg

Quantity Based :-

* The Workability of concrete is increases due to increase in cement & Fine Aggregate content.
* For Increasing these Ingredients in concrete mix the construction cost will be Increasing
* We are acheiving more degree of workability by increasing water content in concrete mix, but Increasing of water content gives less Compressive strength
* At the same time the addmixture also influence the degree of workability
* If you are adding more addmixture than the required the segregation rea^{n} takes place in concrete mix
* If you are increasing the mineral addmixture content we shouldn't acheive Bonding property in Concrete mix.

Properties Based :

* the less size (or) small size Agg yields less workability than the large size Aggregates
* the Flaky & Elongated Agg's yields less workability when compared to rounded shape Agg's. Why because "the Flaky & Elongated shape Agg's are interlocked with one another to block the flow of concrete mix"
* the less weight Agg's yields less workability than the heavy weight Agg "because of its pores in the Internal structure"

Tests on Workability of Fresh Concrete :-

Fresh concrete is sub divided into 2 types:

Fresh concrete

- Normal Concrete mix
- Self Compacting Concrete

It consists cement, Fine Agg, coarse Agg and water

Self compacted Concrete :

It consists cement, Fine Agg, Coarse Agg, mineral add mixture, chemical Addmixture & water content

Tests on Nolmal concrete mix :

1. Slump Cone Test
2. Compaction Factol Test
3. Flow Table Test
4. Vee-bee consistency Test

} According to IS-1199-1950

5. Flow Test (IS-9103-1999)

Slump cone Test :—

By using slump cone Apparatus we are calculating the slump of concrete mix. Based on various Ranges of slump the degree of Wolkability to be determined

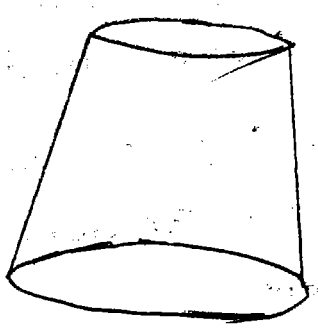
the slump cone Apparatus consists conical shaped mould having 10 cm top dia & 20cm bottom dia and 30 cm of cone Height

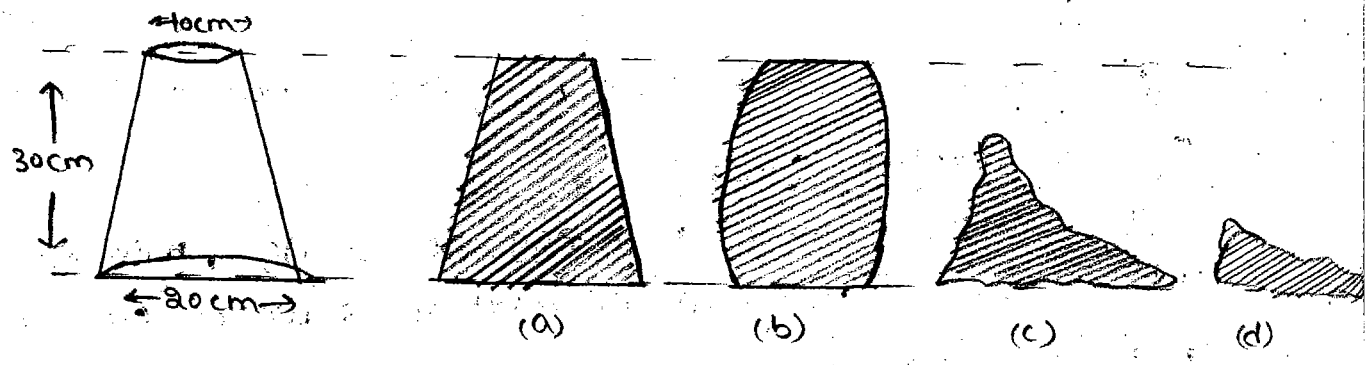
Intially we are preparing the concrete mix to our req proportion.

put the conical mould on flat surface and fill with concrete mix by 3 layers. Each layer must be tamped by using Tamping Rod.

Cienerally in slump cone Test the following slump conditions are occured

a) zero slump
b) True slump
c) Shear slump
d) collapsed slump





Zero slump Indicates a stiff consistent concrete mix. The slump test is not appropriate for measuring the workability of stiff concrete mix.

The True slump is characterize the homoginity of the concrete mix.

The shear slump Indicates the Improper mix (or) Non Homoginity main concrete mix

The collapsed slump represents the lean concrete mix ↑ slope (or) tampered

Workability conditions :

* If the slump value vary blw 0 to 25 mm the concrete mix having very low degree of workability

→ Generally these type of concrete mix are used in Road Construction works & large sections of massive Constructions where power vibrators are used

* If the slump value vary blw 25 to 50 mm the concrete mix having low degree of Workability

→ this type of concrete is used in road constructions & mass concrete foundations where Hand operated vibrators are used

* If the slump value vary blw 50 to 100 mm the concrete mix having moderate (or) Medium degree of Workability

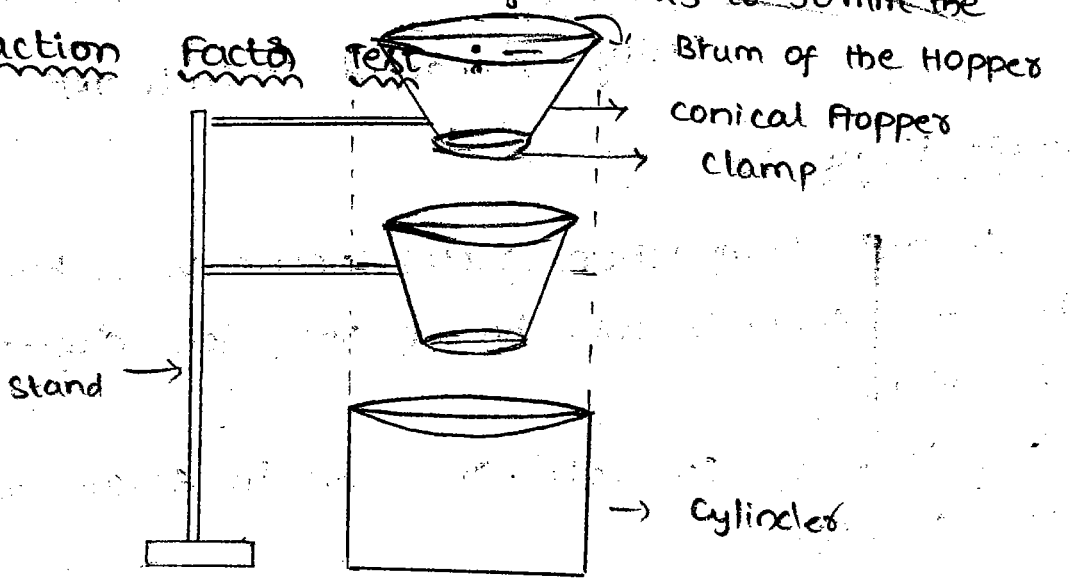
→ this type of concrete used in Flat slabs & Normal Reinforced Construction works where manual compaction is done

If the degree of workability ranges blw 100 to 175 mm then the concrete in Heavy (or) High degree of workability.

Generally this type of concrete are used in conjusted reinforcement is present in construction works. and large Sections of ~~massive constructions~~, power vibrators are used

* If the ~~stamp value vary~~ blw 25 to 50 mm the

Compaction Factor Test



It is used to determine the consistency of a stiff concrete mix

The C-F test apparatus consisting 2 conical Hoopers fitted to a stand (or) fixed Base and a movable cylindrical mould is present to below of bottom conical Hopper.

Intially we must close the clamps which are present below the Hoppers and prepare concrete mix to our require propsitions and fill concrete mix upto the top surface of the brim of top conical Hopper

After 2 min the clamp is released than the concrete mix is filled to the Bottom conical Hopper then after we are releasing bottom clamp also the cylinder is filled with the partially compacted concrete.

Intially we are weighing the empty weight of cylinder after that we are also measure the partially

Compacted concrete

After that we are also measuring the fully compacted concrete in the cylinder by 3 layers

∴ The compaction factor value is

$$\frac{\text{Partially compacted concrete weight}}{\text{Fully compacted concrete test}}$$

Limitations :—

→ If the compaction factor value vary blw 0.78 - 0.80 than the concrete mix having very low degree of workability.

This type of concrete are used in small oriented slc with vibration

→ If the C.F value vary blw 0.85 to 0.92 than the concrete mix having medium degree of workability Generally this type of concrete are used in light reinforced slc with vibrations.

→ If the C.F value is above 0.92 than the concrete mix having high degree of workability. Generally these are used in Heavy reinforced slc without vibrations

Vee- Bee Consistency Test :—

The Vee-Bee Consistency Apparatus is used to determine the workability of stiff concrete mix.

The Test Apparatus Consist a vibrating Table and a cylindrical mould with slump cone Apparatus and a stand Base is fitted to the vibrating table in addition to a conical funnel and movable glass disk

Initially we are preparing the concrete mix in the required proportions and fill the concrete mix into slump cone mould by layers and slowly remove the mould (by layers and slow)^ from the cylinders and place the glass disk at top surface of cone shaped mix and start the vibrator machine & stopclock at a time and measure the time of settlement of (vee-bee time) particular concrete mix.

Limitations :

→ If the vee-bee time vary blw 10-20 sec. the degree of workability is very low and the concrete is used in small slc with vibrations.

→ If the vee-bee time vary blw 10-5 sec, the degree of workability is low

→ If the vee-bee time vary blw 5-2 sec, then the degree of workability is medium (a) High

→ The concrete is generally used in high reinforced slc without vibration

Flow Table Test :

* It is used to determine the Fluidity of concrete mix

The Flow table test apparatus consisting a frustum of a cone is used to place the concrete

The concrete is filled in the mould & kept on the top of table

The top surface of the conical mould is trimmed and lift it.

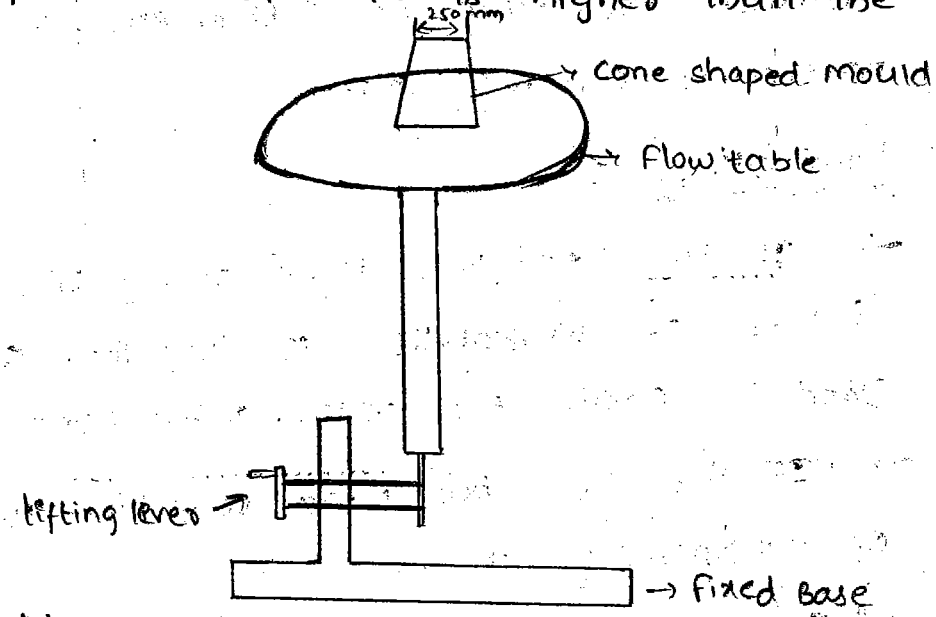
The base dia of conical mould is 250 mm

The table is raised and dropped 15 times at a standard speed

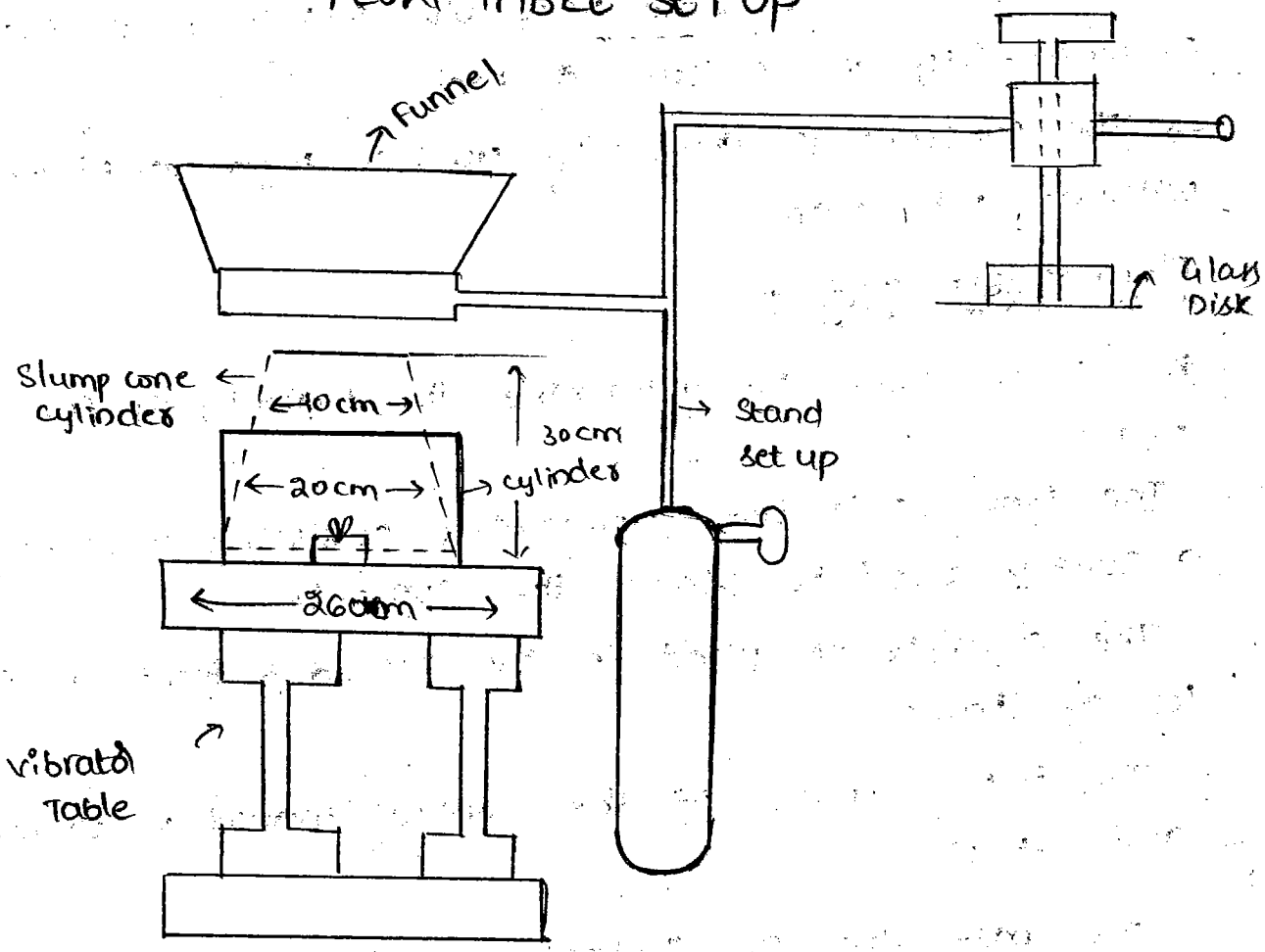
The spread of concrete on the table recorded.

Flow is the percentage increase in the dia of the spreaded concrete over the original dia.

The flow of the lean mix is higher than the stiff mix



FLOW TABLE SET UP



VEE-BEE APPARATUS

Workability Test

- Normal concrete
  - IS 1199 - 1950
    - Slump Test
    - Compacting factor Test
    - Flow Table Test
    - Vee-bee Consistency Test
  - IS 1903-1999
    - Flow Test
- Self compacting concrete
  - Slump Flow Test
  - V - Funnel Test
  - L - box Test
  - U - box Test
  - J - Ring Test
  - Orimet Test
  - GTM Screen stability Test

Compacting :

Compacting

- Hand Compaction
  - Rodding
  - Ramming
  - Tamping
- Vibration Compaction
  - Internal
    - → Needle
  - External
    - → Form
    - → Table
    - → platform
    - → Screened
- Roller Compaction
- Spinning Compaction
- pressure Compactio

Compaction is the process of removing entrapped air bubbles from the fresh concrete and improving the ~~tamper~~ packing of Agg to form dense concrete.

the presence of air bubbles in concrete mix results in honey combing (or) Blow holes in concrete

It directly Effects the strength of structure

the Approximate air content in fresh concrete is 25°1.

which is reduced to 2-5 %. by proper compaction the compacted concrete is dense, strong and durable A poorly compacted concrete requires to be repaired in early stages of its service.

Curing :

Curing is the process of controlling the moisture loss from the concrete during the Hydration of cement. curing influences the strength and durability properties of the Hardened concrete.

the surface of the concrete exposed to sun (&) dowing wind.

It is senstive to curing.

Curing is started Immediately after stiffening of Fresh concrete (&) final setting time

the proper curing results more strength to the structure, Durability and good living of Human

Advantage

Advantage of curing is to avoid structural cracks in Hardened concrete

Methods of curing :

there are so many ways to curing the concrete structure

1. Water curing →
   - Immersion
   - Ponding
   - Fogging & spraying
2. Steam curing →
   - Steam at Atmospheric pressu
   - Steam at High pressure
3. Covering curing →
   - Wet covering
   - Membrane curing

4 Special methods → { Heating form Radiation
Microwave curing
Infrared curing

5. Electrical curing → { Internal → { Concrete, Rebars, Steel wires
External → { Blanket, Steel forms

Effect of Temperature on Workability :— (Flow ability of concrete)

When fresh concrete is laid at the side then proper curing of concrete is required because the structures are exposed to the environment and in these conditions if there is such arrangments against environment is not provided then so many factors effecting the workability of the concrete.

Temperature is one of the factor among all other environmental conditions.

When the temperature increases than in the same proportion the workability of fresh concrete is decreases

When the temperature decreases the workability of concrete may increases at some extent the reason that stands behind is when temperature increases the rate of evaporation of water also increases due to hydration of cement.

The rate of evaporation is decreases hence the concrete will gain early strength. Due to the fast hydration of concrete the concrete gets hard in early time.

Segregation process :——

Segregation can be defined as the separation of constituent materials of concrete mix. A good concrete exhibits good compresive strength and absence of structural cracks.

The Tendency of segregation in concrete mix due to improper selection of concrete Ingredients and poor Workmanship.

Due to the segregation process in concrete mix we acheive Weak strength to the structure and the surface cracks and structural cracks are developed in concrete structure

In generally, the segregation process is of 3 types :

1. The seperation (or) settling down of coarse Agg from cement matrix ↔ (other than coarse Agg in concrete mix)
2. the seperation of cement matrix from coarse Agg
3. The seperation of Excess water (or) the water content present in the concrete mix proportion

these are the 3 Ways of segregation process

→ The Favourable conditions for segregation process are

1. Due to the Excess Water content using in the process of Mixing
2. In long columns (slenders) (or) deep foundations the dropping of concrete mix from High levels

How to avoid segregation

To take care about the selection of materials like grading, shape, Texture & optimum moisture Content will results good concrete mix proportion

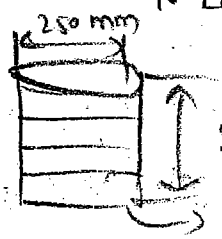
It gives good bond strength to the Concrete structure the cohesive mix shouldn't allow any type of segregation process.

Bleeding of concrete mix :—

The seperation (or) the exhibition of excess water content present in the concrete mix appears on the Top surface of the concrete structure after placing. It is called Bleeding of concrete in Concrete mix

So, We are finding the % of Bleeding water content in Concrete mix proportion is the Ratio of Total water content loss (or) present on the surface of the concrete structure to the Total water content adding to the sample concrete mix

$$\% \text{ Loss of Water} = \frac{\text{Total water collecting from pipette}}{\text{Total water content added to Concrete}} \times 10$$



Fill 5 layers of concrete

Then we Tamp with tamping rod then we get a water at above layer the layer of water will take it out by pipette.

5. MIX DESIGN

To calculate the mix design for a concrete proportion is,

step I :—

To calculate the target strength (f'_{ck}) of mix proportion we are using IS - 10262 : 2009 table 1 for taking standard deviation and the target strength f'_{ck} is

$f'_{cb} = f_{ck} + 1.65 * S$ from class - 3.2 IS 10262 : 2009

$= 40 + 1.65 * 5$

$= \underline{48.25}$

step II :-

slection of water cement ratio is taken by from IS 456 : 2000 table 5

$W/c = 0.40$ and

$c = 360 \text{ kg/m}^3$.

We are taking data from table 5 IS 456 : 2000 to our required conditions

step III :-

slection of water content from IS : 10262 : 2009 table 2 . we are assuming the normal size of Agg as 20 mm.

$W = 186$ lit

For calculating water content we are following table - 2 IS 10262 : 2009 clause NO. 4.2

step IV

calculation of cement content

$W/c = 0.40$

$140/c = 0.40$

$c = 350 \text{ kg/m}^3$.

We are calculated the cement content value from w/c ratio and we are checking the appeared value from table - 5 is IS. 456 : 2000

step 5 :

The proportion of coarse & fine Agg :

0.40 - 0.60

0.50 - 0.60

0.40 - 0.62

0.40 - 0.62 * 0.9

= 0.56

1 - 0.56 = 0.44

The volume of coarse Agg can be estimated from table - 3 in IS 10262 : 2009

The adjustable values taken from the data i.e., exist in class 4.4

And the reduction of coarse Agg according to placing of concrete can be taken clause 4.4 in IS 10262 : 2009.

The calculations are done according to the IS : 10262 : 2009 - clause 4.6.

Grade designation - M35

Type of cement - OPC 43 grade.

Max. nominal size of Agg - 20 mm.

target strength for mix proportioning

$f'_{ck} = f_{ck} + 1.65 * s$

$f_{ck} = 35$

$s = 5\ N/mm^2$

$f'_{ck} = 35 + 1.65 * 5$

$= 43.25\ N/mm^2$

W/C ratio = 0.45

Max water content = 186 lit for 20 mm agg

water content for 100mm slump

$= 186 + \frac{6}{100} * 186$

$= 197.16$

Water content = $197.16 * 0.71 = 140$ lit

w/c ratio = 0.45

cement content = $\frac{140}{0.45} = 311.11\ kg/m^3$

For 20mm — 0.60

0.45 — 0.61

volume of coarse Agg = $0.61 * 0.9 = 0.54$

volume of fine Agg content = $1 - 0.54$

$= 0.46$

Illustrate the mix design proportion for a concrete grade of M35 :—

Concrete mix used in reinforcement at very severe exposure condition. The nominal size of Agg is 20mm. The method of placing of concrete is pumpable and we are using superplasticizer (water reducing agent 1.2%)

It having a specific gravity 1.25. The specific gravity of coarse Agg. 2.59. specific gravity of fine Agg 2.58. sp.gravity of cement 3.15 for opc of 43 grade.

Given data

Type of cement = opc of 43 grade

The min cement content = 340 kg/m^3

sp.gravity of cement = 3.15

exposure condition = very severe for reinforce cement concrete method of concrete placing is pumpable.

Max w/c ratio = 0.45 [IS 456 : 2000 table-5]

Nominal size of Agg = 20mm

workability = 100mm.

Type of addmixture = super plastreizer (1.2%

Type of Agg = crushed Angular Agg

Test data :—

specific gravity of coarse Agg = 2.59

specific gravity of fine Agg = 2.58

Step 1:-

Calculate the target strength of concrete mix

$$f'_{ck} = f_{ck} + 1.65 * s$$

[IS 10262 : 2009 clause 3.2)

Where f'_{ck} = target strength of concrete mix N/mm²

f_{ck} = characteristic compressive strength

s = standard deviation.

[IS - 10262 : 2009 table 1)

$$f'_{ck} = 35 + 1.65 * 5$$

$$= 43.25 \text{ N/mm}^2$$

Step 2:

Selection of w/c ratio

Max. w/c ratio = 0.45 [IS 456 : 2000 table 5)

[For every severe exposure condition)

Based on experience we are adopting a w/c ratio of 0.40

Step 3:-

Calculation of water content from table - 2

IS - 10262 : 2009

According to Nominal size of Agg 20mm water content w = 186 lit (or) kgs (for 25-50 mm slump)

Workability = 100 mm slump.

From clause 4.2 IS 10262 : 2009 the water

$$W = 186 + \frac{6}{100} * 186$$

$$= 197.16$$

By using super plasticizer we are reducing the water content upto 20% from clause 4.2 I.S -10262 : 2009

$$W = 197.16 * \frac{80}{100}$$

$$W = 157.728 \text{ lit}$$

Step 4:-

Calculation of cement content

$$\frac{W}{C} = 0.40$$

$$\frac{157.728}{C} = 0.40$$

$$C = 394.32 \text{ kg/m}^3$$

from table - 5 IS - 456 : 2000 the mix cement content = 340 kg/m³

394.32 > 340 kg/m³

Hence OK.

Step 5:-

Calculation of Agg volume.

From table - 3 IS - 10262 : 2009

Assume fine agg zone - II

$$\frac{w}{c} = 0.50 = 0.62$$

$$0.40 = 0.64$$

In our present mix proportion is designed for a w/c ratio 0.40

There is an increase coarse Agg according to the rate of change ± 0.50% of change in w/c ratio is respectively change of ± 0.01

0.40 = 0.64

From relause 4.41 the concrete is placed by using pumps

The reduction of coarse Agg content is 10% from table-3, IS-10262:2009

coarse content = 0.64 * 90/100

= 0.576

Fine Agg content = 1 - 0.576

= 0.424

Step-6 :—

calculation of Mixdesign.

volume of concrete = $1m^3$

volume of cement = $\frac{\text{Mass of cement}}{\text{sp gravity of cement}} * \frac{1}{1000}$

$= \frac{394.32}{3.15} * \frac{1}{1000}$

$= 125.18 * 0.001$

$= 0.125 m^3$

The design procedure for calculation of mix proportio

Note :

We need test data for various ingredients which are present in concrete mix those are specific gravity of cement, s.p of coarse agg, s.p of fine Agg. s.p of Addmixture, the % of adding addmixture. transportation procedure (or) Method of placing (or) type of cement grade designation and various concrete test procedure.

Step 1 :—

To calculate the tarqet strength of concrete :

For M40 grade the tarqet strength :

$f'_{ck} = f_{ck} + 1.65S$ [From IS-10262-2009 clause 3.2]

Where $f_{ck} = 40 N/mm^2$

f_{ck} → characteristic compressive strength of concrete at 28 days in N/mm^2

S → standard deviation in N/mm^2

S value is taking from IS 10262 from Table I

$f'_{ck} = 40 + 1.65 * 5$

$= 48 N/mm^2$

Step 2 :—

selection of water/cement ratio.

The water/cement ratio is taking from table NO. 5 in IS-456-2000".

Maximum water content i.e.,

Water cement ratio = 0.40 [from codal provision]

The w/c ratio for M40 grade is 0.40 . In certain conditions based on the experience we may reduce the w/c ratio.

step 3:-

selection of water content :—

The water content is selected from IS :10262 from Table NO:2

The water content is selected based on the nominal maximum size of Agg.

Assume the max. nominal size of Agg is 20mm.

∴ The corresponding maximum water content from table is 186 lits (or) kgs

We need to check (or) follow the clauss 4.2 for selecting the water content value.

clause 4.2 indicates the shape of Agg & slump value and the usage of super plasticizer (admixture) based on the Reduction value, (or) adding %'s from class 4.2 we are finally estimating the water content value.

step 4 :- selection

~~calculation~~ of cement content.

cement content is calculated from w/c ratio is selected from step 3

$w/c = 0.40$

w = water content = 186 lit

$$c = \frac{186}{0.40} = 465 \text{ kg/m}^3$$

After

w/c ratio.

It is compared with tabulated value that is present in IS-456 :2000 table-5

From table $c = 320 \text{ kg/m}^3$

From the above observation we are taking highest value of minimum cement content value from calculated and tabulated value.

step 5 :-

calculation of Agg proportions.

The coarse agg content is to be calculated from table-3 from the corresponding value of max. nominal size of Agg. w.r.to the fine aggregate zone.

The tabulated values are designed for the w/c ratio of 0.50 (from clause NO. 4.4) . IS:10262 : 2009

so, there is an increasing (or) decreasing of w/c ratio is to be observed in our design procedure the rate of change of coarse Agg content is ± 0.01 for respective change of ±0.05 in w/c ratio. so, the decreasing of w/c ratio increases coarse agg content with increase in above rate of change.

The correction of coarse agg is also depends on method of placing from clause NO. 4.4.1 IS 10262:2009

MIX PROPORTION CALCULATION

For every mix calculations we are preparing the proportion, for unit volume of concrete which means the volume of concrete is $1 m^3$.

The calculation for ingredients in mix proportions are to be calculated from clause 4.6. IS.10262:2009.

$$\text{Volume of cement} = \frac{\text{Mass of cement}}{\text{sp.gravity of cement}} * \frac{1}{1000}$$

$$\text{Volume of water} = \frac{\text{Mass of water}}{\text{sp gravity}} * \frac{1}{1000}$$

$$\text{Volume of superplasticizer (add mixture)} = \frac{\text{Mass of superplasticizer}}{\text{specific gravity}} * \frac{1}{1000}$$

Mass of chemical admixture $= \frac{2}{100} *$ step4-(c) kg $/m^3$

Sp gravity of admixture = 1.145 (from IS 383-part I)

Mass of coarse Agg = The volume of total Agg * volume of coarse Agg * Sp-gravity of coarse Agg * 1000

Mass of fine Agg = volume of total Agg * volume of fine Agg * Sp-gravity of fine Agg * 1000

calculate mix proportion for reinforced concrete — construction of moderate exposure condition. consider suitable data from the codal provision.

For moderate exposure condition the minimum grade of concrete should be taken from Table NO:5 IS: 456:2000.

∴ The min grade of concrete = M25

codal step 1:- calculate the target strength of mix proportion

For M25 grade of concrete $f_{ck} = 25 N/mm^2$

$$f'_{ck} = f_{ck} + 1.65 * S$$

Where S = standard deviation in N/mm^2

[It is taking from Table NO.1 IS:10262:2009]

$S = 4 N/mm^2$

$$f'_{ck} = 25 + 1.65 * 4$$
$$= 31.6 * N/mm^2$$

step 2:- selection of water cement ratio.

From Table NO:5 IS:456-2000

The maximum water cement ratio = 0.50

step 3:- calculation of water content.

Assume the maximum nominal size of aggregate is 20mm. [used in slab construction & Beam designed]

The water content for 20mm nominal size of Agg is 186 lit.

We are assuming the workability of the concrete is 100mm.

The maximum water content for 100mm slump

$$= 186 + \frac{6}{100} * 186$$

$$= 197 \text{ lit}$$

From clause 4.2 in IS: 10262:2009

There is a reduction of water content upto 20%

The water content for adding of super plasticizer

$$= 197 * \frac{80}{100}$$

$$= 157.6$$

Step 4:- calculation of cement content.

$\therefore$ water cement ratio = 0.50

$$\frac{157.6}{C} = 0.5$$

$$\therefore C = \frac{157.6}{0.5}$$

$$= 315.2 \text{ kg/m}^3$$

From Table NO. 5 IS:456:2000

For moderate Exposure the min content of cement

$$= 300 \text{ kg/m}^3$$

$315.2 \text{ kg/m}^3 > 300 \text{ kg/m}^3$

Hence ok

calculate volume of coarse and fine aggregate.

Assume the fine aggregate is belongs to zone II. The maximum nominal size of aggregate is 20mm.

According to that Table NO:3 IS 10262:2009 particular coarse Agg content provide.

For 0.50 w/c ratio the volume of the coarse Agg content is 0.62

The method of placing of concrete is pumpable we need to reduce the coarse agg. content by 10%.

volume of of coarse Aggregate content is

$$= 0.62 * \frac{90}{100}$$

$$= 0.558$$

Volume of fine Aggregate content is

$$= 1 - \text{V. of C.A.C}$$

$$= 1 - 0.558 = 0.442.$$

MIX calculation :-

Volume of concrete = $1 m^3$

From clause 4.6 IS 10262-2009

i) Volume of cement = $\frac{\text{mass of cement}}{\text{specific gravity of cement}} * \frac{1}{1000}$

$$= \frac{315.2}{3.15} * \frac{1}{1000} = 0.100 \text{ m}^3$$

Volume of water = $\frac{\text{Mass of water}}{\text{specific gravity of water}} = \frac{157.6}{1} * \frac{1}{1000}$

$$= 0.1576 \text{ m}^3$$

Volume of chemical admixture = $\frac{\text{Mass of chemical admixture}}{\text{specific gravity of admix}} * \frac{1}{100}$

Mass of chemical admixture = $315.2 * \frac{2}{100}$

$= 6.304 \text{ kg/m}^3$

volume of chemical admixture = $\frac{6.304}{1.145} * \frac{1}{1000}$

$= 0.0055 m^3$

volume of all aggregates = volume of concrete − [vol of cement + vol of water + vol of chemical admix]

$= 1 - [0.100 + 0.1576 + 0.0055]$

$= 0.7374 m^3$

The Mass of coarse Agg = vol of all in Agg * volume of coarse agg * specific grav of coarse agg * 1000

[from IS 10262 − 2009 clause 4.6]

$= 0.7374 * 0.558 * 2.74 * 1000$

$= 1127.4 kg$

vol Mass of fine Agg = vol of all Agg * vol of fine agg * sp gravity of fine Agg * 1000

$= 0.7374 * 0.442 * 2.74 * 1000$

$= 893.05 kg.$

The mix proportion For Trail mix M35

cement = 315.2 kg/m³ chemical Admixture = 6.304 kg/m³

water = 157.6 kg/m³ w/c ratio = 0.50

Fine Agg = 893.05 kg/m³

coarse Agg = 1123.4 kg/m³

cement : water : Fine Agg : coarse Agg

$\frac{315.2}{315.2} : \frac{157.6}{315.2} : \frac{893.05}{315.2} : \frac{1123.4}{315.2}$

1 : 0.5 : 2.8 : 3.5

slump value : 50, very severe exposure.

For very severe exp:

∴ The min grade of concrete = M35

step-1 calculate the target strength of mix proportion

For M35 grade of concrete $f_{ck} = 35 N/mm^2$

$f'_{ck} = f_{ck} + 1.65 * S$

where S = standard deviation

= 5 N/mm² [Table 1 IS : 10262 : 2009 S = 4 N/mm²]

$f_{ck} = 35 + 1.65 * 5$

$= 43.25$

step 2 :- selection of water cement ration.

From Table No. 5 IS : 456 − 2000

The max water cement ratio = 0.45

step 3 :- calculation of water content.

Assume the maximum nominal size of agg is 20 mm.

The water content for 20mm nominal size is 186 lit.

∴ slump value = 50 mm

∴ water content = 186 lit

There is reduction for adding of super plasticizer.

$$= 186 * \frac{80}{100}$$

$$= 148.8 \text{ lit}$$

step 4 :- calculation of cement content

water-cement ration

$$\frac{w}{c} = 0.45$$

$$c = 330.6 \text{ kg/m}^3$$

From table NO : 5 IS : 456 : 2000

For severe exposure the min content of cement

330.6 < 340

so, we can assume the maximum value of both min content

$$c = 340 \text{ kg/m}^3$$

calculate the volume of coarse & fine Agg.

For 0.45 w/c ratio the volume of Agg is

There is an 0.05 decrease in w/c ration increasing 0.01 for coarse Agg.

∴ volume of coarse Agg = 0.62 + 0.01

= 0.63

For pumpable of concrete reduce by 10%

volume of coarse Agg = $0.63 * \frac{90}{100}$

= 0.567

fine = 0.433

MIX calculation :-

volume of concrete = $1 m^3$

volume of cement = $\frac{\text{Mass of cement}}{\text{sp gravity of cement}} * \frac{1}{1000}$

$$= \frac{340}{3.15} * \frac{1}{1000}$$

$$= 0.107 \text{ m}^3$$

volume of water = $\frac{\text{Mass of water}}{\text{sp gravity of water}} = \frac{148.8}{1} * \frac{1}{1000}$

$$= 0.1488 \text{ m}^3$$

volume of chemical admixture.

Mass of chemical admixture = $340 * \frac{2}{100} = 6.8 \text{ kg/m}^3$

volume of chemical admixture = $\frac{6.8}{1.145} * \frac{1}{1000} = 0.00459$

volume of all in Agg = $1 - [0.107 + 0.1488 + 0.00459]$

= 0.7383

Mass of coarse Agg = $0.7383 * 0.567 * 2.74 * 1000$

= 1147.00

fine Agg = $0.7383 * 0.433 * 2.74 * 1000$

= 875.93

Illustrate

step 1 :- calculation of Target strength.

$f_{ck} = 40 N/mm^2$

$f'_{ck} = f_{ck} + 1.65 * S$

From table NO:2 IS 10262:2009] $S = 5.0$

$f'_{ck} = 40 + 1.65 [5]$

$= 48.25$

step 2 :- selection of water cement ratio.

From Table NO:5 IS 456 :2000

$w/c = 0.45$ and

step 3 :- calculation of water content

From IS 10262 : 2009 table 2

$w = 186 + \frac{6}{100} * 186 = 197.16$

$w = 186$ lit

For calculating water content we are following table-2 IS 10262 :-2009 clause NO :-~~2009~~ 4.2

There is reduction of water content upto 20 %.

∴ The water content for adding superplasticizer

$= 197.16 * \frac{80}{100} = 157.6$ lit

step 4 :- calculation of cement content

$w/c = 0.45$

$C = \frac{157.6}{0.45} = 350.2 \text{ kg/m}^3$

$350.2 > 320 \text{ kg/m}^3$

HENCE O.K

cementicious material (cement + flyash) content

$= \frac{157.72}{0.45} = 350.48 \text{ kg/m}^3$

$350.48 > 320$

Hence O/c

cementicious material content $= 350.48 * \frac{110}{100}$

$= 385 \text{ kg/m}^3$

water content $= 157.72 \text{ kg/m}^3$

30 % w/c ratio $= 0.40$

Fly ash @ 30 % of total cementicious material content $= 385 * 30\% = 115.5 \text{ kg/m}^3$

cement (OPC) $= 385 - 115.5 = 269.5 \text{ kg/m}^3$

saving of cement while using fly ash $= 350.48 - 269.5$

$= 80.98 \text{ kg/m}^3$

Flyash being utilized $= 115 \text{ kg/m}^3$

structure in mild exposure condition. Consider Nominal max size of the Agg is 20mm and assume the suitable test data using codal provision

Min grade of concrete = M20

Step 1 : Target strength of the concrete

$f_{ck} = 20\ N/mm^2$

$f'_{ck} = f_{ck} + 1.65 * S$

[From Table No. 1 IS : 10262 : 2009] , $S = 4.0\ N/mm^2$

$f'_{ck} = 20 + 1.65 * 4.0$

$f'_{ck} = 26.6\ N/mm^2$

Step 2 : Calculation of Water Cement ratio

[From Table No 5 IS : 456 : 2000]

W/c = 0.55

But we consider W/c = 0.40

(Based on experience)

Step 3 : Calculation of Water Content

From IS : 10262 : 2009 Table 2

Max Nominal size 20 given, W = 186 lit

We assume 50 slump

So, W = 186 lit (∵ Codal provisions are made to 50mm slump)

There is a Reduction of water by 20%.

∴ The water content by adding superplasticizer

$\Rightarrow 186 * \frac{80}{100} = 148.8$ lit

W/c = 0.40

$\therefore \frac{148.8}{0.40} = C$

$\therefore C = 372\ kg/m^3$.

[From Table No. 5 IS : 456 : 2000] min cement = 300 kg/m³

$372 > 300\ kg/m^3$.

Hence OK.

Step 5 : Calculation of coarse Agg & Fine Agg volume

For 0.40 W/c ratio there is a decrease of 0.02% in vol of coarse Agg. so we are adding 0.02

[From Clause 4.4.1 in IS 10262 : 2009]

[From Table No. 3 IS 10262 : 2009],

Vol of coarse Agg = 0.62.

$= 0.62 + 0.02$

$= 0.64$

For pumpable concrete Reduce by 10%.

Volume of coarse Agg $= 0.64 \times \frac{90}{100}$

$= 0.576$.

Vol of Fine Agg $= 1 - 0.576$

$= 0.424$.

Mix calculation :

Vol of concrete = $1 m^3$

Vol of cement = $\frac{\text{mass of cement}}{\text{S.P.G of cement}} * \frac{1}{1000}$

$= \frac{372}{3.14} \times \frac{1}{1000}$

$= 0.118\ m^3$

Vol of water = $\frac{\text{mass of water}}{\text{S.P.G of water}} \times \frac{1}{1000}$

$= \frac{148.8}{1} \times \frac{1}{1000}$

$= 0.1488\ m^3$

Vol of C.Ad = $\frac{\text{mass of C.Ad}}{\text{S.P.G of C.Ad}} \times \frac{1}{1000}$

mass of cd.Adt = mass of cement $\times \frac{2}{100}$

$= 372 \times \frac{2}{100}$

$= 7.44$

$= \frac{7.44}{1.145} \times \frac{1}{1000} = 0.0064\ m^3$

Vol of All in Agg = 1 − [Vol of cement + Vol of water + Vol of C. Ad

$= 1 - [0.118 + 0.1488 + 0.0064]$

$= 0.7268$

~~Vol of Coa~~

mass of coarse Agg = Vol of all in agg × Vol of coarse aggs × S.P.G of coarse Aggs × 1000

$= 0.7268 \times 0.576 \times 2.74 \times 1000$

$= 1147.06$

mass of Fine Agg = Vol of all in Aggs × vol of Fine aggs × S.P.G of Fine Aggs × 1000

$= 0.7268 \times 0.424 \times 2.74 \times 1000$

$= 844.36$

0.55
0.40
0.15

0.05
0.05
0.05
0.15

0.05 + — 0.01
0.01
0.01
0.03

0.55
0.40
0.15

0.1

0.5

0.05
0.05
0.05

0.01
0.01
0.01