India's No.1 Study Channel

Concrete Technology

Civil Engineering by Sandeep Jyani Sir

RRB JE CBT 2

Concrete Technology

Top MCQs and Revision

LIVE

9 PM

Concrete

“Concrete is a composite material composed of fine and coarse aggregate bonded together with cement that hardens over time”

Concrete

"Concrete is a composite material composed of fine and coarse aggregate bonded together with cement that hardens over time"

$M5 \rightarrow 1:5:10$ $M15 \rightarrow 1:2:4$

$M7.5 \rightarrow 1:4:8$ $M20 \rightarrow 1:1.5:3$

$M10 \rightarrow 1:3:6$ $M25 \rightarrow 1:1:2$

Fresh Concrete

- Fresh concrete or plastic concrete is a freshly mixed material which can be moulded into any shape.
- The relative quantities of cement, aggregates and water mixed together, control the properties of concrete in the wet state as well as in the hardened state

1. The workability of concrete is influenced most by its :

a) Water-cement ratio

b) Aggregate cement ratio

c) Cement content

d) Water content

1. The workability of concrete is influenced most by its :

a) Water-cement ratio

b) Aggregate cement ratio

c) Cement content

d) Water content

2. Workability of concrete for a given water content is good if the aggregates are

a) Rounded aggregate

b) Irregular aggregate

c) Angular aggregate

d) Flaky aggregate

2. Workability of concrete for a given water content is good if the aggregates are

a) Rounded aggregate

b) Irregular aggregate

c) Angular aggregate

d) Flaky aggregate

3. The compaction of concrete improves

a) Density

b) Strength

c) Durability

d) all option are correct

3. The compaction of concrete improves

a) Density

b) Strength

c) Durability

d) all option are correct

4. For preparing a test specimen it is necessary

a) To mix cement and fine aggregate by dry hand

b) To mix coarse aggregate

c) To mix water to the cement fine aggregates and coarse aggregates

d) All option are correct

4. For preparing a test specimen it is necessary

a) To mix cement and fine aggregate by dry hand

b) To mix coarse aggregate

c) To mix water to the cement fine aggregates and coarse aggregates

d) All option are correct

5. Workability of concrete mix with low water cement ratio is determined by

a) Tensile strength test
b) Slump test
c) Compaction factor test
d) Flexure strength test

5. Workability of concrete mix with low water cement ratio is determined by

a) Tensile strength test

b) Slump test

c) Compaction factor test

d) Flexure strength test

6. The showing up of white fluffy layers on the surface of concrete is termed as _____.

a) Consistency
b) Efflorescence
c) Segregation
d) Workability

6. The showing up of white fluffy layers on the surface of concrete is termed as _____.

a) Consistency

b) Efflorescence

c) Segregation

d) Workability

7. For proper workability of concrete the water cement ratio varies from _____.

a) 0.1 to 0.2

b) 0.2 to 0.4

c) 0.4 to 0.6

d) 0.6 to 0.8

7. For proper workability of concrete the water cement ratio varies from _____.

a) 0.1 to 0.2

b) 0.2 to 0.4

c) 0.4 to 0.6

d) 0.6 to 0.8

8. Separation of coarse aggregate from mortar during transportation is known.

a) Bleeding
b) Creeping
c) Segregation
d) Shrinkage

8. Separation of coarse aggregate from mortar during transportation is known.

a) Bleeding

b) Creeping

c) Segregation

d) Shrinkage

9. Water cement ratio is

a) Volume of water to that of cement

b) Weight of water to that of cement

c) Both volume of water to that of cement and weight of water to that of cement

d) Weight of concrete to that of water

9. Water cement ratio is

a) Volume of water to that of cement

b) Weight of water to that of cement

c) Both volume of water to that of cement and weight of water to that of cement

d) Weight of concrete to that of water

10. Higher workability of a concrete is required if a structure is

a) Mode with cement

b) Thick and reinforced

c) Thin and heavily reinforced

d) Thick and heavily reinforced

10. Higher workability of a concrete is required if a structure is

a) Mode with cement

b) Thick and reinforced

c) Thin and heavily reinforced

d) Thick and heavily reinforced

11. What is the bottom diameter (mm) of the standard mould used in slump test of the concrete?

a) 50
b) 100
c) 150
d) 200

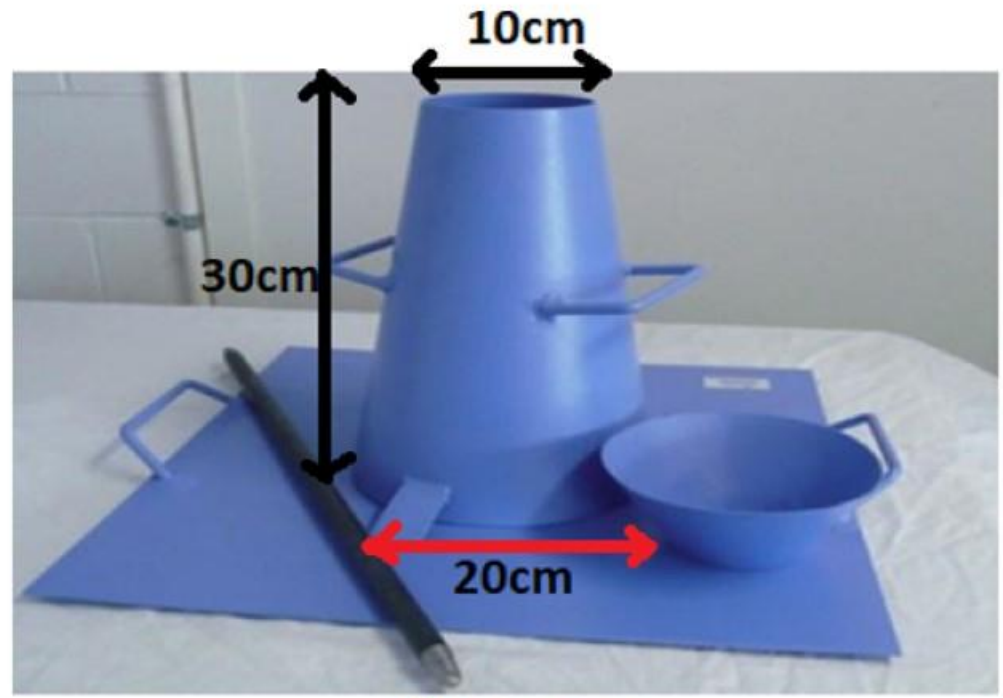
12. What is the bottom diameter (mm) of the standard mould used in slump test of the concrete?

a) 50

b) 100

c) 150

d) 200



Slump Cone

13. If the size of specimen used to test the compressive strength of concrete is decreased, then compressive strength of concrete will

a) Decrease
b) Do not affected
c) First decreases then increases
d) Increases

13. If the size of specimen used to test the compressive strength of concrete is decreased, then compressive strength of concrete will

a) Decrease

b) Do not affected

c) First decreases then increases

d) Increases

14. The common admixture used to accelerate the initial set of concrete is :

a) Gypsum

b) Calcium chloride

c) Mixture of bitumen and inert material

d) By product of bitumen

14. The common admixture used to accelerate the initial set of concrete is :

a) Gypsum

b) Calcium chloride

c) Mixture of bitumen and inert material

d) By product of bitumen

15. The workability of concrete is influenced most by its :

a) Water-cement ratio

b) Aggregate cement ratio

c) Cement content

d) Water content

15. The workability of concrete is influenced most by its :

a) Water-cement ratio

b) Aggregate cement ratio

c) Cement content

d) Water content

16. The process of mixing, transporting, placing and compacting concrete using ordinary Portland cement should not take more than how much time?

a) 30 minutes
b) 40 minutes
c) 75 minutes
d) None of these

16. The process of mixing, transporting, placing and compacting concrete using ordinary Portland cement should not take more than how much time?

a) 30 minutes

b) 40 minutes

c) 75 minutes

d) None of these

17. How does the strength of concrete differ with age of concrete?

a) Increases

b) Decreases

c) No effect

d) Increases, then decreases

17. How does the strength of concrete differ with age of concrete?

a) Increases

b) Decreases

c) No effect

d) Increases, then decreases

18. Bleeding is good to an extent if it occurs when concrete is

a) Transported

b) Mixed

c) Plastic

d) Placed

18. Bleeding is good to an extent if it occurs when concrete is

a) Transported

b) Mixed

c) Plastic

d) Placed

19. the size of commonly used concrete specimen for compression test is:

a) 50 × 30 mm

b) 150 × 150 × 150 mm

c) 150 × 50 × 50 mm

d) 150 × 150 mm

19. the size of commonly used concrete specimen for compression test is:

a) 50 × 30 mm

b) 150 × 150 × 150 mm

c) 150 × 50 × 50 mm

d) 150 × 150 mm

20. _____ are used to press mortar and spread if uniformly.

a) Trowel

b) Aluminum rod

c) Floats

d) Brush

20. _____ are used to press mortar and spread if uniformly.

a) Trowel

b) Aluminum rod

c) Floats

d) Brush

21. The ratio of various ingredients (cement, sand, aggregates) in concrete of grade M20 is

A) 1 : 2 : 4

B) 1 : 3 : 6

C) 1 : 1.5 : 3

D) 1 : 1 : 2

21. The ratio of various ingredients (cement, sand, aggregates) in concrete of grade M20 is

A) 1 : 2 : 4

B) 1 : 3 : 6

C) 1 : 1.5 : 3

D) 1 : 1 : 2

a) Only A

b) Only B

c) Only C

d) Only D

22. Steam curing of concrete is adopted for

a) Precast structure

b) Columns

c) beams

d) Walls

22. Steam curing of concrete is adopted for

a) Precast structure

b) Columns

c) beams

d) Walls

23. The result of Vee-Bee test is expressed in terms of

a) S

b) m

c) N/mm^2

d) kg

23. The result of Vee-Bee test is expressed in terms of

a) S

b) m

c) N/mm^2

d) kg

24. Which of the following statement is true?

a) The quality of water governs the strength of concrete

b) The quantity of water required for concreting, depends upon the grading of aggregate and method of compaction

c) 10% excess of water reduces the strength of concrete by 15%

d) All option are correct

24. Which of the following statement is true?

a) The quality of water governs the strength of concrete

b) The quantity of water required for concreting, depends upon the grading of aggregate and method of compaction

c) 10% excess of water reduces the strength of concrete by 15%

d) All option are correct

25. Which of the following refers to the process of proper and accurate measurement of concrete ingredients for uniformity of proportion?

a) Grading
b) Curing
c) Mixing
d) batching

25. Which of the following refers to the process of proper and accurate measurement of concrete ingredients for uniformity of proportion?

a) Grading
b) Curing
c) Mixing
d) batching

- Following are the steps of Concrete Formation:
  (a) Batching
  (b) Mixing
  (c) Transporting
  (d) Placing
  (e) Compacting
  (f) Curing
  (g) Finishing.

26. How many components are mainly used to prepare concrete?

a) 5

b) 3

c) 2

d) 4

26. How many components are mainly used to prepare concrete?

a) 5

b) 3

c) 2

d) 4

27. Retarders are used for

a) Construction of high rise building

b) Repair works

c) Cold weather condition

d) Grouting deep oil wells

27. Retarders are used for

a) Construction of high rise building

b) Repair works

c) Cold weather condition

d) Grouting deep oil wells

28. Excess vibration during compaction of concrete can lead to

a) Bleeding

b) Segregation

c) High strength

d) Air bubbles

28. Excess vibration during compaction of concrete can lead to

a) Bleeding

b) Segregation

c) High strength

d) Air bubbles

29. If the slump of a concrete mix is 60 mm, its workability is

a) Very low

b) Low

c) Medium

d) High

29. If the slump of a concrete mix is 60 mm, its workability is

a) Very low

b) Low

c) Medium

d) High

Workability	Slump
Very low	-
Low	25- 50
Medium	50-100
High	100-150
Very high	-

30. What is standard size of the cubes (mm) which is used to calculate the strength of concrete?

a) 20
b) 60
c) 70
d) 150

30. What is standard size of the cubes (mm) which is used to calculate the strength of concrete?

a) 20

b) 60

c) 70

d) 150

31. To obtain a very high strength, concrete, use very fine grained.

a) Granite

b) magnetite

c) Barite

d) Volcanic scoria

31. To obtain a very high strength, concrete, use very fine grained.

a) Granite

b) magnetite

c) Barite

d) Volcanic scoria

32. Tensile strength of concrete is found out using:

a) CTM

b) Gradual tensile test

c) Split tensile test

d) Radial tensile test

32. Tensile strength of concrete is found out using:

a) CTM

b) Gradual tensile test

c) Split tensile test

d) Radial tensile test

33. Compaction of concrete is done to:

a) Place concrete on flat surface

b) Remove air bubbles

c) Place concrete on sloping surface

d) Introduce air bubbles

33. Compaction of concrete is done to:

a) Place concrete on flat surface

b) Remove air bubbles

c) Place concrete on sloping surface

d) Introduce air bubbles

34. The final operation of finishing floors is known as:

a) Floating

b) Finishing

c) Trowelling

d) All are correct

34. The final operation of finishing floors is known as:

a) Floating

b) Finishing

c) Trowelling

d) All are correct

35. W_p and W_f are the weights of a cylinder, containing partially compacted and fully compacted concrete. If the compaction factors $(W_p/W_f)$is 0.95, the workability of concrete is:

a) Extremely low

b) Very low

c) Low

d) High

35. W_p and W_f are the weights of a cylinder, containing partially compacted and fully compacted concrete. If the compaction factors $(W_p/W_f)$is 0.95, the workability of concrete is:

a) Extremely low

b) Very low

c) Low

d) High

Workability	Slump	Compaction factor	Use of concrete	remarks
Very low	-	0.78-0.80	Road construction	Compaction factor test
Low	25- 50	0.85-0.87	Light construction	Slump
Medium	50-100	0.92-0.935	Normal construction	Slump
High	100-150	0.95-0.96	Heavy construction	Slump
Very high	-	-	Tremie construction	Flow table test

36. What is the ratio (approximate) of 7 days and 28 days strength of cement concrete

a) 0.45
b) 0.65
c) 0.95
d) 1.15

36. What is the ratio (approximate) of 7 days and 28 days strength of cement concrete

a) 0.45

b) 0.65

c) 0.95

d) 1.15

Age	Strength
1 day	16%
3 day	40%
7 day	65%
14 days	90%
28 days	99%

37. What is the maximum height through which concrete can be poured?

a) 0.1 to 0.6 ,

b) 0.8 to 1 m

c) 0.5 m

d) 2 m

37. What is the maximum height through which concrete can be poured?

a) 0.1 to 0.6 ,

b) 0.8 to 1 m

c) 0.5 m

d) 2 m

As per IS 456, the maximum permissible free fall of concrete may be taken as 1.5m

Que 38. Concrete attains major part of its strength in

a) One week
b) Two week
c) Four Week
d) Five week

Que 38. Concrete attains major part of its strength in

a) **One week**

b) Two week

c) Four Week

d) Five week

Que 39. For constant water cement ratio, decrease in aggregate cement ratio causes:

a) Increase in workability
b) Decrease in workability
c) No change in workability
d) None of these

Que 39. For constant water cement ratio, decrease in aggregate cement ratio causes:

a) **Increase in workability**

b) Decrease in workability

c) No change in workability

d) None of these

Que 40. Characteristic strength of concrete is measured at

a) 14 days
b) 28 days
c) 56 days
d) 7 days

Que 40. Characteristic strength of concrete is measured at

a) 14 days

b) 28 days

c) 56 days

d) 7 days

Que 41. The concrete having slump of 65mm is said to be

a) Dry
b) Earth moist
c) Semi plastic
d) Plastic

Que 41. The concrete having slump of 65mm is said to be

a) Dry

b) Earth moist

c) Semi plastic

d) Plastic

Que 42. Separation of coarse aggregates from mortar during transportation is known as

a) Bleeding
b) Creeping
c) Segregation
d) Shrinkage

Que 42. Separation of coarse aggregates from mortar during transportation is known as

a) Bleeding

b) Creeping

c) Segregation

d) Shrinkage

Que 43. The correct proportion of ingredients in M25 concrete is

a) 1:2:4

b) 1:1:2

c) 1:1.5:3

d) 1:2:3

Que 43. The correct proportion of ingredients in M25 concrete is

a) 1:2:4

b) 1:1:2

c) 1:1.5:3

d) 1:2:3

$$M5 \rightarrow 1:5:10 \qquad M15 \rightarrow 1:2:4$$

$$M7.5 \rightarrow 1:4:8 \qquad M20 \rightarrow 1:1.5:3$$

$$M10 \rightarrow 1:3:6 \qquad M25 \rightarrow 1:1:2$$

Que 44. Ordinary concrete is not used for concrete grades

a) M10

b) M15

c) 25

d) 40

Que 44. Ordinary concrete is not used for concrete grades

a) M10

b) M15

c) 25

d) 40 Ordinary concreteis used upto M25 only

Que 45. Shrinkage in concrete is reduced by using

a) Low water cement ratio
b) Less cement in the concrete
c) Proper concrete mix
d) All of the above

Que 45. Shrinkage in concrete is reduced by using

a) Low water cement ratio

b) Less cement in the concrete

c) Proper concrete mix

d) All of the above

Que 46. The operation of removing humps to form uniform surface of concrete surface is known as

a) Floating
b) Screeding
c) Trowelling
d) Finishing

Que 46. The operation of removing humps to form uniform surface of concrete surface is known as

a) Floating

b) Screeding

c) Trowelling

d) Finishing

Que 47. The initial setting time of fresh concrete should be

a) Lower than 15 minutes
b) Greater than 30 minutes
c) Greater than 1 hour
d) Not more than 10 hours

Que 47. The initial setting time of fresh concrete should be

a) Lower than 15 minutes

b) Greater than 30 minutes

c) Greater than 1 hour

d) Not more than 10 hours

Que 48. Workability of concrete is directly proportional to

a) Grading of concrete
b) Water cement ratio
c) Aggregate cement ratio
d) Time of transit

Que 48. Workability of concrete is directly proportional to

a) **Grading of concrete**

b) Water cement ratio

c) Aggregate cement ratio

d) Time of transit

Que 49. To prevent sulphate attack in concrete, for preparing concrete mix, water pH must be within

a) 7-10

b) 4-6

c) 5-7

d) 6-9

Que 49. To prevent sulphate attack in concrete, for preparing concrete mix, water pH must be within

a) 7-10

b) 4-6

c) 5-7

d) 6-9

Que 50. The permanent deformation of concrete with time under steady load is called

a) Viscoelasticity

b) Viscosity

c) Creep

d) Relaxation

Que 50. The permanent deformation of concrete with time under steady load is called

a) Viscoelasticity

b) Viscosity

c) Creep

d) Relaxation

Que 51. The concrete cubes are prepared, cured and tested according to Indian Standards code

a) IS 515

b) IS 516

c) IS 517

d) IS 518

Que 51. The concrete cubes are prepared, cured and tested according to Indian Standards code

a) IS 515

b) IS 516 Methods for strength of concrete

c) IS 517

d) IS 518

Que 52. Poisson's ratio of cement concrete is

a) 0.28

b) 0.50

c) 0.40

d) 0.15

Que 52. Poisson's ratio of cement concrete is

a) 0.28

b) 0.50

c) 0.40

d) 0.15

Que 53. Too wet concrete may cause

a) Segregation
b) Lower density
c) Weakness of concrete
d) All of the above

Que 53. Too wet concrete may cause

a) Segregation

b) Lower density

c) Weakness of concrete

d) All of the above

Que 54. Concrete gains strength due to

a) Chemical action of cement with coarse aggregate
b) Hydration of cement
c) Evaporation of water
d) All options are correct

Que 54. Concrete gains strength due to

a) Chemical action of cement with coarse aggregate

b) Hydration of cement

c) Evaporation of water

d) All options are correct

Que 55. Light weight concrete is prepared by

a) Using light aggregate

b) Formation of air voids in cement by reducing sand

c) Formation of air voids in cement paste by the substances causing foam

d) All options are correct

Que 55. Light weight concrete is prepared by

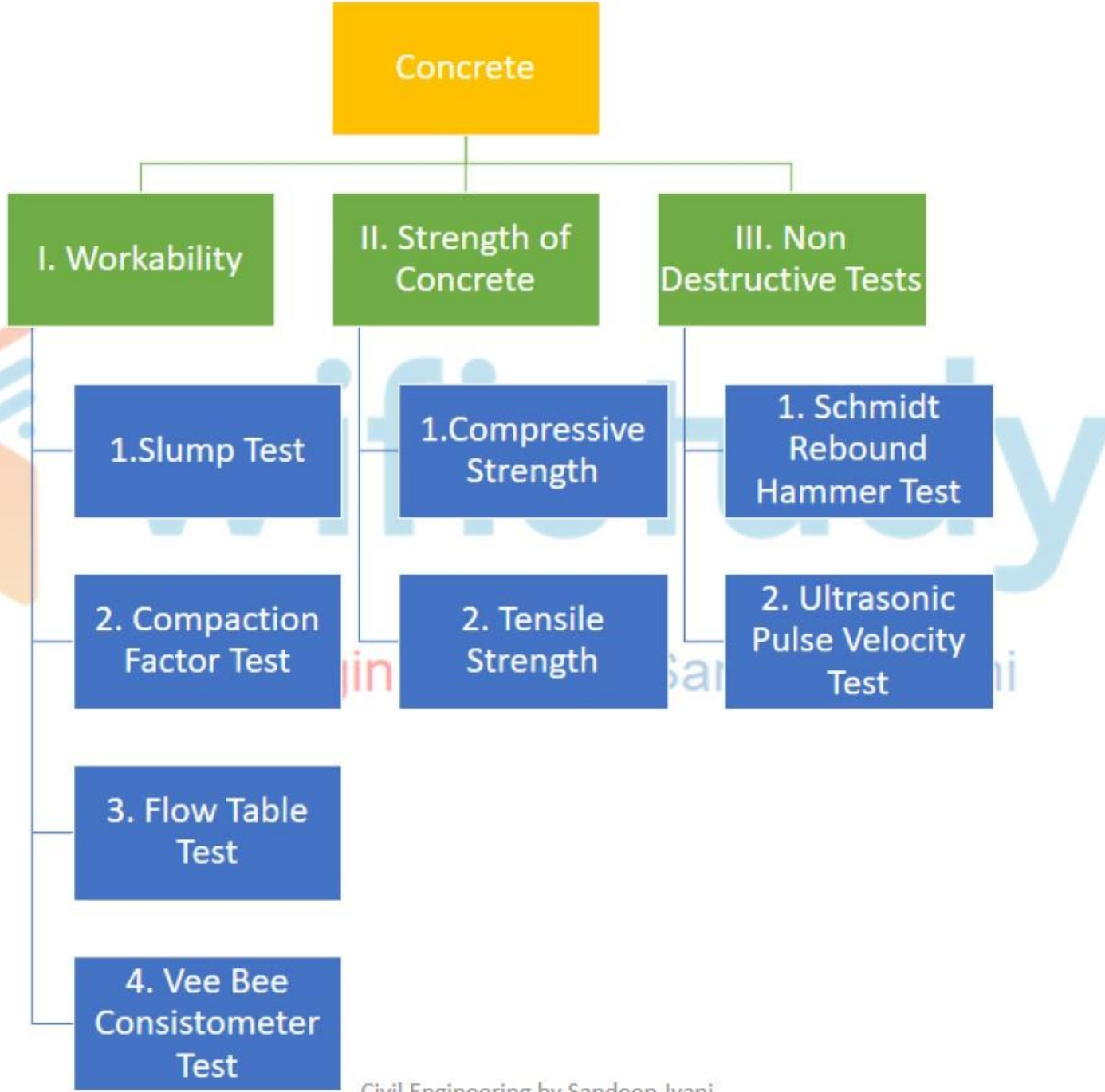
a) Using light aggregate

b) Formation of air voids in cement by reducing sand

c) Formation of air voids in cement paste by the substances causing foam

d) All options are correct

Density of light weight concrete varies from 300-1900kg/m^3


Concrete
I. Workability
II. Strength of Concrete
III. Non Destructive Tests
1.Slump Test
2. Compaction Factor Test
3. Flow Table Test
4. Vee Bee Consistometer Test
1.Compressive Strength
2. Tensile Strength
1. Schmidt Rebound Hammer Test
2. Ultrasonic Pulse Velocity Test

I. Workability

✓Workability is the property of concrete by virtue of which it can be easily mixed, transported, placed, compacted and finished.

✓It may also be defined as the amount of useful internal work required to be done in order to achieve the full compaction.

- To enable the concrete to be fully compacted with given efforts, normally a higher water/ cement ratio than that calculated by theoretical considerations may be required.
- Function of water is also to lubricate the concrete so that the concrete can be compacted with specified effort forthcoming at the site of work.
- The lubrication required for handling concrete without segregation, for placing without loss of homogenous mixturea certain quantity of water is of vital importance

I. Workability

- ✓Workability is the property of concrete by virtue of which it can be easily mixed, transported, placed, compacted and finished.
- ✓It may also be defined as the amount of useful internal work required to be done in order to achieve the full compaction.

Workability Depends upon following factors:

1. Water Content:
   - Addition of water in concrete doesn't affect its workability, moreover it reduces the strength of the concrete due to increase in water cement ratio.
   - In order to increase the workability, cement content is also to be increased in same proportion as that of water , such that water cement ratio remains constant.

I. Workability

2. Aggregate cement ratio:

- Higher is the aggregate cement- leaner is the concrete which in turn reduces its workability due to lesser availability of cement paste to lubricate the aggregates.
- Less is the Aggregate Cement ratio, richer is the concrete which results in high workability

3. Shape of Aggregate:

- Round shape aggregate has more workability because it requires less surface area for lubrication.

4. Texture of Aggregate

- Smooth aggregates - highly workable mixture
- Rough aggregates -poor workable mixture

I. Workability

5. Size of aggregates:

- Larger size aggregates result in the formation of high workable mixture because it requires lesser area to be lubricated

6. Grading:

- Well graded – High workable concrete
- Poorly graded- Low workability

7. Admixture:

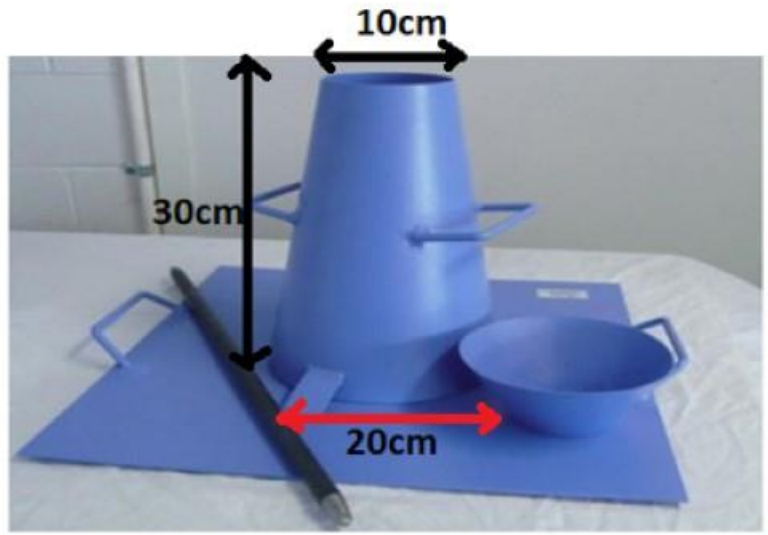
- Addition of plasticizers and superplasticizers result in formation of higher workable concrete

Testing of Concrete for Workability

1. Slump Test
2. Compaction Factor Test
3. Flow Test
4. Vee Bee Test

1. Slump Test:

- Most common method
- Frustum having top diameter 10cm, bottom dimension around 20 cm, height of 30 cm
- Concrete to be tested in filled in the mould in four layers where each layer is compacted 25 no of times with the help of rod
- Mould is removed immediately by lifting it in upward direction which causes the concrete to subsidize and the subsidence of the concrete is referred as slump which may also defined as difference of the height of the mould and the top level of the subsidize concrete.

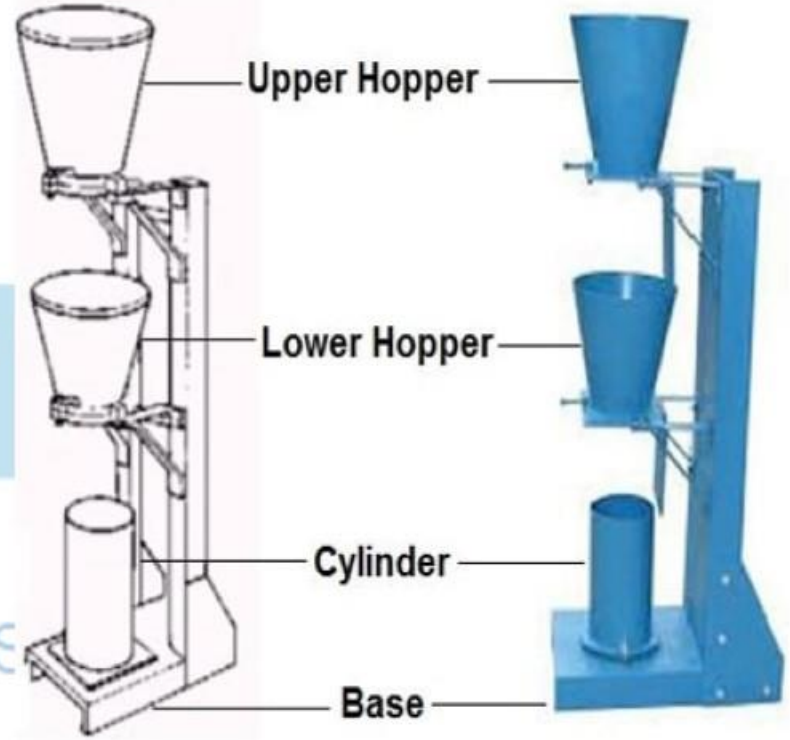


Slump Cone

- Higher the value of Slump, more is the workability
- This test is not suitable for the concrete which process either very high workability or very low workability.

2. Compaction Factor Test:

- This test is used for the concrete possessing very low workability for which slump test is not suitable.
- Principle of this test is based upon finding the degree of compaction achieved by the standard amount of work done by the concrete when allowed to fall from known height
- This degree of compaction is represented in terms of compaction factor that represents the density ratio : *Density of concrete obtained during test to the Density of fully compacted concrete*



Compaction Factor Test

$$\text{Compacting Factor} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

$$\text{Compaction Factor} = \frac{\text{mass of concrete in cylinder during test}}{\text{mass of fully compacted concrete}}$$

$$CF \propto \text{workability} \propto \frac{1}{\text{Wt in cylinder}}$$

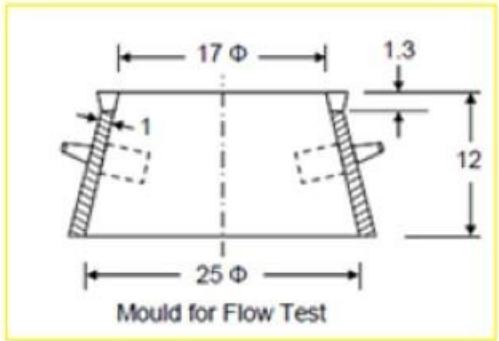
Slump Test and Compaction Factor Test:

Workability	Slump	Compaction factor	Use of concrete	remarks
Very low	-	0.78-0.80	Road construction	Compaction factor test
Low	25- 50	0.85-0.87	Light construction	Slump
Medium	50-100	0.92-0.935	Normal construction	Slump
High	100-150	0.95-0.96	Heavy construction	Slump
Very high	-	-	Tremie construction	Flow table test

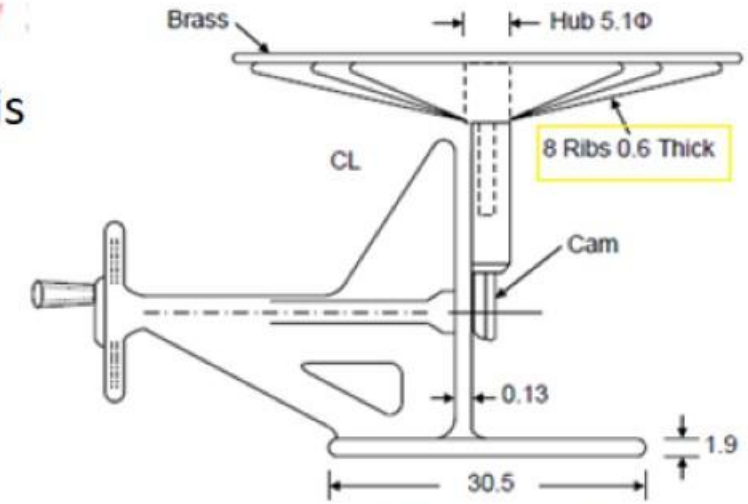
3. Flow Table Test

- This test is done for concrete having very high workability
- Consists of a circular table and mould in form of frustum(top dia 17cm, bottom dia 25cmand height 12cm)
- This mould is then placed on the table and concrete to be tested is filled in it in two layers
- It is raised immediately and table is lifted and **dropped by 12.5 mm, 15 times in 15 seconds**
- The spread of concrete direction is measured in at least 6 directions and is further used to represents the workability in terms of flow percent.

$$\% \text{ flow} = \frac{\text{spread of concrete} - 25}{25} \times 100$$



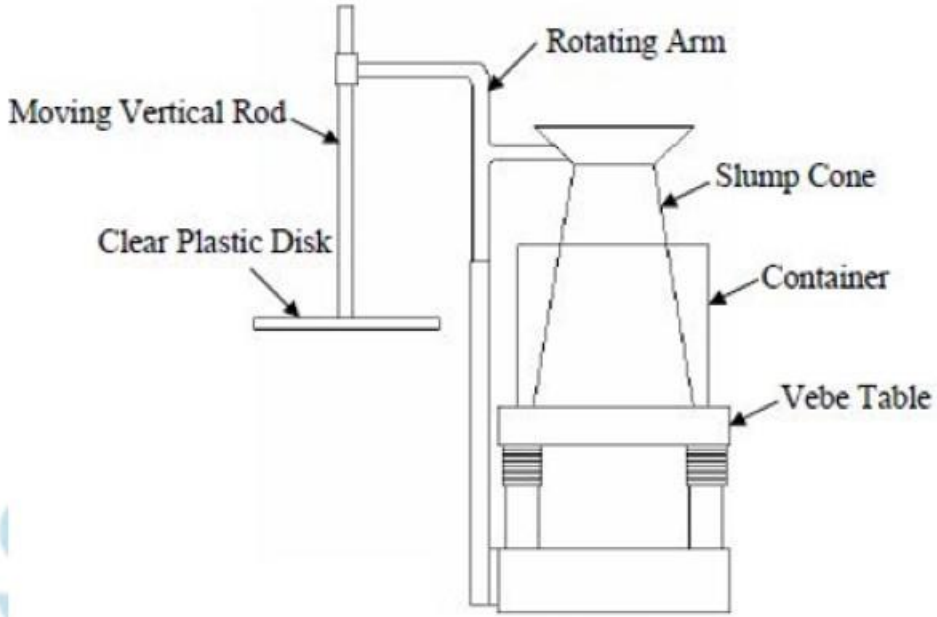
Mould for Flow Test



(All Dimensions in cm)

4. Vee Bee Test

- This test is used for the concrete that possessed low workability having the value of slump limited to 50 mm.
- In this test mould in the form of frustum in placed inside the cylinder and concrete to be tested is filled in the mould that is lifted immediately after it is filled completely.
- The cylinder is then subjected to vibration and the time required by the concrete to assume the cylinder shape is noted which is further used to represent the workability in terms of Vee – Bee Degrees.



Vee Bee Consistometer

Segregation

- Segregation can be defined as the separation of the constituent materials of concrete.
- If a sample of concrete exhibits a tendency for separation of coarse aggregate from the rest of the ingredients, then, that sample is said to be showing the tendency for segregation
- Segregation may be of three types —
  1. **Coarse aggregate separating out or settling down from the rest of the matrix**
  2. **The paste or matrix separating away from coarse aggregate**
  3. **Water separating out from the rest of the material being a material of lowest specific gravity**
- **To avoid segregation, a cohesive mix of concrete may be made by suitable grading, water content, shape and size of aggregates so that any constituent can not escape out of the paste**

Segregation

- Dropping of concrete from heights as in the case of placing concrete in column concreting will result in segregation
- When concrete is discharged from a badly designed mixer, or from a mixer with worn out blades, concrete shows a tendency for segregation
- Vibration of concrete should be preferred in dry mix. It too wet a mix is excessively vibrated, concrete gets segregated
- The use of air-entraining agent appreciably reduces segregation

Bleeding

- Bleeding or Water gain is a particular form of segregation in which some of the water from the concrete comes out to the surface of the concrete, being of the lowest specific gravity among all the ingredients of concrete.
- Bleeding is mostly observed in a highly wet mix, badly proportioned and insufficiently mixed concrete.
- Due to bleeding, water comes up and along with this water, certain quantity of cement also comes to the surface, When the surface is worked up with the trowel and floats, the aggregate goes down and the cement and water come up to the top surface. This formation of cement paste at the surface is known as "**Laitance**".

Bleeding

- As top surface has a higher content of water and is also less aggregate matter; it also develops higher shrinkage cracks
- Water while travelling from bottom to top, makes continuous channels. If the water cement ratio used is more than 0.7, the bleeding channels will remain continuous and unsegmented by the development of gel. This continuous bleeding channels are often responsible for causing permeability of the concrete structures
- Water may also accumulate below aggregates (especially flaky) causing voids later.
- Also below reinforcing bars, particularly cranked bars, reduces bond between reinforcement and concrete

Bleeding

- Bleeding can be reduced by proper proportioning and uniform and complete mixing.
- Use of finely divided pozzolanic materials reduces bleeding by creating a longer path for the water to traverse.
- Use of air-entraining agent is very effective in reducing the bleeding.
- Use of finer cement or cement with low alkali content.
- Rich mixes are less susceptible to bleeding than lean mixes.

Setting time of Concrete

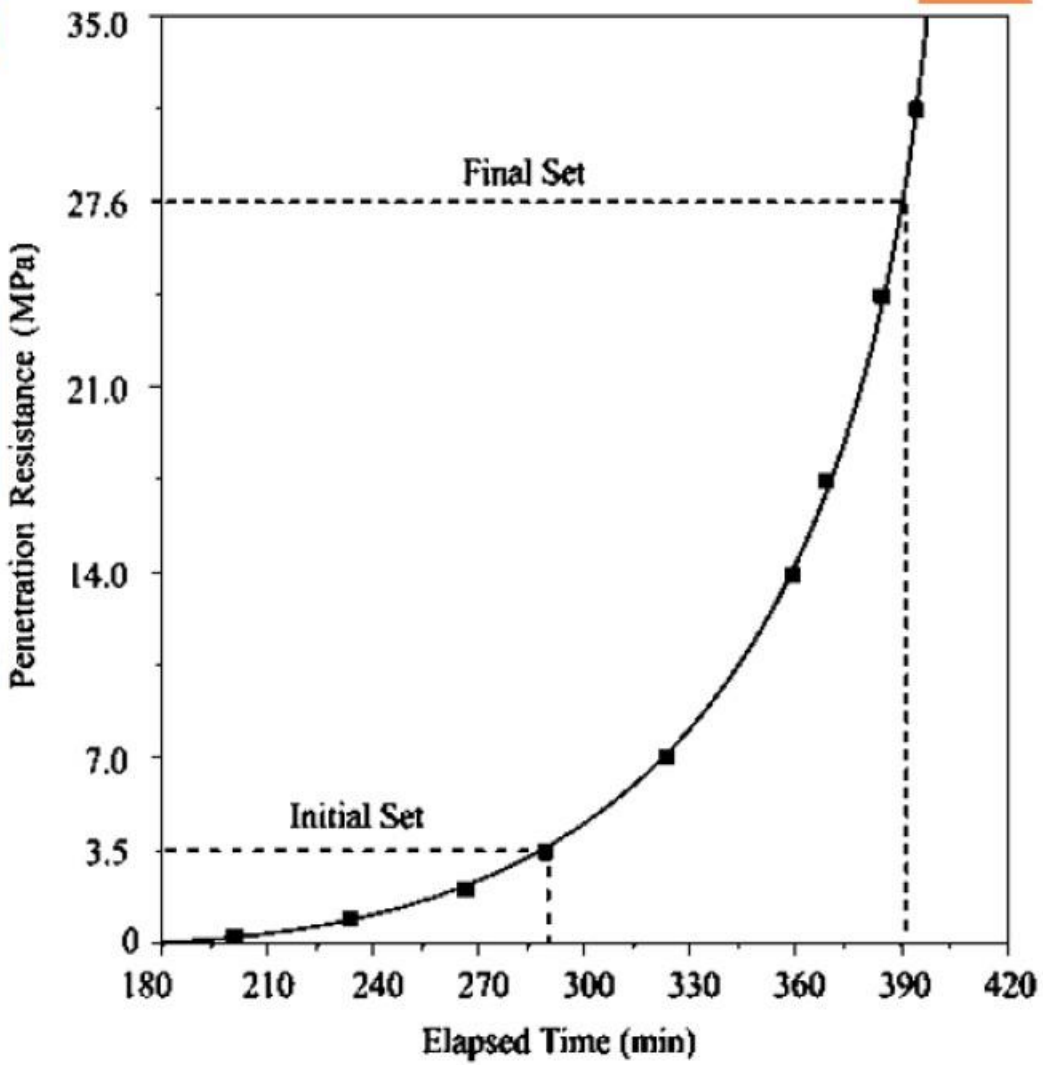
- The setting time of concrete is found by ***Pentrometer test***.
- The apparatus consist of a container which should have minimum lateral dimension of 150 mm and minimum depth of 150 mm.
- There are six penetration needles with bearing areas of 645, 323, 161, 65, 32 and 16 mm^2.
- A device is provided to measure the force required to cause penetration of the needle

Setting time of Concrete

- Bring the bearing surface of needle in contact with the mortar surface.
- Gradually and uniformly apply a vertical force downwards on the apparatus until the needle penetrates to a depth of 25 ± 1.5 mm
- The time taken to penetrate 25 mm depth could be about 10 seconds.
- Record the force required to produce 25 mm penetration and the time of inserting from the time water is added to cement.
- Calculate the penetration resistance by dividing the recorded force by the bearing area of the needle. This is the ***penetration resistance.***
- Plot a graph of penetration resistance as ordinate and elapsed time as abscissa

Setting time of Concrete

- Continue the tests until one penetration resistance of at least 27.6 MPa is reached.
- Connect the various point by a smooth curve
- From penetration resistance equal to 3.5 MPa, draw a horizontal line., the point of intersection of this with the smooth curve, is read on the x-axis which gives the initial setting time.
- Similarly a horizontal line is drawn from the penetration resistance of 27.6 Mpa which gives final set



Process of Manufacture of Concrete

- Ingredients of good concrete and bad concrete are the same.
- If care is not taken and proper procedure is not followed, the resultant concrete is going to be of bad quality.
- Following are the steps of Concrete Formation:
  (a) Batching
  (b) Mixing
  (c) Transporting
  (d) Placing
  (e) Compacting
  (f) Curing
  (g) Finishing.

Process of Manufacture of Concrete

(a) Batching

- The measurement of materials for making concrete is known as batching. There are two methods of batching:
- (i) Volume batching
  - Volume batching is not a good method for proportioning the material because of the difficulty it offers to measure granular material in terms of volume.
  - Exp: Volume of moist sand in a loose condition weighs much less than the same volume of dry compacted sand.
  - Cement is always measured by weight
  - The volume of one bag of cement is taken as thirty five (35) litres
  - Gauge boxes are used for measuring the fine and coarse aggregate
- (ii) Weight batching
  - Weigh batching is the correct method of measuring the materials
  - Different types of weigh batchers are available, The particular type to be used, depends upon the nature of the job.
  - Cement bag is made of 50 kg
  - Density of cement is equal to 1440 kg/m3

Process of Manufacture of Concrete

b) Mixing

- Thorough mixing of the materials is essential for the production of uniform concrete
- There are two methods adopted for mixing concrete:
  - (i) Hand mixing
  - (ii)Machine mixing
- Hand Mixing:
  - Hand mixing is practised for small scale unimportant concrete works.
  - As the mixing cannot be thorough and efficient, it is desirable to add 10 percent more cement to cater for the inferior concrete produced by this method
- Machine Mixing:
  - Mixing of concrete is almost invariably carried out by machine, for reinforced concrete work and for medium or large scale mass concrete work.
  - Machine mixing is not only efficient, but also economical, when the quantity of concrete to be produced is large.

Process of Manufacture of Concrete

b) Mixing

- Machine Mixing:
  - Concrete mixers are designated by a number representing its nominal mixed batch capacity in litres.
  - The following are the standardized sizes of three types:
    - Tilting
    - Non-Tilting
    - Reversing
  - ***Mixing Time:*** Concrete mixers are generally designed to run at a speed of 15 to 20 revolutions per minute. For proper mixing, it is seen that about 25 to 30 revolutions are required in a well designed mixer
  - The mixing time varies between 1½ to 2½ minutes. Bigger the capacity of the drum more is the mixing time. However, modern high speed pan mixer used in RMC, mixes the concrete in about 15 to 30 secs

Process of Manufacture of Concrete

c) Transporting Concrete

- Concrete can be transported by a variety of methods and equipment.
- The precaution to be taken while transporting concrete is that the homogeneity obtained at the time of mixing should be maintained while being transported to the final place of deposition. The methods adopted for transportation of concrete are:
  - (a) Mortar Pan
  - (b) Wheel Barrow, Hand Cart
  - (c) Crane, Bucket and Rope way
  - (d) Truck Mixer and Dumpers
  - (e) Belt Conveyors
  - (f) Skip and Hoist
  - (g) Transit Mixer
  - (h) Pump and Pipe Line







Process of Manufacture of Concrete

d) Placing Concrete

- It is not enough that a concrete mix correctly designed, batched, mixed and transported, it is of utmost importance that the concrete must be placed in systematic manner to produce optimum results
- Placing may be done as
  1. Placing concrete within earth mould (example: Foundation concrete for a wall or column)
  2. Placing concrete within large earth mould or timber plank formwork.
  3. Placing concrete in layers within timber or steel shutters
  4. Placing concrete within usual form work.
  5. Placing concrete under water
- **Form work:** Form work shall be designed and constructed so as to remain sufficiently rigid during placing and compaction of concrete. The joints are plugged to prevent the loss of slurry from concrete.
- **Stripping Time:** Formwork should not be removed until the concrete has developed a strength of at least twice the stress to which concrete may be subjected at the time of removal of formwork.

- **Stripping Time:** Formwork should not be removed until the concrete has developed a strength of at least twice the stress to which concrete may be subjected at the time of removal of formwork

Sr. No.	*Type of Formwork*	*Minimum period before striking formwork*
1.	Vertical formwork to columns walls and beams	16 – 24 hours
2.	Soffit formwork to slabs (props to be refixed immediately after removal of formwork)	3 days
3.	Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days
4.	Props to slab	
	spanning up to 4.5 m	7 days
	spanning over 4.5 m	14 days
5.	Props to beam and arches	
	Spanning up to 6 m	14 days
	Spanning over 6 m	21 days

- Underwater Concreting:
  - Concrete is often required to be placed underwater or in a trench filled with the bentonite slurry
  - A tremie pipe is a pipe having a diameter of about 20 cm capable of easy coupling for increase or decrease of length.
  - A funnel is fitted to the top end to facilitate pouring of concrete

(e) Compaction of Concrete

- Compaction of concrete is the process adopted for expelling the entrapped air from the concrete.
- The lower the workability, higher is the amount of air entrapped.
- If this air is not removed fully, the concrete loses strength considerably
- 5 per cent voids reduce the strength of cocrete by about 30 per cent and 10 per cent voids redduce the strength by over 50 per cent
- The following methods are adopted for compacting the concrete:
  - (a) Hand Compaction
    - (i) Rodding (ii) Ramming (iii) Tamping
  - (b) Compaction by Vibration
    - (i) Internal vibrator (Needle vibrator) (ii) Formwork vibrator (External vibrator) (iii) Table vibrator (iv) Platform vibrator (v) Surface vibrator (Screed vibrator) (vi) Vibratory Roller.
  - (c) Compaction by Pressure and Jolting
  - (d) Compaction by Spinning

(e) Compaction of Concrete

- (a) Hand Compaction
  - (i) Rodding (ii) Ramming (iii) Tamping
- (b) Compaction by Vibration
  - (i) Internal vibrator (Needle vibrator) (ii) Formwork vibrator (External vibrator) (iii) Table vibrator (iv) Platform vibrator (v) Surface vibrator (Screed vibrator) (vi) Vibratory Roller.
- (c) Compaction by Pressure and Jolting
- (d) Compaction by Spinning

f) Curing of Concrete

- Concrete derives its strength by the hydration of cement particles.
- The hydration of cement is not a momentary action but a process continuing for long time.
- Cement requires a water/cement ratio about 0.23 for hydration and a water/cement ratio of 0.15 for filling the voids in the gel pores.
- In other words, a water/cement ratio of about 0.38 would be required to hydrate all the particles of cement and also to occupy the space in the gel pores
- Curing can also be described as keeping the concrete moist and warm enough so that the hydration of cement can continue
- Concrete, while hydrating, releases high heat of hydration. This heat is harmful from the point of view of volume stability. If the heat generated is removed by some means, the adverse effect due to the generation of heat can be reduced. This can be done by a thorough water curing.

f) Curing of Concrete

- Curing methods may be divided broadly into four categories:
  - (a) Water curing : This is by far the best method of curing as it satisfies all the requirements of curing, namely, promotion of hydration, elimination of shrinkage and absorption of the heat of hydration
  - (b) Membrane curing : to obtain a continuous seal over the concrete surface by means of a firm impervious film to prevent moisture in concrete from escaping by evaporation, polyethylene or polyester film, waterproof paper, rubber compounds etc are used
  - (c) Application of heat : The development of strength of concrete is a function of not only time but also that of temperature. When concrete is subjected to higher temperature it accelerates the hydration process resulting in faster development of strength. Concrete cannot be subjected to dry heat to accelerate the hydration process as the presence of moisture is also an essential requisite. Therefore, subjecting the concrete to higher temperature and maintaining the required wetness can be achieved by subjecting the concrete to steam curing.
    - High pressure steam cured concrete develops in one day, or less the strength as much as the 28 days' strength of normally cured concrete
  - (d) Miscellaneous

g) Finishing of Concrete

- For a beam concreting, finishing may not be applicable, whereas for the concrete road pavement, airfield pavement or for the flooring of a domestic building, careful finishing is of great importance
- Surface finishes may be of following type
  - (a) Formwork Finishes
  - (b) Surface Treatment
  - (c) Applied Finishes

Strength of Concrete

- The concrete making properties of various ingredients of mix are usually measured in terms of the compressive strength.
- Compressive strength is also used as a qualitative measure for other properties of hardened concrete
- Strength of Concrete is influenced by:
  a) Ratio of cement to mixing water;
  b) Ratio of cement to aggregate;
  c) Grading, surface texture, shape, strength and stiffness of aggregate particles;
  d) Maximum size of aggregate.
- In the above it can be further inferred that water/cement ratio primarily affects the strength, whereas other factors indirectly affect the strength of concrete by affecting the water/ cement ratio

Strength of Concrete

1. Water/Cement Ratio

- Water Cement Ratio means the ratio between the weight of water to the weight of cement used in concrete mix.
- Normally water cement ratio falls under 0.4 to 0.6 as per IS Code 10262 (2009) for nominal mix (M10, M15 …. M25)
- In 1918 Abrams presented his classic law in the form:
  - $S = \frac{A}{B^x}$
  - where x =water/cement ratio by volume and for 28 days results the constants A and B are 14,000 lbs/sq. in. and 7 respectively.

Strength of Concrete

2. Gel/Space Ratio

- Gel space ratio is defined as the ratio of the volume of the hydrated cement paste to the sum of volumes of the hydrated cement and of the capillary pores.
- Gel/Space ratio $x = \frac{Volume\ of\ gel}{space\ available}$
- Many researchers argued that Abrams water/cement ratio law can only be called a rule and not a law because Abrams' statement does not include many qualifications necessary for its validity to call it a law.
- Instead of relating the strength to water/cement ratio, the strength can be more correctly related to the solid products of hydration of cement to the space available for formation of this product. Powers and Brownyard have established the relationship between the strength and gel/space ratio

Grades of Concrete as per IS - 456 of 2000

Group	*Grade Designation*	*Specified characterstic compressive strength of 150 mm cube at 28 days in N/mm²*
Ordinary Concrete	M 10	10
	M 15	15
	M 20	20
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High Strength Concrete	M 60	60
	M 65	65
	M 70	70
	M 75	75
	M 80	80

Permissible stresses in Concrete All values in N/mm² (IS 456 of 2000)

Grade of concrete	Permissible stress in compression		Permissible stress in Bond (average) for Plain Bars in tension
	Bending	Direct	
M 10	3.0	2.5	—
M 15	5.0	4.0	0.6
M 20	7.0	5.0	0.8
M 25	8.5	6.0	0.9
M 30	10.0	8.0	1.0
M 35	11.5	9.0	1.1
M 40	13.0	10.0	1.2
M 45	14.5	11.0	1.3
M 50	16.0	12.0	1.4

Note: The bond stress may be increased by 25 per cent for bars in compression.

Accelerated Curing Test

- In the accelerated curing test the standard cubes are cast, they are covered with top plate and the joints are sealed with special grease to prevent drying.
- Within 30 minutes of adding water, the cubes having sealed effectively, are placed in an air-tight oven which is then switched on.
- The oven temperature is brought to 93°C in about one hour time.
- It is kept at this temperature for 5 hours.
- At the end of this period the cubes are removed from oven, stripped, cooled, and tested. The time allowed for this operation is 30 minutes.

Maturity Concept of Concrete

- The strength development of concrete depends on both time and temperature it can be said that strength is a function of summation of product of time and temperature. This summation is called maturity of concrete

$$Maturity = \Sigma\,(time \times temperature)$$

- Hydration of concrete continues to take place upto about –11°C. Therefore, –11°C is taken as a datum line for computing maturity
- Exp: A sample of concrete cured at 20°C for 28 days is taken as fully matured concrete. Its maturity would be equal to
  - $28 \times 24 \times [20 - (-11)] = 20832°C\,h$

Tensile Strength of Concrete in Flexure

$$f_{ct} = 0.7\sqrt{f_{ck}}$$

where f_{ck} is the characteristic compressive strength of concrete in N/mm2

Bond Strength of Concrete

- We can consider the bond strength from two different angles;
  - The bond strength between paste and steel reinforcement
  - The bond strength between paste and aggregate

Grade of concrete	Permissible stress in compression		Permissible stress in Bond (average) for Plain Bars in tension
	Bending	Direct	
M 10	3.0	2.5	—
M 15	5.0	4.0	0.6
M 20	7.0	5.0	0.8
M 25	8.5	6.0	0.9
M 30	10.0	8.0	1.0
M 35	11.5	9.0	1.1
M 40	13.0	10.0	1.2
M 45	14.5	11.0	1.3
M 50	16.0	12.0	1.4

High Strength Concrete

- There are special methods of making high strength concrete.
  - a) Seeding
    - This involves adding a small percentage of finely ground, fully hydrated Portland cement to the fresh concrete mix.
  - b) Revibration
    - Concrete undergoes plastic shrinkage. Mixing water creates continuous capillary channels, bleeding, and water accumulates at some selected places. All these reduce the strength of concrete. Controlled revibration removes all these defects and increases the strength of concrete
  - c) High speed slurry mixing;
    - Higher compressive strength obtained is attributed to more efficient hydration of cement particles and water achieved in the vigorous blending of cement paste
  - d) Use of admixtures
    - Use of water reducing agents are known to produce increased compressive strengths.
  - e) Inhibition of cracks
    - The propagation of cracks is inhibited, by Replacement of 2– 3% of fine aggregate by polythene or polystyrene “lenticules” results in higher strength.
  - f) Sulphur impregnation;
    - Satisfactory high strength concrete have been produced by impregnating low strength porous concrete by sulphur

Young's modulus of Elasticity of Concrete

As per IS 456: 2000, young's modulus of elasticity of concrete is ...

$$E_c = 5000\sqrt{f_{ck}}$$

f_{ck} = **Characteristic compressive strength**

Poisson's Ratio

- For normal concrete the value of poisson's ratio lies in the range of ***0.15 to 0.20*** when actually determined from strain measurements

Shrinkage

- The term shrinkage is used to describe the various aspects of volume changes in concrete due to loss of moisture at different stages due to different reasons.

a) Plastic Shrinkage

b) Drying Shrinkage;

c) Autogenous Shrinkage;
   - Where no moisture movement to or from the paste is permitted, when temperature is constant some shrinkage may occur. The shrinkage of such a conservative system is known as an autogenous shrinkage

d) Carbonation Shrinkage
   - Carbon dioxide present in the atmoshphere reacts in the presence of water with hydrated cement. Calcium hydroxide [$Ca(OH)_2$] gets converted to calcium carbon

II. Strength Of Concrete

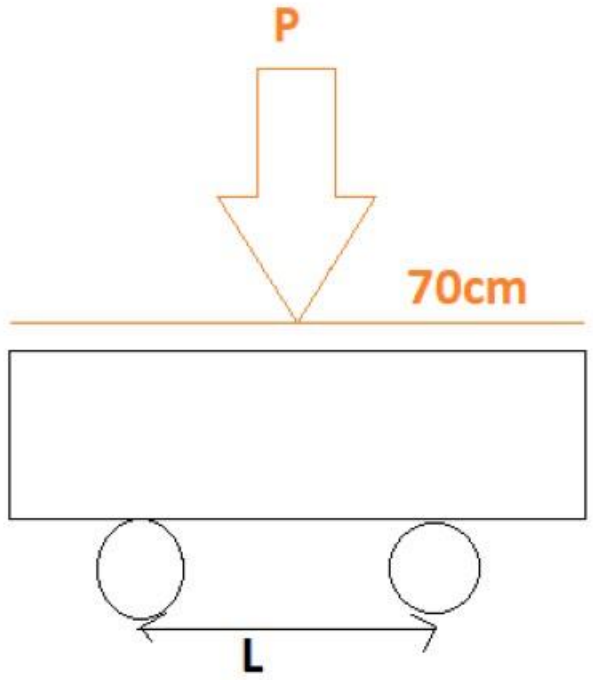
1. Compressive Strength of Concrete

- Compressive strength of concrete is measured in UTM using the mould that may be either be cubical, cylindrical, trapezoidal or prismoidal in shape.
- Generally cubical mould of size 150 mm is used if the maximum nominal size of aggregate is greater than 20 mm and of size 100 mm is used if the maximum nominal size of aggregate is less than 20 mm.
- If cylindrical mould is used, height to diameter ratio is kept to be 2:1. Generally height of 30 cm and dia of 15 cm is used.
- The results obtained from cylindrical mould are found to be more precise than the results obtained from cubical mould.
- Strength of the concrete measured using cylindrical mould is approx 0.8 times the strength obtained from the cubical mould as the straining effects of the platens (plates of UTM) is found to be for the entire height of the cubical mould.

II. Strength Of Concrete

2. Tensile Strength of Concrete

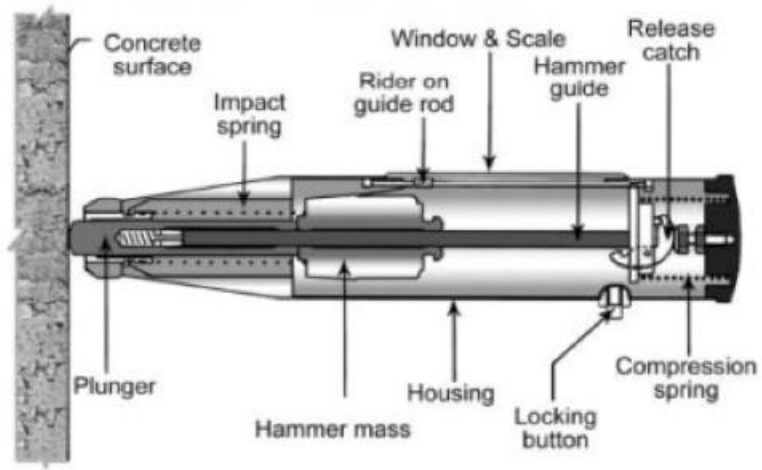
- Tensile, strength of the concrete is tested indirectly, by noting its modules of rupture that is determined by preparing a block of size 15 cm × 15 cm × 70 cm if the Maximum nominal size of aggregate is greater than 20 mm; and of size 10 cm × 10 cm × 50 cm if the maximum nominal size of aggregate is less than 20 mm.
- The beam is then placed over the roller supports and is subjected to the load at which its failure takes place that is further used to find its modulus of rupture (stress at which failure takes place)



III. Non Destructive Tests

1. Schmidt Rebound Hammer

- In this test rebound hammer is used to analyse the quality of hardened concrete which consists of spring controlled rebound mass that slides over the plunger in tubular housing
- When the release button is pressed, rebound mass strikes against the surface to be tested and retracks due to spring force carrying along the rider with it in backward direction.
- Displacement of which is noted over the scale and is termed as rebound number that is further used to analyse the quality of structure.
- Higher is the value of rebound number, better is the quality of the structure. The results obtained from the test are dependent upon various factors such as



2. Ultrasonic Pulse velocity test

- This test deals with the measurement of time of travel of electronically generated mechanical pulse through the structure to be tested that is further used to analyse its quality.
- The mechanical pulse is generated with the help of Electro Acoustic Transducers and detected with the help of Transmitter that is further used to analyse the time of travel and the velocity of pulse through the structure so as to represent the quality of structure.

Velocity (m/sec)	Quality
➢ 4.5	Excellent
➢ 3.5 – 4.5	Very good
➢ 3 – 3.5	Good
➢ < 3	Doubtful

MORTAR

- The term mortar is used to describe the paste obtained by addition of water in the Mixture of binding material like cement or lime and aggregates like sand.
- The binding material used for the preparation of mortar is also termed as Matrix and the aggregate used is also termed as adulterants.

- Qualities of Sand
- Functions of Sand
- Qualities of Good Mortar
- Types of Mortar

Qualities of the sand to be used for Mortar

- It should be free from the presence of organic matter and vegetative matter.
- It should be chemically inert.
- It should not consist of chemical salts that absorb the moisture from the atmosphere.
- It should be well graded.

Functions of sand in Mortar

1. **Bulk** : Sand in Mortar does not impart strength to it but helps in adding Bulk or volume which makes the mortar more economical
2. **Strength:** Sand helps in adjustment of the strength of the mortar that is achieved by increasing or decreasing its proportion in mortar
3. **Surface Area:** Sand Subdivides the base of binding material into number of layers thereby increases the surface area over which mortar can be spread
4. **Shrinkage:** Sand in mortar helps in reducing the shrinkage during the setting process thereby prevents its cracking and increases the durability of the structure.

Qualities or Good Mortar

1. The mortar should not affect the durability of the construction units in which it comes in contact with.
2. It should be capable of bearing the design stresses.
3. It should be capable of resisting the penetration of water to the structure, that is it should offer higher water tightness.
4. It should be cheap, durable and easily workable.

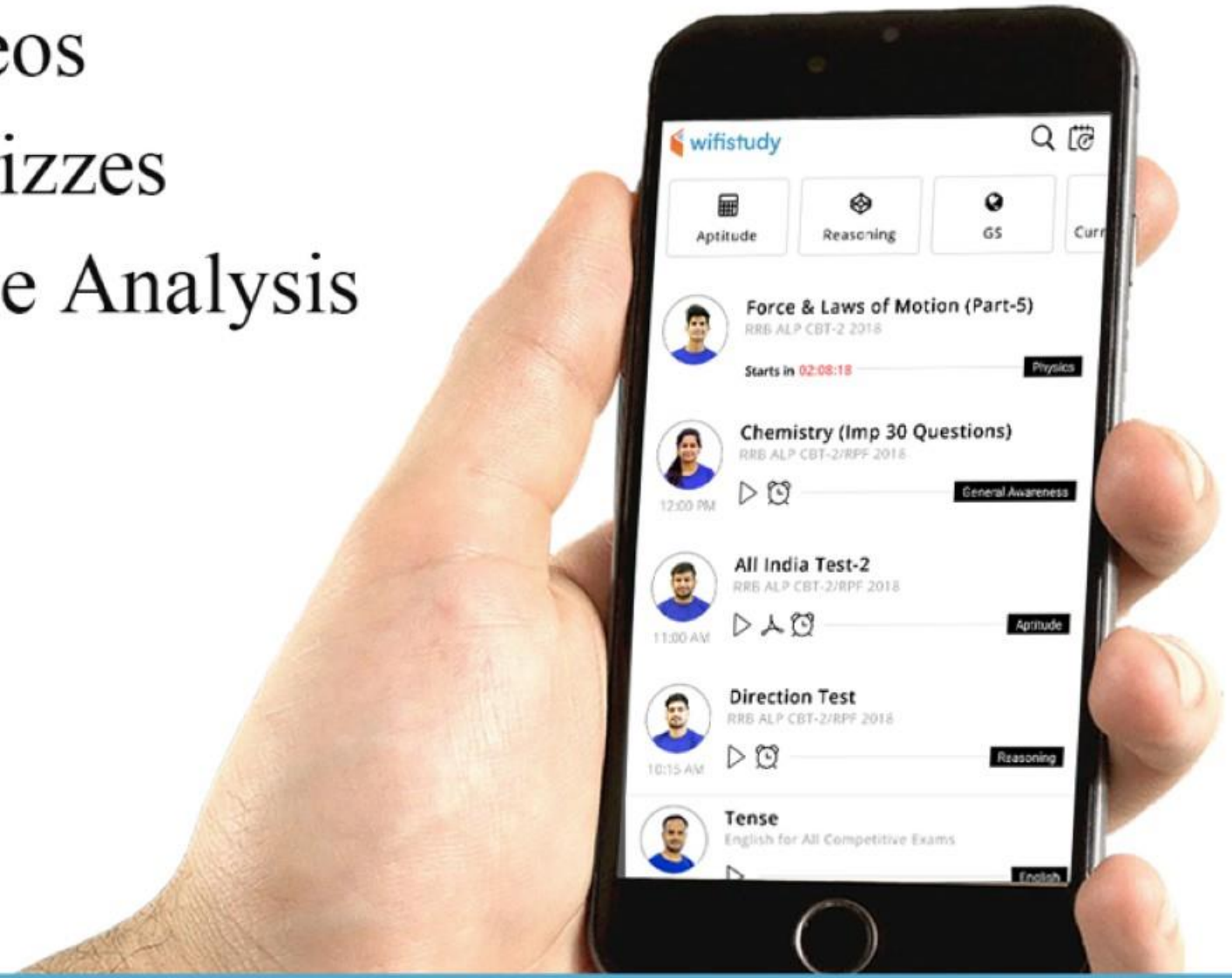
Types of Mortar

- Depends upon type of construction

Type of construction	Type of Mortar	
1) Pointing work	Cement Mortar 1:1/ 1: 3(Dam)	
2) Damp proof Course (DPC)	Cement Mortar 1 : 2	
3) Concrete Pavement	Cement Mortar 1 : 2	
4) Plastering	Cement Mortar 1 : 4	Lime Mortar 1:1
5) Masonary in superstructure	Cement Mortar 1 : 3	Lime Mortar 1:2
6) Masonary in foundation	Cement Mortar 1 : 6	Lime Mortar 1:3

Happy Learning!

- Watch Videos
- Practise Quizzes
- Performance Analysis



GET IT ON Google Play

Available on the App Store

www.wifistudy.com