

CONCRETE

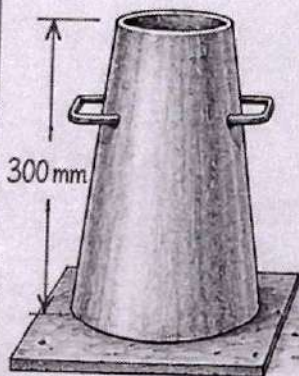
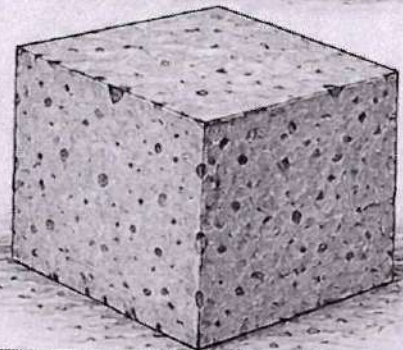
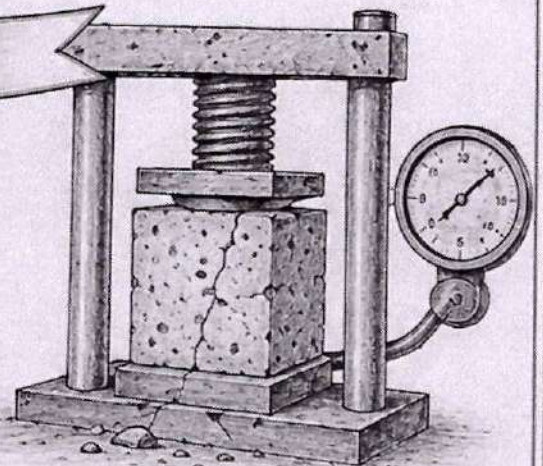
and

Its Testing

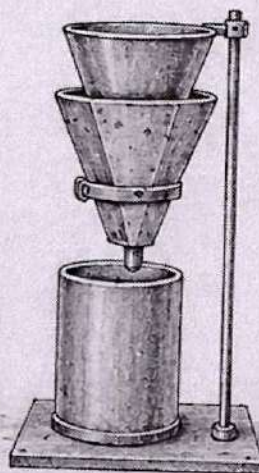
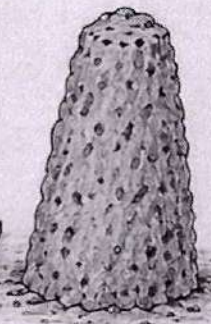
UNIT - III

Includes :

- Concrete
- Water - Cement Ratio
- Properties of Fresh Concrete
- Properties of Hardened Concrete
- Concrete Mix Design
- Testing of Concrete



SLUMP CONE TEST



COMPACTION
FACTOR TEST

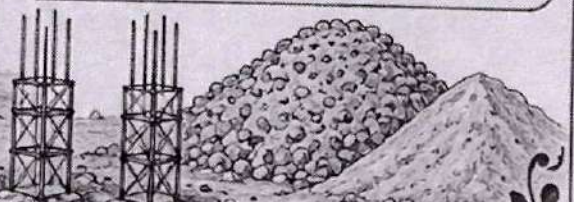
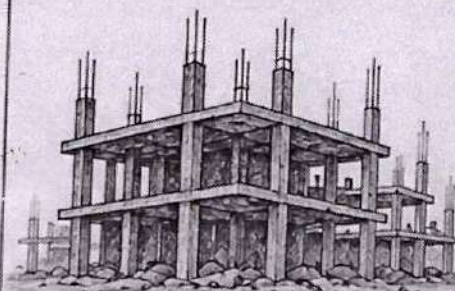
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Subject : Concrete Technology

Subject Code : 313322





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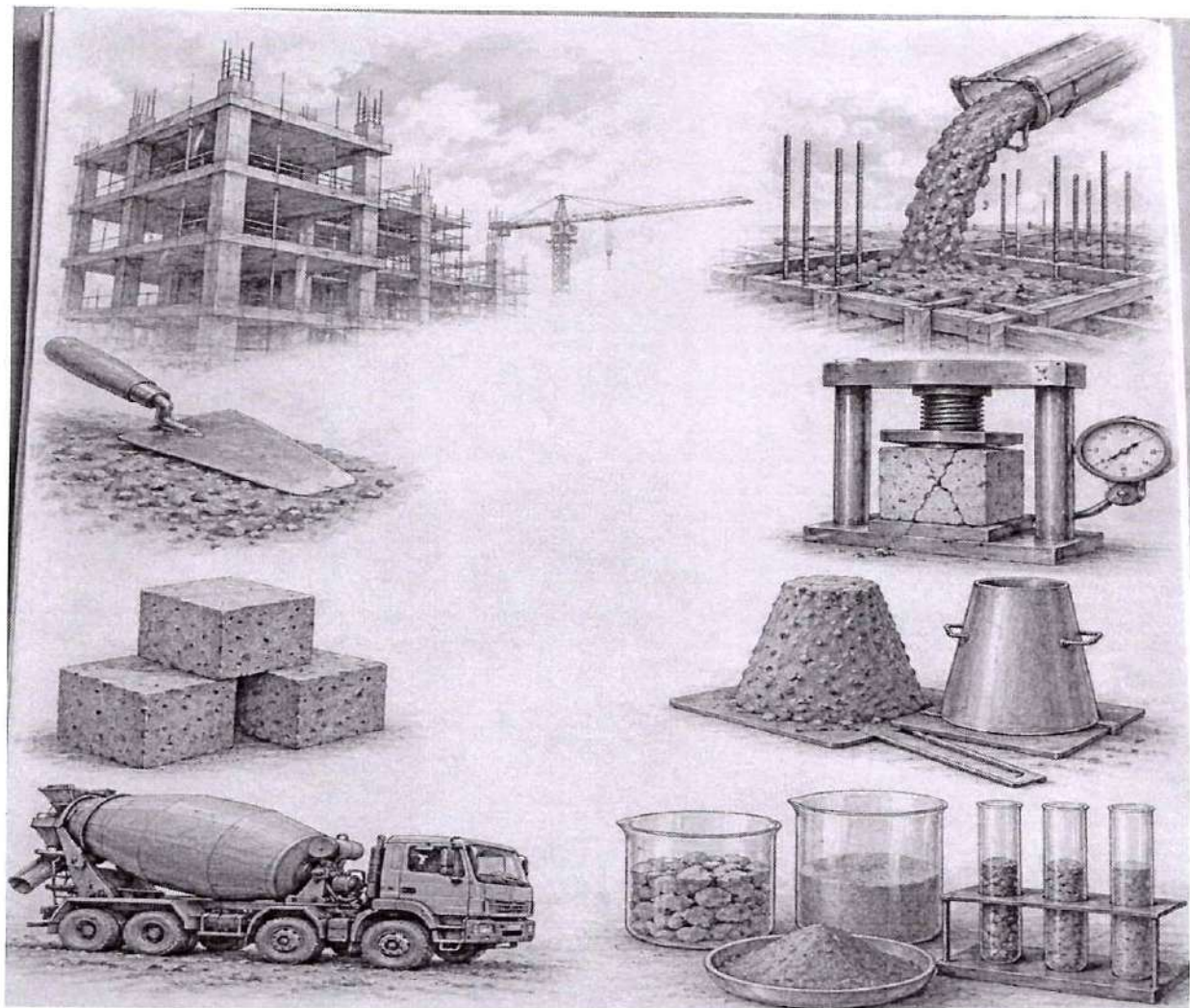
Department of Civil Engineering



Course Title- Concrete Technology
Programme Name -Civil Engineering

Course Code -313322
Semester-Third

Unit	Title	COs	Learning hours	R Level	U Level	A Level	Total Marks
III	Concrete and its testing	CO3	16	4	8	12	24



3.1 concrete :-

Defn:- concrete is an Artificial stone-like material obtained by mixing cement, fine aggregate (sand), coarse aggregate, water and sometimes admixture in proper proportion.

* Necessity of supervision during concreting

Proper supervision is essential to ensure:

- correct batching
- proper water-cement ratio i.e. W/C
- uniform mixing
- proper Transportation
- Adequate compaction
- proper finishing
- proper curing
- Required strength and durability

Grade of concrete (IS 456)

Type	Grades	Uses
Ordinary concrete	M10, M15, M20	PCC, flooring
Standard concrete	M25, to M55	RCC building, bridges
High-strength concrete	M60 and above	High-rise buildings, dams.

Note → M = mix Grade, Number denotes compressive strength at 28 days.

Ex:- M20 = 20 N/mm² compressive strength at 28 days.

3.2 Water cement Ratio :-

Defⁿ:- It is the ratio of weight of water to the weight of cement.

$$\text{water cement ratio} = \frac{\text{weight of water}}{\text{weight of cement}}$$

Prof Abram's Law :- statement :- The strength of concrete is inversely proportional to the water cement ratio.

- Low w/c ratio → High strength
- High w/c ratio → Low strength

Importance of water-cement Ratio :-

- control strength
- Improve durability
- Reduces permeability
- Reduces cracking
- produces dense concrete

* maximum water cement Ratio (IS 456) :-

Exposure	maximum w/c Ratio
mild	0.55
moderate	0.50
severe	0.45
very severe	0.45
extreme	0.40

3.3 properties of fresh concrete :-

- workability :- Workability is the property of fresh concrete which determines the ease of mixing, transporting, placing, compacting and finishing without segregation.
- factors affecting workability :- i) water content
 ii) Aggregate size iii) Aggregate shape iv) cement content
 v) Admixture vi) Temperature vii) method of compaction

* Slump cone Test :-

* Defn :- slump cone test is used to determine the workability of fresh concrete.

* Apparatus :- i) Slump cone ii) Base plate
iii) Tamping rod iv) scale

* Dimensions of slump cone :-

- Height = 300mm i.e. 30cm
- Top diameter = 100mm i.e. 10cm
- Bottom diameter = 200mm i.e. 20cm

* procedure :- 1) clean the cone and base plate.

- 2) place the cone on a smooth level surface
- 3) fill the cone in 4 equal layers.
- 4) compact each layer with 25 strokes using the tamping rod.
- 5) strike off the top surface.
- 6) lift the cone vertically within 5-10 second.
- 7) measure the vertical settlement.

observation slump = original height - final height

* Types of slump :-

- True slump
- shear slump
- collapse slump

◦ precaution :-

- clean apparatus
- use fresh concrete
- lift cone vertically
- perform test immediately

uses :-

- measure workability
- suitable for medium workability concrete.

* Compaction Factor Test :-

Defn:- used for determining workability of low workability concrete.

* Apparatus :-

- Upper hopper
- Lower hopper
- cylinder
- weighing balance

◦ procedure :-

- 1) Fill upper hopper with fresh concrete.
- 2) Open trap door and allow concrete to fall into lower hopper.
- 3) Open lower trap door and allow concrete to fall into cylinder.
- 4) weigh partially compacted concrete
- 5) Empty cylinder.
- 6) Fill cylinder again with full compaction.
- 7) weigh fully compacted concrete
- 8) calculate compaction factor.

* formula :-
$$= \frac{\text{wt. of partially compacted concrete}}{\text{wt. of fully compacted concrete}}$$

* Uses :-

- suitable for low workability concrete.
- more accurate than slump test for stiff concrete.

* Workability Requirement (slump value) :-

Work	slump (mm)
1) Road work	20-40
2) RCC Beams	50-100
3) columns	75-150
4) pumped concrete	100-150

* segregation :- separation of coarse aggregate from cement mortar.

* Causes →

- Excess water
- Improper handling
- poor grading

* prevention →

- proper mix design
- proper compaction
- controlled water cement

* Bleeding :- upward movement of water on the concrete surface.

* Causes →

- Excess water
- poor grading

* prevention →

- proper mix proportion
- proper compaction
- well graded aggregates

3.4 Properties of Hardened concrete

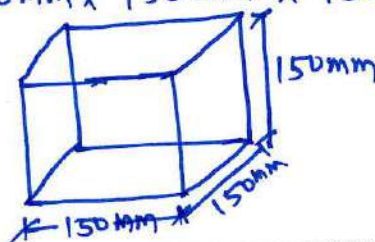
* compressive strength :- Compressive strength is the maximum compressive load carried by concrete before failure.

* compressive strength Test :-

Apparatus :-

- compressive Testing Machine (CTM)
- cube mould
- Tamping rod

* standard cube size :- 150mm x 150mm x 150mm



* Compressive strength Test procedure :-

1. prepare concrete mix.
2. Fill cube mould in 3 equal layers.
3. compact each layer with ~~in~~ 35 strokes.
4. level the top surface.
5. Keep for 24 hours.
6. Remove cube from mould.
7. cure in water for 28 days.
8. place cube in CTM.
9. Apply load gradually until failure.
10. Record maximum load.

* Formula :-
$$\text{compressive strength} = \frac{\text{maximum Load}}{\text{Loaded Area}}$$

* Unit = N/mm^2 or Mpa .

* Durability :- Ability of concrete to resist weathering, chemical attack and abrasion throughout its service life.

* Factors Affecting Durability :-

- Low water-cement ratio
- Good compaction
- proper curing
- good quality materials
- Adequate cover to reinforcement

* Impermeability :- Defn :- Resistance of concrete to the Penetration of water.

* Imposed by →

- low water-cement ratio
- proper compaction
- proper curing

* Dimensional changes → Types -

- shrinkage
- creep
- Thermal expansion & contraction.

* Effects :-

- cracks
- Deflections
- Reduced durability

* 3.5 Concrete Mix Design

* Objective of mix design :-

The main objectives are :-

- Achieve required strength
- Obtain required workability
- Achieve durability
- Use economical quantities of materials
- Obtain a dense and homogeneous concrete.
- Satisfy specified exposure conditions.

* Method of mix Design :-

Common method includes :

1. IS method
2. ACI method
3. DOE method
4. Road Note NO. 4 method

* IS method of concrete mix Design :-

As Per IS 10262

procedural steps :-

1. collect the required design data.
2. select the required grade of concrete.
3. Determine the target mean strength.
4. select the appropriate water cement ratio considering strength and durability requirements.
5. Determine the water-content based on required workability and aggregate size.
6. calculate the required cement content from water content and w/c ratio.
7. check the cement content against the limits specified for the exposure condition.
8. Determine the proportion of coarse aggregate and fine aggregate.
9. calculate quantities of cement, water, fine aggregate and coarse aggregate using the absolute volume method.
10. Apply corrections for moisture condition and water absorption of aggregate.
11. prepare the trial mix.
12. check workability and adjust the mix if necessary.
13. prepare trial cubes and determine compressive strength.
14. Finalize the mix proportion after satisfactory strength and workability are achieved.

3.6 Testing of concrete

A. Significance of Testing :

Testing is carried out to :

- Determine strength
- check quality of concrete
- check uniformity
- Ensure compliance with specifications
- Detect defects.
- Assess durability-related performance
- maintain quality control.

B. 1. Test on fresh concrete :-

- slump test
- compaction factor test
- Vee-Bee test
- flow table test

2. Test on Hardened concrete :-

- Compressive strength test
- Tensile strength test
- Flexural strength test

3. Non-Destructive test :-

- Rebound Hammer test
- Ultrasonic pulse velocity test
- other NDT methods.

C. Compressive strength Test

D. Non-Destructive Testing (NDT)

Non-Destructive Testing is the testing of concrete without causing significant damage to the structure.

* Importance of NDT:

- No major damage to structure

- Useful for existing structures
- Quick assessment
- Help identify weak / defective areas
- can assess uniformity
- Useful for quality control and condition assessment.

* Methods OF NDT :- (only the list of methods required)

Important methods:

1. Rebound Hammer Test
2. Ultrasonic pulse velocity (UPV) Test
3. Penetration resistance test
4. Pull-out test
5. Pull-off test
6. Impact echo test

* Rebound Hammer Test :-

principle :- The rebound Hammer test is based on the principle that the rebound of a spring-controlled mass depends on the hardness of the concrete surface.

Basic working :-

- Hammer is pressed against the concrete surface.
- Spring-controlled mass impact the surface
- The mass rebound
- Rebound number is recorded
- Rebound number is related to surface hardness and can be correlated with compressive strength.

* Limitation :- Rebound number can be affected by:

- surface condition
- moisture
- Age
- Type of Aggregate
- carbonation
- Direction of testing

* Ultrasonic pulse velocity test :-

• principle :- upv test measures the velocity of an ultrasonic pulse passing through concrete.

- Uses :-
- Assess uniformity
 - Detect cracks and voids
 - Identify defective zones
 - Assess quality of concrete

* Basic relationship :- Higher pulse velocity generally indicates denser and more uniform concrete.

* Reference :-

- 3.1 concrete : M.S. Shetty; IS 456:2000
- 3.2 water cement ratio : M.S. Shetty; IS 456:2000; IS:10262
- 3.3 Fresh concrete : M.S. Shetty; IS 1199
- 3.4 Hardened concrete : M.S. Shetty; IS 516
- 3.5 Mix design : M.S. Shetty; IS 10262
- 3.6 Testing concrete : M.S. Shetty; IS 516 ; IS 13311
- MSBTE K-scheme syllabus, MSBTE PYQ & model Ans.

Unit-3 concrete and its testing (Question Bank)

Que. No.	2 marks Questions
1	Define concrete.
2	Define fresh concrete
3	Enlist properties of fresh concrete
4	Enlist different grades of concrete as per IS 456
5	Define creep of concrete
6	Define water cement ratio
7	Define workability of concrete
8	Define shrinkage
9	Define creep
Que. No.	4 & 6 marks Questions
1	State Duff Abraham's water cement ratio law. Explain effect of w/c ratio on strength of concrete with graph.-w24
2	State four precautions to be taken during placing of concrete. w24
3	Explain determination of workability by slump cone test method w24
4	Explain step by step procedure of concrete mix design as per IS 10262-2009- 6marks- w24
5	Suggest the degree of workability in terms of slump. 1) Mass concrete foundation 2) Road Pavement 3) Heavily reinforced concrete. -6marks- w24
6	State any four effects of excess silt on properties of concrete s25
7	State the necessity of supervision in concreting operations and precaution to be taken to avoid the wastage of material-s25
8	Define impermeability of concrete. Enlist factors affecting it.-s25
9	List the various methods of NDT and explain rebound hammer test with its working principle. S25 -6marks
10	Explain segregation and bleeding in concrete -w25
11	State the properties of hardened concrete-w25
12	Explain the laboratory procedure to determine the compressive strength of concrete cubes with reference to following points: i) Preparation of test specimen ii) iii) Procedure of testing Interpretation of results -6marks w25
13	State the necessity of supervision of concreting operations -s26
14	State the two importance of NDT of concrete. Enlist the methods of NDT. - s26
15	Explain any two properties of harden concrete. s26
16	Define workability. Explain stepwise procedure of compaction factor test with neat sketch. s26
17	State any four factors affecting the workability of concrete
18	explain term segregation state the various situation of segregation
19	State any four precaution to be taken to avoid segregation
20	explain term bleeding what are the causes of bleeding
21	State the prevention measures to reduce bleeding.

