

## Chapter 1 - Introduction to Concrete Technology

\* Concrete - It is a construction material artificially obtained by hardening the mixture of binding material, fine aggregates, coarse aggregates and water in pre-determined proportions.

• Characteristics of concrete -

- a. It gains strength with time.
- b. It needs proper curing.
- c. Concrete are of various types depending upon purpose and strength required.
- d. It is a common construction material.

• Mixture of cement and water - matrix, gel.

• Mixture of cement, sand & water - mortar.

\* Importance of Concrete Technology -

- i. Understand the significance of concrete.
- ii. It helps to understand the properties of concrete.
- iii. It guides for repair and maintenance of existing concrete structure.
- iv. It guides the engineers for proper proportion of ingredients and adding admixtures, if needed.

\* Requirements of good concrete -

- a. Aggregates must be clean, hard and durable.
- b. It should have good workability.

- c. It should be compact and dense.
- d. It should be a homogeneous mixture.
- e. Its water cement ratio should be accurate.
- f. It should be impermeable with minimum shrinkage.
- g. It should be economical.

\* Grades of Concrete - Concrete is graded according to its compressive strength like M5, M7.5, M10, M15, M20, M25, M30 etc...

In this naming 'M' refers to min and the numeric value determines its compressive strength after 28 days of curing.

- Ex - M5 has a compressive strength of  $5 \text{ N/mm}^2$  after 28 days of curing.
- M5, M7.5 - Low grade concrete.
- M10 - M20 - Ordinary concrete.
- M25 - M55 - Standard concrete.
- M60 - M80 - High strength concrete.

\* Classification of Concrete -

a. Based in binding material used -

Cement concrete

Lime concrete.

b. Depending upon purpose -

Fibre reinforced concrete.

Light weight concrete.

Dis-entrained concrete.

High early strength concrete.

Mass concrete

Coloured concrete.

c. Depending upon design-

Plain cement concrete.

Reinforced cement concrete

Pre-stressed concrete.

d. Depending upon strength-

Lean concrete.

Rich concrete.

• Advantages of Concrete-

a. Economical in long run.

b. High compressive strength.

c. It is fire resisting.

d. It is strong in compression and equally in tension, when reinforced.

e. It is durable and impervious to moisture.

f. Its strength increases with age.

g. It is not liable to rot and decay.

• Disadvantages of concrete-

a. Dead weight of concrete is high so, require intense shuttering.

b. It expands and shrinks with temperature.

c. It needs time for curing.

• Threats for concrete in future -

- i. Shortage and availability of natural aggregate.
- ii. Increased labour cost.
- iii. Availability of skilled workers.
- iv. Delay in revision of Indian standards to match global research and development.

\* Weight -

a. PCC -  $24 \text{ kN/m}^3$

b. RCC -  $25 \text{ kN/m}^3$

• Grades of cement - 33, 43 and 53

## Chapter - 2      Ingredients of Concrete

- Binding material - cement.
- Fine aggregates - sand
- Coarse aggregates - broken stones and gravels.
- Water
- Admixtures.

\* Cement - It is an extremely fine binding material having cohesive and adhesive properties.

• It is obtained by burning argillaceous & calcareous materials.

• Clinker - Product obtained by burning cement ingredients at about  $1450^{\circ}$  -  $1500^{\circ}$ . Then it is cooled and ground to obtain cement.

• Portland - A stone - as cement resembles after hardening of cement.

• One bag cement -

$$\text{weight} = 50 \text{ kg}$$

$$\text{volume} = 0.035 \text{ m}^3$$

• Raw materials for cement -

a. Calcareous Materials - Lime stone, chalk, oyster

$\text{CaCO}_3$  as major constituent -

b. Argillaceous Materials - Clay, shale, slate and selected blast furnace slag (alumina as major substance)

\* Note - Inventor of cement - Joseph Aspdin - 1824

Manufacturing cement in India - 1904 - Jamil Nadu

## \* Chemical composition - OPC

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S.No.	Chemical constituents	Range (in %)	Common Proportions
1	Lime ( $\text{CaO}$ )	60 - 65	6.3
2	Silica ( $\text{SiO}_2$ )	17 - 25	2.2
3	Alumina ( $\text{Al}_2\text{O}_3$ )	3 - 8	6
4	Iron Oxide ( $\text{Fe}_2\text{O}_3$ )	0.5 - 6	3
5	Magnesium Oxide ( $\text{MgO}$ )	0.5 - 4	2-5
6	Sulphur Tri oxide ( $\text{SO}_3$ )	1 - 3	2
7	Alkalies	0.5 - 1	1

• In addition, calcium sulphate / gypsum is added to cement to adjust its setting time - 3% by weight

• Various Function of cement Ingredients -

- Lime - Provides strength
  - Excess - Expands & disintegrates.
  - Deficit - Reduces strength & setting
- Silica - Provides strength and binding property to cement.
  - In excess - increases the setting time.
- Alumina - Lowers temperature for clinker formation.
  - Sets the cement quickly (early setting)
  - \* Excess - Lowers cement strength.
- Iron Oxide - Provides colour, hardness and strength.
- Magnesium Oxide - Provides colour and hardness to cement.
  - \* Excess - makes unsound, cracks.
- Sulphur Tri oxide - Makes cement sound and durable.
  - \* Excess - Makes cement unsound.
- Alkalies in excess cause efflorescence.
- Gypsum - It increases initial setting time of cement.