Durability

The ability of concrete to withstand the conditions for which it is designed without deterioration for a long period of years is known as durability.

OR

Durability of concrete may be defined as the ability of concrete to resist weathering action, chemical attack, and abrasion while maintaining its desired engineering properties.

Durability is defined as the capability of concrete to resist weathering action, chemical attack and abrasion while maintaining its desired engineering properties. It normally refers to the duration or life span of trouble-free performance. Different concretes require different degrees of durability depending on the exposure environment and properties desired. For example, concrete exposed to tidal seawater will have different requirements than indoor concrete.

Concrete will remain durable if:

- The cement paste structure is dense and of low permeability
- Under extreme condition, it has entrained air to resist freeze-thaw cycle.
- It is made with graded aggregate that are strong and inert
- The ingredients in the mix contain minimum impurities such as alkalis, Chlorides, sulphates and silt.

Durability

The **durability of concrete** is vital with regards to a structure's lifespan. The **importance** of **concrete durability** cannot be underestimated. **Concrete durability** is simply defined as its ability to resist weathering action and chemical attack, while maintaining the desired engineering properties.

Five Ways to Make Concrete More Durable

- Mix Design. Durability starts with a concrete mix design that is properly matched to the service conditions that the concrete will be exposed to. ...
- Construction Joints. Construction joints in a concrete structure are unavoidable. ...
- Low Permeability. ...
- Proper Curing. ...
- Concrete Placement.

Durability

Following are the factors affecting durability of concrete.

- Cement Content
- Compaction
- Curing
- Cover
- Aggregate Quality
- Water Quality
- Concrete Compaction
- Curing Period
- Permeability
- Moisture
- Temperature
- Abrasion
- Carbonation
- Wetting and Drying Cycles
- Freezing and Thawing
- Alkali-Aggregate Reaction
- Sulfate Attack
- Organic Acids

Durability

Durability of Concrete depends upon the following factors

Cement content

- Mix must be designed to ensure cohesion and prevent segregation and bleeding. If cement is reduced, then at fixed w/c ratio the workability will be reduced leading to inadequate compaction. However, if water is added to improve workability, water / cement ratio increases and resulting in highly permeable material.

Compaction

- The concrete as a whole contain voids can be caused by inadequate compaction. Usually it is being governed by the compaction equipments used, type of formworks, and density of the steelwork

Curing

- It is very important to permit proper strength development aid moisture retention and to ensure hydration process occur completely

Cover

- Thickness of concrete cover must follow the limits set in codes

Permeability

- It is considered the most important factor for durability. It can be noticed that higher permeability is usually caused by higher porosity. Therefore, a proper curing, sufficient cement, proper compaction and suitable concrete cover could provide a low permeability concrete

Durability

There are many types but the major ones are:

Physical Durability

- Physical durability is against the following actions
- Freezing and thawing action
- Percolation / Permeability of water
- Temperature stresses i.e. high heat of hydration

Chemical Durability

- Chemical durability is against the following actions
- Alkali Aggregate Reaction
- Sulphate Attack
- Chloride Ingress
- Delay Ettringite Formation
- Corrosion of reinforcement

Durability

1. External Causes:

- Extreme Weathering Conditions
- Extreme Temperature
- Extreme Humidity
- Abrasion
- Electrolytic Action
- Attack by a natural or industrial liquids or gases

2. Internal Causes

a) Physical

- Volume change due to difference in thermal properties of aggregates and cement paste

Frost Action

b) Chemical

Alkali Aggregate Reactions

i. Alkali Silica Reaction ii. Alkali Silicate Reaction iii. Alkali Carbonate Reaction

- Corrosion of Steel