

Q 1 (a) Discuss the action of cyclic freezing and Thawing on concrete?

Answer Freeze-thaw deterioration is a mechanical process that is common cause of damage to concrete constructed in the colder climate. For freeze-thaw damage to occur, the following conditions must exist:

- The concrete must undergo cyclic F&T.
- The pores in the concrete, during freezing, must be nearly saturated with water.

Scaling is the deterioration of the upper concrete surface is characterised by the peeling off or flaking away of concrete surface.

Upon freezing, water held in the cement paste and the aggregate particles expand and can cause deterioration of concrete. Water experiences about 15 percent volumetric expansion during freezing.

The deterioration occurs from the outer surface inward in almost a layering manner. The rate of progression of freeze-thaw deterioration depends on the number of cycles of freezing and thawing the degree of saturation during freezing. The porosity of concrete and the exposure condition.

Q 1(b) What do you mean by Alkali Aggregate Reaction

Answer: Alkali-aggregate reaction (AAR) is the expansive reaction between the alkaline pore solution of concrete and certain minerals in the aggregates.

The principal source of alkalinity in the pore solution is from the cement itself, but any source of sodium or potassium can contribute to the reaction provided that the alkali can move from its source into the pore solution of the concrete.

AAR has been divided into two types of reaction depending on the types of minerals involved.

(a) Alkali-silica reaction

Chemical reactions between aggregates containing certain reactive constituents and alkalis and hydroxyl ion released by the hydration of cement can have a deleterious effect on concrete.

(b) Alkali-silica reaction

The reaction between the alkaline pore solution and argillaceous dolomitic limestones containing clay impurities. No expansive alkali-silica gel is formed in this reaction.

Q 2. (a) What is concrete crazing? What corrective measures can be taken to control it?

Answer: Concrete crazing is the development of a network of fine random cracks on the surface of concrete caused by shrinkage of surface layer. These cracks are rarely more than 3mm deep, they do not affect the structural integrity of concrete and rarely do they affect durability.

Crazing in concrete usually occurs because of wrong construction practices like:

- 1) Poor or inadequate curing
- 2) Excessive laitance on surface
- 3) Over vibration leading extra bleed.
- 4) Intermittent wet curing and drying
- 5) Sprinkling cement on the surface to dry up bleed water.

# Preventive Measure

- Proper and early start of curing
- Use of curing compound on surface
- Never sprinkle dry cement on the surface of the plastic concrete.

Q-2 (b) What is carbonation? Describe the corrosion of steel by it?

Answer! Carbonation can be defined as the reaction of carbon dioxide with the hydrated cement. The carbon dioxide gas is present in atmosphere with varying percentage from rural to urban and highly industrialized area.

Carbonation is caused by the penetration of air into concrete. In the presence of moisture, carbon dioxide from the air reacts with hydroxides, such as calcium hydroxide, to form calcium carbonate and carbonic acid. Both of these products can lower the alkalinity of normal concrete below the pH level at which the protective oxide film on the reinforcing steel is stable. Without the protective oxide film, the reinforcing steel begins to corrode. The resulting rust causes expansion, cracking and spalling.

The carbonation of concrete

