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A study of Deterioration on R.C.C. Structure

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ABSTRACT:All reinforced concrete structures suffer from deterioration due to action of changes in the atmosphere. Since deterioration of R.C.C. structure is very common problem nowadays it can lead towards a serious damages on R.C.C. structure if neglected and also tedious to repair afterwards. Deterioration occurs due to exposition to the atmosphere in particular environment, moisture content etc. which then vastly differs the repair methodology. Hence study of the deterioration of R.C.C. structure is must for verifying the extent of damage on R.C.C structure also to avoid the same problems in the near future. The paper emphasizes on the study of deterioration of concrete. Temperature variation, moisture content, Permeability of cement paste and other factors which are the influencing factors for deterioration of R.C.C. structure.

KEYWORDS:R.C.C Structure, Deterioration, Building, Permeability, Porosity, Holistic Models.

I. INTRODUCTION

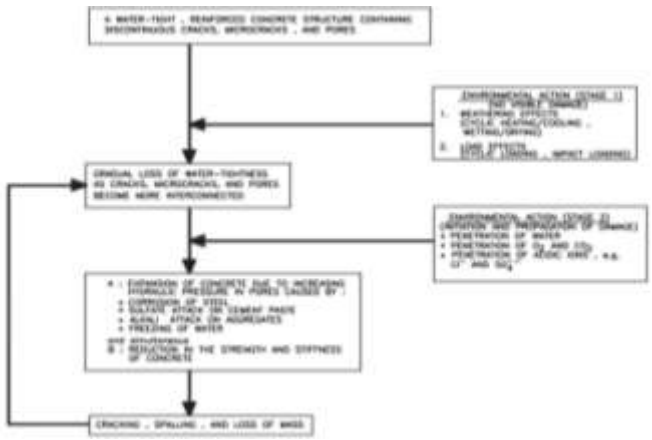
As the deterioration process in concrete begins with penetration of various aggressive agents. Hence, low permeability is the key to its durability. Durability of a reinforced concrete structure depends on the environment in which it is exposed, as also on the time and properties of concrete.

Although it is different to generalised the cause of deterioration due to interacting nature of various factor. Efforts have been made to group the various types such as chemical and physical. Three Holistic Models and deterioration of R.C.C. have been illustrative which represent a quantitative design with the help of these models it is easy to understand a procedure of deterioration of R.C.C. structure. In this paper, we will discussed and materialised process of deterioration with the help of Holistic Models one by one.

MODEL I

According to this model it happens in two stages. In the first stage, due to loading and weathering effects i.e. expel cycle of wetting and drying, seasonal temperature variation, freezing and thawing etc. the voids and micro cracks in the interfacial zone between the cement paste and coarse aggregate of reinforcing steel become interlinked. When the interlinked network of micro cracks gets connected to any crack present in surface. This provides a primary mechanism of fluid transport into the interior of concrete.

Once this happens the permeability of concrete increases greatly and beginning of second stage starts. In second stage, water, oxygen, carbon dioxide and acidic ions penetrates into concrete easily. The presence of these elements facilitates various physical and chemical changes as a results of which the material eventually undergoes cracking, spalling and partial loss of strength and stiffness.



Holistic Model I of concrete deterioration from environmental defects

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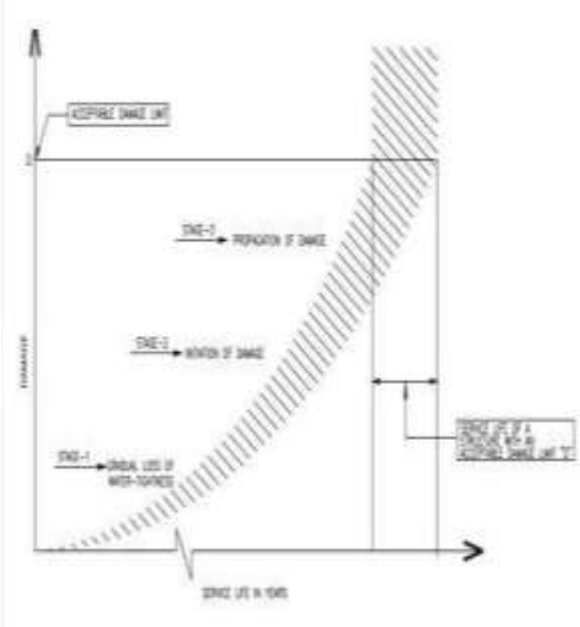
MODEL II

According to this model it happens in three stages. It starts with the gradual loss of water-tightness then initiation of damage which finally leads towards a propagation of damage.

During first stage, no noticeable weakening of material but some protective barrier is broken down such as De-passivation of reinforcement by CO2 or by chloride penetration. Once the first step is occurred the initiation of damage in R.C.C structure gets start.



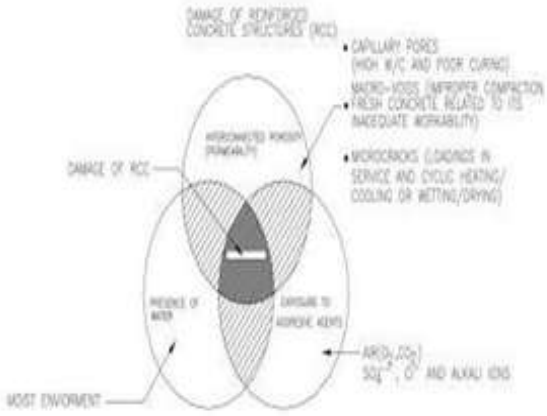
Holistic Model II of deterioration of RCC

MODEL III

This Model III of deterioration of concrete in which water-cement ratio plays a major role. This model represents three principles which offers an overall view of co-existence.

1. Interconnected porosity of cement paste
2. Exposure to aggressive agents
3. Intermittent presence of water

In absence of any of three element damage to R.C.C structure won't appear.



Holistic Model III Ternary Representation of damage of RCC

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II. PERMEABILITY OF CONCRETE

Permeability in concrete can be controlled by the factors like water-cement ratio, degree of hydration or curing, air voids due to deficient compaction, micro cracks due to loading and cyclic exposure to thermal variation. The permeability in cement paste is the function of water-cement ratio. Given good quality of materials, right proportions and good practice, permeability of concrete is the direct function of porosity and interconnection of pores of cement paste. The interconnectivity is related to:

1. Capillary Porosity – High Water-cement ratio
- Inadequate curing

2. Air Voids- Improper compaction

3. Micro crack- Loading Effect
- Weathering Effect
- Initial care
- After care

4. Macro crack- placement
- Hardening process
- Increasing chemical attack
- Corrosion of reinforcement

CAPILLARY POROSITY

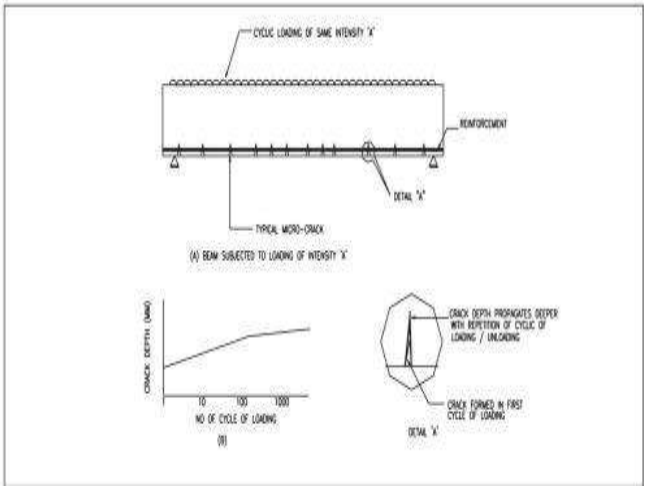
The volume of hydrated cement product is significantly higher than the volume of its constituents. As a result of hydration, increase volume of hydrated gel eventually fills parts of capillary pore volume. This helps in creating discontinuity in capillary pores. This extra volume of water entrap in the cement paste after completion of hydration leaves interconnected pores called capillaries in hardened concrete which becomes means of passage for external or environmental chemicals into the concrete. This porosity increases with increase in water-cement ratio.

AIR VOIDS

Air voids are much larger than capillary pores. They formed due to inadequate compaction in the form of discrete air bubbles. These air voids may get interconnected to capillary pores system.

MICRO CRACKS

During Service life of R.C.C. structure. It is subjected to various types of loading system and extreme exposure condition of temperature variation. Micro cracking combined with capillary porosity is generally responsible for ingress of aggressive chemicals in R.C.C.



Crack Propagation in tensile zone of an R.C.C. Beam

The structural members having different thermal exposure conditions on the opposite faces more particularly those located on the exterior are subjected to loading due to temperature gradient within the cross section. This is due to difference in temperature on the two faces of member during different times. As a result, tensile stresses in excess of tensile strength of concrete could develop across the cross section and result in formation of micro crack. This process is cyclic due to seasonal temperature variation condition. Cyclic nature of loading is responsible for further increase as crack depths propagate deeper with each cycle.

Any cracks which allows aggressive agents to travel freely into the concrete is named as Macro cracks. These macro cracks may vary from 0.1 to 0.3 mm. Any cracks wider than this is likely to cause durability problem. Macro cracks in

concrete may occurs due to variety of reasons such as Improper placement, settlement crack of fresh concrete, Cracking due to intrinsic sulphate attack, alkali aggregate reaction, heat of hydration, increase volume of corroded reinforcement exerting bursting pressure on concrete and excessive loading.

III. CONCLUSIONS

The main objective of this paper is to study the causes of deterioration which affects the concrete, ultimately effecting the concrete structure. Durability and permeability of concrete plays an important role in deterioration of concrete. This paper concludes that low permeability and lack of durability in concrete are main cause deterioration of concrete which we can easily control by following construction methodology while construction of structure and by adding water-reducing admixtures to lower water content in concrete to reduce permeability.

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