

Causes, Evaluation and remedies to cracks in civil structure – A brief study

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Abstract : *Cracks in the Civil structure is common problem. The usefulness of the structure depends upon the integrity of the structure. However good looking the structure may be, a crack renders the beauty as well as its durability. In this paper efforts are made to give brief introduction to causes for the cracks and its remedies. This report describes reasons for leakages, dampness, types of cracks and appropriate method for sealing it with proper precaution. There are many reasons for cracks; may be uneven settlement, improper use of material, faulty design, mechanical movement, etc. As per the type of crack and importance of the structure a method is selected for its repairing, however only selection of method merely does not guaranty the repair work. Utmost care and in depth study of the site situation is necessary for the successful work.*

Keywords— *Causes, Leakage, Repair materials, Repairing methods, Surrounding condition,*

INTRODUCTION

Introduction: In today's world almost all structure are built using concrete in one form or the other. The benefits of the concrete are that ingredients needed for concreting are easily available and technology needed is not that complex. It is also comparatively cheaper. The structures are intended to give service designed for. However many a times even after spending large amount and using "A" grade material, either there is constant leakage, dampness, or uneven settlement. To overcome these problems many repair techniques are available and still research are going on for more satisfactory result.

Understanding Ingredients: The raw material used for cement mainly consists of lime, Silica, alumina and iron oxide. The reaction between these materials is responsible for the properties of the concrete. In general the proportion of raw material for Portland cement is as CaO – (60 to 67%), SiO₂ – (17 to 25 %), Al₂O₃ – (3 to 8%), Fe₂O₃ – (0.5 to 6.0 %), MgO (0.1 to 4.0 %) , Alkalies (K₂O, Na₂O) – (0.4 to 1.3 %), SO₃ – (1.3 to 3.0) .

The complex elements and compounds take part in reaction in presence of water resulting in a solid substance. Although utmost care is taken during casting of concrete sometimes it is difficult to obtain desired result. An ideal concrete should be strong, durable and waterproof.

Water –tightness: Grade of Water –tightness: B S 8102 has classified concrete into several grade, depending upon the extent of " Water tightness "

TABLE I

Sr no	Grade	Description
1.	Grade I	Water will not flow freely nor will run through the concrete.
2.	Grade III & IV	This is damp-proof with no visible water ingress but also high level of water – vapour resistance will be achieved.

Water proof = watertight + Damp proof

Causes of Dampness, Leakages: However the concrete has been hardened, there is possibility of fine cracks. Permeability in concrete occurs; under pressure and it depend on the size of cracks. The interesting fact is narrower the pores i.e finer the cracks, there shall be more capillary action and broader the cracks, more shall be the permeability. Thus, only addressing the problem of permeability and not attending the capillary action will not give us the desired result. Also it is clear that, passing of water through concrete alone does not depend on water height.

Some other causes:

- It is better to use mix design instead of following the practice of volumetric mix
- During casting of concrete, generally heat of hydration is neglected. For fine cracks and internal cracks heat of hydration is the main cause. Using of ice or cold water can considerably reduce heat generation. Proper and complete curing can help.
- The ingredients used should be invariably washed, i.e sand, aggregate and water should be potable. The dust, soil present in the ingredients does not get mixed with cement, and has tendency to remain separate from other material. This results in weak concrete with voids.



Slab Leakage

- Proper proportion of water is required. Not excess, nor less. The excess water will come out of mixer, with cement, leaving pores behind and less amount of water will create empty space in concrete.
- Cracks: In any type of concrete, cracking occurs especially in tension zone. When the cracks are beyond limit than the specified, water and air enters in the structure resulting in the corrosion, and deteriorating of structure. This gives passage to dampness and water.



Leakage

- **Moisture :** Constant moisture condition can affect the composition of concrete. It is observed that when the concrete is slightly drier than saturated water and oxygen can enter into the structure.
- **Permeability:** Penetration of moisture is easier in porous concrete compared to dense concrete. Study reveals if W/C ratio is increased by 0.1, permeability of concrete increase by 1.5 times. Other factors making concrete permeable is poor curing and poor compaction. Poor curing and poor compaction results in increase up to 5 to 10 times of permeability. Water cement ratio should not exceed 0.55 for ordinary structure and 0.45 for marine structures.

- **Chlorides:** Chlorides enter the concrete during concreting through any media, or say aggregates. Chloride also enters if any member is in contact with sea water. CaCl_2 increases shrinkage crack in concrete. It should be limited to 1.5 % with low W/C ratio, adequate cover to reinforcement, good compaction and good grading of aggregate should be ensured.

Repairs of water leakage cracks in civil structures: Civil Structures leaks because of cracks or some other reason. Cracks in the structure are dangerous to stability as well as renders the structure useless. In residential area or in commercial area leakages does not allow full function of structure. The repairs of the crack are complicated to very complicate because of the condition in which one has to work. Sometime repairs have to be carried out under continuous leakage. Hence a proper knowledge of repair technique and experience can help us to solve this widespread problem.

There are many type of material available for the crack repair as well as different type of methods are there. A proper selection of material and method is must for successful repair of crack in structure.

Cementitious grout : This is quiet popular method. In this method very fine cement is (maximum grain size : less than $16\mu\text{m}$) used with water is proper proportion with admixture as recommended. The property of expansion of the finished product and the ease of cement slurry to enter into very fine cracks seals the crack perfectly. Generally the work place i.e the surface where the material is to applied should be moist and wet otherwise in dry condition there is possibility of shrinkage of slurry creating space in between. As only cement and water is used as main material the place where it is be used should be stable i.e without any movement, movement may break the grouted material.

Resin Grout : When resin is mixed with hardener it fills the crack and get stuck to the surface of the crack. There are two type of the epoxy resin hydrophobic epoxy and hydrophilic epoxy. Due to adhesive property epoxies are used for structural bonding and water leakage problem

Synthetic rubberized gel grout: It is a mixture of macromolecule resin, such as synthetic rubberized gel and asphalt compound, and bentonite. It can be used directly without mixing it with other components at work site. It bonds well in water because of its expanding property of bentonite component, and can respond well to the movements of cracks because of its high flexibility of rubberized gel component.

The method selection for repairing work depends on cost, durability, applicability, importance of structure, time available, skill availability etc

Grouting injection methods: There are three types of injection method. Three main types in the grouting injection method for water-leakage cracks are..

- 1) Intercept injection. A hole is drilled at a certain distance from the crack diagonally up till it intercepts the crack. This hole is used for injection material. The grouting material spreads on all side. It is ensured that the crack is filled fully from all side and appropriate pressure is created to make it sealed.
- 2) Negative side injection. Here the cementing material is directly injected into the crack from the same side and it is ensured that all space is properly filled.
- 3) Positive side injection. In this method a hole is drilled parallel to the crack and at a particular distance it connects negative and positive sides. The material is injected into the hole which fills the layer making it hardened and creating an impervious layer

CONCLUSIONS

The civil structures are intended for public use. If proper attention is not given during construction or in the workmanship it results in useless. Proper identification of cracks and its cause can lead us to exact treatment needed. Latest technology with modern material is now available. Use of such type of material may increase the life of the structure and fulfil its purpose.

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