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Preventive Measures and Treatment Methods of Crack in Buildings

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ABSTRACT: *Cracks are the most common type of problem in any type of building. It affects the stability and appearance of buildings. We all love to have a house which structurally safe and beautiful but it is not so easy, we have to overcome natural calamity, soil failure, construction faults, improper design, and inadequate joints causing to develop cracks in buildings. So, it is important to understand the cause of cracks and the effective measures should be taken for prevention. Though cracks cannot be prevented entirely but they can be prevented by using proper material and techniques of construction. On timely identification of such cracks and adopting preventive measure are essential. In this paper, we will discuss about types of cracks, causes of cracking and preventive measures to be taken along with the techniques for treatment of cracks.*

KEYWORDS: *Cracks, Causes, Prevention, Prevention, Grouting*

INTRODUCTION

Cracks in building is a universal problem faced throughout the world. The first and most common reason of crack development is the stress component exceeding its strength component which can be associated to the externally applied loads such as dead, live, wind or seismic loads, or foundation settlement or stresses developed internally due to thermal movement, moisture changes or chemical action.

An engineer should have a sound knowledge of all the facts of concrete technology i.e. of the behavior of construction techniques, and types of cracks likely to occur, their causes and respective remedial measure. Cracks also occur due to settlement, temperature, shrinkage effect, poor construction practice etc.

Types of cracks:

(a) Structural cracks:

Structural cracks are caused by a variety of issues, like poor soil bearing, overloading, swollen soil, and poor construction sites. Generally, structural cracks are accompanied by interior problems, like sloping floors and doors and windows that stick when closed. Structural cracks usually have some tell-tale signs.

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(b) Nonstructural cracks:

A non-structural foundation crack is one that doesn't threaten a building's structural integrity. They're mainly caused by concrete shrinking during the curing process. That doesn't mean they're harmless though. For example, non-structural vertical cracks caused by concrete shrinkage can cause leaks in basements. Crack on wall, parapet wall, driveway is called non-structural cracks.

CAUSES AND PREVENTION OF CRACKS

1. Moisture Changes:

In India, houses are mostly made of concrete, bricks, mortar etc. These construction materials are natural water absorbing components. When they absorb moisture, they expand and on drying, shrink. Hence develops the cracks in walls due to change in moisture. Consequently, if building materials used possess expanding or contracting natures, then existing cracks increase or sometimes new cracks also get formed.

Preventive measures:

- Provide movement joints
- Use minimum possible quantity of water for mixing cement concrete or cement mortar
- Compact concrete properly; vibrated concrete suffers lesser shrinkage compare with manually compacted concrete
- Finally, avoid the use of excessive cement

2. Movement due to thermal variation:

The cracks due to thermal movement is caused either due to external heat i.e., due to variation in ambient temperature, or due to internally generated heat i.e., due to heat of hydration in mass concrete during construction. Thermal movement Thermal movement is related to seasonal temperature and weather changes. Every building will shrink and expand as the temperature, moisture and humidity (the amount of moisture in the air) changes throughout the year.

Preventive Measures: Joints should be constructed like construction joints, expansion joints, control joints and slip joints. The joints should be planned at the time of design and be constructed carefully.

3. Elastic deformation:

It occurs due to material strain under stress. When two materials having two different properties built together under the effect of then different shear stresses occur at the junction of two different materials. Dead load and live load are the main cause of elastic deformation any structural component of a building.

Preventive Measures: Create slip joints under the support of concrete slab on walls. Provide horizontal movement joints between the top of brick panel and reinforced cement concrete beam/slab.

4. Movement due to creep:

Gradual and slow time dependent deformation of concrete structure under sustained loads is known as creep. It may generate excessive stress and lead to the crack development. Creep increases with increase in water and cement content, water cement ratio and temperature.

Preventive measures:

- Use minimum possible quantity of water.
- Provide compression reinforcement if possible
- Avoid formwork removal at early ages.
- Cure concrete properly.
- Assign proper cross section for the concrete element.

5. Movement due to chemical reaction:

Chemical reactions may occur due to the materials used to make the concrete or materials that come into contact with the concrete after it has hardened. Concrete may crack with time as the result of slowly developing expansive reactions between aggregate containing active silica and alkalis derived from cement hydration, admixtures or external sources.

Preventive measures: For structural concrete in foundation, if sulphate content in soil exceeds 0.2 per cent or in groundwater exceed 300 ppm, use very dense concrete and either increase richness of mix to 1:1.5:3 and to prevent cracking due to corrosion in reinforcement it is desirable to specify concrete of richer mix for thin sections in exposed locations.

6. Foundation movement and settlement in soil:

Shear cracks occur due to large differential settlement in foundation. Building constructed on expansive soils which are susceptible to swelling on absorbing moisture and shrink on drying due to change in moisture content of the soil. These are extremely susceptible to cracking. Special measures to foundation movement of a corner on an end of building they are usually diagonal in shape. These cracks are wide at top and decrease in width downward. These cracks can be easily distinguished from those due to thermal or moisture movement.

Preventive measures:

- Plan for under-reamed piles in foundation for construction on shrinkable soils

- Plan for plinth protection around the building
- Slip / expansion joints to ensure that new construction is not bonded with the old construction and the two parts (Old and new) are separated right from bottom to the top. When plastering the new work, a deep groove should be formed separating the new work from the old.
- For filling deep - say exceeding 1.0m, Soil used for filling should be free from organic matter, brick-bats and debris filling should be done in layers not exceeding 25 cm in thickness and each layer should be watered and well rammed.
- If filling is more than 1 meter in depth, process of flooding and compaction should be carried out after every meter of fill.

Cracking due to vegetation:

Existence of vegetation may be the cause of cracks in walls due to expansive action of roots growing under the foundation or in brick masonry. Plants take root and begin to grow fissures of walls.

When soil under the foundation of a building happens to be shrinkable clay, cracking in walls and floors of the building may occur either due to dehydrating action of growing roots on the soil which may shrink and cause foundation settlement or due to upward thrust on portion of the building.

Preventive measures: Do not let trees grow too close to the buildings, compound walls etc. Remove any saplings of trees as soon as possible if they start growing.

CASE STUDY

For a better understanding, some cases are taken at Bansal IET Lucknow. This institute was built in 2007 and it has world class Infrastructure. Most of the structure already have started showing deep cracks at various locations all across the building which leads to the decrease in in durability as well as strength of the structure. Cracks generated in the building has many reasons which are responsible for the structural and nonstructural cracks. In April 2022, the building was inspected carefully and each type of cracks were photographed and recorded for further reasoning. These cracks are categorized on basis of-

Thin – less than 1mm in width

Medium - 1 to 2 in width

Wide – more than 2mm in width

Figure 1: Front view of the institute

Figure 2: Cracks on walls

Causes For the Occurrence of Cracks:

The important causes responsible for occurrence of the cracks are:

- Structural deficiency resulting from design deficiency or construction deficiency and overloading.
- Settlement of ground
- Temperature and Shrinkage effects
- Cracks due to faulty workmanship and poor construction practice.

METHODOLOGY

1.) Epoxy injection

2.) Routing and sealing

3.) Flexible sealing

4.) Stitching

5.) Providing additional reinforcement

6.) Drilling and plugging

7.) Prestressing method

8.) Grouting

9.) Dry packing

10.) Overlays

11.) Autogenous healing

12.) Surface coatings

Here we will discuss about most popular repair technique of cracks such as grouting:

Crack repair by Grouting:

Based on the grouting material used there are two methods:

1) Portland cement Grouting:

Wide cracks in gravity dams and thick concrete walls can be repaired by filling the Portland cement grout in cracks. This method is proved effective in preventing water leakage, but will not structurally bond cracked sections. In this method the very first step is cleaning the concrete along the crack by using air jetting or water jetting, then grout nipples at suitable intervals is installed,

then sealing is done between the seats with sealant, then the crack should be flushed to clean it and test the seal and then grouting the whole area. To improve the properties of the grout, water reducers or admixtures may be used.

2) Chemical grouting:

Chemicals used for grouting are silicates, urethanes and acrylamides. Two or more chemicals are combined to form a gel, a solid precipitate or foam as opposed to cement grouts that consists of suspensions of solid particles in a fluid. Chemical grouts can be used in moist environments and in very fine fractures. But with some limits of control of gel time.

CONCLUSION

This paper is divided into four parts. First part comprises of basic introduction about cracks and second part contains causes and prevention of cracks third is case study and fourth one about techniques to cure. From the above case study, we have concluded that some preventions could be taken care of during the construction process itself. Any lack of attentiveness can lead to a cause for damage in the building in its future, which can also lead to the failure of structure. Cracks may occur due to various reasons, as discussed earlier. The occurrence of cracks cannot be stopped but particular measures can be taken to restrict them to reduce the level and degree of consequences.

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