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BUILDING CRACKS CAUSES AND REMEDIES

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ABSTRACT

Building cracks are major type of problem in any building. Cracks in concrete cannot be prevented entirely but they can be controlled by using proper usage of materials, method of construction and design criteria. So timely perception of such cracks and adopting preventive measures is essential. This project gives the explanation about various causes of crack and suitable remedial measures. From this project work it is found that building cracks has direct and indirect impacts on buildings. And also, it is found that building cracks do not cause structural problem directly but it facilitates the activities which ultimately cause the problem. Hence this project work come up with conclusion that different types of cracks can be repaired by different repair technique depending upon cause of the crack and intensity of crack.

INTRODUCTION

cracks may be classified based on their activeness, time of occurrence, width and the components of building on which they are developed. Based on components of building cracks are broadly classified into two main groups:

1. **Non-structural cracks**: These type of cracks occurs majorly due to internally induced stresses in buildings and normally do not endanger safety but destroys the aesthetic appearance, creates the impression of faulty construction or gives feeling of building instability. Cracks on walls, parapet wall etc… are considered as non-structural cracks.

2. **Structural cracks**: Structural cracks majorly occurs due to incorrect design, faulty construction or overloading and may endanger the safety of a building. The cracks in beams, columns, slabs and footing are called as structural cracks.

Cracks may be straight, stepped, toothed, map pattern or random and may be horizontal, vertical or diagonal pattern. Occurrence of cracks in closely spaced fine cracks at the surface of a material is called as crazing.

In order to be able to prevent or to minimize occurrence of cracks, it is necessary to understand basic causes of cracking and to have knowledge about certain properties of building materials. Principle causes of occurrence of cracks in buildings are as follows:

- Moisture Changes.
- Thermal variations.
- Elastic deformation.
- Creep.
- Chemical reaction.
- Foundation movement and settlement of soil, and
- Vegetation.

1. MOISTURE CHANGES:

Most of the building materials having pores in their mortar, burnt clay bricks, some stones, timber, etc. Expand on absorbing moisture and shrink on drying. These movements are reversible as it is cyclic in nature and is caused by increase or decrease in the inter-pore pressure with moisture changes, extent of movement depending on molecular structure and porosity of a material.

INITIAL SHRINKAGE

Initial Shrinkage, which is somehow irreversible, normally occurs in all building materials that are cement or lime-based for example, concrete, mortar, masonry units, masonry and plasters. This shrinkage is one of the main cause of cracking in structures. Influence of these factors on shrinkage is as follows:a) CEMENT CONTENT: Richer the mixer, greater the drying shrinkage. Conversely, largethe volume of aggregates in concrete, lesser the shrinkage.b) WATER CONTENT: Greater the quantity of water used in the mix, greater the shrinkage. Thus a wet mix has more shrinkage than a dry mix which is otherwise similar. c) AGGREGATES:- By using the largest possible maximum size of aggregates in concrete and ensuring good grading, requirement of water for concrete of desired workability is reduced and the concrete thus obtained has less shrinkage because of reduction in the porosity of hardened concrete.

2. THERMAL VARIATION

A well Known phenomenon of science is that all materials, more or less, expandon of astructure, internal stresses are set up in the component, resulting in cracks due to tensile or shear stress. Extent of thermal movement in a component depends on a number of factors, such as temperature variation, dimensions, co-efficient of thermal expansion and some other physical properties of the Materials.

3. ELASTIC DEFORMATION

Structural components of a building such as walls, columns, beams and slabs normally consists of materials like masonry, concrete, steel, etc, undergo elastic deformation due to load in accordance with Hook's law, the amount of deformation depend upon elastic modulus of the material, magnitude of loading and dimensions of the components.

4.MOVEMENT DUE TO CREEP

Some building materials such as concrete, brickwork and timber when subjected to sustained loads not only undergo instantaneous elastic deformation but also exhibit a gradual and slow time-dependent deformation known as creep or plastic strain.

5. MOVEMENT DUE TO CHEMICAL REACTION

Certain chemical reactions in building materials result in appreciable increase in volume of materials, and internal stresses are set up which may result in outward thrust and formation of cracks. The materials involved in reaction also get weakened In strength. Commonly occurring instances of this phenomenon are sulphate attack on cement products, carbonation in cement-based materials, and corrosion of reinforcement in concrete and brickwork, and alkali-aggregate reaction.

6.FOUNDATION MOVEMENT AND SETTLEMENT OF SOIL

Shear cracks in buildings occur when large differential settlement of foundation occur either due to unbalanced bearing pressure under different parts of the structure or due to bearing pressure on soil being in excess of safe bearing strength of the soil or due to low factor of safety in the design of foundation. Buildings constructed on shrinkable clays (expansive soils) which swell on absorbing moisture and shrink or dry as a result of change in moisture content of the soil, are extremely prone.

7. CRACKING DUE TO VEGETATION

Existence of vegetation, such as fast growing trees in the surroundings of compound walls can sometimes cause cracks in walls due to expansive of roots growing under the foundation. Roots of a tree somehow spread horizontally on all sides to the extent of height of the tree above the ground and when trees are located close to a wall; these should always be viewed with suspicion.

OBJECTIVE OF THE STUDY

The main objective of the project study is to find the genesis of the cracks, to study three case studies of buildings with a life period of 10-40 years, to come up with the remedies like epoxy injection, routing and sealing, stitching etc. This study involves in the identification of structural and non-structural cracks, cracking pattern, spalling of concrete, uniformity of strength distribution, corrosion in reinforcement, extent of deformation in the structural members.

Double story R.C.C building:

Salient features:

- Year of construction ⟷ 2007
- Type of structure ⟷ RCC framed structure
- Location ⟷ JNTUCE Pulivendula.
- Cause ⟷ foundation settlement.

VISUAL OBSERVATIONS:

- ❖ More cracks, spalling of concrete, concrete cover on reinforcement are fall down, diagonal cracks at corners, top of the doors and windows cracks are observed, cracks width is 6-7 mm width, maximum cracks occur in walls.

Remedies:

- ❖ Structure foundation should be backfill with good soil.
- ❖ The material used should be good quality.

Remedies: The purpose of remedies is to rectify the observed defects and bring the building to reasonable shape so, that all services start functioning. This enables the use of building for its intended purpose

Remedies do not give structural strength or stability. In fact remedies building may be misleading. So it hide structural defect but appearance is good. If the structure weak it may cause collapse also for changing environmental condition.

Remedies including following interventions:

- Attending to root leakage during rain etc…
- Patching cracks and plastering
- Setting right installation and wiring etc….
- Fixing services such as plumbing
- Re-building partition walls, plastering, non-structural walls etc…,
- Re-fixing roof tiles
- Remedies to flooring and concreting slope for drainage etc…
- Providing decorative finishes and white washing etc…
- Painting and wood work

Remedies materials:

The nature of remedies is to guide the selection of materials and depending on the cause of failure. Several remedies materials are available in commercially. The use of materials depend upon the nature of the damage and intensity of the damage, environmental condition, required life of building, important of structure and available funds.

The basic remedies material can be classified as epoxy resins, epoxy mortar, gypsum cement mortar, fibre-reinforced concrete.

Epoxy resins:

These are used for following reasons:

Bond between plastic concrete to hardened concrete.Bond between two rigid materials.For the purpose of patch work.

Surface preparation:

The crack should clean and cut properly. Effective chemical are removed by using water or some solvents. After flushing of water and chemicals dry out some time. The surface should be sealed

Fixing injection ports: Surface with help of surface ports repair material into the crack. They remove the need to drill into the concrete, decrease labour time and clean up. The base of the port is placed over the crack and bonded to the surface with an epoxy paste.

Seal the surface: Use an epoxy adhesive material Rhino Carbon Fibre's to seal over the surface ports and exposed cracks. The paste cures in about 20 to 45 minutes to provide a surface seal with high bond characteristics that holds up under high strength. The entire exposed crack is covered with the paste of epoxy, leaving only the port holes uncovered.

Inject into the crack: Begin injecting at the lowest port on the wall and continue until the epoxy or urethane begins to slowly out of the port above it. That's the visual impression that the crack has been filled to that level. Plug the first port with the cap present and move up to the next port, repeating this procedure until the entire crack has been filled with epoxy or urethane. Let the compression spring on the dispensing tool push the material into the crack using slow, constant pressure. This will reduce the chances of leaks or blow-outs and allow time for the repair material to fully penetrate the crack.

METHODOLOGY

As most of cracks occurred in our area is due to the differential settlement, so, as to find out the soil type and soil bearing capacity, some of the experiments are conducted to find out them. Here we took the help of presumptive analysis in order to relative comparison between type of soil present here and required bearing capacity. These are the following experiments conducted in order to find out the type of soil.

- Sieve analysis
- Liquid limit
- Plastic limit
- Bearing capacity
- Presumptive analysis

The following are the results we drawn:

- Liquid limit -32%, Plastic limit-16.32%, D10-0.65mm, D30-0.8mm, D60-1.3mm, Cu-2, Cc-1,Ip-15.68%, Hence from the above data we can conclude that it is uniformly graded sandy soil

From the data we collected the present soil is having the soil bearing capacity-18 t/m3.But from the IS1904 the standard soil bearing capacity of medium sandy soil is-24.5 t/m3.Because due to low bearing capacity ***differential settlement*** occurs.

CONCLUSION

This project work gives the conclusion that for non-structural dormant cracks can be treated by cementious or polymer modified cementious. Structural cracks can be treated by epoxy injection. In case of active cracks polyurethane sealant is the best. If the cracks occurred in water retaining structures, polyurethane injection is the most suitable.

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