

Study of Structural Cracks on Residential Buildings

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Abstract: A project reveals about the structural failure study of masonry building. A crack is a complete or incomplete separation of wall by breaking or fracturing, it forms into two or more parts. There are some types of cracks are structural, non-structural, and based on width and depth. It affects the building and it also destroy the walls. The cracks reduces the stiffness, leakage of buildings, durability and performance of the building. Most of the unreinforced masonry buildings, wall partially are in some cases completely collapsed under strong motion dominated by the out of plane failure mode, masonry building perform poorly under seismic action. To strength of URM walls using strengthening agents has popular means of enhancing both the walls out of plane and in plane capacities. Cracks may be of uniform width throughout or be narrow at one end, gradually widening at the other. Cracks may be straight, toothed, stepped, map pattern or random and may be vertical, horizontal or diagonal. It may be only at the surface or may extend to more than one layer of material. The cracks are not only from earthquakes, so we are initiating to find the name of the cracks, types of cracks and their causes.

Keywords: Finally, determine the structural failure of the buildings and their remedies the materials to cure the cracks.

I. INTRODUCTION

1.1 CRACKS

Cracks in the building are of common occurrence. A building component develops cracks whenever stress in the component exceeds its strength. Stress in a building component could be caused by externally applied forces, such as dead, live, wind, or seismic loads, or foundation settlement or it could be induced internally due to thermal movements, moisture changes, chemical action, etc.

A crack is a complete or incomplete separation of the wall by breaking or fracturing, it forms into two or more parts. There are some types of cracks are structural and non- structural. Structural cracks which are due to incorrect design, faulty construction or overloading and non-structural cracks are mostly due to internally induced stresses in building materials and this generally does not directly result in structural weakening. Several types of cracks occur in masonry walls in a building which can be minor and insignificant, some requiring expensive repairs and in some extreme cases the only solution is total demolition of the wall. Causes of these cracks in masonry walls can be movement of building causing settlement and subsidence.

If a structure is unable to accommodate this movement, cracking is likely to occur. The appearance of distortions and cracks can be visually unattractive and disconcerting for occupants, and if left untreated they can affect the integrity, safety and stability of the structure. Effective treatment requires first that the causes of cracking are understood. Only then can a strategy for repair be implemented.

1.2 Human Error:

The human error which may occur during the execution of a structural project and may endanger the safety of the structure. The table has given below shows an attempt to categories the types of human error which may occur during the execution of a structural project and may endanger the safety of the structure.

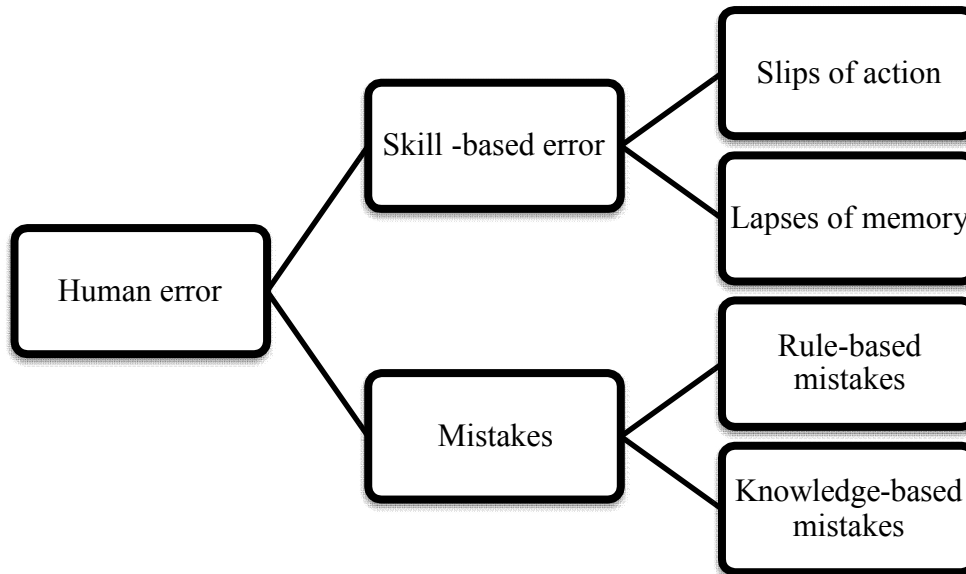


Fig.1.1. Human Error

1.3 REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES

Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

1.3.1 REPAIRS TO OVERCOME LOW MEMBER STRENGTH NEED FOR STRENGTHENING

- Load increases due to higher live loads, increased wheel loads, installations of heavy machinery or vibrations
- Damage to structural parts due to the ageing of construction materials or fire damage, corrosion of the steel reinforcement, and impact of vehicles Improvements insatiably for use due to limitation of deflections, reduction of stress in steel reinforcement and reduction of crack widths
- Special Modification of structural system due to the elimination of walls/columns and openings cut through slabs.
- Errors in planning or construction due to insufficient design dimensions and insufficient reinforcing steel.

1.4 VERTICAL CRACKS AT WINDOW SILL LEVEL

These are due to vertical shear caused by differential strain lightly loaded masonry below the opening and a heavily loaded portion of the wall having no opening avoid large window.



Fig 2 Vertical cracks at window sill level

- Width-Above 3mm
- Type: non- structural, wide crack
- Probable causes: - settlement of soil, Shrinkage or overloading

CAUSES

In most of the buildings cracks will nominally occur on the window sill level it is quite common when the window opening is above 1.0m wide. If the brickwork which was constructed up to sill level is allowed to settle well by giving proper curing, there will be no effect of cracks.

If not the brickwork could not attain its full strength and therefore the sudden load over this sill, the surface may induce stresses at the openings and cracks may develop. These cracks are due to vertical shear caused by differential strain in the lightly loaded masonry below the opening and heavily loaded portion of the wall having no openings. It can be seen that portions of the wall marked „A“ act as pillars and are stressed much more than the portions marked „B“ below the windows. Thus as a result of differential stress, Vertical shear cracks occur in the wall.

REPAIR :

- To make vertical crack repairs, use epoxy. The injection ports included in your kit should be injected along the crack pushing them in as far as possible. One port should be placed at each end of the crack and the others should be spaced
- ½ inch to inch apart.
- Coat the damaged area inside and out with epoxy adhesive by using a paintbrush. Make sure that you get the adhesive as close as you can to the ports but not on top of them. You then have to wait for three minutes until the adhesive becomes sticky.
- Fill the injection ports with epoxy, starting from the lowest to the highest port. You should stop filling the current port if you can see the epoxy in the hole of the one above it. Each port should be covered with its corresponding cap and the epoxy should be left to dry for 2 days.
- The injection ports should be hammered at a 45-degree angle. Then, each port should be pulled out of the crack. A putty knife or paint scraper should be used to remove the excess epoxy on the window sill.

1.5 DIAGONAL CRACKS IN BRICK MASONRY WALL OVER LINTEL

Diagonal cracks occur due to drying shrinkage of foundation soil then built on shrinkable clay soil and has a shallow foundation fast-growing trees near the building. They are due to differential strain in internal and external load-bearing walls to which cross walls are bonded. Diagonal cracks accomplished by outward tilting of external walls. Internal walls undergoing random cracking and floor cracking becoming an event due to the moisture moment of shrinkage soil when the foundation is shallow.



Fig.5.2 DIAGONAL CRACKS IN BRICK MASONRY WALL OVER LINTEL

CAUSES

- The main reason for this type of crack is due to the differential strain between the R.C.C. and masonry structure because of the difference in elastic shrinkage, elastic deformation and creep in the lintel.
- Diagonal cracks that extend up from the ends of the lintel are often caused by corrosion of the steel lintel.
- The corrosion product of steel will occupy 10 to 20 times as much space as the steel itself. This expansion generates tremendous pressure when confined and is capable of bending the steel angles, breaking apart the brick masonry, or lifting the brick.
- The cracks are thin and could be filled in at the time of removal of finishing coat.

REPAIRS

- Chemical grouts consist of a solution of two or more chemical such as urethane and sodium silicate that reacts to form a gel.
- This grout opposed cementing grouts that consist of a suspension of solid particles in a fluid.
- The main advantages of chemical grout include applicability in a moist environment and their ability to be applied in very fine facture. Crack as narrow as 0.05 mm can be filled with chemical grouts.

1.6 EXTENSION CRACKS

When the extension of the existing building is desired, new construction should not be bonded with the old. Two parts should be separated by a step or expansion joint right from the foundation to top. Care should be taken while excavating below the foundation

When the existing structure is 20 – 25 m long, the old and the new work should be separated by an expansion joint with a gap of about 25 to 40 mm to allow room for unhindered expansion of the two portions.



Fig.5.3 EXTENSION CRACKS

CAUSES

These cracks are due to the expansion of brickwork. When clay bricks are fired because of high temperature, after burning, as the temperature of bricks falls, the moisture hungry bricks start absorbing moisture from the environment and undergo gradual expansion. It could be assumed that almost entire expansion takes place in the first 3 months. If bricks are used in masonry soon after unloading from the kiln, brickwork will in course of time, expand and may crack. An example of expansion in the external wall of brickwork walls A and C on expanding cause rotation of wall B and vertical cracks at „x“

REPAIRS

- Sealing of cracks can be used in conditions requiring remedial repair and where structural repair is not necessary.

- This method involves enlarging the crack along its exposed face and filling and sealing it with a suitable joint sealant.
- A common and effective use is for waterproofing by sealing cracks on the concrete surface where water stands, or where hydrostatic pressure is applied of moisture to reach the reinforcing steel or pass through the concrete, causing surface strains or others

1.7 FLEXURAL TENSION CRACK AT LINTEL LEVEL

Flexural cracks on the soffit of a slab will run at right-angles to the span, again roughly uniformly spaced in the region of maximum moment. In beams and slabs in buildings that have been correctly designed, average crack widths should not exceed 0.3 mm.

In bridges, the cracks should generally be narrower. In general, the cracks will be uniformly spaced along the most heavily loaded portion of the beam, i.e. near mid the span in sagging or over the supports hogging.

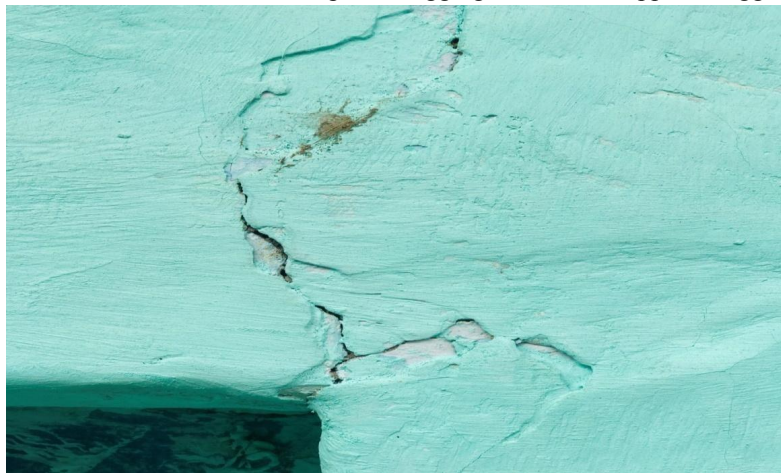


Fig.4 FLEXURAL TENSION CRACK AT LINTEL LEVEL

CAUSES

Internal stresses in building components could be compressive, tensile or shear. Most of the building materials that are subjected to cracking. Tensile and shear cracks by closely examining their physical characteristics. These cracks are due to moisture changes, thermal variations, foundation movement and settlement.

REPAIRS

- To make flexural tension cracks to use polyurethane chemicals
- Polyurethane grouts are usually used to repair cracks that are 0.12mm and greater in width both wet and active leaking a significant amount of water through joints or cracks.
- These grouts are semi-flexible thus they tolerate some change in crack width.

II. CONCLUSION

This research work concludes that through it is impossible to guarantee against cracking, yet attempts can be made to minimise development of crack and also not all type of crack require same level of attention, The potential causes of crack can be controlled if proper consideration is given to construction material and technique to be used. 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. So we initially determined the materials for repairs, repair, rehabilitation and retrofitting of structures and remedies to control as well . We have “ chosen causes prevention and repair of cracks in buildings by modern techniques”. Finally we got a moderate result comparing to old one.

III. ACKNOWLEDGMENT

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