



Causes, Repair and Preventions of Cracks

Rashmi Bade¹, Prajakta Sonekar², Shuja Ahmad², Irfan Ali²

¹Assistant Professor, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur,
Maharashtra, India.

²UG Scholar, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur,
Maharashtra, India.

ABSTRACT

Cracks are the detrimental element of any building, hence detailed inspection is needed to ensure the safety and serviceability of the building. Now there are many types of cracks and their corresponding repairs, measures and methods to fix them. This review presents some information regarding causes, repair and prevention of cracks. Cracks in concrete cannot be prevented entirely but can be controlled by using various methods and techniques most of which hide the cracks and fix them to some extent if they are minor cracks, however if the cracks are major, there may be some big underlying problems with the structure below the ground level and/or with the soil surrounding the foundation which requires immediate solutions in order to avoid any mishaps.

Keywords: Soil, Cracks, Causes, Prevention, Remedies, Repair

I. INTRODUCTION

Concrete is the major component which is being used in every stage of construction and it may result in something damage or defects during its service life. There are some damages that cannot be completely prevented, cracks are one of them. Building component develops cracks whenever stress in that component exceeds its strength[11]. They have to be taken into account while designing the plan with proper countermeasures to repair them when they occur. Almost all the structures develop cracks and hence they need to be maintained both internally and externally from cracks causing sources. Despite proper treatment, cracks eventually occur, for such cases some remedies are needed to prevent formation of cracks depending upon the size, shape, location, behaviour and other characteristics of

cracks[6]. Cracks in many buildings are an undesirable and uncontrollable feature. Some cracks result from wear and tear, while others are linked to deterioration in construction or design. Some of the causes of cracks in buildings are soil expansion and contraction, soil consolidation, vibration, wind, snow loading, overloading and impacts in structure[2].

II. CLASSIFICATION OF CRACKS

Cracks are classified into two categories:

A) Structural cracks: The most common causes of cracking are ground movement (beneath foundation) cause by shrinkage, vibration and on. Cracks are formed due to faulty design, poor construction, swollen soil and poor bearing capacity of soil. This may endanger safety of building[3]. Examples of

structural cracks are the cracks in beam, column, slabs etc.

B) Non-Structural cracks: They are caused by change in moisture content and thermal movement. Non-Structural cracks are formed due to the induced stresses in building components and internal forces developed due to variation in moisture content, temperature variation, crazing etc[5]. These type of cracks are generally vary from 1 to 3 mm in size. Examples of Non-Structural cracks are cracks on parapet wall, drive-way etc.

Types of cracks occurring in beams are: Flexural, Shear flexural, Torsional, Tension, Disturbance cracks

Types of cracks occurring in columns are: Horizontal, Diagonal, Corrosion/Bond cracks.

Types of cracks occurring in slabs are: Flexural, Shrinkage, Top flexural cracks.

Other types of Non-structural cracks developed are due to temperature changes, gas and liquids penetrating, excess moisture. Following are some types of Non-Structural Cracks.

III. TYPES OF CRACKS

The magnitude of cracks can be characterized by its dimension and direction. They can be horizontal, vertical, diagonal and random in shape.

A) According to shape

1) Horizontal crack:- Horizontal crack runs in zigzag pattern which is at 45-degree angle. The zigzag pattern may form due to water damage and soil pressure[4]. These type of crack occurs at the centre or at top most portion of the wall. Such cracks need immediate attention to prevent further damage.

2) Vertical Crack:- These type of crack occurs near the junction of wall and ceiling indicating settlement of foundation. It runs in same direction as dry wall.

3) Stair step crack:- These type of crack appearance of flight of stairs and runs in both vertical and horizontal direction. They are usually found in unfinished basement [3].

B) According to size:

1) Thin crack:- These type of cracks are less than 1mm in width and does not require any action to repair it. They are also known as hairline cracks[5].

2) Medium crack:- These type of crack are 1 to 2mm in width and can easily treated by using normal remedies. Also known as fine crack.

3) Wide crack: These cracks are more than 2mm in width and can be marked by suitable linings.

IV. CAUSES

Cracks are caused due to separation of concrete materials fracturing, so it is essential to prevent formation of cracks within specific time[1]. It is also caused due to deterioration of concrete and corrosion of reinforcement provided[3]. Major causes that lead to cracking are as follows:

Moisture Variation

Settlement of foundation

Temperature variation

Vegetation

Creep formation

A) Moisture Variation:- Building materials have pores in their burnt clay bricks, mortar, some stones etc. These materials expand on absorbing moisture and contract or shrink on drying depending upon the atmospheric conditions. These actions are cyclic in nature and are caused due to variation in the pore water pressure[3]. Water table play important role in formation of cracks. The various causes of initial shrinkage are:

Content

Aggregates

Use of accelerators

Curing

Presence of excessive fines

Humidity

B) settlement of foundation:-

Settlement of building built on made-up soil may occur when water due to heavy rains or floods enters into the foundation . These settlement is basically due to the excessive load of water acting on foundation.Such settlements are generally not uniform and cause cracking in the structure. [1]These may due to the following reasons:

Unequal bearing pressure under different components of the structure.

Bearing pressure on soil being in excess of safe bearing strength of the soi.

factor of safety in the design of foundation

Local variation in the nature of supporting soil

C) Temperature variation: Most of the concrete materials expand when they are heated, and contract when they are cooled. The expansion and contraction with changes in temperature occur regardless of the structure's cross-sectional area[8]. It is one of the most patent cause of cracking in buildings which needs to be cured intime. Magnitude of settlement, however, varies for different materials depending on their molecular structure and other properties.

Factors affecting the thermal movement are:

Color and Surface Characteristics

Thermal Conductivity

Provision of an Insulating or Protective Layer.

Internally Generated Heat

D) Vegetation: Availability of vegetation near the walls can cause cracks in the wall due to expansion of roots growing across and under the foundation. Tree roots spread on all the sides above the ground creating an obstruction in the structure[3]as shown in fig(a)



Fig. (a)

E) Corrosion: Corrosion is basically an electrochemical reaction. Small anode and cathodes are created and flow of ions corrode the bars.Reinforcement corrosion is basically due to the corrosive environment that is due to the influence of chloride ions and other materials such as ferric and ferrous oxidation of steel[6].Corrosion cracks in concrete structure are developed along the line of reinforcements. Fig.(b) shows magnitude of cracks caused due to corrosion.

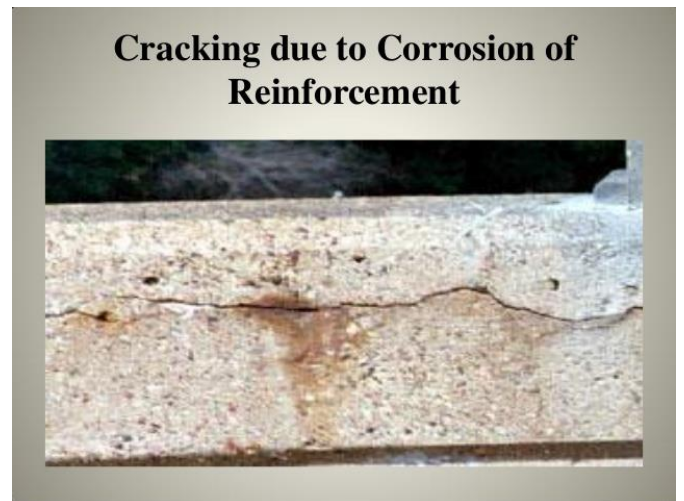


Fig.(b)

There are two types of corrosion :

- 1)Crevice corrosion
- 2)Pitting corrosion

V. REPAIRS

a) Epoxy injection is a method of repairing non-moving cracks in walls, slabs, columns and piers. The epoxy is injected and letting it dry[1].The technique generally consists of providing entry and venting ports at close intervals along the cracks, sealing the crack on exposed surfaces, and injecting the epoxy under pressure.

b) Gravity filling involves low viscosity monomers and resins used to seal cracks with a width of 0.001 to 0.08 inch.

d) Stitching is done to provide a permanent structural repair solution for masonry and cracked wall reinforcements, done by drilling the holes on both sides of the cracks, cleaning them and anchoring the legs of the staples in the holes with a non-shrink grout[1].

e) Hairline cracks can just be re-plastered or repainted to fix them and make them disappear.

f) Routing and sealing is a method in which the crack is made wider on the surface, then the groove is filled with a flexible sealant, this is common and easier than the procedures, training required for epoxy injection, and can be done on vertical and curved surface[1].

VI. OBSERVATION

Fig.(c) shows old house compound wall



shutterstock.com • 305967149

Fig.(c)

Width:-1 to 2 mm

Type:- Wide(non structural)

Shape:-horizontal

Cause:-settlement of foundation



Fig.(d)

Width:-2 to 3mm

Type :- non structural crack

Shape:-vertical

Cause:- improper mixing of materials

Fig.(e)



Fig.(e)

Width:-1 to2mm

Type:-non structural

Shape:- zigzag pattern

Cause:-settlement of foundation

VII. PREVENTIONS

- a) By creating slip joints under the RCC slabs on walls cracks by elastic deformation can be prevented.
- b) Slabs should be provided with thermal insulation. Joints should be made such as expansion, slip, control joints to prevent cracks from thermal movement.
- c) Concrete should be of good quality. Use richer mix of cement concrete 1:1.5:3 to prevent cracks.
- d) In mixing of cement concrete or cement mortar, Use minimum quantity of water, as per water cement ratio.
- e) Do not use excessive cement in the mortar mix. Because as a general rule, the richer the mix is, the greater is the shrinkage.
- f) The design of foundation should be based on sound engineering principles.
- g) To prevent cracking problem due to corrosion in reinforcement, it is necessary to specify concrete of richer mix.
- f) Joints should be construed like construction joints, expansion joints and slip joints. It should be planned at the time of design and be construed carefully.

VIII. CONCLUSION

Cracks may occur due to several reasons as discussed above. The formation of cracks cannot be completely eliminated nor completely stopped but several measures can be undertaken to prevent their consequences [3]. Several prevention factors should be taken care of during actual construction process itself. Cracks can also be cured by using self healing phenomenon such as using bacterial concrete where it converts calcium lactate to calcium carbonate which results in crack healing [6]. Through this research we come to a conclusion that there are various methods to repair cracks when they form, but there is no sure way to prevent cracks before they form or even during their formation. By observing several cracks

and tendency of cracking we also concluded that not all type of cracks require same level of attention. Taking into consideration proper repair and maintenance, adequate construction materials, proper techniques, the potential causes of crack can be minimized to a large extent.

IX. REFERENCES

- [1]. Pooja Nama, Ankush Jain, Rajat Shrivastawa, Yash Bhatia: International Journal of Engineering Research and Applications, ISSN:2248-9622, Volume5, Issue5
- [2]. Rama Pramanick: International Journal of Computational Engineering Research, Volume9, Issue2, February 2019, ISSN(e):2250-3005
- [3]. Shivani More, Tejas Hirlekar, A Review on Causes, Prevention, Repair and Maintenance of Cracks in Building, Nov-2017, ISSN:2395-0056
- [4]. Rishab Pathak, Deepak Rastogi: International Journal of Science and Research, Volume6, Issue5, May 2017, ISSN:2319-7064
- [5]. Mr. Shyam Doshi, Dimpy Patel, Kevin's Patel, Pinal Manvani: Global Research and Development Journal for Engineering, volume3, Issue5, February 2018, ISSN:2455-5703
- [6]. Vinoth.T, Rahimunissa.A, Manikandeswari.S, val anvan.E, Thangam.D, Volume 6, Issue5, September- October 2016, ISSN(online):2250-0758
- [7]. P. Suganthy, R. Gajendran: International Journal of Engineering Technology, Management and Applied Sciences, Volume 5, Issue7, January 2017
- [8]. Kishor Kumar, Namesh Killemsetty: IOSR Journal of Mechanical and Civil Engineering, Volume11, Issue5, September 2016

- [9]. Sholihin Asad, Mukhahar and M.Sukiiman: The 2 International Conference on Rehabilitation and Maintenance in Civil Engineering 2013
- [10]. M.S. Shetty, Concrete Technology: Theory and Practice, ISCode: 456-2000
- [11]. J.S.Kalyan Rama, V.R.Raghava Sudhir, V.Ramesh: Study of cracks in building by V R Siddhartha College of Engineering.