



Causes of Cracks on Concrete and its Prevention

Miss. Diksha C. Dhore^a, Miss. Swati P. Tembhurne^b, Miss. Samta M. Jumde^c, Mr. Rahil S. Ali^d, Mr. Mayur D. Raut^e, Prof. J. S. Hunge^f, Prof. N. N. Kamatwar^g

^{a,b,c,d,e}B.Tech Student, Shri Sai College of Engg. & Tech. Bhadrawati, Dist Chandrapur,442902,(MS), India

^{f,g} Assistant Professor, Shri Sai College of Engg. & Tech. Bhadrawati, Dist Chandrapur,442902,(MS), India

DOI: <https://doi.org/10.55248/gengpi.234.4.38903>

ABSTRACT

Cracking is the most common problem in a concrete structure in real-life service conditions. Crack-free concrete structures are very real to find in the real world. Cracks in plain and reinforced possess a challenge to civil engineers for six decades. Concrete can undergo cracking depending on the mix composition, exposure environment, hydration rate, and curing conditions. Understanding the causes and consequences of cracking thoroughly is very essential for selecting proper measures to resolve the cracking problem in concrete. The types of cracks and their patterns if those cracks are hazardous for structures such as slabs, beams, columns, or retaining walls etc. and how we can identify the crack. Why cracks are formed what are their causes? What precautionary major do we take while before placing, during placing and after placing concrete? If cracks are observed in the structure how to repair them, there are techniques and procedures to repair cracks

Keywords: Concrete, cracking, mechanism, prevention, technique to repair the crack.

Introduction

Concrete plays a critical role in designing and constructing the nation's infrastructures. Concrete is the maximum broadly use production cloth today. The main constituents of concrete are coarse aggregate, fine aggregate, cement and water. Fine aggregate is the most important constituent of concrete. Generally, river sand or pit sand is used as fine aggregate in concrete.

Together best and coarse aggregate make about 75-80% of the total volume of concrete and hence it is very important to find suitable types and good quality aggregate. In general consumption of natural sand is high due to the large use of concrete Hence the demand for natural sand is very high in developing countries to satisfy the rapid infrastructure growth. For a few years the escalation in the value of sand because of administrative regulations in India. demands comparatively greater cost at around two to three times the cost of quarry dust even in places where river Sand is available nearby In recent years, the state of degradation of concrete infrastructure has become a critical issue in North America.

A yearly cost of \$18 billion has when estimated for concrete repair, protection and strengthening in the United States alone (Emmons and Sordidly,2006). Concrete sturdiness troubles have left homes and infrastructure in deteriorating condition. Rehabilitation techniques and materials are becoming increasingly important in the construction industry. Cracking especially poses a danger to the structural integrity in addition to the sturdiness of concrete.

The increase of water and harmful agents leads to damaging mechanisms, such as the corrosion of steel reinforcement. Accordingly, cracks are required as preventative maintenance measures to prolong the service life of the structure. The successful repair of cracks would reduce the deterioration effect resulting in a longer service life prolonging the service life defers the rehabilitation or replacement of the bridge and government sectors responsible for the management of multiple bridges would experience economic benefits.

The development of these small cracks causes elastic deformation of concrete. The addition of fibre in the plain concrete will control the cracking due to shrinkage and also reduce the bleeding of water. As Civil Engineers, we must be able to analyse and design parts of a Building like beams, Columns, Slab, etc. (Giri et al., 2023)

The result of a longer service life is also indicating of sustainable practice. Concrete inherits certain types of cracks in the pre-hardening stage and also develops some other types of cracks in post Hardening stage in due course of time due to various reasons, despite our almost care in the prevention of cracks.

Objective

- Take a look at the numerous kinds of cracks in concrete.
- To look at reasons for cracks in concrete.

- To study the prevention of cracks in concrete.
- To study the techniques to repair and filling up cracking in concrete

2. Literature Survey

1. Rishabh Pathak, Deepak Rastogi

concluded from their research on “**Case Study on Cracks in Public Buildings and their**” cracks are inherent and detrimental elements of building detailed investigation should be carried out regularly to ensure the accessibility and serviceability of the building. For rehabilitation of cracks, it's miles essential to apprehend the reasons and the sorts of cracks regarded withinside the structure. This paper quickly describes the reasons and sorts of cracks and their remedial measures. Nondestructive trying out techniques are used to get entry to the electricity of the shape at a primary instance To recognise the real kingdom of the shape whether or not it'll be serviceable/manageable or to be demolished. Few case research has been carried out at one-of-a-kind public homes at Gwalior M.P. Political science, monetary and archaeological blocks of Jiwaji University. Moti Mahal building. NITM (Nagaji Institute of Technology and Management building. They have been mentioned cracks and they have been suspended as to whether or not they'll be paintings or must be demolished. The motive of this observation is to decide the placement of the shape whether or not it's far further Serviceable or now no longer and secondly, if we use the identical construction how it will likely be repaired. (Pathak & Rastogi, 2015)

2. Hongke Pan, Ling Pi

has winded up from their research on “**Study on Cracks in Concrete Structures and the Database**” because of material properties and low tensile strength, the concrete structure has its inherent properties: structure is easy to crack, and even many times it is working with cracks. Based on the extensive investigation, is analyzed and summarized the mechanism of cracks in concrete structures, and the manifestation forms and occurrence characteristics and laws of various cracks in this paper. Then a crack database is tried to establish to seek and summarize the relationship and laws between the types of cracks and the forms of crack distribution, to provide references and helps for quick inquiry, judgment and scientific prevention and control about cracks in engineering, and ultimately to improve the durability and service life of the structures. (Pan & Pi, 2018)

3. Rajveer Singh Narwaria, Archana Tiwari

has come to an end from their research on “**Development of cracks in concrete, preventive measures and treatment methods: A review**” Cracks in the building is the most common problem that occurs in any type of concrete structure such as beams, column, etc... So, it's far vital to apprehend the reason and the measures to be taken for prevention. Though cracks in concrete can't be avoided however they could be managed through the usage of good enough fabric and approach of creation and thinking about layout criteria. But because of a few defective steps taken at some stage in the creation or because of a few unavoidable motives exceptional cracks starts to appear on various structural and non-structural parts of the building in due course of time. There are cracks which need to be identified at the appropriate time, so proper care of such cracks can be taken. This paper offers facts approximately numerous causes, prevention of cracks and remedy strategies for such causes.(Narwaria& Tiwari, 2016)

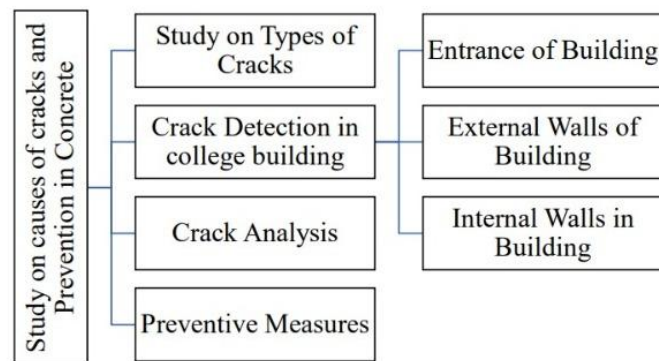
4. Pooja Nama, Ankush Jain, Rajat Srivastava and Yash Bhatia

has come to an end from their research on “**Study on Causes of Cracks & its Preventive Measures In Concrete Structures**” The trouble of cracking in construction is turning into a hard puzzle for engineers nowadays. Cracking is an unavoidable reaction of any shape even as designers are seeking to put off most of the reasons for cracking and layout tolerance for different factors. We all need our construction structurally secure however it isn't always so easy. Some defective steps at some stage in production and a few unavoidable motives extraordinary form of cracks begins off evolved to seem on diverse structural and non-structural elements of the building. The restore substances and restore method are specific relying upon sorts of cracks in line with their positions in structure. Some forms of cracks critically want interest as they're structurally hazardous. In this paper, we can talk approximately the trouble engineers are dealing with i.e. of cracking after construction and what preventive measures should be taken along with the techniques to cure cracks. (Nama et al., 2015)

5. Mr. HarshalShankarraoKhode

has wrapped up their research on “**Research case study for types, causes, preventive measures and advanced rectification techniques of cracks in concrete structure**” Cracking is a common problem in concrete structures in real-life service conditions all over the world. Crack-unfastened concrete systems are very uncommon to discover in the actual world. Concrete can go through early-age cracking relying on the combination of turn composition, publicity environment, hydration rate, and curing conditions. Understanding the reasons and results of cracking very well is vital for deciding on the right measures to remedy the early-age cracking hassle in concrete. This paper will help to find out the main motives and outcomes of early-age cracking in concrete. Also, this paper can be beneficial to undertake powerful remedial measures for lowering or removing the early-age cracking hassle in concrete. Different kinds of early-age cracks, the elements affecting the initiation and increase of early-age cracks, The reasons for early-age cracking, and the modelling of early-age cracking are mentioned in this paper. A range of examples of numerous early-age cracking issues of concrete determined by exclusive structural factors also is shown. It was hoped that the records conveyed in this paper may be useful to enhance the carrier lifestyles of concrete structures. (Harshal&Khode, 2008)

Methodology



The methodology of the project deals with the series of operations performed for the completion of the project. For ease the project was divided into two Phases as stated:

I- (Material testing): It involves material testing for checking the suitability of the material as a construction material. The entire test was conducted on processed samples to get desired output.

II- (Cube Testing): It involves a series of operations including material sorting, processing, batching, mixing, shuttering, curing and testing under standard conditions. (Bhashakhetre et al., 2017a)

3. Types of Cracks

1 Structural Cracks:

These cracks occur due to incorrect design, faulty construction or overloading and these may endanger the safety of the building.

2 Cracks in beams due to increased shear stress :

These cracks also are referred to as shear cracks and are willing at forty-five ranges with the horizontal. These cracks in beams may be averted via way of means of offering extra shear reinforcements close to the help wherein the shear pressure is maximum. Shear strain is most at a distance of $d/2$ from the guide wherein d is the powerful intensity of the beam.



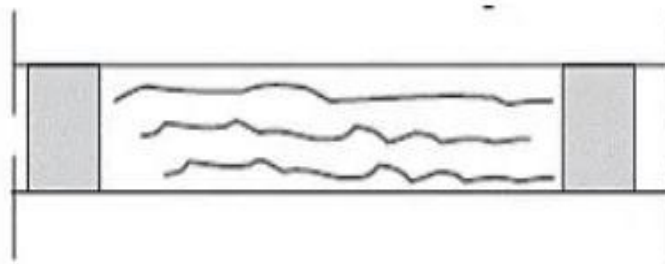
3 Cracks in concrete beams because of corrosion or inadequate concrete cover :

Generally, beams are supplied with a slab on the pinnacle, so the pinnacle of the beam isn't always uncovered to the environment. The bottom of the beam is uncovered to the surroundings and if the duvet to reinforcement is insufficient, then corrosion of reinforcement takes place. So, cracks because of corrosion of reinforcement seem at the lowest of the beam. Cracks due to reinforcement corrosion can cause sapling of concrete in severe cases and can be avoided with the aid of using suitable great manipulation at some stage in its production with the aid of using supplying good enough rebar cowl in keeping with environmental conditions.



4 Cracks parallel to principal metal in case of corrosion in beams :

These cracks additionally seem because of corrosion of reinforcement however at the lowest face of the beam. These seem parallel to principal reinforcements on the bottom. The motive of this corrosion is likewise because of the provision of inadequate reinforcement cowl which ends up in corrosion of foremost reinforcement.



5 Horizontal crack :

Horizontal crack or crack which runs a zigzag 45-degree angle, the purpose for this zigzag shape is probably excessive including basis transferring or water damage. Severe cracks generally require instant interest and may encompass a few reconstructions to save you in addition to damage.

ii) Coarse Aggregate

Crushed annular granite from a local source was used as the coarse aggregate. The specific gravity was 2.7, and the coarse aggregate used in the project work of 60% of 20mm aggregate and 40% of 10mm aggregate. The tests are conducted as per IS codes on Aggregate various tests are conducted such as Specific Gravity test, Water Absorption test, Impact test, Crushing Value Test and Abrasion test. (Bhashakhetre et al., 2017b)

The basic elements of construction and testing of the cubes for specific readings can be obtained only if the results of quality checks are nearby the standard range. (Bhashakhetre et al., 2017) (Tajne , Gayatri; Shende, Shreyas ;Marve, 2022)

Conclusion

Cracks are inherent and negative factors of constructing targeted investigation should be carried out regularly to ensure the accessibility and serviceability of the building. For rehabilitation of cracks, it's far essential to apprehend the reasons and the styles of cracks regarded inside the structure. This paper rapidly describes the reasons and kinds of cracks and their remedial measures. Non-destructive checking out strategies are used to get entry to the power of the shape at a first Instance to recognize the real kingdom of the shape whether or not it is going to be serviceable/workable or to be demolished. Few case research had been carried out at extraordinary public homes at Gwalior M.P. Political science, monetary and archaeological blocks of Jiwaji University. Moti Mahal building. Which have been pronounced cracks and that they have been in suspension to whether or not it'll paintings or must be demolished. The motive of this take a look at is to decide the location of the shape whether or not it is similarly serviceable or now no longer and secondly, if we use the equal construction the way it will be repaired.

References

- Bhashakhetre, C. S., Chalkhure, A. N., Marve, S. R., &Wadhai, N. T. (2017a). Partial Replacement of Course and Fine Aggregate By Plastic Waste and Bed Ash. *International Research Journal of Engineering and Technology(IRJET)*, 4(6), 914–918. <https://irjet.net/archives/V4/i6/IRJET-V4I6171.pdf>
- Bhashakhetre, C. S., Chalkhure, A. N., Marve, S. R., &Wadhai, N. T. (2017b). Plastic Waste Prevention System Analysis & Application. *International Journal of Innovative Research in Science, Engineering and Technology*, 6(7), 12625–12631. <https://doi.org/10.15680/IJRSET.2017.0607023>
- Giri, R., Khan, A., Shende, S. R., Khanke, S. A., &Shradhesh, R. (2023). A Review on Analysis and Design of Multistorey Hospital Building (G + 4) *International Journal of Research Publication and Reviews A Review on Analysis and Design of Multistorey Hospital Building*. March. <https://doi.org/10.55248/gengpi.2023.4.34359>

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- Harshal, M., & Khode, S. (2008). "Research Case Study for Types, Causes, Preventive Measures and Advanced Rectification Techniques of Cracks in Concrete Structures" (Today Is the Biggest Challenges / Problems All Over World'S in 21 St Century). *International Research Journal of Engineering and Technology*, July 1712. www.irjet.net
- Nama, P., Jain, A., Srivastava, R., & Bhatia, Y. (2015). Study on Causes of Cracks & Its Preventive Measures. *International Journal of Engineering Research and Applications*, 5(5), 119–123.
- Narwaria & Tiwari. (2016). Development of cracks in concrete, preventive measures and treatment methods: A review. *International Research Journal of Engineering and Technology*, 671–677.
- Pan, H., & Pi, L. (2018). Study on Cracks in Concrete Structures and the Database. *IOP Conference Series: Earth and Environmental Science*, 189(2). <https://doi.org/10.1088/1755-1315/189/2/022078>
- Pathak, R., & Rastogi, D. (2015). Case Study on Cracks in Public Buildings and their Remedies. *International Journal of Science and Research*, 6(5), 2319–7064. www.ijsr.net
- Tajne, Gayatri; Shende, Shreyas; Marve, S. R. (2022). A Review on Manufacturing Process and Techniques of Hume Concrete. *International Journal of Research Publication and Reviews*, 04(01), 1806–1812. <https://doi.org/10.55248/gengpi.2023.4149>