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Analysis of Concrete Structures Including its Maintenance and Repair

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ABSTRACT: Concrete structures are widely used in the construction industry due to their durability and strength. However, over time, these structures may deteriorate due to various factors such as exposure to harsh weather conditions, chemical attacks, and structural overload. Maintenance and repair of concrete structures are essential to ensure their longevity and safety. This paper provides an overview of the different types of maintenance and repair techniques used for concrete structures, including preventive maintenance, corrective maintenance, and rehabilitation. The paper also discusses the importance of regular inspections and testing to identify potential issues before they become major problems. Additionally, the paper highlights the use of advanced technologies such as non-destructive testing and repair materials to enhance the effectiveness of maintenance and repair activities. Overall, this paper emphasizes the need for proactive maintenance and repair strategies to ensure the safety and longevity of concrete structures.

KEYWORDS: Rehabilitation, Durability, Longevity, Non-Destructive testing

I. INTRODUCTION

India's witnessing a construction boom in many sectors such as highways, seaports airports, residential and commercial buildings, urban as well as a rural projects. We need to keep them safe and usable for long period without much maintenance and repair. Today's scenario taking an example of bridge sector: by taking the survey of about 1.7 lakhs bridges we found that about 6000 bridges are 'structurally distressed'. This number could be much more as the survey is itself inadequate and incomplete. The major reasons for failure of concrete structure are:

- 38%: Ill-suited design of repair works.
- 19%: poor workmanship
- 16%: Incorrect diagnosis of the reason of the initial damage or decay of the project.
- 15%: Unsuitable specifications of materials used.
- 12%: Other factors

Preventive maintenance is required instead of corrective maintenance because prevention is better than cure. The cost of prevention is less than that of cure. According to the NACE impact report corrosion cost in India is about 3 to 4% of the gross domestic product but we can minimise this by doing quality work. Therefore, the corrosion management team is appointed because the perceived actual risks are high. The corrosion management team requires a transformation of mindsets and specialists that are able to think out of the box and come up with the best possible and durable repair solutions. Often the maintenance and repair are much more complicated than new construction. Consider a beam which has defects. But its repair cost is more than replacement cost. In such conditions we still can't replace the beam if it has supports as walls as it can lead to failure of other parts of structure.

So even if the repairing cost is more, the only solution is to repair the beam. In such conditions, we mandatorily do repair even if it is more complicated than new construction. For concrete structures, repair and rehabilitation can be roughly divided into two types: a) repair in which damages from degradation and cracking are repaired to restore the original structural shape and size while the core is mostly intact; and b) repair that is required to strengthen the load-bearing capacity of any members that have accumulated structural flaws over time. The major goal of repair is to restore the building's architectural form so that all services may immediately resume operation and the building's functionality. Repair does not purport to increase the building's structural stability. Historic and ancient structures need to be repaired if



they are to regain part of their previous strength, durability, and stability. In developed nations like India, the new technologies and repair materials that have been widely adopted by sophisticated nations are also being tested. For the repair of existing structures, a variety of construction materials are employed, hence in this paper, various repair is utilised to restore the structural strength of buildings have been considered. It also emphasises the numerous techniques applied to structural restoration and repair.

II. LITERATURE SURVEY

J.J. Beaudoin (2008) The resilience, longevity, and adaptability of concrete structures make them a common choice for building materials. These structures, however, may degrade over time as a result of a number of reasons, including climate change, chemical contamination, and harm to the structure. In order to preserve the service life and security of concrete structures, maintenance and repair are crucial. ACI Committee 546 gave their excellent contributions in the field of maintenance and repair of concrete structures which resulted in significant improvement of the maintenance and repair fragment of the construction industry.

M.G. Alexander et al. (2012) The presentations presented during the third international conference on concrete repair, rehabilitation, and retrofitting are collected in this volume. Materials, techniques, and case studies are just a few of the many topics that are covered in relation to the upkeep and repair of concrete structures. The papers offer details on the most recent research and industry best practises.

M.A. Sozen et al. (2013) This essay specifically addresses the upkeep and repairs of concrete bridges. It goes through the numerous kinds of damage that can happen to bridges as well as the various methods of repair. To maintain the security and longevity of concrete bridges, the authors also stress the significance of periodic checks and preventative maintenance.

Saleem Akhtar (2014) Steel bars buried in reinforced concrete (RC) structures that corrode shorten their lifespan and compromise their resilience, leading to early failure. This increases the expense of inspection and maintenance on decaying structures. As a result, monitoring reinforcement corrosion is crucial for preventing the early failure of structures. This essay makes an effort to highlight the significance of keeping an eye on reinforcement corrosion and covers many techniques for assessing the corrosion state of RC structures, particularly the hal-cell potential (HCP) method. This essay also offers a few corrosion-prevention strategies for concrete.

Yan Niu (2017) An essential part of a project to remediate a site is the preparation of the construction site. The basis and centre of the procedure of land development is material research. Therefore, it is important to research any materials that may be utilised during the process of preparing a building site. This paper reviews and discusses studies on construction materials that are frequently used on construction sites, including recycled concrete, geosynthetics, soil stabilisers, soil improvers, insulation for buildings materials, and inorganic fibre insulation materials. Construction of reference materials was engaged in the land clean-up project.

Abdullah Almusallam (2001) This investigation was done to determine how much corrosion reinforcing steel bars had and how that affected their mechanical qualities. Reinforcing steel rods with diameters of 6 and 12 mm that were corroded in reinforced concrete samples were taken out and put to the test in tension. The results showed that, when estimated on the actual area of cross-section, the level of reinforcement corrosion had no effect on the tensile strength of steel bars. However, when using the nominal diameter in the computation, the tensile strength is lower than the 600 MPa criterion set forth in ASTM A 615 when the degree of corrosion was 11 and 24% for steel bars with 6- and 12-mm diameters, correspondingly. A brittle breakdown is also indicated by reinforcing steel bars with greater than 12% corrosion.

The literature survey highlights the importance of maintenance and repair for concrete structures. It provides insights into the various methods, materials, and best practices used in the field. The survey also emphasizes the importance of preventive maintenance to avoid costly repairs in the future. Overall, the literature survey provides a valuable resource for construction professionals involved in the maintenance and repair of concrete structures.

III. OBJECTIVES

In order to increase the safety and longevity of structures, it is our goal to research and analyse the best maintenance and repair methods available.

The following are the goals of our study:

1. To recognise typical architectural harm types and their root causes.
2. To assess the efficiency of various maintenance and repair methods.
3. To make suggestions for bettering structural maintenance and repair.
4. To increase understanding of the significance of good structural maintenance and repair for durability and safety.

IV. METHODOLOGY

The methodology for preparing our research paper on the topic of maintenance and repair of structures involved the following steps:

1. Literature review: This involved searching academic databases, journals, and other relevant sources to find existing research and studies on maintenance and repair techniques for structures.
2. Collecting data: After conducting the literature review, the next step was to collect data through various methods such as surveys, interviews, or experiments. This involved gathering information from experts in the field, conducting site visits to observe maintenance and repair practices, or analysing data from previous studies.
3. Analysing data: Once data has been collected, it was to be analysed to identify patterns and trends that can help answer the research question. This involved using statistical analysis tools or qualitative methods such as content analysis.
4. Drawing conclusions: Based on the analysis of the data, conclusions have been drawn about the most effective and cost-efficient maintenance and repair techniques for structures. These conclusions are supported by evidence from the literature review and data collection.

V. CONTENT

The following modules are included in our research:

A) Problems causing damage and deterioration of the component:

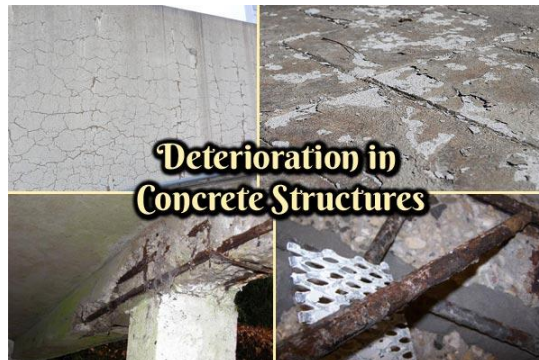
1. Oxidation of embedded metals

Corrosion of metal surfaces that are embedded in or covered by another substance, such as concrete, dirt, or water, is known as oxidation of embedded metals. This kind of corrosion happens when corrosive substances like atmospheric moisture, oxygen, and chemical substances are allowed to enter the metal's protective covering and react with the metal's outermost layer. This process over time may weaken, corrode, and ultimately ruin the metal. In infrastructure including bridges, pipelines, and buildings, embedded metal corrosion is a frequent issue that, if left unchecked, can raise serious safety and financial issues.



2. Cementitious component degradation

Cementitious component degradation refers to the progressive destruction or deterioration of cement-based building materials like mortar and concrete. Contact to naturally occurring components like moisture, cycles of freezing and thawing, and chemical agents are only a few causes of this. Cracking, splitting, scaling, and discolouration are a few of the different ways that degradation can appear. Deterioration can impair the cementitious system's structural integrity and raise safety issues if it is not corrected. So as to avoid deterioration and preserve their longevity, it is crucial to constantly inspect and repair these systems.



B) Solutions to rectify the examined problems:

1. Condition examination

In construction, condition examination is the process of assessing the present status of a facility or piece of infrastructure to establish its general condition and pinpoint any possible problems or areas of concern. The foundation, walls, roof, electrical and plumbing systems, and other parts of the structure are often thoroughly inspected as part of this examination. The aim of the assessment is to locate any possible flaws, damage, or degradation as well as any potential safety risks or code breaches. To enhance the condition and increase the lifespan of the structure, recommendations for improvements, repairs, or other remedial measures may be made based on the assessment's findings. Condition evaluations are frequently performed by qualified experts, such as engineers or building inspectors, and may be required by local building guidelines and regulations.

2. Method and supplies for surface repair

The procedures and materials used to restore or repair damaged surfaces of a building or infrastructure are referred to as surface restoration strategies and materials in the construction industry. The most typical forms of surface damage include rust, cracks, holes, and spalls. The nature and amount of the damage, the anticipated usage of the structure, and its lifespan will all affect the repair approach.



3. Surface cleaning and safeguarding procedures

Before any construction or repair work can be done, a surface must be cleaned and prepared. This procedure is known as surface cleaning. This entails clearing the surface of any dirt and debris, eliminating any loosened or broken material, and checking that the surfaces are clean and devoid of pollutants. To guarantee that repair materials bond correctly and that the surface is sturdy and long-lasting, appropriate surface cleaning is essential. In the field of building, safeguarding procedures include the use of coatings, sealants, or other compounds to shield a surface from deterioration or harm. These treatments can aid in preventing water infiltration, corrosion, and other types of damage that could shorten a structure's lifespan. Concrete, masonry, or metal surfaces can get protective coatings, and help to extend the lifespan of the structure.



4. Waterproofing

Making a surface or structure impervious to water infiltration is known in the construction industry as waterproofing. This is often accomplished by coating or putting a waterproofing membrane to the surface, which stops water from penetrating and causing harm. In places like basements, roofs, and foundations that are subject to moisture, waterproofing is extremely crucial. Without adequate waterproofing, water can lead to mould growth, structural damage, and other problems that can be expensive to fix. A structure's lifespan can be increased and its vulnerability to water damage reduced through waterproofing.



5. Ideas for fixing structures

In the field of construction, structural repair is the process of restoring or strengthening a structure that has been weakened or damaged for a variety of reasons, including ageing, natural disasters, or subpar building techniques. Restoring the building's structural integrity and ensuring its stability and safety are the two objectives of structural rehabilitation. Finding the root of the problem and creating a strategy to fix it are both components of structural repair. This could entail fixing or replacing broken structural elements, strengthening already-existing elements, or adding fresh supports or bracing. To avoid further damage, the buildings throughout structural architecture may be enhanced as part of the restoration procedure. Construction must include structural maintenance in order to make sure that structures are secure and fit for their intended purposes. It calls for specialised training and experience in engineering, building methods, and materials science.

6. Tender requirement and case investigations

The particular demands and standards that are listed in a tender document are referred to as tender specifications in the construction industry. The scope of the project of work, materials to be employed, timetables, and budget are all detailed in these specifications. They are used to make sure that all bidders are aware of the specifications for the project and are capable of submitting precise and competitive bids. Case investigations in construction are actual instances of successfully completed building projects. They are employed to offer insight into the issues, options, and best practises used during the project. Case research can be utilised to guide future initiatives and assist construction industry experts in drawing lessons from the past. They could also be employed as marketing instruments to highlight a business's capabilities and expertise.

VI. CONCLUSION

The research report highlights the crucial importance of maintenance and repair for concrete structures to ensure their durability and safety. The literature review conducted as a part of the research has revealed various types of concrete constructions and numerous techniques for their maintenance and repair. The report emphasizes the significance of



routine inspections, diagnoses, and rehabilitation approaches to minimize future costly repairs. Preventive maintenance is also identified as a key factor in prolonging the life expectancy of concrete structures. The study emphasizes the importance of implementing good maintenance and repair procedures to maintain the strength and safety of concrete structures. By following these procedures, owners can ensure that their structures remain safe, durable, and cost-effective in the long run. Therefore, the report provides valuable insights into the maintenance and repair of concrete structures and highlights the need for regular upkeep to ensure their longevity.

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