

Slab Strengthening by Retrofitting

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Abstract: *Retrofitting is the modification of existing structures to improve the performance and durability of the structure. Retrofitting on a slab typically involves adding structural enhancements or improvements to an existing structural member to strengthen it or to accommodate new loads or uses.*

Day to day concrete structure to need retrofitting due to various factors like corrosion, lace of detailing, and failure of bonding etc. Due to this defect we choose the main structural member as slab.

In retrofitting, Ferro cement strengthening techniques, a versatile construction material, offers numerous advantages such as affordability, ease of construction, and adaptability to various shapes and sizes. However, to optimize its performance and durability, it requires appropriate strengthening techniques. This project explores a range of methods aimed at enhancing the structural integrity of ferro cement structures. Through a comprehensive literature review and experimental investigations, this study identifies key strengthening techniques including increasing reinforcement density, optimizing mesh configuration, controlling cracking, applying surface treatments, ensuring proper curing, and implementing quality control measures during construction. The effectiveness of these techniques is evaluated through laboratory testing and numerical simulations to assess their impact on structural performance, durability, and cost-effectiveness. Additionally, case studies and real-world applications demonstrate the practical implementation and benefits of these strengthening techniques in diverse engineering scenarios such as building construction, marine structures, water tanks, and bridges. The findings of this project contribute to advancing the understanding and utilization of ferro cement as a sustainable and resilient construction material, thereby promoting its widespread adoption in various infrastructure projects.

Keywords: *safety, modernization, history, resilience, economical, rules.*

1. INTRODUCTION

Concrete structures, including slabs, serve as the backbone of modern infrastructure, providing stability and support to various architectural marvels. However, over time, these structures can deteriorate due to various factors such as aging, environmental conditions, and increased loads beyond their original design capacity. Among these structures, concrete slabs often face challenges related to cracking, deflection, and inadequate load-bearing capacity, necessitating interventions to enhance their strength and durability.

The need for strengthening concrete slabs through retrofitting arises from the imperative to ensure safety, minimize maintenance costs, and extend the lifespan of infrastructure assets. By exploring and evaluating different retrofitting methods, this paper seeks to provide insights into the selection criteria, design considerations, and practical implications for engineers, architects, and stakeholders involved in the maintenance and rehabilitation of concrete structures. Structural strengthening, repair or upgrade of reinforced concrete (RC) structures is an art that has evolved into a complex science. It includes the use of conventional cement-based materials, as well as new materials that involve advanced composites. Regardless of the experience and experimental knowledge we have gained in more than a hundred years of reinforced concrete construction, concrete still deteriorates due to natural causes and man-made errors. The strengthening / repair assessment and design and the resulting design of the solution are typically more complex than new construction. When strengthening is going to be undertaken, all failure modes must be evaluated. Strengthening a structure for flexure may lead to shear failure instead of giving the desired increased load bearing capacity. It should also be noted that not only the failure mode of the strengthened member is important. If a critical member in a structure is strengthened, another member can become the critical one. Because of stiffness change in an undetermined structural system, the whole structure must be investigated. The strengthening should also be designed with consideration to minimize the maintenance and repair needs. When a strengthening is designed, the consequences from loss of strengthening

2. RESEARCH ELABORATIONS

In very early 20th century some buildings and concrete structures that have been build are in deprived state and therefore those structure need to be exchanged or retrofitted. In retrofitting, the restructure must be designed for both safety and durable, with responsiveness given to the case of retrofitting construction and post-retrofitting maintenance, as well as overall economy and environment-friendliness. The Ferro cement is used, in general, to replace the damaged concrete and reinforcement (if also damaged). Strengthening with Ferro cement improves cracking resistance, flexural stiffness and the ultimate loads compared to the original unstrengthened element. These improvements depend on the full composite action between the Ferro cement the important parameters involved in the technique selection of the retrofitting process. Are introduced and categorized by using the concept of value management, new scheme evaluate for relative advantage of each proposed retrofitting design. The study will be implemented for RC slabs, column, beams, walls etc. and sometimes retrofitting is also used in wall thicknesses and the walls will be exposed to different exterior and interior climatic conditions for insulation and energy saving The directives aimed to accelerate the transformation of existing buildings towards net zero energy/emissions buildings. Sometimes they need to be retrofitted to have better behaviour under earthquakes, Ventilation, heat recovery, low-temperature heating in Retrofitting, energy conservation, environmental impacts and indoor air quality.

3. METHOD OF RETROFITTING

1. Concrete overlay
2. Steel plate bonding
3. Carbon fibre reinforcement
4. Epoxy injection
5. Post-tensioning

6. Fibre reinforced polymer wrapping
7. Adding shear reinforcement
8. Ferro cement strengthening techniques

Ferro Cement Strengthening Techniques

Ferro cement strengthening techniques involve methods used to enhance the strength and durability of ferro cement structures. These techniques typically include reinforcing the ferro cement matrix with materials such as steel mesh, wires, or synthetic fibres, optimizing the arrangement of reinforcement, controlling cracking, applying surface treatments, ensuring proper curing, and implementing quality control measures during construction. The importance of ferro cement strengthening techniques lies in enhancing the structural integrity, durability, and longevity of ferro cement structures. Here's why these techniques are crucial.

Safety: Strengthening techniques help prevent structural failures, reducing the risk of collapse and ensuring the safety of occupants.

Durability: By reinforcing the ferro cement matrix, these techniques increase resistance to environmental factors such as corrosion, erosion, and impact, thereby extending the lifespan of the structure.

Cost-effectiveness: Strengthening techniques can mitigate the need for frequent repairs and maintenance, saving both time and money over the long term.

Versatility: With proper strengthening, ferro cement structures can be used in various applications such as building construction, marine structures, water tanks, and bridges, expanding their utility and applicability.

Sustainability: Strengthening techniques can contribute to the sustainability of structures by prolonging their lifespan and reducing the consumption of materials through the use of optimized reinforcement strategies.

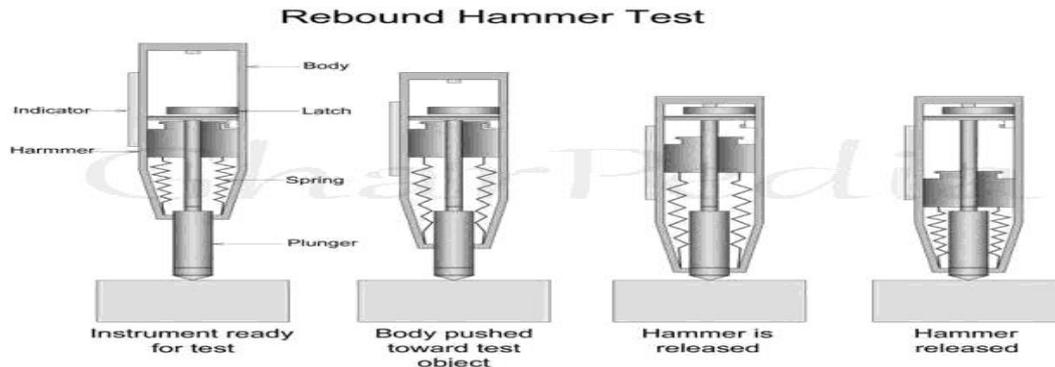
Non-Destructive Testing Ndt

NDT can be used to inspect the quality and integrity of the retrofitting materials before, during, or after the retrofitting process. NDT can also be used to detect any cracks, defects, or deterioration in the original or retrofitting structure.

NDT is essential for maintaining the safety, reliability, and performance of infrastructure, industrial facilities, and manufactured products. It provides valuable insights into the condition of materials and components without causing damage, making it a crucial tool for asset management, risk mitigation, and regulatory compliance

Rebound Hammer Test:

Principle: The Rebound Hammer Test, also known as the Schmidt Hammer Test, is a non-destructive test used to assess the compressive strength of concrete by measuring the rebound of an impact hammer off the surface of the concrete.



Procedure:

1. The rebound hammer, which contains a spring-loaded mass, is pressed against the surface of the concrete to be tested.
2. The hammer is then released, and it impacts the concrete surface.
3. The rebound distance (the distance the hammer bounces back) is measured using a scale on the hammer.
4. The rebound value is compared to a calibration curve or table to estimate the compressive strength of the concrete.

POLYPROPYLENE FIBRE

Polypropylene fibre is a synthetic fibre made from the polymer polypropylene. It's commonly used in construction for reinforced concrete slabs. These fibres are added to the concrete mixture to enhance its durability, strength, and crack resistance. Overall, incorporating polypropylene fibres in concrete slabs can lead to a more robust and long-lasting construction material. Industrial it's known for its lightweight nature, strength, and resistance to mildew, making it suitable for both indoor and outdoor use. Additionally, it can be easily recycled, making it environmentally friendly.



Epoxy Rustop

Sika is a company that produces a wide range of construction chemicals, including anti-corrosive coatings. Sika's anti-corrosive coatings are designed to protect steel and concrete structures from corrosion caused by environmental factors such as moisture, chemicals, and salt.

Sika's anti-corrosive coatings typically consist of epoxy, polyurethane, or acrylic-based formulations, depending on the specific application requirements and environmental conditions. These coatings are applied to surfaces using various methods such as brushing, spraying, or roller application.



RETROFITTING ON SLAB

Assessment: We evaluate the condition of the existing slab to determine the extent of deterioration, cracks, and structural weaknesses.



Preparation: We clean the surface of the slab thoroughly to remove any loose debris, dirt, or old coatings. It's crucial to have a clean and rough surface for better adhesion. and also performing NDT test to find the strength of the structures.



Application of Bonding Agent:

we apply a bonding agent or primer as a rust top (anti rust coating and bonding agent) to enhance the bond between the existing slab and the ferro cement layer. This step helps in improving the adhesion and durability of the retrofit.



Fabrication of Ferro cement Layer: We Prepare the ferro cement mixture by combining cement, sand, water, Polypropylene fibre and materials such as wire mesh. The mixture should have a suitable consistency for easy application and good workability.



Placement of Ferro cement Layer:

We apply the ferro cement mixture into the prepared surface of the slab using trowels or sprayers. Ensure uniform thickness and proper compaction of the ferro cement layer to achieve optimal structural strength and durability.



Embedding mesh: Insert additional elements such mesh into the fresh ferro cement layer to enhance its tensile strength and ductility. Proper placement and mesh are essential to resist bending and shear forces effectively.



Curing: We cure the ferro cement layer by keeping it moist for a specified period to allow for hydration and proper development of strength. Curing helps prevent shrinkage cracks and ensures the durability of the retrofitting system.



Quality Control: again we are performing NDT test on finish work to conduct quality checks throughout the retrofitting process to verify compliance with design specifications and structural requirements.

Monitoring and Maintenance: we Monitor the performance of the retrofitted slab over time and perform regular maintenance to address any signs of distress or deterioration

4. RESULTS OR FINDING

Rebound hammer test – 26-01-24



Sample no.	Rebound number			Avg. rebound number	Compressive Strength
1	23	25	27	25	21.36
2	27	22	26	25	21.36
3	25	26	24	25	21.36
4	24	27	24	25	21.36
5	14	15	15	14.66	17.06

6	20	18	16	18	19
7	22	23	22	22.33	20.69
8	22	23	21	22	20.21
9	20	20	21	20.33	19.12

Avg. compressive strength = **21.66 kn/m³**

5. CONCLUSIONS

In this paper we understanding the properties and performances of utilizing ferro cement strengthening techniques would typically summarize the key findings, outcomes, and lessons learned from the project. It might include, Evaluation of the effectiveness of ferro cement strengthening techniques in enhancing structural performance. Comparison of the performance of ferro cement with traditional strengthening methods. Assessment of cost-effectiveness, durability, and sustainability of ferro cement solutions. Identification of any limitations or challenges encountered during the project. Recommendations for future research or application of ferro cement in similar projects. Overall, a summary of how the project contributes to the advancement of knowledge in the field of structural engineering and construction materials

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Conclusions