

# Slab Strengthening by Ferro Cement Techniques

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**Abstract:** Retrofitting is the process of to improve te existing building structure. Retrofitting of existing structures involves strengthening or modifying the structural elements to improve their performance, durability, and safety. In retrofitting, Ferro cement strengthening techniques is technique to strengthen and repair damage of the structures. In this paper, the application of Ferro cement strengthening techniques in existing concrete slab is being investigated for its effectiveness in enhancing the structural performance, wide range of applicability and high durability.

Ferrocement is the construction material consisting of wire meshes and cement mortar application of Ferrocement in constructions vast due to the low self-weight, lack of skilled workers, etc. Retrofitting is the process of increasing the seismic resistance of damaged or weak structure by appropriate techniques. Retrofitting of earthquake damaged structure is done by repairing and strengthening the damaged portions of the structure and making it reusable. Ferrocement used as retrofitting due to their easy availability, economy, durability and their property of being cast to any shape without needing significant formwork. In many circumstances, it can provide the most economical solution for a structural rehabilitation problem. The manufacturing process of Ferro cement strengthening techniques and the field application of Ferro cement strengthening techniques is very easy and selected results from experimental and analytical.

**Keywords:** Ferrocement, Retrofitting, Seismic Resistance, Compressive Strength.

## 1. INTRODUCTION

Cracks in concrete may accelerate the corrosion of the embedded reinforcing steel, and may reduce the service life and increase the maintenance cost of concrete structure. In addition, due to the low tensile strength of concrete, the structural concrete elements deteriorate when the concrete are subjected to extreme loadings, or react to corroded reinforcing steel.

Retrofitting in the construction industry refers to the re-strengthening of the existing structures to make them seismic resistant. Retrofitting is an economic approach to increase the life span of an existing structure rather than redeveloping it. Retrofit means to apply new technologies to an older system. Any retrofitting of an existing building that aims to reduce the carbon emissions and environmental impact of the building.

Retrofitting is the process of adding or modifying structural elements to improve the performance of existing buildings or bridges. Retrofitting materials are often used to enhance

the strength, stiffness, ductility, or durability of the original structure. But how can you test the strength of retrofitting.

#### **Types of retrofitting-**

- Concrete overlay
- Steel plate bonding
- Carbon fibre reinforcement
- Fibre reinforced polymer wrapping
- Adding shear reinforcement
- Ferro cement strengthening techniques

**Our topic is based on slab strengthening by retrofitting.** The failure of a slab can occur due to various reasons, including inadequate structural design, poor construction quality, overloading or environmental factors. Common types of slab failures include cracking, excessive deflection, and even collapse in extreme cases for our suitable type of retrofitting is Ferro cement strengthening techniques.

Because of quick and easy installation requires less preparation than traditional FRP strengthening and also ensures minimal downtime. Cost-effective solution compared to traditional concrete strengthening. Does not add significant weight or mass to the structure, which makes it ideal for historical buildings and structures. Outstanding performance for strengthening irregularly-shaped structures and substrates.

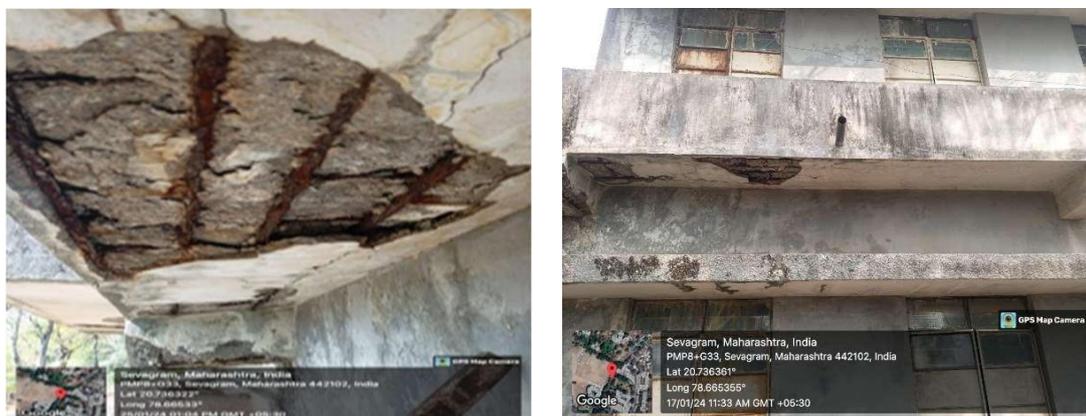
## **2. METHODS**

### **1. Site Selection:**

Firstly we observed that old building structure so, we found that old building structure in college campus. Then we check the strength of building by using NDT method. So, we found that this building has decreases loss of strength due to age of building and other environmental action.

- **Assessment of Deterioration:** This assessment should include identifying the causes of deterioration, such as moisture ingress, chemical exposure, or structural overloading.
- **Structural Integrity:** Assess the structural integrity of the slab to determine if it can be repaired or if strengthening is required. Factors such as cracks, spalling, delamination, and loss of reinforcement should be evaluated to understand the severity of deterioration.
- **Safety Considerations:** Safety should be a top priority when selecting a site for deteriorated slab repair. Assess any potential risks associated with working on the site. such as unstable conditions, hazardous materials, or proximity to traffic or other hazards.
- **Repair Options:** Consider the available repair options for the deteriorated slab, such as patching, overlaying, or full-depth replacement. The choice of repair method will depend on the extent of deterioration, budget constraints, and long-term durability requirements.
- **Environmental Conditions:** Evaluate the environmental conditions at the site, such as temperature, humidity, and exposure to corrosive elements. These factors can impact the effectiveness of repair materials and methods and should be taken into account when selecting a repair site.
- **Long-Term Performance:** Consider the long-term performance of the repair solution when selecting a site for deteriorated slab repair. Choose materials and methods that will provide durable and sustainable results to minimize future maintenance needs. By carefully considering these factors and conducting a thorough assessment of the site, you can select

a suitable location for deteriorated slab repair that meets safety, structural, and durability requirements.



### 3. STRENGTH TEST:

#### Non-Destructive Testing (Ndt):

Non-destructive testing (NDT) refers to the evaluation of materials, components, or systems without causing damage or altering their properties. NDT is crucial in quality control, safety, and reliability across various industries, including aerospace, automotive, and manufacturing. It is used for condition assessment and quality control of components and machine condition before or during their active use. NDT methods include visual inspections, ultrasonic testing, vibration analysis, magnetic particle testing, and radiography, among others. The advantages of NDT include cost efficiency, time effectiveness, minimal wastage, enhanced safety, and reliable results.

These are just a few examples of the many methods of NDT that are available. The choice of method depends on the type of material being inspected, the type of defect being sought, and other factors such as cost, accessibility, and required accuracy.

#### Rebound Hammer Test:

Principle: The Rebound Hammer Test, also known as the Schmidt Hammer Test, is a non-destructive test used to assess the strength of a slab. The rebound hammer test involves striking the surface of the concrete slab with a hammer and measuring the rebound of the impact. The rebound value is correlated with the compressive strength of the concrete, providing an indication of its overall strength.



### **Procedure:**

1. **Preparation:** Before starting the test, ensure that the concrete slab surface is clean and free from loose debris. It is also important to mark the test locations on the slab where measurements will be taken.
2. **Calibration:** Calibrate the rebound hammer according to the manufacturer's instructions. This involves checking and adjusting the instrument to ensure accurate and consistent results.
3. **Test Locations:** Select representative locations on the concrete slab where the test will be conducted. Typically, multiple test points are selected to obtain an average value of the concrete strength.
4. **Test Procedure:**
  - Hold the rebound hammer perpendicular to the concrete surface at the selected test location.
  - Apply a firm pressure to the hammer to ensure good contact with the concrete.
  - Press the trigger or release mechanism to activate the impact.
  - The rebound hammer will strike the surface and rebound back, and the instrument will measure and display the rebound value on a scale.
  - Record the rebound value for each test location.
5. **Repeat Tests:** Conduct multiple tests at each selected location to ensure consistency and accuracy of results. Typically, three to five tests are performed at each location, and an average rebound value is calculated.
6. **Interpretation:** The rebound value obtained from the test is correlated with the compressive strength of concrete.

### **Epoxy Rustop**

"Epoxy Rustop" is a type of epoxy coating specifically designed to prevent rust and corrosion on metal surfaces. Epoxy coatings are known for their excellent adhesion, durability, and resistance to chemicals, making them a popular choice for protecting metal surfaces from corrosion.

Here are some key features and benefits of Epoxy Rustop coatings:

- **Corrosion Protection:** Epoxy Rustop coatings create a protective barrier on metal surfaces, preventing moisture and corrosive substances from reaching the metal substrate. This helps to inhibit the formation of rust and corrosion, extending the lifespan of the metal.
- **Adhesion:** Epoxy coatings have excellent adhesion properties, ensuring that the coating bonds tightly to the metal surface. This helps to provide long-lasting protection against corrosion.
- **Durability:** Epoxy Rustop coatings are highly durable and resistant to wear, abrasion, and impact. They can withstand harsh environmental conditions, making them suitable for both indoor and outdoor applications.
- **Chemical Resistance:** Epoxy coatings are resistant to a wide range of chemicals, including acids, alkalis, and solvents. This chemical resistance helps to protect the metal surface from chemical corrosion.
- **Versatility:** Epoxy Rustop coatings can be applied to various metal substrates, including steel, aluminum, and iron. They can be used in industrial, commercial, and residential applications to protect metal surfaces from rust and corrosion.
- **Easy Application:** Epoxy coatings are easy to apply using brush, roller, or spray application methods. They cure quickly to form a tough, protective film on the metal surface. Overall,

Epoxy Rustop coatings are an effective solution for preventing rust and corrosion on metal surfaces, providing long-lasting protection and extending the lifespan of metal structures and equipment.



### **Retrofitting on Slab**

#### **o FERRO CEMENT STRENGTHENING TECHNIQUES**

Ferro cement strengthening techniques can be describe as a type of thin composite material made of cement mortar reinforced with wire meshes. The wire meshes are uniformly distributed in continuous layers with relatively small diameters. The ferrocement was used, ingeneral, to replace the damaged concrete and reinforcement (if also damaged).

The steps of applying this technique consist in removing the concrete from the cracked affected zone with the help of a concrete chisel and hammer. After that a layer of galvanized welded wire mesh and a layer of skeletal steel are fixed with the original reinforcement of theslab. The concrete surface must roughened before the additional reinforcement is placed. The dimensions of the additional reinforcement result from the design and technological restrictions. Finally the cement mortar is applied and left to cure for 28 days.

The importance of ferro cement strengthening techniques lies in enhancing the structural integrity, durability, and longevity of ferro cement structures.

#### **O Polypropylene Fibre:**

Polypropylene fiber is a type of synthetic fiber that is widely used in various industries due to its excellent properties. Polypropylene fibers are derived from the polymer polypropylene and are known for their high strength, durability, and resistance to chemicals and moisture.

Polypropylene fibers are often added to concrete mixtures to improve the strength and durability of the concrete. The fibers help prevent cracking and increase the toughness of the concrete.

Overall, polypropylene fibers are versatile materials with a wide range of applications across different industries due to their excellent properties and performance characteristics.

There are several advantages of polypropylene fibers that make them a popular choice for various applications:

- **High Strength:** Polypropylene fibers have high tensile strength, making them durable and resistant to stretching or breaking under tension.
- **Chemical Resistance:** Polypropylene fibers are resistant to a wide range of chemicals, including acids, alkalis, and solvents. This makes them suitable for use in environments where exposure to chemicals is a concern.
- **Moisture Resistance:** Polypropylene fibers are hydrophobic, meaning they repel water and

do not absorb moisture.

- **Lightweight:** Polypropylene fibers are lightweight, which makes them comfortable to wear in textiles and easy to handle in manufacturing processes.
- **Low Cost:** Polypropylene fibers are cost-effective compared to natural fibers or other synthetic fibers. This makes them a popular choice for applications where cost efficiency is a priority.
- **Good Insulation Properties:** Polypropylene fibers have good insulation properties, making them suitable for use in applications where thermal insulation is required.
- **Recyclable:** Polypropylene fibers are recyclable, which makes them an environmentally friendly choice compared to some other synthetic fiber. Overall, the combination of high strength, chemical resistance, moisture resistance, and other advantageous properties make polypropylene fibers a versatile material with a wide range of applications in various industries.



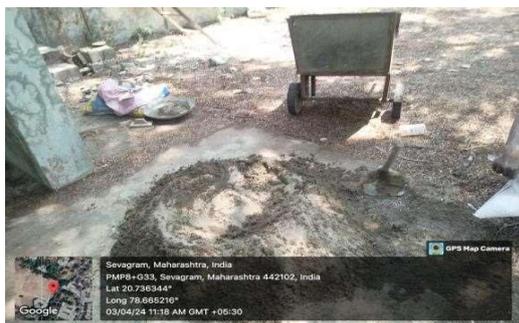
○ **Embedding Mesh:**

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.



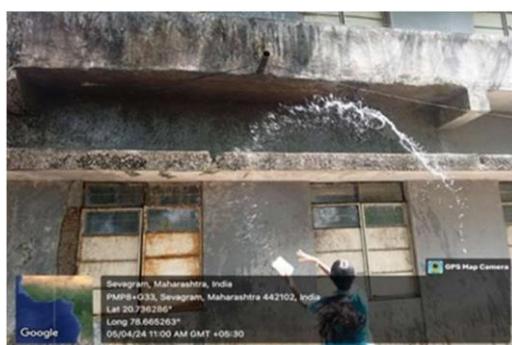
○ **Fabrication of Ferro Cement Layer:**

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. 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.



○ **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. And we curing for 28 day.



**Retesting the Strengthening Of Slab:**

Reapplying NDT test after finish the work of slab retrofitting.

**4. RESULTS OR FINDING**

Rebound



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/m<sup>3</sup>**

## 5. CONCLUSIONS

Efficacy:

Retrofitting methods such as epoxy injection, carbon fiber reinforcement, or steel plate bonding have demonstrated significant improvements in the strength and durability of weakened slabs. Structural Integrity: Through retrofitting, the structural integrity of the slab is restored, reducing the risk of failure due to increased load, aging, or damage.

Cost-Effectiveness: Retrofitting offers a cost-effective solution compared to complete slab replacement, providing substantial savings while extending the lifespan of the structure.

Sustainability : Retrofitting promotes sustainability by minimizing material waste associated with slab replacement and reducing the environmental impact of construction activities. A conclusion section is not required.

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