Investigation on efficacy of admixtures in repairing and improving the characteristics of concrete cylinders.

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ABSTRACT

Cracks can be seen in any type of building. We all want a home that is both structurally sound and visually appealing, but this is not always possible. Overcoming natural disasters, man-made disasters, construction flaws, incorrect design, and the formation of cracks on the building. Although cracks in buildings cannot be completely avoided, they can be avoided by utilizing adequate materials and repair techniques. Early detection of such flaws and the implementation of preventive measures are critical. Active cracks demand extra treatment as they spread.As a result, it is required to identify the type of crack, crack pattern, and cause of the cracks, as well as the defensive measures to be done to deal with the cracks. This study employs Crack X plast, a chemical admixture with non-shrinking properties, RoffSupercrete, a liquid white Acrylic Polymer admixture, Ground Granulated Blast Furnace Slag (GGBS), a byproduct of the steel industry, and fly ash, a byproduct of thermal power plants. The efficiency of the aforementioned chemical and mineral admixtures has been investigated.

Keywords— chemical admixture, cracks, mineral admixture, repair

#  INTRODUCTION

 Concrete is the most robust and long-lasting commodity when properly prepared. Good grade concrete cannot be produced easily. The following are the causes of concrete cracking. Although concrete does not require much water to attain its strength, extra water is used at construction sites to increase workability. This surplus water has a higher impact on the concrete's strength. Another cause of cracking is shrinkage. Concrete shrinks after hardening. This is due to excess water evaporation in concrete. Concrete dries quickly, which creates cracking. Cracking is further exacerbated by foundations that are poured during the cold season. This plainly suggests that cracks can emerge at any time, making it critical to repair them.

# MATERIALS

## A. The materials utilized in the study are listed in the table below.

Table I Properties of materials used

|  |  |
| --- | --- |
| **Material** | **Classification** |
| **Cement** | Ordinary Portland Cement |
| **Fine Aggregate** | M-Sand |
| **Coarse Aggregate** | 12.5 mm gravel |
| **Water** | Potable |
| **Ground Granulated Blast Furnace Slag (GGBS)** | Portland |
| **Fly ash (FA)** | Class F |
| **Crack X Paste** | Polymer modified type |
| **Roff Shotcrete Acrylic Polymer** | Acrylic polymer |

Concrete was made using ordinary Portland cement, m sand, 12.5 mm gravel, and potable water. Four materials were chosen and used in the repair process. GGBS, fly ash, Crack X paste, and Roff shotcrete acrylic polymer are all used in the construction. For restoring concrete cylinders, two mineral admixtures and two chemical admixtures were chosen.

# METHODOLOGY

**Collection of materials**

**Initial Test on Materials**

**Mix design**

**Casting of cylinders**

**Testing of cylinders**

**Repairing of cylinders using GGBS, FA,CXP & RSAP**

**Testing of repaired cylinder**

**Results and discussions**

**Conclusion**

**Figure1. Methodology**

# EXPERIMENTAL INVESTIGATION

 After the gathering of the materials, a preliminary cement, sand, and gravel test was carried out. For cement, tests on consistency, setting time, and specific gravity were performed. Both aggregates underwent a sieve analysis test, and the fineness modulus was determined. Bulk modulus testing were conducted in addition to measurements like specific gravity. IS 10262-2009 was used for mix proportioning. Use is made of M25 grade concrete in a mix ratio of 1:1.62:2.57:0.4. 6 150 mm-sized cubes and 12 150 mm-diameter cylinders were cast together and let to cure. At 7, 14, and 28 days after curing, cylinders and cubes are tested for compressive strength and split tensile strength. The cracked cylinders that were put through testing are fixed. Initially, a crack measuring equipment was used to gauge the crack's depth. Later, the first crack propagation for the first day was observed and its length of propagation for the seventh day was compared. Following this, three cylinders' cracks were sealed using Fly ash mixed with water after GGBS powder was formed into a paste by adding water and then injected into the cracks. The last three cylinders were repaired using Crack X paste, three cylinders, and Roff Shotcrete Acrylic Polymer. Later, using a compression testing machine, the split tensile test was performed after being let to dry for 24 hours.

**Figure2. Cylinder repairing process**

# RESULTS AND DISCUSSIONS

A. The concrete cube's compressive strength test results show that the mix proportioning was done correctly. Figure 3 depicts the target strength as it has been attained.

**Figure 3. Compressive strength of concrete cube**

B.The Split tensile Strength of concrete cylinders before and after repairing using GGBS is shown in figure 4.

**Figure 4. Split Tensile Strength of Concrete Cylinders before and after repair using GGBS**

C. The Split tensile Strength of concrete cylinders before and after repairing using FA is shown in figure 5.

**Figure 5. Split Tensile Strength of Concrete Cylinders before and after repair using FA**

**D.** The Split tensile Strength of concrete cylinders before and after repairing using CXP is shown in figure 6.

**Figure 6. Split Tensile Strength of Concrete Cylinders before and after repair using CXP**

**E.** The Split tensile Strength of concrete cylinders before and after repairing using RSAP is shown in figure 7

**Figure 7. Split Tensile Strength of Concrete Cylinders before and after repair using RSAP**

F. Comparative analysis

Comparative research on the effectiveness of chemical and mineral admixtures is presented. Figure 8 compares and graphically displays the split tensile strength of concrete cylinders repaired with GGBS, FA, CXP, and RSAP.

**Figure 8. Split Tensile Strength of Concrete Cylinders using GGBS, FA, CXP & RSAP**

# CONCLUSIONS

* To fix cracks in concrete cylinders, two chemical admixtures, Crack X Paste (CXP) and Roff Shotcrete Acrylic Polymer (RSAP), and two mineral admixtures, Granulated Blast Furnace Slag (GGBS), Fly ash of F Class (FA), are employed.
* In this inquiry, M25 grade concrete is used in the design. The desired strength has been attained.
* The big straight-line cracks that had been repaired did not reopen, and the repaired cylinders failed as a result of the emergence of fresh significant straight-line cracks. When repair efforts include retrofitting, new cracks can be prevented.
* Concrete cylinders' split tensile strength has increased. When GGBS is used, an increase of 12%, 2%, and 8% is observed on days 7, 14, and 28.
* When FA is employed, only a slight rise or no increase is seen. 7th day: 3% rise; 14th day: no change; 28th day: 0.3% increase.
* In the case of the two mineral admixtures selected, GGBS performs well in use.
* Concrete cylinders' split tensile strength has increased. When CXP is employed, an increase of 16%, 17%, and 19% is seen at the 7th, 14th, and 28th days, respectively.
* When RSAP is utilized, increases of 6% on day 7, 3% on day 14, and 3% on day 28 are noted.
* Crack X Paste outperforms the other two chemical admixtures in terms of effectiveness.
* Concrete structures can be repaired at any stage of deterioration with these simple, effective admixtures.

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