Study on the effectiveness of admixtures in repairing and enhancing the properties of concrete cylinders

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ABSTRACT

In all kinds of construction, cracks are found. We all dream of a home that is structurally stable and appealing, but it's not so easy. Overcoming natural calamities man made disasters, construction faults, inappropriate design, cracks are formed on the building. Though the cracks in buildings cannot be avoided totally they can be prohibited by using enough material and technique of repair. On timely recognition of such cracks and adopting preventive measure are essential. Active cracks require special attention as they gradually propogate.So, it is necessary to recognize the type of crack, crack pattern and their cause along with the defensive measures to be taken to deal with the cracks. Crack X plast a chemical admixture with non shrinking property, RoffSupercrete a liquid white Acrylic Polymer admixture, Ground Granulated Blast Furnace Slag (GGBS)byproduct from steel industry and fly ash a byproduct of thermal power plant are used in this study. An attempt has been made to study the effectiveness of the above chemical and mineral admixtures.

Keywords—chemical admixture, cracks, mineral admixture, repair

I. INTRODUCTION

When prepared properly, concrete is the most durable and long-term product to use. Good quality concrete cannot be achieved in ease. The following are the reasons for cracking of concrete.Concrete does not require much water to achieve its strength, but in usage at sites more water usage is done for improved workability. This excess water affects the concrete strength to a greater extent. Shrinkage is another reason for cracking. After concrete hardening, it shrinks. This is due to the evaporation of surplus water in concrete. Concrete will dry rapidly which also causes cracking. Foundation poured in cold season also contributes to cracking. This clearly indicates crack may appear at any time so it is important to repair the cracks.

II. MATERIALS

*A.*Materials used in the study is shown in the below table.

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
RoffShotcrete Acrylic Polymer	Acrylic polymer

Ordinary Portland cement, m sand, 12.5 mm gravel and potable water was used for making concrete. Four materials were selected and used for repairing process. GGBS, Fly ash, Crack X paste and Roffshotcrete acrylic polymer. Two mineral admixtures and two chemical admixtures were chosen for repairing concrete cylinders.

III. METHODOLOGY

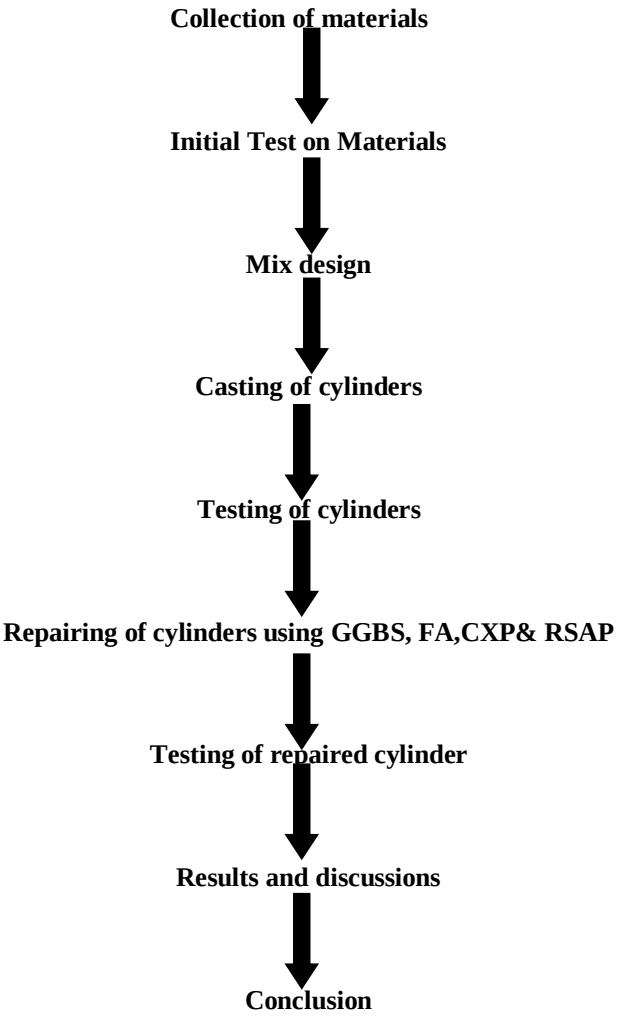

Figure1. Methodology

IV. EXPERIMENTAL INVESTIGATION

After the collection of materials, initial test on cement, MSand and gravel was conducted. Fineness test, consistency, setting time and specific gravity test was conducted for cement. Sieve analysis test was conducted for both aggregates and fineness modulus was calculated. Along with it tests like specific gravity, bulk modulus was also done.Mix proportioning was carried out using IS 10262-2009. M25 grade concrete in the mix ratio 1:1.62:2.57:0.4 is used. 12 cylinders of size 150 mm diameters, 300 mm height was cast along with 6 cubes of 150 mm size and cured. After curing of cylinders and cubes, they are tested for compressive strength and split tensile strength at 7, 14 and 28 days. The tested cylinders are repaired for their cracks. Initially the depth of crack was measured using crack measuring device. Later initial propagation of crack for the first day was observed which was compared with its 7^{th} day propagation length. After this using GGBS in the powder form was made to paste by adding water and then injected into cracks of three cylinders and for the three cylinders, Fly ash mixed with water was used for sealing of cracks. Using Crack X paste, three cylinders and RoffShotcrete Acrylic Polymer the remaining three cylinders were repaired. Later left for drying for 24 hours and tested for split tensile test using Compression Testing Machine.

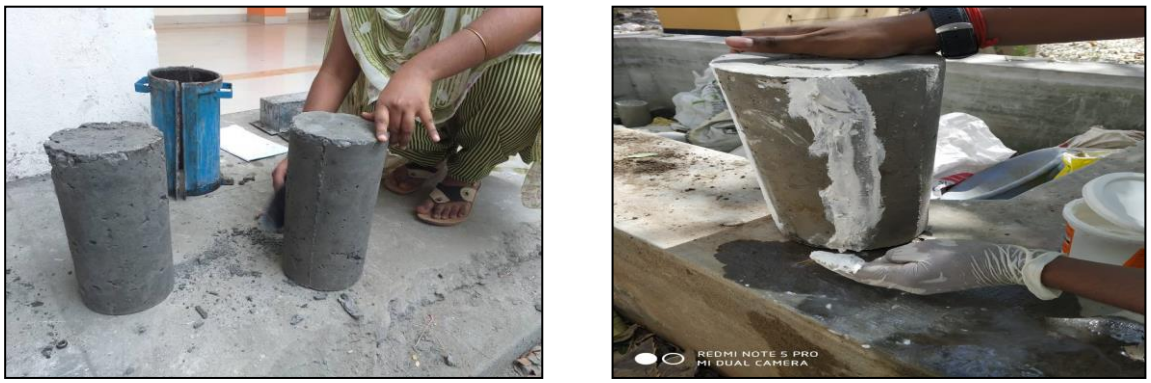

Figure2. Cylinder repairing process

V. RESULTS AND DISCUSSIONS

A.Theresults of compressive strength of concrete cube indicates that mix proportioning done is correct. The target strength is achieved and is shown in Figure 3.

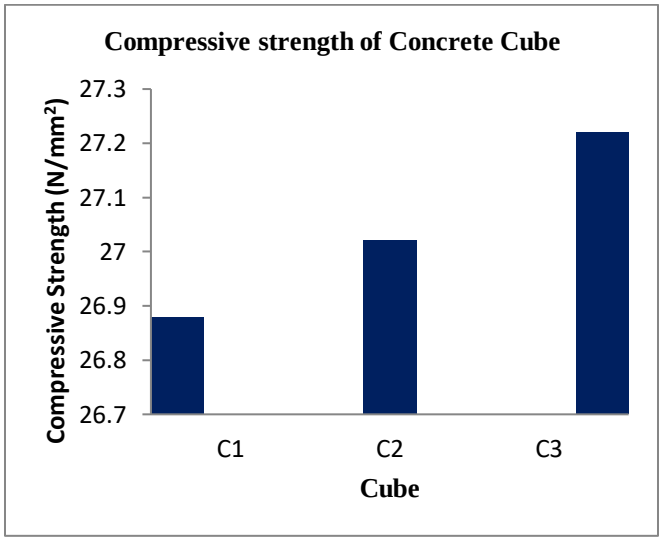

Figure 3.Compressive strength of concrete cube

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

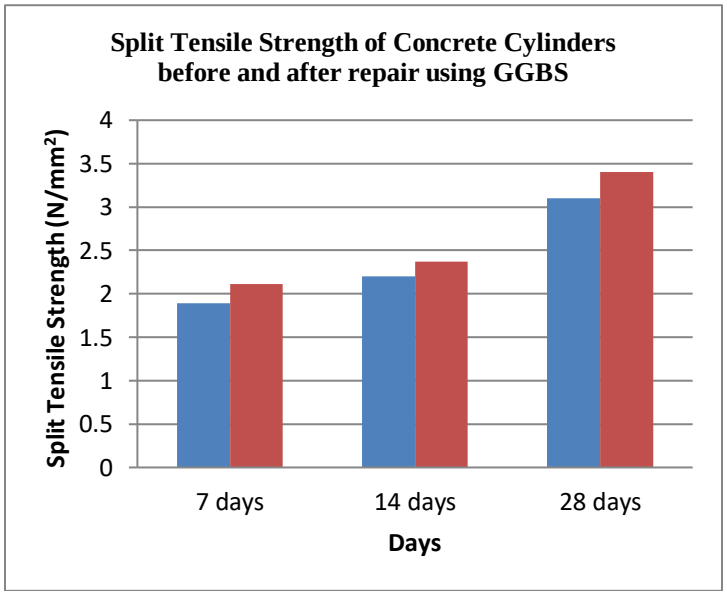

Figure 4.Split Tensile Strength of Concrete Cylinders before and after repair using GGBS

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

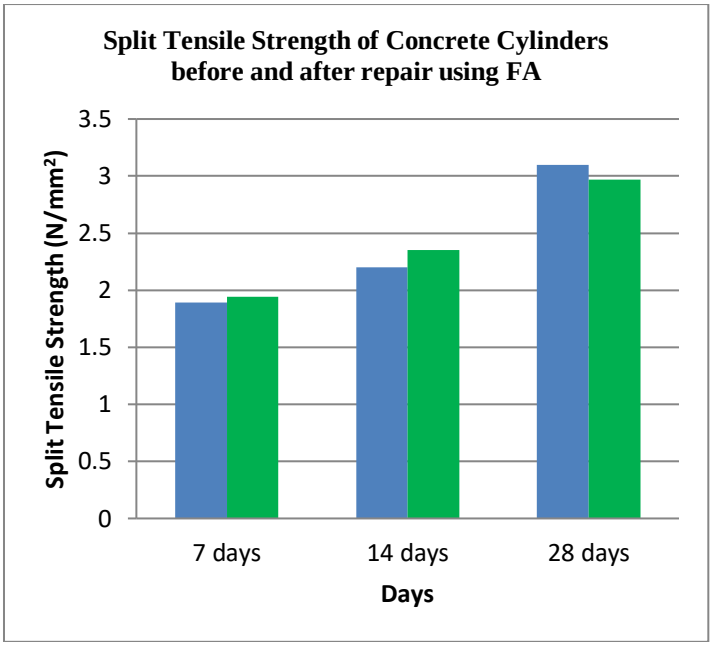

Figure 5.Split Tensile Strength of Concrete Cylinders before and after repair using FA

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

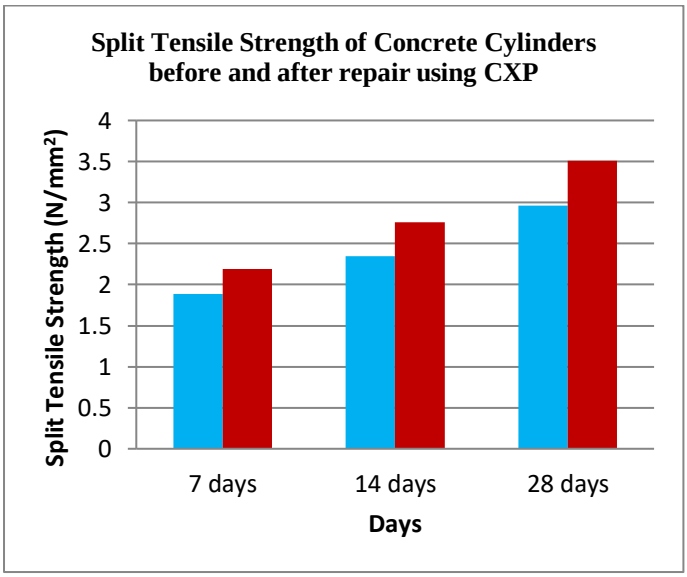

Figure 6.Split Tensile Strength of Concrete Cylinders before and after repair using CXP

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

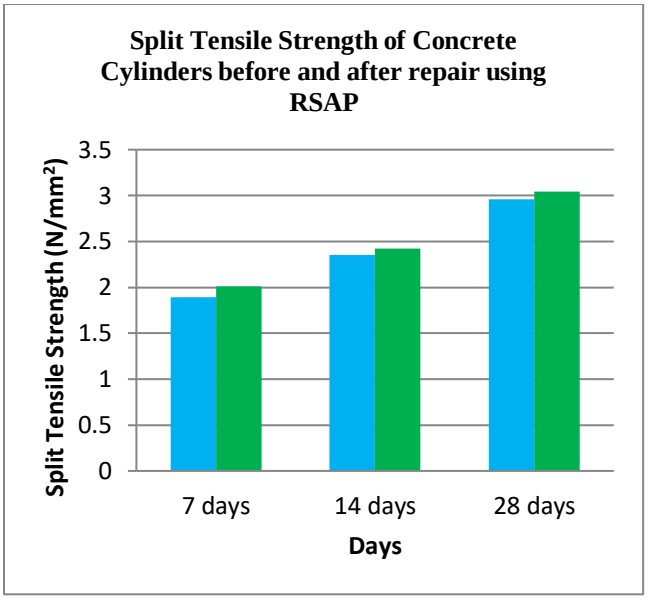

Figure 7.Split Tensile Strength of Concrete Cylinders before and after repair using RSAP

F.Comparitive study

The efficiency of mineral and chemical admixtures are presented as comparative study. The split tensile strength of concrete cylinders repaired using GGBS, FA, CXP and RSAP are compared and graphically represented in Figure 8.

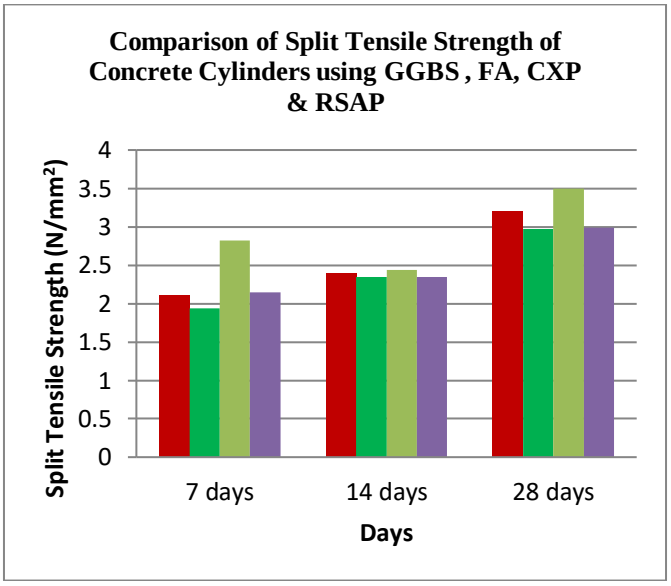

Figure 8.Split Tensile Strength of Concrete Cylinders using GGBS, FA, CXP & RSAP

VI. CONCLUSIONS

- The two mineral admixtures Granulated Blast Furnace Slag (GGBS), Fly ash of F Class (FA) and two Chemical admixtures Crack X Paste (CXP) and RoffShotcrete Acrylic Polymer (RSAP) are used to repair cracks in concrete cylinders.
- M25 grade concrete is designed and used in this investigation. The target strength is achieved.

- The repaired major straight line cracks did not reopen and the repaired cylinders failed due to formation of new major straight-line cracks. Arising of new cracks can be avoided when repairing is extended to retrofitting.
- Increase in Split Tensile Strength of concrete cylinders is observed. 12%, 2% and 8% increase is noticed at 7^{th} day, 14^{th} day and 28^{th} day respectively when GGBS is used.
- Only minimal increase or no increase is observed when FA is used. In 7^{th} day 3% increase, 14^{th} day no change and 0.3% on 28^{th} day is recorded.
- Among the two mineral admixture chosen, GGBS proves efficient in usage.
- Increase in Split Tensile Strength of concrete cylinders is observed. 16%, 17% and 19% increase is noticed at 7^{th} day, 14^{th} day and 28^{th} day respectively when CXP is used.
- In 7^{th} day 6% increase, 14^{th} day is 3% and 3% on 28^{th} day is recorded when RSAP is used.
- Among the two chemical admixture chosen, Crack X Paste proves efficient in usage.
- Using this type of readily available and efficient admixtures, repairing can be done at any stage of failure of concrete structures

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