

Study of Crack Repair in Reinforced Concrete Structures Using Suitable Materials

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ABSTRACT—Out of numerous serious problems that occur in reinforced concrete, formation of cracks and their propagation has its own say. Different types of cracks can form due to numerous reasons which include reinforcement corrosion, environmental effect, load impact and settlement of framework which can then affect the useful lifetime of any structure hence making the reinforced concrete structure less durable. Crack repairs, with the help of suitable materials, need to be done in order to reinstate the original strength of the structure. Water penetration test besides compression test were used to study the effectiveness of different materials used for repair work in current study. Results elaborated that polymer injection with materials available in local market can restore the actual strength of reinforced concrete elements and works more effectively as compared to other additives. It was found out through Water penetration test that water resistance was shown by all polymer injection materials.

Index Terms—Repair, reinforced concrete, cementitious materials, cracks.

I. INTRODUCTION

Reinforced concrete structures are a standout amongst the most prevalent on the planet. They are regularly utilized as a part of common and water driven designing. Amid their administration time, such type of structures have a tendency to disintegrate. Cracks are one of the most concerning issues showing up in strengthened concrete. The reasons that reason cracking of structures could be unique: reinforcement corrosion, impact of load, flimsy settlement of framework, effects from the environment, and so on. Cracks cause the diminishing of the structure's sturdiness and life span [1-3]. Consequently, it is imperative to repair these harmed structures. Diverse repair strategies have been effectively created to fortify a given structure or part of it to reestablish its serviceability and quality. It is likewise judicious to consider the toughness viewpoint when repair or reinforcing is completed. The last determination of a reasonable and best strategy for the most part relies upon straightforwardness, speed of use, basic execution and aggregate cost [4]. The correct repair of splits relies upon knowing the causes and choosing the repair systems that consider these causes; generally, the repair may just be brief. Effective long haul repair systems must assault the reasons for the breaks and additionally the splits themselves. These days all makers of repair materials endeavor to enhance their items so as to give more general and innovatively less complex repair materials

for the market. It is of extensive enthusiasm to contrast financially accessible infusion materials and cementitious materials and to appraise the reasonableness of them for the cracks repair in various conditions.

Considerable amount of research has been done on use of different materials for crack repairs. Bester assessed the got to Elevate Quality Control and Quality Affirmation for Specialized Concrete Split Repair within the South African Development Industry and his comes about uncovered that there's exceptionally small dialog among the partners with respect to quality control and acknowledgment criteria when performing concrete fix repairs, not one or the other for the distinguishing proof of fix repair disappointment specifically after the completion of the fix repair, nor for long term execution of the fix repairs [5]. Kruger examined Concrete Split Repair with Polymer Altered Materials. The Require for Specialized Preparing of Implements, Providers, Experts and Clients and proposed that in spite of the fact that there's assertion that polymer-modified concrete patch repair could be a profoundly specialized field; there's an unacceptably low level of preparing in each of these segments with respects to the proper choice, application and care of such repair materials. Off base detail, improper fabric determination, misconception of the fabric properties and lacking quality control are results of this need of information and understanding which along these lines may lead to untimely disappointments and/or under-performance of the repair. In

expansion, the overview comes about moreover demonstrate that the workforce performing the physical repair work, is primarily incompetent and a few genuine intercession is required to redress this circumstance [6]. Ahn worked on Modern Surface-Treatment Method of Concrete Structures Utilizing Break Repair Adhere with Mending Fixings and concluded that water spillage can be avoided which the strength of a concrete structure can be made strides through self-healing. Too, it was confirmed that the splits were superbly closed after 28 days due to application of the split repair adhere. These comes about demonstrate the ease of use of the break repair adhere for concrete structures, and its self-healing effectiveness [7].

II. MATERIALS USED

The materials used in this research included three cementitious mortars which were prepared in three different ways; No additive was added in first mix, expansive additive was used in second and third mix was modified with polymer additive. Cement, aggregate and water used in preparation of concrete specimens were according to ASTM standards.

III. METHODOLOGY

For checking the flexural and compressive strength of mortars, specimens were prepared with dimensions of 40mm x 40mm x 160mm. Test specimens were then splitted into two parts from the center at an angle of 60 degrees to the horizontal and then they were repaired with the materials mentioned. Afterwards, compressive strength tests were performed to the check the overall decrease or increase in compressive strength compared to the control sample.

IV. RESULTS AND DISCUSSION

Effect of additives on mortar strength

For checking the effects of additives in the mortar mix, flexure and compressive strength tests were performed after a period of 28 days. Table 1 and figure 1 show the different values obtained for all the specimens tested.

Table 1 Flexural and compressive strength of mortar

Mortar type	Compressive strength (MPa)	Flexural Strength (MPa)
Mortar with no additive	22.12	3.9
Expansive additive Mortar	23.91	4.78
Polymer additive mortar	28.89	4.32

It can be seen from the table that addition of additives did have some effects on the mortar strength. In case of compressive strength, polymer additive proved to be the best modification as increase of 27% was noticed whereas in case of flexural loading, modification by expansive additive proved

to be more fruitful with an increase of 23% in overall flexural strength

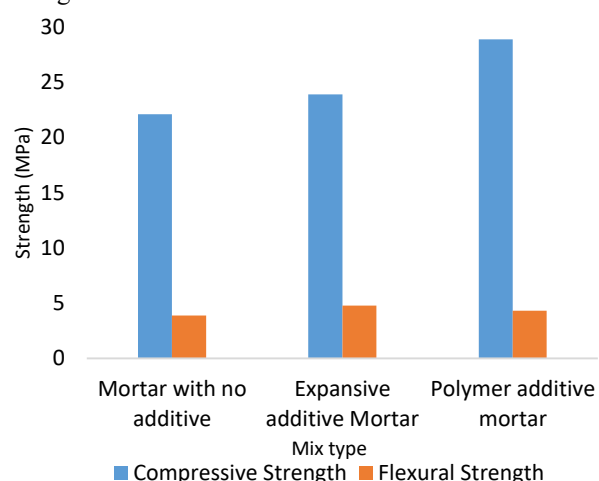


Fig 1 Flexural and compressive strength for mortar

Effect of additives on mortar strength

When repaired samples were put to compressive loading, the following results were obtained which is demonstrated by figure 2 below.

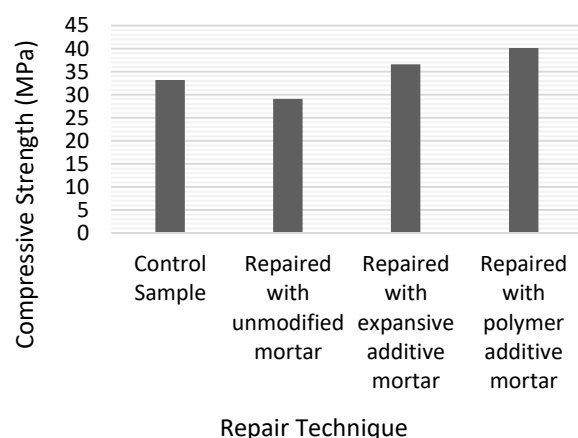


Fig 2 Compressive Strength of repaired samples

It can be seen from figure that samples repaired with polymer additive mortar displayed best results with an increase of strength of around 18%. Strength also increased with expansive additive mortar but decreased than control sample when only cementitious mortar was used.

Penetration of water in repaired samples

Table 2 shows the time taken for the water to penetrate the specimens.

Table 2 Water Penetration time (min).

Mix type	Time taken
Mortar with no additive	15
Expansive additive Mortar	31
Polymer additive mortar	18

From the above table it can be seen that expansive additives showed most resistance against water penetration when added in mortar.

V. CONCLUSION

- In case of compressive strength, polymer additive proved to be the best modification as increase of 27% was noticed.
- In case of flexural loading, modification by expansive additive proved to be more fruitful with an increase of 23% in overall flexural strength. Expansive additive mortar also showed more resistance against water penetration.

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