Effect Of Bonding Chemical On Bond Strength Between Old And New Concrete

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Abstract ---An experimental study was performed to evaluate the bond strength between old and new concrete layers, using different tests for adding epoxy based bonding agent. A total of five different types of tests were conducted, specimen first had the substrate surface prepared by wire-brushing, against steel formwork. The Epoxy based bonding chemical agent was applied and the new concrete was added. Compression test, slant shear test, flexure test and split tensile test were performed to evaluate the bond strength between old and new concrete. Analysis of the results indicates that the application of an epoxy-based bonding agent is improving the bond strength.

Keywords—Concrete, Bond Strength, Bonding chemical.

I. INTRODUCTION

A construction joint is used in cases of machinery breakdown, an unexpected shortage of materials, bad weather conditions, mass area concrete pouring, and future expansion. In this study the bond strength between old and new concrete was evaluated by using epoxy based bonding chemical containing base and hardener. The effect of the bonding chemical was test and inferred by [1-4] split tensile test, flexure test, compression test, slant shear test. The forces which are applied in each test and the failure mode were noted and discussed. While this study can provide individually useful information on bond characterization of the bonding chemical used it also contains discussions about each test and comparison of their results. Construction joints cause reduction of the strength required to induce failure by 25% to 35% below the computed value for the particular section compared with a monolithic casting.

II. MATERIALS AND MIX PROPORTION

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. Cement was used ordinary Portland cement [OPC-53Grade], The specific gravity of cement was 3.25.

A. AGGREGATE [F.A, C.A].

River sand confirming to zone II as per IS: 383-1970 was used as fine aggregate (F.A) [5][6]. Specific gravity of fine aggregate was 2.6. Coarse Aggregate is confirming to IS: 383-1970 was used as a coarse aggregate (C.A). Specific gravity of coarse aggregate was 2.7.The maximum size of aggregate was 4.75mm for fine aggregate and 20mm for coarse aggregate.

B. WATER

Potable water is generally considered satisfactory for mixing and curing of concrete. Hence clean drinking water available in the college water supply system was used for casting as well as curing of the test specimens.

C. BONDING CHEMICAL (EPOXY)

Epoxy based Bonding chemical was used in this work. The bonding chemical is having two parts, one is hardener and second is base, it is having the quantity of 465gms and 535gms respectively and the total weight is 1000gms.The hardener part should be poured totally in to the base, the two parts must be thoroughly mixed with the low speed mixer (150 to 200rpm about 3 to 4 minutes) to get uniform colour of the mixed material. Mixed material was applied on the prepared surface using brush.

Fig1: Bonding chemical

Fig 2: Mixing of bonding chemical [Base + Hardener]

TABLE 1. Concrete mix proportion

WATER	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
197	394.32	638.35	1191.6
0.5	1	1.61	3.03

III. EXPERIMENTAL STUDY

The experimental study had the main purpose of computing the strength influence of adding the bonding chemical of the concrete surface on the bond strength between old and new concrete. The tests selected for the study, were the first compression test in Fig 6 second is the split tensile test in Fig.7, Third is flexure test in Fig. 9 and fourth is the slant shear test Fig 8.

A. Casting of specimen

In this study total 75specimens were tested in various test method like, compression test, split tensile test, slant shear test and flexure test. The size of thespecimenforcube150x150x150mm, for cylinder 150mmdia and 300mm long, for prism 100x100x500mm [7][8]. The mould was cleaned without any dust and pebbles, The concrete was mixed as per design mix and casted the specimen partially with vertical and slant joint. After 24hours the specimen was prepared roughness as shown in Fig 3.surface preparation. The epoxy based bonding chemical was applied the specimen surface and the new concrete was fully poured in mould is shown in Fig.4.

B. Surface preparation.

Fig. 3. Surface preparation

The adopted the roughening techniques were those commonly used in practice. The following techniques were followed for surface roughness work; surface prepared with steel brush, surface prepared partially chipped using chisel and surface treated with sand blasting methods.

Fig. 4. Concrete casted fully/partially.

Fig 5. Prism/ Cylinder

IV. RESULTS AND DISCUSSIONS

A. COMPRESSION TEST

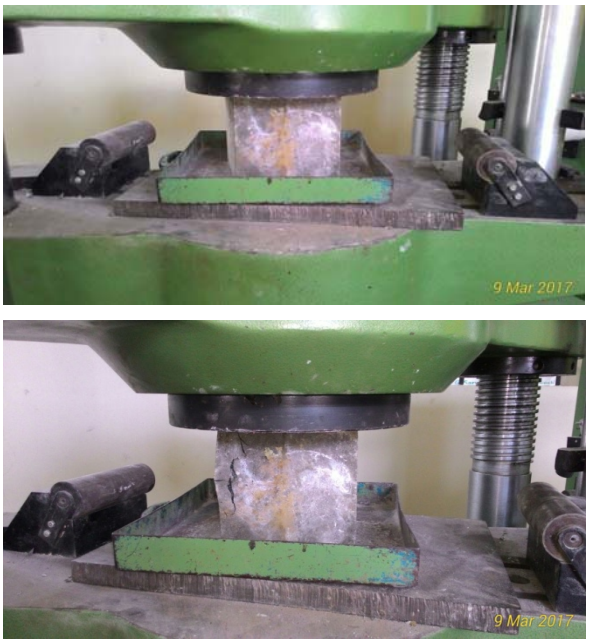
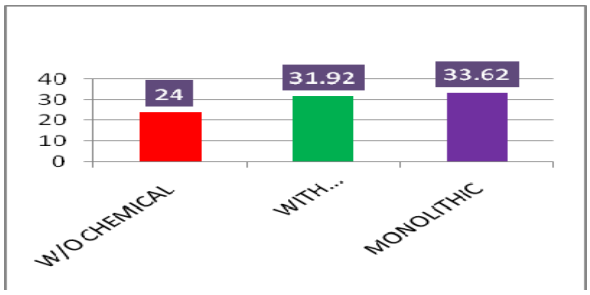


Fig. 6. Compression test

The old and new concrete bond strength was calculated through this compression test using the specimen of cube with epoxy bonding chemical. The compressive strength of the overlay mixtures were measured and provided as shown in Fig 5. In this cube three different specimen was tested, (monolithic casted specimen, without applying of epoxy based bonding chemical and applying of epoxy based bonding chemical) from these three different cube specimen result shown in Table 2. The cube specimen was casted monolithically, it was tested after 28days curing, the average compressive strength of cube result was 33.62N/sqmm. The second cube specimen was casted without bonding chemical with vertical joint, it was tested after 28days curing, and the average compressive strength of cube result was 24N/sqmm. The third cube specimen was casted with bonding chemical with vertical joint, it was tested after 28days curing, and the average compressive strength of cube result was 31.92N/sqmm. Comparing the above results, where we used the bonding chemical in vertical joint the compressive strength was comparatively good.

TABLE 2. Test Result of compression test

W/O CHEMICAL	24	N/MM^2
WITH CHEMICAL	31.92	N/MM^2
MONOLITHIC	33.62	N/MM^2



Bar chart 1. Compression test

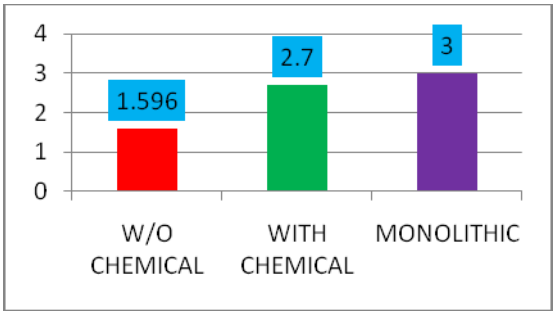
B. SPLITE TENSILE TEST

Fig 7. Split tensile test

The old and new concrete bond strength was calculated through this split tensile test using the specimen of cylinder with epoxy bonding chemical. In this cylinder three different specimen was tested, (monolithic casted specimen, without applying of epoxy based bonding chemical and applying of epoxy based bonding chemical) from these three different cube specimen result Table 3.and bar chart. The cylinder specimen was casted monolithically, it was tested after 28days curing, the average split tensile strength result was 3N/sqmm. The second cylinder specimen was casted without bonding chemical with vertical joint, it was tested after 28days curing, and the average split tensile strength of cylinder result was 1.596N/sqmm. The third cylinder specimen was casted with bonding chemical with vertical joint, it was tested after 28days curing, and the average split tensile strength of cube result was 2.7 N/sqmm. the above results, where we used the bonding chemical in vertical joint the split tensile strength was comparatively good.

TABLE 3. Test result of splite tensile test

WITHOUT CHEMICAL	1.596	N/MM^2
WITH CHEMICAL	2.7	N/MM^2
MONOLITHIC	3	N/MM^2



Bar Chart 2. Split tensile test

C. Slant shear test for cylinder

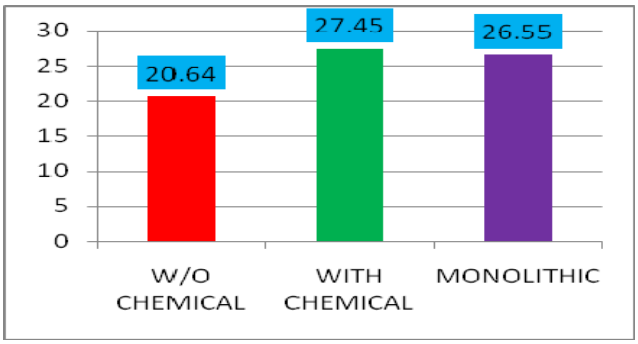
Fig. 8.Slant shear test for cylinder

The bond strength for all methods, except for the splitting, was calculated by [9][10] dividing the maximum load at failure by the bond area; that is, for the slant shear test, the bond area is a sloping surface. For continuous-bond specimens, i.e., specimens that were monolithically cast in a single stage, there is no predefined interface plane. Therefore, bond failure calculations do not have any physical significance and were not reported. However, to allow comparison of the results of repaired specimens with a monolithic sample, an equivalent the applied force by the corresponding non continuous bond area values, e.g., sloping area in the case of slant shear test.

Table 4. Slant shear test - cylinder

W/O CHEMICAL	20.64	N/MM^2
WITH CHEMICAL	27.45	N/MM^2

MONOLITHIC	26.55	N/MM2



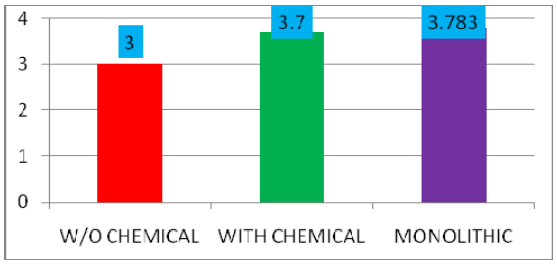
Bar Chart 3 – Slant shear test for cylinder

D. Flexure test-prism

Fig. 9. Flexure test- Vertical joint

TABLE 5. Flexure test-vertical joint

W/O CHEMICAL	3	N/MM^2
WITH CHEMICAL	3.7	N/MM^2
MONOLITHIC	3.783	N/MM^2



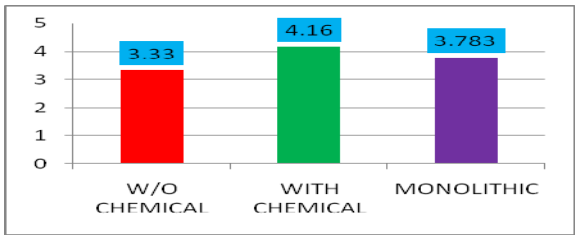
Bar Chart 4. Flexure test –vertical joint

E. Flexure test- slant joint

Fig. 10. Flexure test-Slant joint

TABLE 6. Flexure test-slant joint

W/O CHEMICAL	3.33	N/MM^2
WITH CHEMICAL	4.16	N/MM^2
MONOLITHIC	3.783	N/MM^2



Bar chart 5.Flexure test-slant joint.

V. CONCLUSIONS

The bond strength between old and new concrete has been calculated from five different testing methods with 75 specimens. Each test representing a different state of stress. Based on the results obtained, the following conclusions can be drawn by bond strength is comparatively good in compression test. The monolithic casted concrete and the epoxy based

bonding chemical applied specimen results were giving good results. Construction joints cause reduction of the strength required to induce failure by 25% to 35% below the computed value for the particular section compared with a monolithic casting. From these study, if applied the epoxy based bonding chemicals in construction joint we can get good compressive strength about 25%-35% greater strength.

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