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Bond Behaviour of Epoxy Coated Rebar Induced in Self Compacting Concrete

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Abstract*: This paper analyses the bond behaviour of epoxy coated rebar induced self-compacting concrete. Experimental program is designed to check the workability and pullout tested is performed to evaluate the bonding performance of rebars. Two mixes of self-compacting concrete are chosen to form a fine paste of cement that could make bonding between concrete and reinforcement. A reference mix of SCC is made using ordinary reinforcement and pullout test values are compared. Workability and compressive strength values of SCC are also analysed and compared.

Keywords: SCC, bond behaviour, workability, pullout test.

I. INTRODUCTION

Concrete is a complex material, which has a versatile role in construction industry. Reinforcement is induced in concrete to increase the tensile strength and to withstand the loads on the structure. In recent years corrosion has been prevailing phenomenon that could weaken the strength of concrete. Major reasons of corrosion would be like exposure of concrete to the chloride environment very likely marine environments, where chloride contents very severe. To overcome the scenario, epoxy coated rebars are introduced. Studies are carried out to test resistivity of rebar to chloride environment.

Use of self-compacting concrete (SCC) is increasing due to its high workability and strength. In this study epoxy coated rebars are induced in SCC to study the bond behaviour of reinforcement.

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II. EXPERIMENTAL METHODOLGY

A. MATERIALS

i. CEMENT:

COMPOSITION	*OPC (%)*
SiO_2	14.02
Al_2O_3	2.65
Fe_2O_3	2.57
CaO	42.88
MgO	0.61
SO_3	0.38
Na_2O	0.27
K_2O	0.31
Mn_2O_3	0.2
TiO_2	0.00
Cl	0.00

Table 1 : XRD analysis of OPC

Ordinary Portland cement of 53 grade is used and specific gravity of cement is 2.65. properties of cement are shown in in table 1.

ii. Aggregates and admixtures

Gravel of size 12mm is used as coarse aggregate and river sand of size passing through 2.36 mm sieve is used as fine aggregate. Class F fly ash is used as admixture in SCC.

iii. Super plasticizer:

Gelenium- g60 is used as superplasticizer to enhance the flow of SCC and to embed in formwork.

B. MIX DESIGN

A mix proportion of 1:1.5:2 and water to cement ratio is taken as 0.60. superplasticizer is taken nearly 40% of the weight of the cement. Fly ash is mixed constantly nearly 50% of weight of cement. Viscosity modifying agent is added to mix to ensure the workability of concrete. Electrical drum mixer is used to mix SCC.

C. WORKABILITY TESTS ON SCC

To know the workability of SCC, following tests are conducted,

i. Slump flow:

Slump flow test is conducted on SCC to find out the horizontal flow of concrete. Slump flow diameter is 625mm and time taken to reach 500mm, T_{50cm} is 3.2sec.

Fig 1: Slump flow of SCC

ii. V- Funnel:

V-funnel test is conducted on SCC to find out the vertical flow of SCC and time taken for vertical flow is 9.2sec.

Fig 2: V-funnel test on SCC

iii. L-box Test:

L-box test is conducted to know the filling and passing ability of SCC. H_2/H_1 ratio of SCC is equal to 0.6.

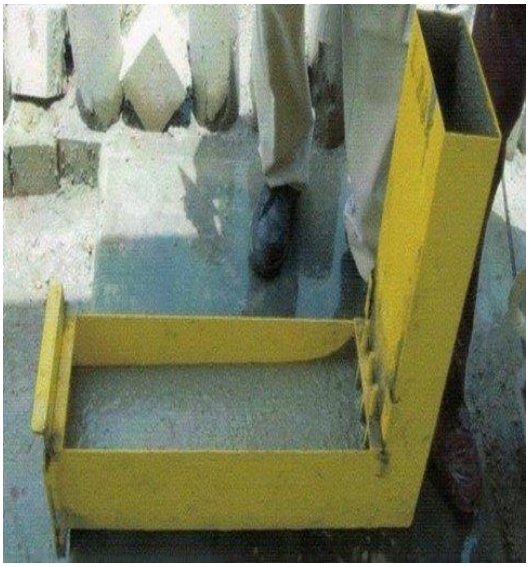


Fig: 3 L-box test on SCC

iv. U-box Test:

U-box test is conducted on SCC to find out the filling ability. H_2-H_1 value is noted and nearly equal to 0.8. Recommended values of tests are shown in Table 2.

Fig 4: U-Box test of SCC

Sl.no	*Property*	*recommendedRange*	*Workability test results*
1	Slump flow diameter(mm)	500-700	625
2	T_{50cm} (sec)	2-5	3.2
3	V-Funnel(sec)	6-12	9.2
4	L-Box (H_2/H_1)	0.8	0.89
5	U-box (H_2-H_1)	0-1	0.89

Table 2: Recommended test values for SCC

D. PULLOUT TSET

To conduct pullout test on SCC, specimens were made with rebars at the center and rebar is arranged such that nearly 60cm is outside the cylinder. Test specimen is as shown in fig 5. Pullout test setup is as shown in fig 6. 16mm diameter steel bars and epoxy coated rebars were chosen to conduct the test.

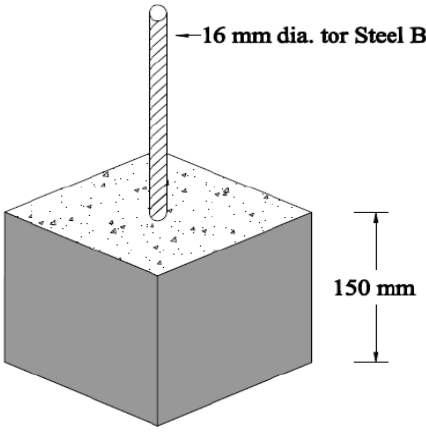
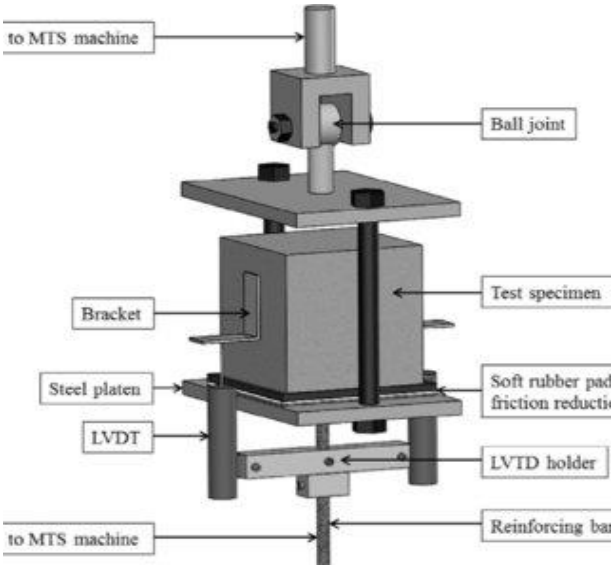
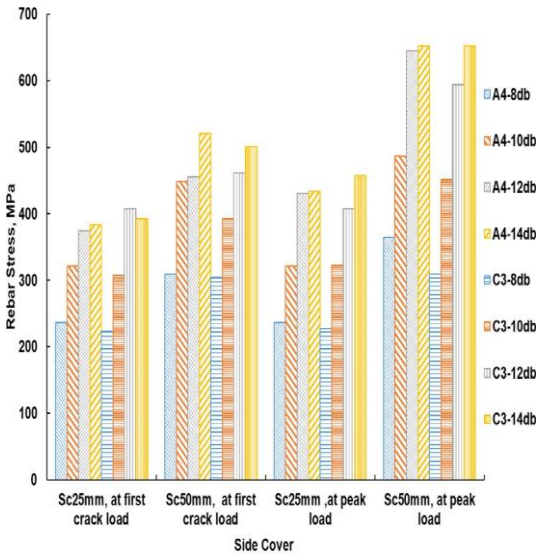


Fig 5: Pullout test specimen test specimen is arranged and care is taken such that test values should be more accurate.

III. TEST RESULTS

Test specimen is arranged and bar is connected to the holder and pullout strength values of concrete are plotted in chart 1.





(a) Rebar stress at failure

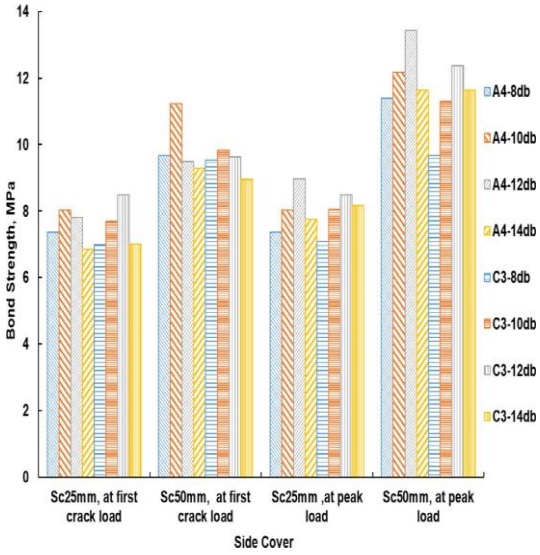


Fig 6: pullout test setup

Table 3: bond strength in MPa

Type of concrete	First crack	Peak load
Conventional	7.6	7.61
Mix type	First crack	Peak load
Conventional	7.22	7.63
scc	8.3	8.96

Bond strength of self compacting concrete is more in first crack as well as during the peak load compared to conventional concrete.

Pullout test values of both TMT induced rebar and Epoxy coated rebar (EC rebar) SCC are nearly same. Bond stress values of the SCC are compared and plotted in chart. Crack behaviour of test specimen is shown in fig 7

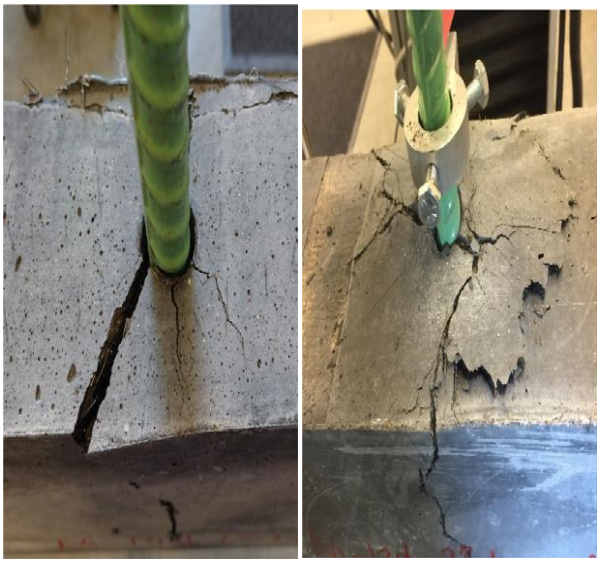


Fig 7: Crack induced in epoxy coated rebar

IV. CONCLUSION

From the test results following conclusions can be drawn

- Though the compressive strength values of SCC with Epoxy coated rebar is high, bond slip behaviour of concrete is high but the rate of difference between first crack and peak load is nearly same same compared to TMT induced SCC.
- As SCC can be induced into gaps and form work can be easily filled, epoxy coated rebar shows less friction to the SCC, Due which adhesiveness of rebar and concrete were effected.
- To analyse the bond behaviour more and to give clear reason for same same bonding behavior of both types of reinforcement long term testing is required and recommended

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