



Bonding of Steel and FRP Bars in Self Compacting Concrete

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ABSTRACT

In this research, numerous tests have been carried out for estimating the bond strength of steel and FRP bars with self- compacting and normal concrete specimens. The main experimental part of the research was concentrated on a pull out test. Two mix designs have been used for making self- compacting concrete and super plasticizer dosages of the two mixes were different. Therefore, the effect of super plasticizer dosage on bonding strength is also studied in this research.

Comparing the pull out test results on self- compacting and normal concrete showed that in all conditions, the bonding of steel bars was more than that of FRP bars., Moreover, self- compacting concrete containing higher dosages of super plasticizers had more bonding strength. The existing models were not exactly enough for estimating the bonding strength of FRP bars. Therefore ABAQUS software is used for modeling this phenomenon, and two models including two and three dimensional models were compared. The results of this section showed that the three dimensional modeling was better than the others for estimating the experimental results.

KEYWORDS

Bond Strength, Self Compact Concrete (SCC), Fiber Reinforcement Polymer (FRP) Bar, Pull Out Test.

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1- INTRODUCTION

There are various studies on modeling the bond interaction of bars to concrete [1-4]. The bonding strength of FRP and steel bars should not be the same because of the lower modulus of elasticity and shear strength of FRP bars. In this research, numerous tests have been carried out for estimating the bond strength of steel and FRP bars with self compacting and normal concrete specimens. The main experimental part of the research was concentrated on a pull out test. Two mix designs have been used for making the self compacting concrete, and the superplasticizer dosages of the two mixes were different. Therefore, the effect of superplasticizer dosage on bonding strength is also studied in this research.

2- METHODOLOGY

The existing models were not exact enough for estimating the bonding strength of FRP bars [9-11]. Therefore, ABAQUS software is used for modeling this phenomenon, and two models including two and three dimensional models were compared. The results

of this section showed that the three dimensional modeling was better than the others for estimating the experimental results.

3- MAIN CONTRIBUTION

Comparing the pull out test results on self-compacting and normal concrete showed that in all conditions, the bonding of steel bars was more than that of FRP bars. Moreover, self compacting concrete containing higher dosages of superplasticizers had more bonding strength.

4- SIMULATION RESULTS

Table 6 shows the bonding strength of FRP and steel bars in different circumstances. According to this table, it is not possible to express a constant equation for estimating the bonding strength of different bars in SCC. Therefore, it is concluded to use three dimensional modeling in ABAQUS software for this purpose.

Table 6- Bonding strength of the investigated bars in SCC and NC concrete

Number	Specimen	$\sqrt{F'_c}$	Loaded end slip (mm)	F_{max} (N)	d_b (mm)	$l_d=5d_b$ (mm)	$A=\pi d_b l_d$ (mm ²)	$U=F_{max}/A$ (MPa)	$U'=U/\sqrt{F'_c}$
1	ST/14-1/SCC1	6.04	4.16	29570	14	70	3077.2	9.61	1.59
2	ST/14-2/SCC1	6.04	4.26	34400	14	70	3077.2	11.18	1.85
3	ST/16-1/SCC1	6.04	5.04	46530	16	80	4019.2	11.58	1.92
4	ST/16-2/SCC1	6.04	12.15	58480	16	80	4019.2	14.55	2.41
5	ST/16-3/SCC2	5.76	5.51	47120	16	80	4019.2	11.72	2.03
6	ST/16-4/NC	5	3.93	40640	16	80	4019.2	10.11	2.02
7	ST/18-1/SCC1	6.04	3.61	44650	18	90	5086.8	8.78	1.45
8	ST/18-2/SCC1	6.04	4.73	48070	18	90	5086.8	9.45	1.56
9	ST/20-1/SCC1	6.04	4.85	50780	20	100	6280	8.09	1.34
10	ST/20-2/SCC1	6.04	5.93	59610	20	100	6280	9.49	1.57
11	FR/10-1/SCC1	6.04	9.16	15790	9.53	47.65	1425.89	11.07	1.83
12	FR/12-1/SCC1	6.04	6.63	21560	12.7	63.5	2532.25	8.51	1.41
13	FR/16-1/SCC1	6.04	7.97	36170	15.88	79.4	3959.14	9.14	1.51
14	FR/16-2/SCC1	6.04	7.01	39580	15.88	79.4	3959.14	10	1.66
15	FR/16-3/SCC2	5.76	11.26	31570	15.88	79.4	3959.14	7.97	1.38
16	FR/16-4/NC	5	7.99	13080	15.88	79.4	3959.14	3.3	0.66
17	FR/25-1/SCC1	6.04	7.32	36400	25	125	9812.5	3.71	0.61

5- REFERENCES

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