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Research on the Bond between Anchors in High Strength Reinforced Concrete Beams

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ABSTRACT

This paper discuses experimentally the effect of steel bar diameter and embedment length on the bond stresses, bond stress versus slip relation, failure pattern and load versus deflection response of high strength reinforced concrete beams with dimensions (100 mm width x200 mm height x1100 length). Four beams specimens were provided with three embedment lengths (80 mm), (100 mm) and (120 mm) in addition to two different bar diameters (10mm) and (16mm). The test results concluded that the bond stresses and the relative displacement decrease with increasing the embedment length and bar diameter.

Keywords: Bond Stress, slip, high strength concrete, embedded length, bar diameter.

I. Introduction

Due to importance of bonding failure in concrete structures, several investigations have been developed to enhance the bond strength between steel bar and concrete. Most of the studies that dealt with the effect of development length on bond characteristics concluded that increasing the development length impact positively on the bond characteristics [1-6].

The effect of bar diameter has been studied by [Mohammad N.S Hadi][7] [Kazim Turk et.al][8], [Soroushain P. and Choik.][9] and [Al-Aukaily A. F.], these investigations concluded that the bond strength decreased with increasing bar diameter.

The increasing of concrete compressive strength have a beneficial effect in improving the bond characteristics and this is what has already been proven by [A. Forough – Asl et.al][11], [Kafeel Ahmed][12] , [Khodaie and Nahmat][13] and [M. Veera Reddy][14].

In recent decades, studies on the bond characteristic between steel bars and new type of concrete has emerged [Forough – Asl et.al][11] and [M. Mazloom and K. Momeni][15] studied the bond between reinforcement bars and self-compacting concrete. They concluded that bonding strength was increased when using self-compacting concrete in comparison with normal strength concrete.

Also, the bond between reinforcement bars and reactive powder concrete was studied by [Mahesh Maroliya][16], [Deng Zong - Cai][17] and [Lee M. et.al][18]. The improvement of bond characteristics is clear when using reactive powder concrete.

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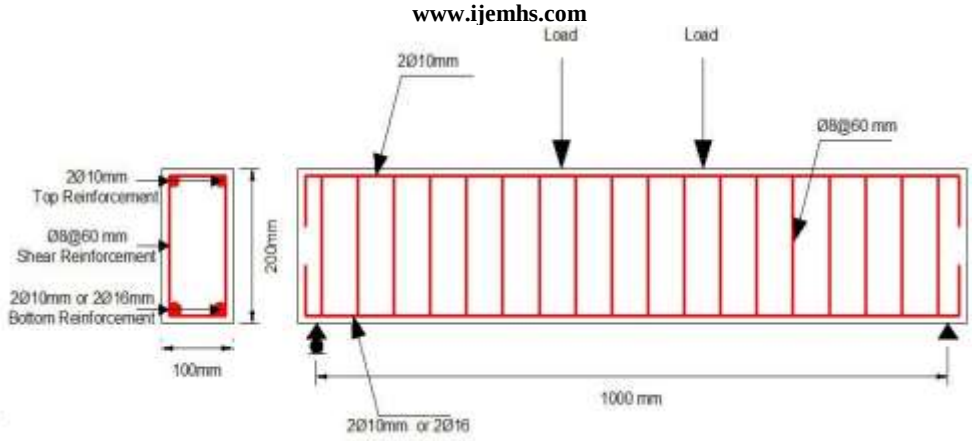

Figure 1 Experimental Detail of Tested Beams

II. EXPERIMENTED PROGRAM

The Experimented program of this study includes casting and examining four high strength reinforced concrete beams with dimensions (100 mm width x 200 mm height x 1100 length) to study the effect of development length and steel bar diameter on the bond characteristics between reinforcement steel and concrete, in addition to three specimens of cube, cylinders and prisms to evaluate the compressive strength, modulus of rupture and modulus of elasticity for concrete mix. The beams are tested under two points loads with (210mm) distance between them. The section dimensions, steel bars distribution and testing set up are shown in Figure (1) and Table (1).

Table 1 Experimental Details of Tested Beams

Specimen Conf.	Dimensions (mm)			Flexural Reinforcement		Shear Reinforcement
	Width	Height	Length	Tension Reinforcement	Compression Reinforcement	
B1	100	200	1100	2Ø10	2Ø10	Ø8@60mm
B2	100	200	1100	2Ø10	2Ø10	Ø8@60mm
B3	100	200	1100	2Ø10	2Ø10	Ø8@60mm
B4	100	200	1100	2Ø16	2Ø16	Ø8@60mm

III. Conclusion

The test results led to the following conclusions:

1 – Increasing embedment length has a significant effect on decreasing the bond stresses.

2 - Increasing bar diameter leads to a decrease in the bond stress.

3 – In the first stage of loading, the chemical bonding between steel bar and concrete is sufficient to carry the applied stresses.

4 – Due to increasing the frictional contact area, the slip between steel bar and concrete decreased when increasing the embedment length.

5 – The slip between steel bar and concrete decreased when increasing the bar diameter.

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