International Journal of Research in Advent Technology (IJRAT)
(E-ISSN: 2321-9637)
Special Issue National Conference "CONVERGENCE 2018", 09th April 2018

To Check the Impact of Headed Bars Interms of Anchorage Strength in Concrete

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Abstract- The Headed bars provide a practical alternative to hooked bars and eliminate congestion problems caused by standard hooks. Headed bars is also used to minimize slip, ease of placement, and more accurate dimension of reinforcing cages. Recent advances in welding technology have made it cost effective to attach steel plates to reinforcing bars. It is felt that headed reinforcement will offer several advantages over straight and hooked reinforcing bars such as reduced congestion, lower bond slip and improved confinement of joints. This work presents an experimental Investigation on the Pullout capacity of the new developed headed bars to be used in the reinforced concrete structures. The main focus of this present study is the anchorage behaviour of headed bar embedded in concrete in terms of embedded depth and bond stress is investigated. The variables used for the experimental work are embedded depth, different size and shapes of heads of headed bar. The results of the test indicated that Pullout load required for Circular headed bars is maximum as compared to other headed bars at different embedded depth also as the embedded depth increases Strength index, Pullout load and Bond Stress increases. In most of the specimens slip of the Circular headed bar is minimum as compared to other and slip of the Square headed bars is maximum. Higher grade of concrete increases Pullout load, Strength index and Bond stress while it the decreases Slip of the bar. Due to large head slip of the headed bars decreases because large head holds large concrete in cylindrical specimen. Currently there are no Provisions in Bureau of Indian Standard that cover use of the headed bar in structural design, through this research and the research done by other authors will provide sufficient useful information for the further study.

Index Terms- Headed bar, Pullout Capacity, Anchorage strength, Bond stress, Embedded depth

1 Objectives-

The objectives of this research work to study the effect of bearing ratio of headed bar on anchorage strength in pullout test.

1.1 To determine the effect of different head shapes 1 and its bearing ratio on the bearing capacity of headed bar.

1.2 To study bond stress of headed bar.

1.3. Pull-out behaviour of Headed bar. 2

1.4. Effect of Grade of Concrete on Pullout Capacity of headed bar

2 Scope-

The variables were chosen to create a comprehensive study of headed bar. 1)

2.1 The study is an Experimental investigation on Anchorage behaviour of the headed bar in cylindrical 2) specimens.

2.2 In this experimental work Grade of concrete varied (M20 & M30) and bar diameter kept constant.

2.3 Various failure modes of Headed bar were 3) observed and studied and some concluding remarks were suggested from the experimental work. 4)

3 Gap in Research-

Based on the literature review, it can concluded 5) that

3.1 No special code and clause is design for headed bar in current Bureau of Indian standard.

3.2 Pull-out study on cylindrical specimens with different head sizes and shapes with different embedment depth Research done by very few people.

3.3 Use of standard 90˚and 180˚ hooked bars up to required development length often results in steel congestion, difficult fabrication and construction, as well as poor concrete placement.

3.4 The purposed study will developed basic data on anchorage of high-strength reinforcing bars and use those results to formulate design criteria for reinforced concrete structures

4 Advantages of headed bars-

4.1 The reinforcement can be placed exactly at the desired location.

4.2 It also saves considerable construction costs because the concentrated can minimize the member size, for example reduced concrete depth, formwork and excavation for footings.

4.3 Headed bar are easy to place, even if no of bars are more which saves considerable time and labour.

4.4 Reduced congestion and ease of placing of headed bars will improve construction thus speeding up a project.

4.5 The concrete also benefits because adequate space for pouring and vibration will give better concrete up a project.

5 MATERIAL PROPERTIES AND TESTING-

5.1 Introduction-

In present work headed Bars, cement, sand, aggregate and Water are the main Materials which affect the behaviour of specimens. So, it is very necessary to know the properties and characteristics of materials before going to use it in the construction.

Table-5.1- Properties of cement

property		Average value	Recommended standards as per I.S
Specific Gravity		4 (Standard)	4
Fineness (%)		4	< 10 %
Consistency (%)		28	-
Soundness (mm)		1.9	< 10
Initial setting time (min)		75	>30
Final Setting time (min)		170	< 600
Compressive Strength (N/mm^2)	3 days	24.9	
	7 days	45.3	
	28 days	48.3	

5.2 Testing of cubes and cylinders-

5.2.1 Compressive Strength of cubes and Cylinder- The compressive strength of cubes a Determined using cubes of size 150 x 150 x 150 mm and compressive strength of cylinder also done of diameter 150 mm and total depth 300 mm .The results are shown below.

Table-5.2-Compressive Strength of Specimens

Sr. No	Sample	Compressive strength of cubes (N/mm^2)	Compressive strength of Cylinders (N/mm^2)
1	Sample No 1	24	21.75
2	Sample No 2	22	23.75
3	Sample No 3	23	18.75
		Avg = 23	Avg = 21.42

6 EXPERIMENTAL WORK-

6.1 Test procedure-

All the headed bars were pulled out of concrete cylinders in a Universal testing machine the loading was applied to the bar gradually.

6.2 Failure Mechanism-

6.2.1 Conical Fracture of Concrete- Conical fracture of concrete is characterized by a cone of concrete centered on the head being pulled out with bar.

6.2.2 Splitting failure- Splitting Failure occurs in case of embedded depth of 12.5d in splitting failure the concrete part in the middle around the headed bar was breakout when the load is applied to the specimen.

6.2.3 Yield Failure of bar-Yield Failure of bar occurs in case of embedded depth of 16.7d even with small bearing ratio Because in this case pullout load exceeded the yield load and hence yield failure occurs.

7 RESULTS-

7.1 Test results of different Bearing ratio, Head Size and Shape

Table -7.1 Test results of specimens

Sr. No	Specimens	P_u (kN)	Normal Stress (N/mm^2)	Max. Bond stress (N/mm^2)	Strength index
1	SB6T8E8.4d	19.62	174	5.20	0.34
2	SB6T8E12.5d	39.24	347	6.93	0.7
3	SB6T8E16.7d	55	487	7.3	0.97
4	CB6T8E8.4d	37.27	330	9.88	0.65
5	CB6T8E12.5d	56.5	500	10	1
6	CB6T8E16.7d	78.5	695	10.41	1.38
7	RB6T8E8.4d	24.78	220	6.57	0.43
8	RB6T8E12.5d	44.5	394	7.86	0.78
9	RB6T8E16.7d	65	575	8.62	1.14

P_u = Pullout Load determined from the test.
Strength index = (P_u / 0.2*f_y) = (Pullout load obtained from test / bar area*proof stress steel)

Table-7.2 Test results of specimens with failure pattern

Sr. no	Specimens	Failure pattern
1	SB6T8E8.4d	Conical fracture of concrete
2	SB6T8E12.5d	Vertical splitting of concrete
3	SB6T8E16.7d	Yielding of bar
4	CB6T8E8.4d	Conical fracture of concrete
5	CB6T8E12.5d	Vertical splitting of concrete
6	CB6T8E16.7d	Yielding of bar
7	RB6T8E8.4d	Conical fracture of concrete
8	RB6T8E12.5d	Vertical splitting of concrete
9	RB6T8E16.7d	Yielding of bar

7.1.2 Effect of embedded Depth vs. Strength index- Effect of embedded depth on Strength index is such as the embedded depth increases the corresponding strength index increases

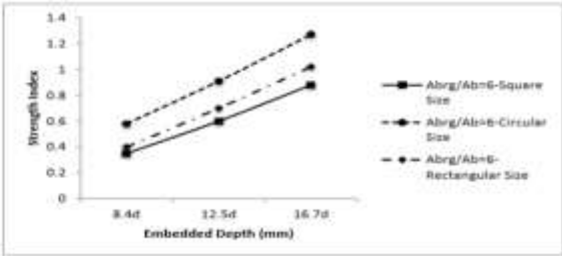

Fig-7.1 Effect of Embedded Depth vs. Strength index

7.1.2 Effect of Embedded Depth vs. Bond stress (M20)-it was found that as the embedded depth increases corresponding bond stress increases as shown in Fig.7.2 In case of bearing ratio of circular size bond stress is maximum.

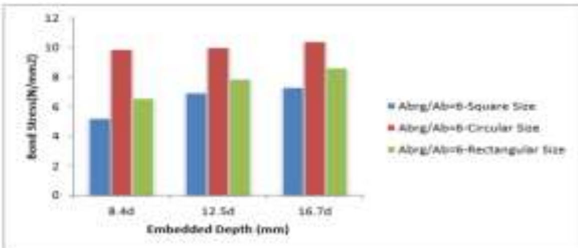

Fig-7.2 Effect of Embedded Depth vs. Bond stress

7.1.3 Effect of Embedded Depth vs. Load -

Effect of embedded depth on load is such that higher embedment depth requires higher pullout load.

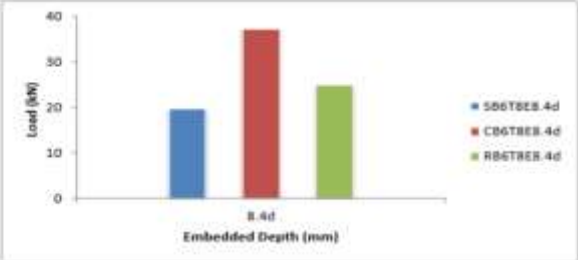

Fig-7.3 Load vs. Embedded Depth for different head shapes

7.1.4 Pullout Strength vs. Slip of bar -

The head load increased at the faster rate than the pullout force and caused increase in slip of bar.

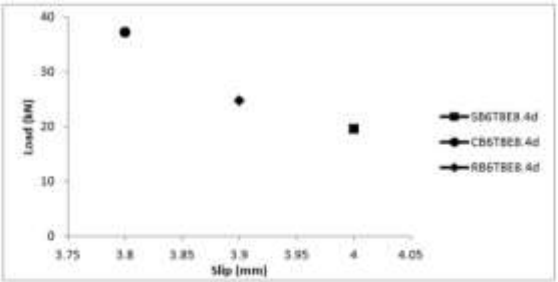

Fig-5.4 Slip vs. Pullout Load

8 Discussion-

8.1 Effect of bearing ratio- the bearing ratio increases the corresponding head area of the headed bars increases so large the head area more is Pullout force at all embedded depth.

8.2 Effect of embedded depth-The anchorage strength seems to increase consistently with increase of the embedded depth. .

8.3 Effect of Head Size and shape- The head size increases corresponding area of head increases so it has holds large concrete area around the net bearing area of head and it required large load for pullout and hence slip of the bar decreases.

8.4 Effect of Concrete Grade:- The grade of Concrete is increased corresponding strength increases and Pullout load increases. it is clear that circular headed bar has High Strength index, Bond stress and Pullout load.

9 CONCLUSION

9.1Larger embedded depth with 16.7d with effectively provided pullout resistance.

9.2 Conical fracture of concrete occurs in case of embedded depth of 8.4d of bearing ratio and size.

9.3 Vertical splitting of concrete occurs in case headed bar of all size and shape of embedded depth 12.5d.

9.4 Yielding of bar occurs in specimens with embedded depth 16.7d without any sign of anchorage failure of all bearing ratios.

9.5 Bearing area of head around the concrete and its embedded depths affects the Slip of the bar.

9.6 As embedded depth increases Corresponding Strength index, bond stress and Pullout load increases and Slip of the bar decreases.

9.7 Bond stress, Strength index, Pullout load is high for circular size of headed bar.

9.8 Grade of concrete increases Strength index, Bond stress and Pullout load but Decreases Slip.

9.9 maximum slip occurs in case of Square size of headed bar.

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