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Bond Behaviour of Steel and Concrete with Pull-Out Test

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Abstract*: This experimental investigation presents the influence of rebar's which has protecting coating, rested rebar and fresh rebar and there bond strength development between the steel and concrete. Pull-out experiment was conducted Universal Testing Machine (UTM) which has a capacity of 400 KN as per IS code procedure. The tested rebar includes rusty rebar, acid preserved rebar and cement chemical compound anticorrosive coated rebar. The Concrete mix design for M25 grade of concrete were used and therefore 18 concrete cube specimens with external projection of steel rod were tested. The various load slip behaviour was studied at the free end finish and loaded end victimization dial gauges. The last word bond stress just like the lowest load worth of 0.025 mm metal slip and 0.25 mm slip was thought of as a result of the usable bond strength of steel rebar's and concrete. The check results blatant correlation exists between Load at 0.025 mm free finish slip and 0.25 mm loaded finish slip. It had been found that presence of rust and cement compound anticorrosive coating among the steel concrete interface appreciably can increase the bond strength of the order of 20 % and 27 % severally for 16mm diameter bars as compared to rust free rebar. For 20mm dia. Bars has totally different bond strength for rusty rebar's and therefore the increase in bond strength for coated bars are compared with 2 differing kinds of uncoated bars and rusted rebar's were determined. It's over that presence of rust influences in reduction / increase in bond strength hoping on the character of rust at the interface among the initial ages. Application of cement compound coating has been improves the bond strength of the order of 31% – 37 % to satisfies the necessities of Burse Indian Standards code (IS)

***Keywords* : Pull-Out , M25 , Rust free, Coated, Acid Pickiling**

I. INTRODUCTION

This experimental investigation presents the influence of rebar's which has protecting coating, rested rebar and fresh rebar and there bond strength development between the steel and concrete.

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Pull-out experiment was conducted Universal Testing Machine (UTM) which has a capacity of 400 KN as per IS code procedure. The tested rebar includes rusty rebar, acid preserved rebar and cement chemical compound anticorrosive coated rebar. The Concrete mix design for M25 grade of concrete were used and therefore 18 concrete cube specimens with external projection of steel rod were tested. The various load slip behaviour was studied at the free finish end and loaded finish using dial gauges. The ultimate bond stress like the lowest load price of 0.025mm metal slip and 0.25mm slip was thought of because the usable bond strength of steel rebar's and concrete. The take a look at results open correlation exists between Load at 0.025 mm free finish slip and 0.25 mm loaded finish slip. It absolutely was found that presence of rust and cement compound anticorrosive coating inside the steel concrete interface appreciably can increase the bond strength of the order of 20 % and 27 % for 16mm diameter bars as compared to rust free rebar. For 20mm dia. Bars has completely different bond strength for rusty rebar's and therefore the increase in bond strength for coated bars area unit compared with 2 differing kinds of uncoated bars and rusty rebar's were determined. It's over that presence of rust influences in reduction / increase in bond strength wishing on the character of rust at the interface inside the initial ages. Application of cement compound coating improves the bond strength of the order of 31% – 37 % as a result of satisfies the necessities of Indian Standards code (IS).

II. TEST PROGRAMME

The type of rebar investigated includes rusted rebar's, rust free rebar's and anticorrosive coated rebar's. In each type six pullout specimens were casted. The diameter of the rebar has two different types 16mm and 20mm were used. Finally 18 sample specimen's has been exanimated by pull-out Experiment.

A. Preparation of Rebar for Pullout Test

The rebar procured from the location obtained from the single batch is used for the study. The rebar is Nine months old once manufacturing within the industrial plant. The diameter of the rebar is 16 mm and 20 mm. The rebar is move the required length and in one face facing was done in order that to facilitate measure of free end slip during testing. Figure 1 shows the facing method for rebar's.

Fig. 1.Facing Process of Rebar in Progress

B. Preparation of Rebar's

In case of rusted rebar, the rust element isn't disturbed / cleaned and are used as such. To organize rust free rebars, the rusted rebar is immersed within the derusting solution (contains 200th concentration HCL acid additional with corrosion inhibitor to stop base metal attack) for 30 minutes to make sure complete rust removal. Figure 2 shows the rebar pickling process. Just in case of coated bars, the rusted rebar is clean with steel wire brush improvement before application of cement polymer anticorrosive coating. Figure 3 shows the Cement polymer anticorrosive coating ongoing.

Fig. 2.Rebar Pickling Process

Fig. 3.Cement polymer anticorrosive coating in progress

C. Mould Setup

Universal Testing Machine (UTM) that contains a capability of 400 KN was accustomed to do the tests. Specimens for pull out check was ready as per Indian Slandered (IS 2770 — Part I -1967) strategies of Testing Bond in a controlled concrete. Concrete cubes of size a hundred and fifty millimeter was casted with a bottom picket plate of 20 mm that contains a centrally embedded rebar provided up to 20 mm from low face of the cube. The rebar extended over the highest face for an adequate length to facilitate gripping the rod on the machine. To avoid the cracks the Spiral reinforcement of half-dozen millimeter diameter is fastened with a pitch of 30 mm for a diameter of 120 millimeters. To avoid the bond on the brink of load end, plastic sleeves were provided inside the remaining length. Figure 4 shows the arrangement of the mould for pull out check.

Along with every set of test specimens, three 150 mm cubes were conjointly casted to evaluate the compressive strength of the concrete specimens. Testing specimens were impressed in water for 28 days as curing to obtain maximum strength. Once the curing process is completed the top of the cube surface is a close to cement capping was done on surface are of the cube face of the specimen to seating of specimen on the testing. Figure 6 shows the specimens after finishing of cement capping.

Fig. 4. Mould setup used for Bond Strength Test

Fig. 5.Pull out Specimens after Cement Capping.

D. Pull out test set-up

A special fixture to carry the specimen during testing was fabricated as per procedures by Indian slandered in I S 2770 – 1967 – part I at a value of Rs. 25,000. This fixture assembly is connected to the upper engrossing facilities in the Universal Testing Machine. The test specimen is hanged through the holding fixture in and the other way up manner and therefore the extended rebar is gripped to the bottom facilities. Once load is applied, the top platen is mounted and only bottom fascinating facilities will move downward and pullout action is formed. The test was applied as per IS 2770 - part I - 1967. Figure 6 shows the schematic diagram of pull out test set-up. The subtle dial gauge with a least count of 0.001mm was wont to measure free end slip and a dial gauge with 0.01mm least count was used to measure loaded end slip. Figure 4.8 shows the pull out test in progress.

Along with every set of test specimens, three 150 mm cubes were also cast to determine the compressive strength of the concrete of the test specimens. Test specimens and cubes were water cured for 28 days. Once the curing amount, a near cement capping was done on the top face of the specimen to facilitate proper seating of specimen on the testing facility. Figure 5 shows the specimens after cement capping.

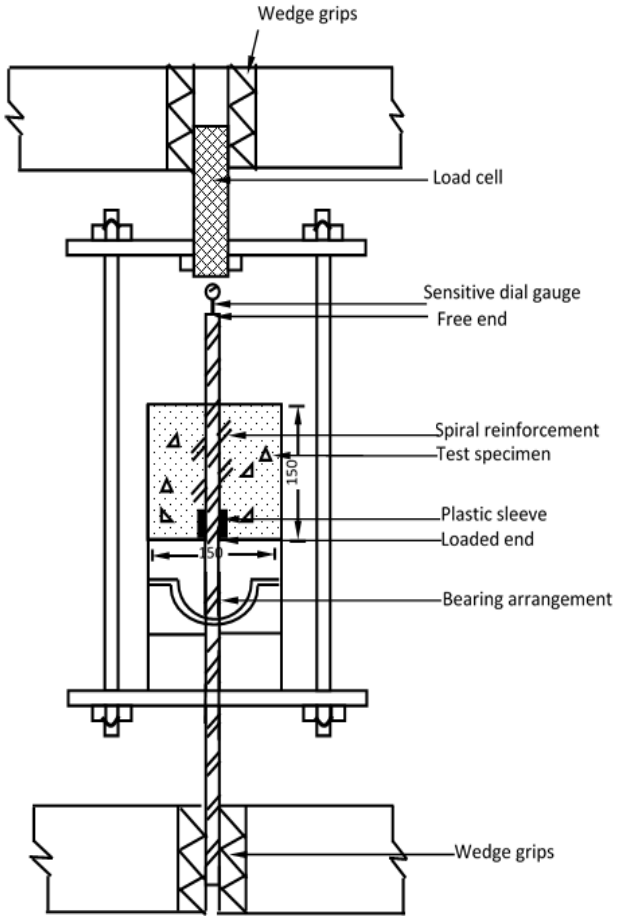

Fig. 6.Schematic diagram of pull out test set-up

III. RESULTS AND DISCUSSION

Since the coated rods material which contains admixture and cement slurry coating, the synchronous association of cement among the coatings material and concrete improves the adhesion appreciably as compared to rust free and rusty rebar. It can even be seen that the bond strength at 0. 025mm slip for rusty and rust free rebar isn't following a typical pattern despite the diameter of rebar. It's thanks to the actual indisputable fact that presence of rust at the interface would possibly influence in increment or reduction in bond strength at the initial stages relying upon the character and intensity of rust.

Fig. 7.Experimental Arrangement of Pull out experiment

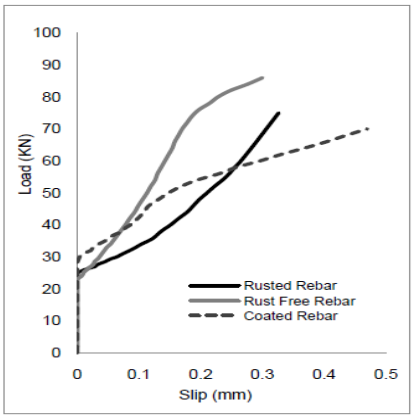

Fig. 8.various Slip Behaviour of 16mm Rebar's

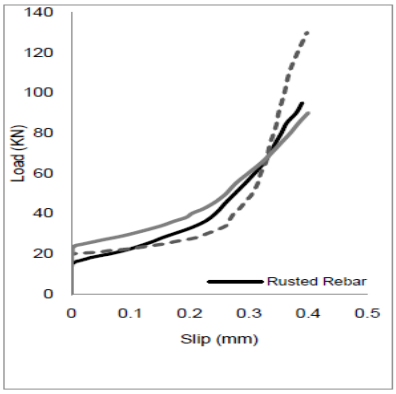

Fig. 9.various Slip Behaviour of 20mm Rebar's

The Load various slip behaviour of rusty rebar, rust free rebar's and coated rebar's at the loaded end. The necessary observation the load values at 0.25 mm slip is sort of like the 0.025 mm atomic number 26 slip values has varied. The Bureau of Indian standards provides additional necessary to the 0.025 mm atomic number 26 slip and 0.25mm slip. Thus rock bottom bond strength obtained from each the higher than condition is that the unstable bond strength. The pull-out strength is that the different necessary parameter stressed by the Indian standard (IS 2770 – 1967). Therefore bond strength was conjointly analyzed supported this values.

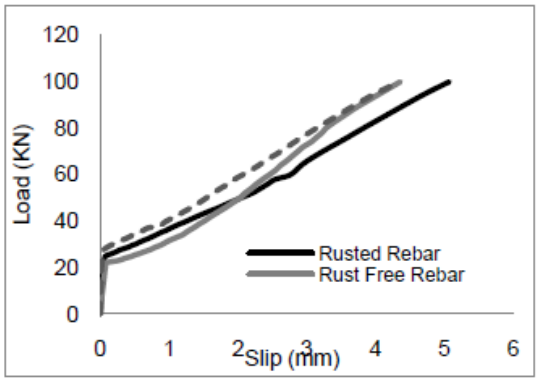

Fig. 10. Load slip Behavior of rebar bar of 16mm at the loaded end

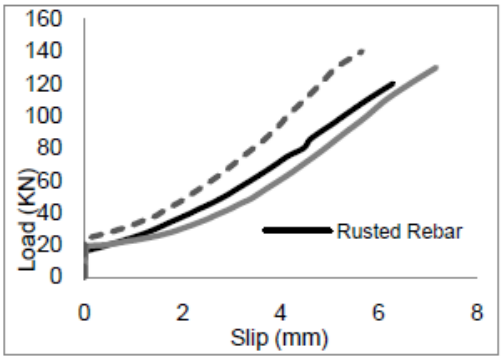

Fig. 11. Load slip Behavior of rebar bar of 16mm at the loaded end

Table 1: Observation on Rusted, Coated Rebar's and Rust free

SL. No	TYPE OF REBAR	LOAD at (KN)			ULTIMATE LOAD(KN)
		0.25mm FE slip	0.25mm FE slip	0.25mm LE slip	
1	16mm - Rust free rebar	27.50	67.00	23.00	120.80
2	16mm - Rust free rebar	26.75	57.50	27.25	115.20
3	16mm - Coated rebar*	32.50	57.50	31.00	105.20
4	20mm - Rust free rebar	20.25	32.5	19.75	157.98
5	20mm - Rusted rebar	17.25	42.00	18.00	169.15
6	20mm - Coated rebar*	25.50	48.00	26.00	159.15

Table 2: Bond Strength of Rusted, Coated Rebars and Rust free

SL. No	TYPE OF REBAR	LOAD at (KN)		Usable Bond Strength (N/mm2)	Variation (%)
		0.25mm FE slip	0.25mm LE slip		
1	16mm - Rust free rebar	27.50	23.00	5.72	-
2	16mm - Rust free rebar	26.75	27.25	6.65	+16.25
3	16mm - Coated rebar	32.50	31.00	7.71	+34.80
4	20mm - Rust free rebar	20.25	19.75	3.14	-
5	20mm - Rusted rebar	17.25	18.00	2.75	-12.42
6	20mm - Coated rebar	25.50	26.00	4.06	+29.30

Table 3 : Bond Strength of Rusted ,Coated Rebars and Rust free

SL .No	TYPE OF REBAR	ULTIMATE LOAD at (KN)	ULTIMATE BOND STRENGTH (N/mm2)	Variation (%)
1	16mm - Rust free rebar	120.80	30.04	-
2	16mm - Rust free rebar	115.20	28.65	-4.63
3	16mm - Coated rebar	105.20	26.16	-12.92
4	20mm - Rust free rebar	157.98	25.14	-
5	20mm - Rusted rebar	169.15	26.92	+7.08
6	20mm - Coated rebar	159.15	25.33	+0.76

It may be determined that the bond strength values for the Rust free rebars is 5%, 12 over the rusty rebar's and Coated rebar's severally for 16mm dia rebar. encase of 20mm dia rebar has a discount in ultimate load in bond strength for Rust free rebar of the order seven-membered as compared to rusty rebar wherever a coated rebar's has exhibits same behaviour. According to Indian Standard (IS 13620 – 1993), the reduction in bond strength thanks to the presence of coating is allowable as 200th. Whereas Cement chemical compound anticorrosive coating improves the bond strength appreciably of the order of 30 minutes as compared to Rust free rebar.

Fig. 12. Close View of Rebar after Pull out Test

The close view of rebar after pull out experiment in this we can clearly find the unboud fill of 20mm has been inserted.

IV. CONCLUSION

Based on the experiment conducted on two various types of dia 16 mm and 20 mm TMT rebar with concurrent of Rusted rebars, Acid pickled (Rust free) the rusted rebars treaded with acid pickled and chemical Coated rebars, which is concluded with their results. Coated rebars has improved the usable ultimate bond strength to 20-27% as compared to Rust free rebar's and Acid pickled (Rust free) rebars in 16mm dia bars. Coated rebar's has improved the unstable bond strength to 31-37% as compared to Rust free rebar's and Acid pickled (Rust free) rebars in 20 mm dia bars because of excellent compatibility at the concrete - steel interface. The bond strength has rasied when the diameter of the bar has increased when 16mm to 20mm. Cement chemical compound anticorrosive coated 16mm and 20mm bars makes the codal necessities of Indian Standard (IS-13620–1993) with reference to ultimate bond strength between steel and concrete.

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