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COMPARISON AND TEST METHODOLOGY TO EVALUATE STEEL – CONCRETE BONDING STRENGTH OF THIN REINFORCING BAR

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Abstract— This paper presents comparison of bonding strength and compressive strength between steel and concrete. The bond strength measures the effectiveness of the grip between concrete and steel.In pullout tests on Mild steel bars , the maximum load generally represents the bond strength that can be developed between concrete and steel.With Mild steel bars the maximum load is not very different from the load at the visible slip,But in the case of deformed bar,the maximum load may corresponds to a large slip which may not be obtained in practice before other type of failure occur.It is preferable therefore than comparing plain and deformed bar determined not only the maximum load,But also the load arbitrary amount of slip and also plot the complete load slip curves for the plain and deformed bar under comparison.In bonding strength test,comparison of the load at a relative movement(slip) between steel and concrete of 0.125mm at the free end of the bar in a pullout test. The analysis of the test data shows that a significant co-relation exists between the compressive strength of cube cured under standard conditions and the bonding strength of concrete.

Keywords—Mild steel bar, pullout test , bonding strength

I. INTRODUCTION

This project deals with the method for comparison of the bond resistance of different types of reinforcing bars with concrete by pull-out test. The Beam Tests for determining the bond properties of reinforcing bars will be covered subsequently in separate parts.

This method of test is intended to provide a standardized procedure for comparison of bond characteristics between concrete and different types of steel reinforcing bars. Such determinations may be made for any purpose,from routine acceptance tests to research testing, in so far as applicable to a particular project. The method is offered as one workable procedure, to be employed either in its entirety or with modifications to meet specific conditions. The method may also be used with some suitable modifications, if necessary,for comparing different concrete mixes for their bond characteristics with steel reinforcing bars.

The bond strength, or the measure of the effectiveness of the grip between concrete and steel, has no standard quantitative definition. In pull-out tests on Mild steel bars, the maximum load generally represents the bond strength that can be developed between the concrete and steel. With Mild steel bars the maximum load is not very different from the load at the first visible slip, but in the case of the deformed bar, the maximum load may correspond to a large slip which may not in fact be obtained in practice before other types of failure occur. It is preferable, therefore, when comparing plain and deformed bars to determine not only the maximum load but also the load at arbitrary amounts of slip and also plot the complete load-slip curves for the plain and deformed bars under

comparison. One such basis of comparison is the load at a relative movement (slip) between steel and concrete of 0.025 mm at the free end of the bar in a pull-out test.

1.1 PULL OUT TEST :

A pullout test gauges the strength of a particular specimen through the use of dedicated tension jacks,which are injected into the specimen under testing.This test is usually conducted in industrial settings to prevent malfunctions that may be brought on by loosened and weekened hardware due to variety of factors , such as unstable temperature.This test is typically conducted to set up hardware strength for airports, railways and other types of commercial and industrial structures.

1.2 SCOPE OF THE WORK :

- To determine the bond strength between ordinary mild steel bars and cement concrete.
- In a reinforced concrete beam with overlapping reinforcement by pullout test.

1.3 FACTORS AFFECTING THE CONCRETE PULLOUT TEST:

The pullout strength can be related to compressive strength.Such relationships are affected by following factors.

- The arrangement of the embedded insert.
- The dimensions of bearing ring.
- The depth of embedment.
- The type of aggregates uses in concrete.

Relation between test strength and compressive strength are more trusted if both concrete pullout test specimens and compressive strength test specimens are of ,

- Similar size ; and
- Consolidated to similar density,and
- Cured under same conditions.

1.4 USE OF CONCRETE PULLOUT TEST :

Concrete pullout test is used to estimate the in-situ strength of concrete for the determination of the following point .

- To determine whether the reinforced concrete structure may be placed into service or
- To determine the strength of concrete for carrying out post-tensioned operations or
- To measure the time for removal of forms and shores based on the actual strength of the in-situ concrete; or
- To terminate the curing of concrete based on the targeted strength achievement.

II. MATERIALS USED

Material that go for making concrete for this study were tested before casting the specimens. The properties obtained from the tests were used in mix design.
The preliminary tests were conducted for the following materials.

2.1 Bars:

Loose scale and rust shall be thoroughly removed from the bars by wire brushing and bars inspected to ensure that they are free from grease, paint, or other coatings which would affect their bond. Suitable solutions may also be applied, if necessary, to clean the grease or oil. The end of the reinforcing bars on which the stem of the dial gauge is to bear in the test, shall be ground to a reasonably smooth surface normal to the axes of the bars.

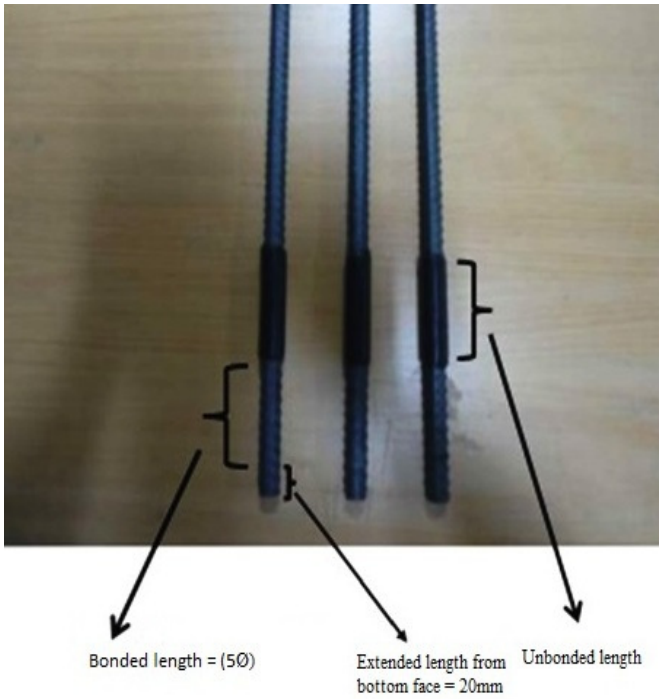


Fig.1. Preparation of Mildsteel rod.

III. MIX DESIGN FOR M30 GRADE

Cement	= 338kg/m^3
Water	= 186kg/m^3
Fine aggregate	= 793 kg/m^3
Coarse aggregate	= 1104kg/m^3
Water cement ratio	= 0.55

IV. CASTING AND TESTING OF CUBES

The quantities as per mix design are mixed with care and concrete cubes of size (150mmx150mmx150mm).The concrete specimens are cured for 7, 14 and 28 days in laboratory. Then concrete cubes are tested in laboratory to get their compressive strength and bonding strength values for various proportions.

Fig.2. Casting of cube.

Fig.3. Test specimen.

4.1 TEST PROCEDURE

The test specimen shall be mounted in a suitable testing machine in such a manner that the bar is pulled axially from the cube. The end of the bar at which the pull is applied shall be that which projects from the top face of the cube as cast.

In assembling the testing apparatus on the specimen the distance between the face of the concrete and the point on the loaded end of the reinforcing bar at which the device for measuring slip is .attached, shall be carefully measured so that the elongation of the bar over this distance may be calculated and deducted from the measured slip.

The load shall be applied to the reinforcing bar at a rate not greater than 2 250 kg/min, or at no-load speed of the testing machine head of not greater than 1·25 mm/min, depending on the type of testing machine used and the means provided for ascertaining or controlling speeds.

The movement between the reinforcing bar and the concrete cube, as indicated by the dial micrometers shall be read at a sufficient number of intervals throughout the test to provide at least 15 readings by the time a slip of 0·25 mm has occurred at the loaded end of the bar. The dial micrometers shall be read at the loaded and unloaded ends and reading recorded to an estimated 0·1 of the least division of the dial.

The loading shall be continued and readings of movements recorded at appropriate intervals until:

a) the yield point of the reinforcing bars has been reached,

b) the enclosing concrete has failed (the type of failure shall be noted), or

c) a minimum slippage of 2-5 mm has occurred at the loaded end.

Fig.4. Arrangement of pull-out specimen in UTM

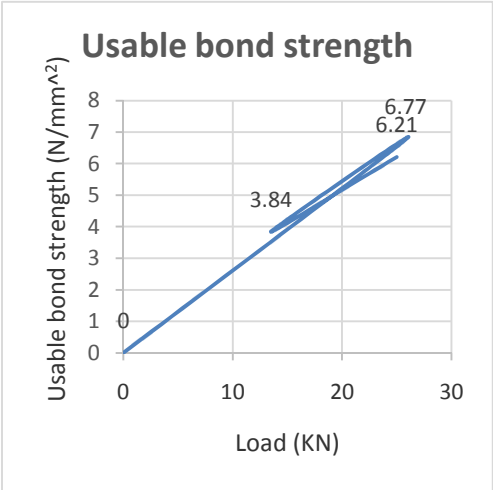
V. RESULT AND DISCUSSION

TEST RESULTS OF COMPRESSIVE STRENGTH:

TEST RESULTS OF BOND STRENGTH :

Compressive strength of concrete with various mix combination is determined at 7, 14 and 28 days for M20 grade of concrete. The result of bonding strength are given in below graph:

Bond strength values of cubes for 28 days



CONCLUSION

- The first objective of this study is to produce R.C.C.concrete with density in the range of 1400kg/m^3.
- The compressive strength of concrete cubes was observed for (5%) 7 days, 28 days curing for the mix ratio is 1:1.6:3.2 were 14.7, 27.22 N/mm² respectively. The compressive strength at 28 days obtained was satisfying the minimum requirement of light weight concrete. Thus the mix ratio 1:1.6:3.2 can be used for reinforced cement concrete.
- Usable bond strength of MS rebar is nearer to ultimate load value which means mild steel cannot withstand more load once slip occurs.

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