Indo-Iranian Journal of Scientific Research (IIJSR)
Volume 1, Issue 1, Pages 246-252, October-December 2017

An Experimental Investigation on Splicing of Reinforcement in Reinforced Concrete Beam by Bar Coupler

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Article Received: 15 October 2017 *Article Accepted: 30 November 2017* *Article Published: 28 December 2017*

ABSTRACT

Reinforced cement concrete is the concrete with certain percentage of steel reinforcement embedded in it. This reinforcement is provided mainly to take care of the tensile stresses developed in the member. Reinforcement also limits the size of cracks in concrete due to shrinkage and temperature variation. Splicing of reinforcement bars in R.C members since the manufacturing length of reinforcement bar is 12m only in the market does not suit always to the exact dimensions of the members. The common types of splices adopted are lap splice and welded splice. The lapped joints are not always an appropriate means of connecting reinforcing bars. The use of laps can be time consuming in terms of design and installation and can lead to greater congestion within the R.C member because of the increased amount of rebar used. The cost of reinforcement also increased. The cost of reinforcement can be reduced and increase the load carrying capacity of RCC beam by using coupler to join the end of reinforcement. The investigation reported in this paper was carried out the behavior of splicing of reinforcement by bar coupler in beam. Test the flexural strength of M40 grade coupler reinforced concrete beam. The mix proportions of M40 grade concrete are designed by using Indian standard method and Fe 415 grade steels are used. Two numbers of RC beams casted (conventional lap and coupler reinforcement) for flexural strength test. The results showed that comparison of the flexural strength of conventional lap RC beam and coupler reinforced beam and analysis of cost of reinforcement. Comparison between conventional RC beam and bar coupler used RC beam. Tensile strength of coupler used reinforcement bar. Ultimate load carrying capacity of conventional RC beam. Ultimate load carrying capacity of bar coupler used RC beam. Are analyzed in phase-II project work.

Keywords: Zero-Droop, Low Stacking Force and Contamination.

1. INTRODUCTION

General: Reinforcement is a general term used in RCC Structures Standard and by designer, reinforcement processors and building contractors. Steel bars includes deformed bars, plain bars, wire, fabric and steel products, all of which increase the tensile and compressive stress carrying properties of concrete. Steel reinforcement is also the essential contributor towards crack control of concrete structures.

Concrete is very good in compression but weak in tension. Various members in structure are always subjected to tensile forces, bending forces etc. To take these factors and to transfer them safely to other members, the structural members are always reinforced with steel reinforcement bars.

There are four common types of reinforcing bars.

1. Mild steel bars
2. Cold twisted deformed bars (C.T.D)
3. High yield strength deformed bars (H.Y.S.D)
4. Thermo mechanical treated steel bars (TMT)

In building construction C.T.D/HYSD/TMT bars are used as primary reinforcement i.e. main steel and mild steel bars are used as secondary reinforcement such as ties, stirrups and distribution steel. Generally mild steel of 6mm diameter is used as secondary reinforcement and deformed bars of diameter 8, 10, 12, 16, 20, 25, 32 & 40 mm used as main reinforcement.

Reinforcement shall have concrete cover and the thickness of such cover shall be as follows

1. At each end of reinforcing bar not less than 25mm or twice of such bar diameter whichever is greater.
2. For longitudinal reinforcing bar in a beam not less than 25 mm
3. Footings : 50 mm
4. Raft foundation Top : 50 mm
5. Raft foundation Bottom/ sides : 75 mm
6. Strap Beam : 50 mm
7. Grade Slab : 20 mm
8. Column : 40 mm (d>12mm) 25 mm (d= 12mm)
9. Shear Wall : 25 mm
10. Beams : 25 mm
11. Slabs: 15 mm or not less than diameter of the bar.
12. Flat Slab : 20 mm
13. Staircase : 15 mm
14. Retaining Wall on Earth : 20/ 25 mm
15. Water retaining structures : 20 / 30 mm
16. Sunshade (Chajja) : 25 mm
17. Hook for stirrups is 9D for one side
18. No. of stirrups = (clear span/Spanning) + 1

2. MATERIALS USED

Cement - Ordinary Portland cement of review 53 is utilized as a part of the pervious cement and the concrete is utilized as a coupling material.

Coarse aggregate - Locally accessible pulverized blue rock stones adjusting to reviewed total of ostensible size 12.5 mm according to Seems to be: 383 – 1970. Smashed rock total with particular gravity of 2.77 and going through 4.75 mm strainer and will be utilized for throwing all examples. A few examinations infer that most extreme size of coarse total ought to be confined in quality of the composite. Notwithstanding bond glue – total proportion, total sort impacts concrete dimensional dependability.

Water - Water utilized for blending ought to be compact drinking water having pH values between 6 to 8 and it ought to be free from natural matters and the strong substance ought to be inside as far as possible according to IS 456-2000 and fitting in with IS 3025-1964. In the present test concentrate the water accessible inside the school grounds is utilized for all reasons.

Fine aggregate-Naturally available fine aggregate is used for casting the beam specimens. The fine aggregate was passing through 4.75 mm sieve with grading as per Indian standard specification (IS 383:1997) was used.

The most commonly used fine aggregate is the river sand. It passes through 4.75mm sieve.
The three types of sand are,

1. River Sand
2. Pit sand
3. Sea Sand

Sand covers the major part of the construction forum. Until the introduction of fly ash and quarry dust river sand was the only fine aggregate to be used. In Tamil Nadu the most common places where river sands are collected are Trichy and karur.

Reinforcement - Thermo mechanical treated reinforced steel bars (TMT) is used for longitudinal main reinforcement with 16 mm diameter. For shear reinforcement 6 mm diameter two legged stirrups were used with a spacing of 100 mm c/c. Thread is formed at end of the reinforcement with 20 mm length for each bars. The properties of reinforcement is tabulated in table.1

Properties of reinforcement

Sl. No.	**Properties**	**Description**
1	Yield strength	415 N/mm^2
2	Grade	Fe 415
3	Type	TMT
4	Carbon content	0.55 to 1.5%
5	Thermal resistance	Up to 600ºC
6	Minimum % of elongation at failure	14.5%

Reinforcement bar couplers: Lapped joints are not always an appropriate means of connecting reinforcing bars. The use of laps can be time consuming in terms of design and installation and can lead to greater congestion within the concrete because of the increased amount of rebar used.

Available to suit bar sizes 12mm to 50mm, the couplers are installed quickly and easily on site without the need for specially trained personnel or specialized, expensive machinery. The length of reinforcement bar coupler is 70 mm used to connect two main longitudinal bars. The external diameter of coupler is 25 mm are used.

Bar coupler

Dimensions of the couplers required for different diameter of bars are tabulated in table.2

Table 2 Dimensions of couplers

Bar diameter (mm)	12	16	20	25	28	32
External diameter	21	26	32	40	45	50
Coupler length	32	40	48	60	66	72
Weight (kg)	0.04	0.09	0.16	0.32	0.43	0.58

Thread coupler is designed to meet the requirements of BS 8110 and to achieve failure loads in excess of 115% of the characteristic strength of grade 500 rebar. A nominal allowance of +25mm should be allowed per threaded bar end.

The couplers are generally torque onto the reinforcing bar in the bar threading shop, the internal threads protected by plastic end caps. The threaded ends of the continuation bar are protected by plastic thread protectors.

3. MIX PROPORTION

Based on IS Method:

Target strength = 60Mpa

Max size of aggregate used =12.5mm

Specific gravity of cement = 3.15

Specific gravity of fine aggregate (F.A) = 2.6

Specific gravity of Coarse aggregate (C.A) = 2.64

Dry Rodded Bulk Density of (F.A) =1726Kg/m3

Dry Rodded Bulk Density of (C.A) = 1638 Kg/m3

Design mix proportions

Water	cement	Fine aggregate	Coarse aggregate
141.61litr	504.21 Kg/m^3	683.24 Kg/m^3	1108.13Kg/m^3
0.29	1	1.2	2.2

Cement: Fine agg (kg/m3): Coarse agg (kg/m3): Water (l/m3): Super plasticizer (l/m3) (1: 1.2 :2.2 :0.29 :0.8)

4. EXPERIMENTAL ANALYSIS

A.Tensile strength test of steel bar

Observation:

Diameter of rod (M.S) d = 16 mm

Gauge Length (L4) = 300 mm

Gauge Length of Extensometer = 330 mm

Least Count of Extensometer = 0.01mm

Ultimate load = 83.5 KN

Area = (π /4) x d2

= (π/4)x 162

= 201.06 mm2

Calculation:

Ultimate Stress = ultimate Load /Area

= (83.5 x 1000) / (201.06)

= 415.29 N/mm2

Bar coupler

Couplers has been tested and approved by UK CARES to show compliance with the requirements of BS 8110. The most common sizes have been tested and approved by the DIBt and are Covered by Approval No

Z-1.5-179."Mechanical Steel Reinforcement Couplers" and have been awarded KOMO Certificate No. K23495/02.

5. CONCLUSION

The mix proportion of M60 grade concrete. Dimensions of couplers are determined. The length of coupler is 40mm, external diameter of coupler is 26 mm, and weight of coupler is 0.09 kg. Tensile strength of TMT reinforced bar is tested by using UTM machine the tensile strength is 415 N/mm2.Thermo mechanical treated reinforced steel bars (TMT) is used for longitudinal main reinforcement with 16 mm diameter. The length of the thread at reinforcement end is 20 mm.

The following analysis are made in phase –II project

1. Tensile strength of coupler used reinforcement bar.
2. Ultimate load carrying capacity of conventional RC beam.
3. Ultimate load carrying capacity of bar coupler used RC beam.
4. Comparison between conventional RC beam and bar coupler used RC beam.
5. Cost analysis.

6. REFERENCE

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