International Journal of Research in Engineering, Science and Management
Volume 5, Issue 5, May 2022
https://www.ijresm.com | ISSN (Online): 2581-5792


# Detailed Study on Investigation on Behaviour of RC Beams Using Rebar Coupler

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***Abstract*: The aim of the project is to test the behaviour of RC beam by using tapered threaded mechanical coupler. In lap splicing the two rods are overlapped each other. In overlap, the load transfer to steel and concrete. The load in one rod is transferred to another rod. If using the coupler they do not overlap with each other and less reinforcement is required and material cost can be reduced.**

***Keywords*: Behaviour of RC beam, Tapered threaded mechanical couplers.**

## 1. Introduction

In construction of building steel reinforcement plays a main role to transfer the shear force and tension. The RC coupler is used to reduce time during construction and requirements of steel

*Mechanical splices:*

Mechanical splicing coupler having threads at inside on each ends of the joints and RC bars with having matching thread at outside. Coupler is a device made of threaded for joining the two reinforcing bars to transfer axial tension from one to another bar. They are manufactured from steel on a lathe machine. The manufacturing process involves cut, sanding, bore, thread, drilling and finish.

*Taper threaded couplers:*

In this coupler the threading is to be carried out on RC bar at some shape of inclination. The slighted threading to be fixed all threads at same time in joint. This type of taper threaded couplers are used in columns and not be used in raft.

## 2. Literature Review

F. Nateghi-Alahi, Mohamad Reza Shokrzadeh (2019), The main problem of reinforcement crowding for seismic detailing. It happened particularly challenging for ductile. Mechanical couplers can so suggestion an attractive different that reduce the drawbacks of reinforcement splice. The absence of dependable information on rebar coupler performance remarkably hinders their utilize, as of this problem couplers are specifically not allowed in seismic Regulations. In this paper since supplying an overview of several rebar coupling systems for all specimen, the particular way of behaving mechanical RC couplers interweave forms is argue, and their clue showing variables are compared.

## 3. Scope and Objective

The range of the project is to detailed learning the way of beahve and strength of tapered threaded mechanical couplers and beam.

*Objective:*

1. To study the ability, longevity and way of behaving of mechanical couplers.
2. To learn the behaviour of RC beam using couplers, B1 and B2. B1 beam is coupler used in 12mm rod and B2 beam is coupler used in 16mm rod.
3. M30 grade concrete for Mix design
4. To determine casting procedure of cube, cylinder, prism and necessary beams using coupler
5. Compare the result of conventional, B1 and B2 beam.

## 4. Preliminary Investigation

In this preliminary investigation is to share out the material property used in study and behaviour of coupler.

### *A. Materials Used*

1. Cement
2. Fine aggregate
3. Coarse aggregate
4. Water
5. Tapered threaded coupler

#### *1) Cement*

Table 1
Properties of cement

| S.No. | Properties | Value |
|---|---|---|
| 1 | Consistency test | 30% |
| 2 | Initial setting time | 31min |
| 3 | Final setting time | 7% |
| 4 | Specific gravity | 3.16 |
| 5 | Fineness test | 310min |

#### *2) Fine aggregate*

Fine aggregates is consist of sand or squash stone with particles. i.e., M sand passing through a 4.75mm sieve and retained on 300 microns.

#### *3) Coarse aggregate*

Graded irregular and granular material such as gravel. Isa squash hard blue granite jelly available in local area was used.

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Aggregate also very important for power, heat and flexible properties of concrete. The maximum size of CA is limited to 16mm. The properties of coarse aggregate are given in table.

Table 2
Properties of coarse aggregate

| S.No. | Properties | Test result |
|---|---|---|
| 1 | Relative density | 2.63 |
| 2 | Impact value | 12% |
| 3 | Water absorption | 0.47% |
| 4 | Bulk density | 1546 kg/m$^3$ |

*4) Water*

Water plays a main role for mixing the concrete and for curing purposes. The value of PH level of water should not be less than 6.

*5) Tapered threaded coupler*

The mechanical Tapered threaded coupler is manufactured by girder coupler manufacturing.

## 5. Experimental Investigation

*Mix Proportion:*

Cement = 436.78 Kg/Cum
Fine aggregate = 744.73 Kg/Cum
Coarse aggregate = 1157.56 Kg/Cum
Water = 196 lit/m$^3$
Mix ratio = 1: 1.70: 2.65

Table 3
Compressive test for cube

| Cube No. | Duration | Cube Dimension (mm) | Load (kN) | Compressive strength (N/mm$^2$) | Average compressive strength (N/mm$^2$) |
|---|---|---|---|---|---|
| 1 | 7 days | 150x150x150 | 540 | 24 | 26.45 |
| 2 | | | 650 | 28.89 | |
| 3 | 28 days | 150x150x150 | 850 | 37.78 | 37.33 |
| 4 | | | 830 | 36.88 | |

Table 4
Split tensile test

| Specimen | S.No. | Dimension | Load (kN) | Split tensile strength | Avg tensile strength(N/mm$^2$) |
|---|---|---|---|---|---|
| Conventional Concrete | 1 | d=150mm L=300mm | 21.20 | 3.00 | 3.11 |
| | 2 | | 22.75 | 3.22 | |

Table 5
Flexural test

| Specimen | S.No. | Dimension | Load (KN) | Flexural Strength | Average Flexural Strength (N/mm$^2$) |
|---|---|---|---|---|---|
| Conventional Concrete | 1 | 100x100x500 | 22.95 | 3.7 | 3.8 |
| | 2 | | 26.33 | 3.9 | |

Table 6
Results for tensile test with coupler Conventional Beam (CB)

| S.No. | Specimen | Dimension L = 1M | LOAD (kN) | Ultimate Stress N/mm$^2$ |
|---|---|---|---|---|
| 1 | TMT Bar | D = 12 mm | 50 | 442.12 |
| 2 | With Coupler | D =16 mm | 75 | 373.02 |

| Load (kN) | Deflection (mm) | Load (kN) | Deflection (mm) |
|---|---|---|---|
| 0 | 0 | 27 | 3.790 |
| 4.5 | 0.207 | 31.5 | 5.035 |
| 9 | 0.512 | 36 | 6.808 |
| 13.5 | 1.109 | 40.5 | 9.513 |
| 18 | 1.807 | 45 | 14.519 |
| 22.5 | 2.712 | | |

Table 7
Experimental test results of RC conventional beam

| Specimen No. | Maximum Load (kN) | Central Deflection (mm) | Ductility Factor | Energy Absorption Capacity (kN-mm) | Stiffness (kN/mm) |
|---|---|---|---|---|---|
| 1 | 45 | 15 | 6.8 | 609 | 16.5 |

Table 8
Load deflection behaviour of RC beam with 12mm coupler (B1)

| Load (kN) | Deflection (mm) | Load (kN) | Deflection (mm) |
|---|---|---|---|
| 0 | 0 | 40.5 | 5.413 |
| 4.5 | 0.609 | 45 | 6.211 |
| 9 | 1.012 | 49.5 | 7.414 |
| 13.5 | 1.491 | 54 | 8.611 |
| 18 | 2.012 | 58.5 | 10.091 |
| 22.5 | 2.467 | 63 | 11.813 |
| 27 | 3.135 | 67.5 | 14.152 |
| 31.5 | 3.910 | 72 | 18.123 |
| 36 | 4.611 | | |

Table 9
Load deflection behaviour of RC beam with 16mm rebar coupler (B2)

| Load (kN) | Deflection (mm) | Load (kN) | Deflection (mm) |
|---|---|---|---|
| 0 | 0 | 45 | 3.529 |
| 4.5 | 0.201 | 49.5 | 4.228 |
| 9 | 0.429 | 54 | 4.920 |
| 13.5 | 0.712 | 58.5 | 5.601 |
| 18 | 1.079 | 63 | 6.213 |
| 22.5 | 1.306 | 67.5 | 7.120 |
| 27 | 1.751 | 72 | 8.090 |
| 31.5 | 2.090 | 76.5 | 9.590 |
| 36 | 2.529 | 81 | 11.090 |
| 40.5 | 3.012 | 85.5 | 13.5 |

Table 10
Experimental test results of RC beams with rebar couplers

| Specimen No. | Maximum Load (kN) | Central Deflection (mm) | Ductility Factor | Energy Absorption Capacity (kN-mm) | Stiffness (kN/mm) |
|---|---|---|---|---|---|
| B1 | 72 | 18 | 6 | 1134 | 9.4 |
| B2 | 85.5 | 13.5 | 6.8 | 1188 | 18 |

## 6. Result

Finally, the result obtained from the above comparission of beams are B2 beam having higher strength than the B1. B1 beam having higher strength than the conventional beam.

## 7. Conclusion

The strength of the coupler in tensile is noted by its Ultimate stress of the 12mm coupler joint rod of 1m is almost 62% of its tensile strength of uncut plain rod and Ultimate stress of 16 mm coupler joint rod of 1m is almost 63% of its tensile strength of uncut plain rod.

*RC Beam with 12 mm Coupler Spliced:*

- The final load carrying capacity of the coupler spliced beam was 60% more than the ultimate strength of the conventional beam.
- The first crack load of the coupler spliced beam is 1.6 times greater than the conventional beam.
- The stiffness value of the coupler spliced beam was 1.2% more than the conventional beam.
- The energy absorption of the coupler spliced beam was 2 times more than the conventional beam.
- The ductility factor of beam of the coupler spliced beam was 1.2% more than the conventional beam.

*RC Beam with 16 mm Coupler Spliced:*

- The final load carrying capacity of the coupler spliced beam was 90% more than the ultimate strength of the conventional beam.
- The first crack load of the coupler spliced beam is 2.25 times greater than the conventional beam.
- The stiffness value of the coupler spliced beam was 1.2% more than the conventional beam.
- The energy absorption of the coupler spliced beam was 2 times more than the conventional beam.
- The ductility factor of beam of the coupler spliced beam was 1.2% more than the conventional beam.

## References

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