Analysis of Cost Effectiveness of Parallel Thread Mechanical Coupler Instead of Splicing

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Abstract— Splicing of reinforcement is the basic requirements in the steel reinforcement because off the standard length availability of the steel bars that is 12m. The commonly used method is lap splicing because of its cost effectiveness and it also consumes lesser time while fixing, making fixing handling of steel reinforcement easier. For higher dia steel reinforcement the another method which can be used is weld splicing where the lap length can be reduced but extra arrangements of welding is required. The method which can be used is the use of mechanical couplers. The mechanical coupler are proven to be cost effective in comparison to lap and weld splices. The aim of the study is to make cost comparison of the mechanical couplers and lap splicing based on the practical experiences. For carrying out this study chemical and physical tests on couplers were also performed to ensure the quality of couplers.

Keywords: Mechanical Couplers, Cost Effective, Splicing

I. INTRODUCTION

In reinforced structures, splicing of reinforcement is necessary in case where the required length is more than the standard length of bar. There are three most commonly used method

1) Lap splicing
2) Weld Splicing
3) Mechanical couplers.

1) Lap Splicing:

The most commonly used method is lap splicing because of its workability and cost effectiveness. . However, there are some disadvantages of lap splicing one is excess wastage of material and the second is the congestion in reinforcement because of splicing. Generally the lap length is considered as 50 times diameter of the bar, since lap length is directly related to diameter of bar , it increases with increase in the dia of bar thus wastages % are higher for larger dia bars. Usually 10-15% steel is considered as extra while budgeting and wastage calculations.

2) Welding Splicing:

Welded splices can be used to avoid disadvantages of the lap splicing but here also the steel wastages can be reduced and also high workmanship is required to ensure proper quality of welding.

3) Mechanical Splicing:

The other method which has been developed to overcome disadvantages of lap splicing and weld splicing is the mechanical joint which is also called rebar coupler. This is the new technique in the construction industry. There are three types of rebar coupler, one is tapered threaded coupler, parallel thread coupler and mechanically bolted couplers. Rebar mechanical coupler can be justified for the shortcomings in the lap and welding splices however, use of coupler is still not widespread in Construction industry.. Therefore, this study focuses on finding the cost effectiveness of the coupler and to provide recommendation on the use of rebar couplers. The following objectives are expected to achieve through the study is to understand cost effectiveness of mechanical coupler.

II. METHODOLOGY

The steps involved in the research are as follows:

1) Identification of the costs of the parallel thread mechanical coupler.
2) Quality testing of the mechanical couplers.
3) Workmanship cost required for the forging and threading of the steel bars.
4) Cost of fixing of mechanical coupler.
5) Comparison of cost against lap splicing

1) Cost Of Parallel Thread Mechanical Coupler.

The cost of mechanical coupler varies from size to size.
The following table consists of cost of the couplers Diameter wise.

Diameter of Coupler.(MM)	Cost of Coupler (Rupees)
10mm	50
12mm	56
16mm	62
20mm	68
25mm	76
32nm	95

2) Quality Testing of Mechanical Coupler.

It is very much important to conduct the quality tests on the mechanical coupler as it directly transfers the load from one reinforcement to another reinforcement directly.

The Quality Standards of the coupler can be identified and studied from IS-16172: 2014

Genereally physical and chemical analysis is performed on the mechanical couplers.
The Physical Analysis involves

1) Static Tensile test.
2) Slip Test.
3) Cyclic Tensile Test.
4) Low Cycle Fatigue Test.
5) High Cycle Fatigue Test

3) Workmanship on Couplers.

The workmanship involved in the mechanical coupler is of Forging and threading of the steel rebars so that they can be easily fixed.

The workmanship cost of threading and forging was estimated as 40 Rs per Coupler.

4) Cost of Fixing Of Mechanical Coupler.

The cost of mechanical fixing of mechanical coupler dia wise may differ as the cost of coupler differs diameter wise.

Following is the table which shows the cost of fixing of Coupler diameter wise.

Diameter of Coupler.(MM)	Lap Length (50d)	Cost of Lapping	Cost of Fixing. (Rupees)
10mm	.5m	22.22	90
12mm	.6m	24	96

16mm	.8m	56	102
20mm	1m	111	108
25mm	1.25	217	116
32nm	1.6	455	135

The cost of fixing also includes the cost of coupler and the cost of fixing of couplers.

5) Cost Comparison.

The following is the table consist of cost of lapping of Steel reinforcement diameter wise.

The cost of steel is considered as Rs 45/kg.

Following is the table which shows the cost of lapping Diameter wise.

Diameter of bar	Lap Length(50d) (m)	Lap weight (kg)	Cost of Lapping(Rs)
10mm	.5	.493	22.185
12mm	.8	.69	31.05
16mm	.8	1.26	56.7
20mm	1	2.46	110.7
25mm	1.25	4.82	216.9
32nm	1.6	10.112	454.95

The following table consist of comparison of the cost of lapping vs the cost of fixing diameter wise.

Diameter of Coupler.(MM)	Cost of Lapping (Rupees)	Cost of Fixing. (Rupees)
10mm	22.22	90
12mm	24	96
16mm	56	102
20mm	111	108
25mm	217	116
32nm	455	135

III. Results & Discussions.

- As from the above comparisons it is clear that the use of mechanical coupler is cost efficient for the larger diameter bars.
- The cost of lapping goes on increasing with the increasing diameter of the bar size.
- However it can be observed that the cost of workmanship of coupler remains same for all diameter of bars.
- In this study the cost of reinforcement fixing is not taken into considered. It only includes the cost of coupler and cost of threading and forging and the cost of lapping only.
- The study shows that the cost of lapping is very much cheap for the diameter of bars up to 16mm and mechanical splicing is not cost effective upto 16mm.
- However for 20mm dia bar the use of coupler option is still debatable. However if the volume is large then the use of coupler will be cost efficient.
- The cost of binding wires can also be saved in mechanical splicing.
- The cost incurred in scrap steel because of conventional lapping can also be reduced to very extent in mechanical lapping.
- The welding lapping also requires minimum of 500mm lap length for welding it with reinforcement.
- In welding lapping it is difficult to monitor the quality of lap.
- Thus from above results it is cleared that the mechanical lapping is highly cost efficient for the bars of sizes above 20mm.
- It is the best value engineering one can practice and can make construction more economical and cost efficient.

IV. Conclusion

From the above study it can be concluded that the mechanical splicing is one of the best option for cost saving and economical construction where the sizes of bar varies between 20mm to 32mm.

By looking at the current construction scenarios and the scale at which the projects are being operated economical construction plays a very vital role and for this economical construction the engineering team are trying to practice more value engineering to make the project safe as well as economically viable.

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