

Use of Efficient Tools for Tying Rebar on Indian Construction Sites

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Abstract: In construction of a RCC structure, there is an essential part of making a reinforcement cage, which can be made by tying different re-bars with the help of a tie wire as per the design requirements. There are different tools for tying of re-bars like – conventional hook, hand twister and automatic tying machine. In India, there is a huge lack of skilled workmen force and hence use of conventional hook is most prominent at construction site which indirectly hamper the project productivity and hence increases the cost of construction. It is very important to introduce new better tools in Indian construction industry which are already in practice in other countries. This paper deals with the use of new innovative tools for tying of steel re-bars at construction site and the comparison of these different tools on basis of various criterions like time consume in tying one knot, cost of tools, productivity measurement and health problems related to workmen while using different tools for tying of re-bars.

1. INTRODUCTION

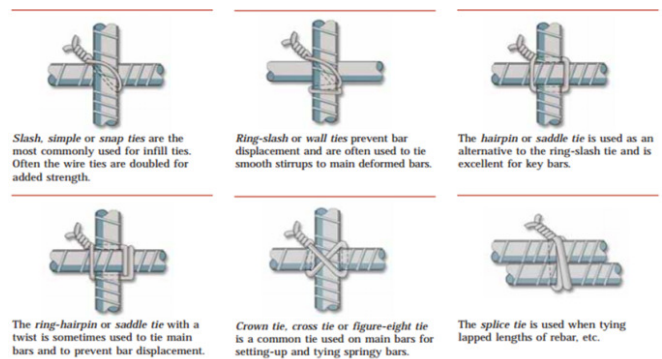
India is a country where world's second largest amount of concrete is produced with an average of 280 million tonnes and 20,000 metric tonnes of steel re-bars per year. This data show that how extensively India is investing in construction sector which directly pronouncing the use of new and innovative techniques at construction site which increase the productivity and hence reducing the cost of construction. In all RCC structures, use of steel re-bars, formwork and concrete are three essential parts which required higher cost, time and labor inputs. Out of which, tying of re-bar is one of the process in making of steel re-bar cage before pouring concrete which consumes higher time and labor as per current work scenario in India. Due to lack to skilled labor, and huge difference between the demand and supply of technology, new tools and techniques are not implemented directly on construction sites. In this manuscript, three different tools are examined at construction site to calculate the productivity rate and time consumption required to tie re-bar knot.

2. THEORY

2.1. Definition

"Tying of re-bar" is the process of connecting re-bars together with the help of tying wire. There are different types of tie

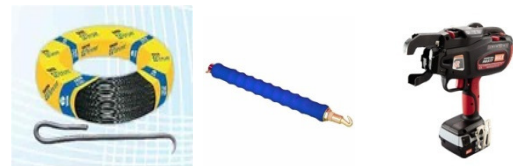
wires [3-4] – Regular steel wire, electro – galvanized wire and polyester coated wire that are used in construction industry depend upon the type of and value of structure. There are generally five different types of ties that are in practice at construction sites in India – slash tie, crown tie, hairpin tie, ring – slash tie and ring – hairpin tie. Figure 1 shows different types of ties.



Φιγυρε 1. Διφφερντ τυπε οφ τιεσ υσε ιν χονστρουχτιον σιτε.

2.2. Tying tools

There are three types of tools for tying steel re-bars at site – conventional hook, hand twister and automatic tying machine. Figure 2 shows three different ways for tying steel re-bars.



Φιγυρε 2. Διφφερντ τυπεσ οφ τυνιγ τοολσ χονωεντιον αλ ηοοκ, ηανδ ταιστερ ανδ αυτοματιχ τυνιγ μαχηνε.

2.2.1. Conventional hook

This is a very basic tool which is most common at Indian construction sites by which a workman ties the re-bars with the help of tie wire. Conventional hook is a re-bar which is

twisted and bended with the help of bending machine to make fit for tying purpose. This tool has many problems related to productivity of work as well as the health related issues for workmen. As, while using conventional hook tool, there is a requirement of twisting the tool again and again for each and every tie wire to tie re-bar which consumes more time and quality also hampers. Another problem is related to the productivity of the work, that is this tool is not cover with any grip which can protect hook to become hot during working hours, thus frequently, a workman has to drop it for a while and work hampers. Some issues related to the health problems of a workman are the musculoskeletal injuries to the back and upper limbs.

2.2.2. Hand twister

This tool is an up gradation over a conventional hook tool. Hand twister completely eliminates the twisting effort for tying of re-bar with the use of tie wire. It has a spring mechanism that allows a workman to just plug tie wire and pull backwards which allows twisting of a tie-wire. This tool is more convenient in comparison with conventional tool in many respects.

2.2.3. Automatic tying machine

This tool is most recent and is best in comparison to other two types of tools. This tool allows very fast working condition with minimal health problems to the workmen. Automatic tying machine is costly tool but it makes very efficient working conditions which increase the productivity tremendously and hence overall cost gets reduced.

3. TESTING

An experimental study has been conducted by the author of this manuscript. Conventional hook and hand twister are used and time is calculated. For Automatic tying machine, the time is taken from the other technical paper as mentioned in a reference. After observing the time taken for tying a re-bar with one tie wire, a hypothetical 10 storey building is taken and the total time in making reinforcement cage of floor and foundation up-to 10th storey is calculated and shown in Table1.

Ταβλε 1. Τιμε ρεθυιρεδ το τιε ονε ρεβαρ κνοτ βη υσε οφ παρτιχ υλαρ τοολσ.

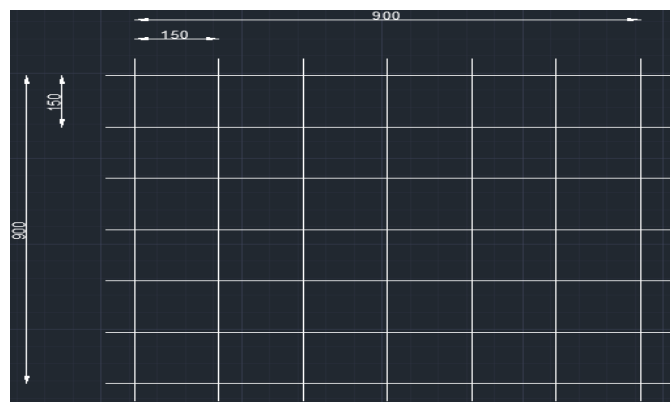
S. No.	Re-bar tying Tool	Time taken to tie one knot
1	Using Conventional hook	13 – 15 sec
2	Using hand Twister	9 – 10 sec
3	Using Automatic Tying Machine	4 – 5 sec

The time taken to tie one knot includes:-

- Taking out one bending wire from the lot.
- Shaping and Sizing of a bending wire by hand.
- Placing of a bending wire at a correct position.
- Tying of a bending wire with use of conventional hook / manual twister / tying machine.

4. ILLUSTRATION

For an illustration, we are taking a G + 10 storey building with an area of 15m x 30m, in which distance between each steel bar is 150 mm as shown in Figure 3.



Φιγυρε 3. 900μμ ξ 900μμ ρεινφορχεμεντ χαγε ηαδωνη βαρ σπαχι νη 150μμ.Σηοαωνη σπαχινη βετωεων τη ρεινφορχεμεντ βαρσ.

For simplifying it, let's take a reinforcement cage of 900mm x 900mm, having 49 joints to be tied with tie wire. For a building area of 15m x 30m, there are 556 such segments of 900mm x 900mm that will accommodate in it and for a whole ten storey building, there are 24 such meshes of reinforcement will be required to tie. The calculations are shown in Table 2.

Ταβλε 2. Χαλχυλατιον οφ τοταλ δαωνσ τηατ αρε ρεθυιρεδ το τιε σλαβ κνοτσ οφ Γ+10 στορεη βυιλδινη ωιτη τη ηελπ οφ ονε ω ορκμιαν.

1	2	3	4	5	6
S. No.	Re-bar tying tool	Time taken to tie one knot	Time taken to tie 900 x 900 mm steel cage (3*49)	Time taken to tie 15m x 30m steel cage (4*556)	Time taken to tie whole building steel cages (5*24)
1	Conventional Hook	13 – 15 sec.	14*49 = 686 sec.	686*556 = 381416 sec. or, 106 hrs.	216 days

				or, 9 days	
2	Hand Twister	9 – 10 sec.	9.5*49 = 466 sec.	466*556 = 247976 sec. or, 69 hrs. or, 6 days	144 days
3	Automatic Tying Machine	4 – 5 sec.	4.5*49 = 221 sec.	221*556 = 122876 sec. or, 34 hrs. or, 3 days	72 days

Ταβλε 3. Ποιντ οφ διφφερενχε βετωεεν υσε οφ τηρεε τοολσ ι ν Ινδιαν χονδιπινσ.

Point of Difference	Conventional Hook	Hand Twister	Automatic Tying Machine
Total time taken for tying steel with one tie wire	13 – 15 sec.	9 – 10 sec.	4 – 5 sec.
Productivity	1	1.5	3
Health related problems to workmen	Very sever musculoskeletal injuries to the back and upper limbs.	Less sever musculoskeletal injuries to the back and upper limbs.	Very less musculoskeletal injuries to the back and upper limbs.
Work efficiency	Frequently drop out the tool because of overheating and absence of grip.	Fewer drops out of tool because of good grip and elimination of twisting effort.	Very few drops out of tool because of good handle ability and workability.
Cost	Rs. 10/- to Rs. 50/-	Rs. 1800/- onwards.	Rs. 12000/- onwards.

5. CONCLUSION

By above results it is clear that if in construction, automatic tying machine is use instead of conventional hook, productivity will increase tremendously by 300% and the cost of construction will reduce. Thus it is required to use such new tools and techniques at Indian construction sites which can enhance the productivity and quality of work [1-2-5]. In Table 3, the comparisons of all three tools are depicted.

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