A PAPER ON OPTIMIZATION OF STEEL WASTE AT CONSTRUCTION SITE

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Abstract : This study has been undertaken to investigate the determinants Waste of bars can be minimized with minimum use of discrete bars in market length. In order to achieve this goal, the accurate and detailed information bars is extracted, followed by both rapid and efficient bar combination.. No research paper is directly deal with reduction of steel waste at construction site, although many paper have proposed indirect approaches to utilize the safety, quality , constructability , recycling and reusing of steel waste at construction building. This paper , therefore prepared with the aim of developing a Steel stock software which provide us a full detail of Received stock and Issued or Balanced Stock of different length of bars which required to help in minimize steel waste during cutting and bending of waste bars.

At the same time , the BBS study is also help to enhance the software which ultimately result in reduction of steel waste. The effectiveness of the suggested software was validated by case studies. Cutting one-dimensional stocks to suit the construction project requirements result in trim or cutting losses, which is the major cause of the one-dimensional construction waste. The optimization problem of minimizing the trim losses is known as cutting stock problem (CSP). A genetic algorithm (GA), a linear programming (LP) model, and an integer programming (IP) model were developed to solve this problem in minimizing the reinforcement bar.

Key Word – Optimization of steel waste at construction site, cutting pattern for reduction of steel waste and their various importance by using various software.

1 INTRODUCTION

The construction and demolition sectors are Under increasing pressure to improve performance, reduce steel waste and According to IS2549:1994 the waste is around 2 to 5% in india. In a drive towards the circular economy reducing waste is a priority for various private and government sectors and there are many new regulations measures and reduce steel waste within the construction site. Steel waste construction products are inherently low waste through all stage of building life cycle production construction and end of life building. Everyone in the construction site can contribute to tackling this by reducing steel waste, using material in better way and waste for recycling Reinforcing steel bars are usually collected and sent to scrap sites Where it is melted down into a small pieces of steel bars and turn Back into new reinforcing bars. The entrepreneurs in this business collect the used steel bars From debris and manually then sell them it at half the price of the New steel bars .new homeowners tend to buy from these rebars Sellerrs to cut down on cost. The increasing steel price make a tool with a high quality algorithm to reduce steel waste more important. The optimization of reinforced steel bar estimates is a classical cut optimization problem with one exception, because reinforcement bars are cut in different lengths with standard measuring units the algorithm should be able to select best steel length with lesser scrap waste therefore minimizing the cost and steel wastage.

2 LITERATURE REVIEW

Now a days, a lot of construction company are not focusing on the wastage of steel reinforcement and they are keep dumping it everyday at construction site. Therefore it is imperative that these bar wastes generated from these sites are managed efficiency before we run out of space for land filling. Therefore it also help in generating all possible cutting pattern of steel reinforcing bar and also include the mathematical programming theory to solve the method that yield minimum waste. On the successful testing of the software will result in minimizing the steel waste. The study shows to construction project that the bar bending list during construction has less steel waste as compared to the project that have no bar bending list at site.

At last , according IS code around 2-3% steel waste generated at construction site so from detail study of literature review we get a conclusion that whatever waste is coming it should be optimize as per engineering drawing and reduce the waste up to 1.5 %.

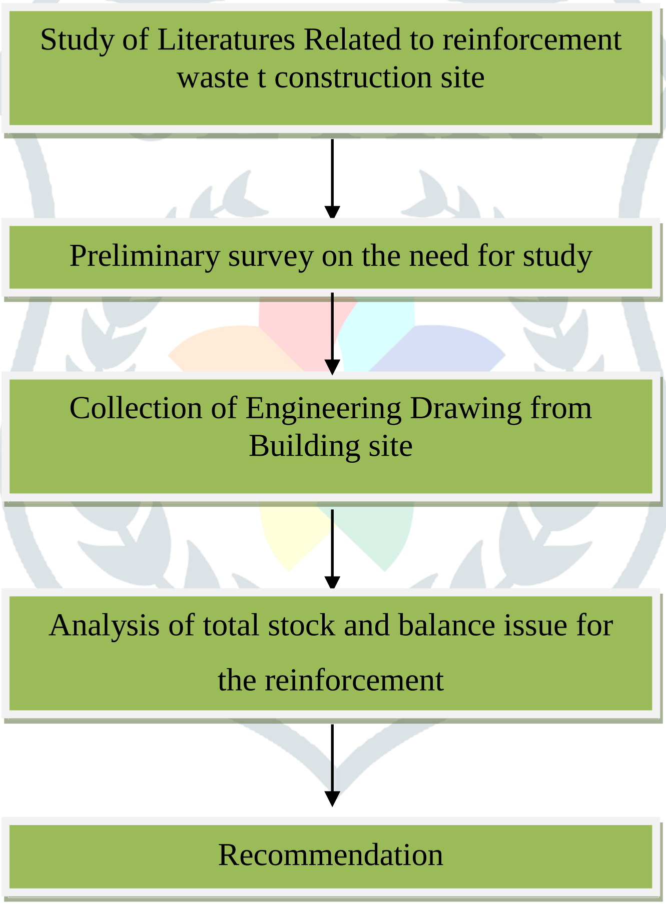
3 OPTIMIZATION SOFTWARE FOR REINFORCED END BAR CUTTING

The increasing steel price make a tool with a high quality algorithm to reduce steel waste more important. The optimization of reinforced steel bar estimates is a classical cut optimization problem with one exception, because reinforcement bars are cut in different lengths with standard measuring units the algorithm should be able to select best steel length with lesser scrap waste therefore minimizing the cost and steel wastage.

Therefore the objective of this study is to find the method for reducing waste of steel reinforcing steel from cutting .

3.1 METHODOLOGY

It is proposed to minimize the steel of the reinforcement wastage in construction work by preparing BBS(Bar Bending Schedule) and showing the utilization of balance steel else where and thereby to calculate the reduction in wastage.



3.2 RESULT

3.2.1 OPTIMIZATION OF STEEL WASTE AT COLUMN OF 20 MM DIAMETER.

Total weight of reinforcement for 20mm diameter = 1046.73kg
After 3% of total waste of reinforcement = 0.03x1046.73= **31.40kg**
Lap length in column for compression is **30ϕd**
Lap length = **30ϕd** **=** 30x20 =**600mm**
2x0.600 = **1.20**
Now unit weight for 20mm@2.42
1.20x2.42 = **2.904kg**

Now calculation for crank at **75ϕ**
crank look like right angle triangle, with the help of Pythagoras theorem we get the length crank is 106
so there are four reinforcement of 20mm diam. = 4x106=**424**
Now the unit weight0.42@2.42
0.424x2.42 = **1.026**
Now the total no of reinforcement is 8 then,
1.026x8 = **8.20kg**
Then total of **Lap length + crank**, we get,
2.904 + 8.20 = 11.104kg
31.40 - 11.104
= **20.296kg**

Total wastage = $\frac{wastage}{total\ purchase}$

so, we get it , =$\frac{20.296}{1046.73}$100
= 1.93% (waste reduction occur)

3.2.2 OPTIMIZATION OF STEEL WASTE IN COLUMN OF 16MM DIAMETER.

Total weight of reinforcement for 16mm diameter = **969.76kg**
After 3% wastage = **29.092kg**
Now in percentage we get = $\frac{29.092}{969.76}$100
= 3%
Lap length in column for compression is,
= **30ϕd = 30x16 = 480mm**
= 2x0.480 = 0.96
= 0.96 @ 1.58 = 1.516kg
Now calculation for crank length at **75ϕ**
So with the help of Pythagoras theorem we get the unknown length
Crank length = 106
So, there are four reinforcement of 16mm dia
= **4x106 = 424mm**
= **0.424x1.58 =0.66**
Total no of reinforcement is 8 in column
= **0.66x8 = 5.35kg**
Now total weight of reinforcement for lap length and crank length
Lap length + crank length
= **1.516 + 5.35 = 6.875kg**
Now from the starting calculation we get,
= **29.092 - 6.875 = 22.217 kg**
= $\frac{22.217}{969.76} \times 100$
= **2% (steel optimization has been done)**

3.2.3 Optimization of steel waste in drain cover for 10mm diameter

Total weight of reinforcement for 10mm diameter,
= **1347.02kg**
Weight of reinforcement with 3% of waste
= **0.03x1347.02**
= **40.4kg**
Now there is a size of drain cover is **600x450 and 10ϕ 100** centre to centre
Now the length drain from top
= **600-25-25 = 550**
= $\frac{550}{100}$ = **5.5 no + 1**
= **6.5 no.**
Now the actual length of reinforcement required in drain is
= **6.5x550 = 3.57m**
Similarly length for the bottom of the drain
= **450-25-25 = 400**
= $\frac{400}{100}$ = **4 no +1 = 5 no**
= **5x400 = 2.00 m**

Now adding both the length of top and bottom of drain

= **3.57+ 2 = 5.57m**

Now multiplying this length with the unit weight of reinforcement of 10mm

= **5.57 @ 0.62 , we get,**

= **3.45kg**

So , we require 6 no of drain so,

= **6x3.45 = 20kg** of steel is require

Again from the above we get it

= **40.4- 20 = 20.4 kg = 1.5 % steel optimized.**

3.2.4 optimization of steel waste in slab for 8mm diameter

Total Weight of reinforcement for 8mm diameter

= 329.245kg

After 3 % waste of reinforcement we get

= 0.03x329.245 = 9.877kg

Waste in percentage we get it

$= \frac{9.87}{329.24} \times 100 = 3\%$

Now I have to utilize the waste in such a manner that it 1% reduction in result

So, let us take a size of the slab 3 x 3

Then the area of the slab will 9 m square,

Take a chair of 1m of size so we need a total 9 chair

So, 9 @ 0.395 = 9x0.395= 3.55kg

This mean 3.55kg is used from the remaining of 9.87kg

= 9.87 - 3.55 = 6.32

Now in percentage form we get it

$\frac{6.32}{329.24} \times 100 = 1.9\%$

This mean from 3 % waste it bring to 1.9% so there is an optimization occur

3.2.5 Optimization of steel waste in beam for 16mm diameter

Total weight of reinforcement for 16mm diameter is

= 1347.00kg

After 3% of waste reinforcement we get ,

= 0.03x 1347 = 107.76kg

Now in percentage we get it

$= \frac{107.76}{1347} \times 100 = 8\%$

Now the size of the beam is 450x600mm

Providing spacer in extra bar and total no of bar is 6

The length = 450-30-30 = 390mm

Then total no of bar is six then

= 6x0.390 = 2.34m

So the unit weight of 16 mm diameter is 1.58kg per meter.

= 2.34 @ 1.58 = 3.69 kg

So the weight of steel used in beam after providing spacer is 3.69 kg

There is a requirement of 4 beams

= 4x3.69 = 14.788kg

Then from above we get it

= 107.76 - 14.76 = 93 kg

$= \frac{93}{1347} \times 100 =$ 6 % waste is come from 8% this mean it optimized.

3.2.6 Optimization of steel waste in beam for 20mm diameter

Total weight of reinforcement for 20mm diameter is

= 969kg

After 3 % of waste reinforcement we get,

= 0.03x969 = 29 kg

Now in percentage we get it

$= \frac{29}{969} \times 100 = 2.99\%$

The size of the beam is 450x600mm
Providing spacer in extra bar and total no of bar is 6
Then length =450- 30-30 = 390mm
Total no of bar is six then we get
6x0.390 = 2.34m
Unit weight of 20mm diameter is 2.42 kg per meter
= 2.34 @ 2.42 = 5.66kg
There is a requirement of 4 beams
= 4 x 5.66 = 22kg
From above we get it
= 29- 22 = 7 kg waste occur.

4. CONCLUSION

S.No.	Description	Total Weight Of Reinforcement (In Kg)	Waste In Reinforcement Including 3% Waste	Waste After Reduction (In Kg)	Waste After Reduction (In %)
1	Column (20mm)	1046.73	31.401	20.296	1.93
2	Beam (16mm)	1347.00	40.41	22	1.63
3	Slab	329.24	9.877	3.55	1.9
4	Plinth Beam (10mm)	1347.20	40.4	20	1.5
5	Column (16mm)	969.76	29.092	6.875	2
6	Footing (20mm)	1240.45	37.33	26.24	2.11

5. RECOMMENDATION

The above table indicates the optimization of steel waste with actual figures and accordingly other optimization can also be done to reduce the steel waste in the construction with the help of various software which is basically required for the optimization of steel waste at construction site. The waste that has been occurred can also be used in the following items to reduces further wastage and they are as follows :-

1). Chair
2). Development length Ld
3). Crank
4). Lintel
5). Loft
6). Window cill
7). Ferrow cover
8). Chain cover
9). Kitchen counter.

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