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Optimum design of multi-storeyed building with respect to aspect ratio

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***Abstract*—**The Main Objective Of This Study Is To Investigate The Weight Of Total Required Reinforcement In A Building With Respect To Its Aspect Ratio. The Aspect Ratio Of The Building Is The Ratio Between Its Length And Breath. Thus The Main Objective Of This Project Is To Determine At Which Aspect Ratio The Steel Present In The Building Design Will Be A Cost Effective Approach. The Results Obtained For Three Building Designs Is Compared With Each Other And A Final Graph Is Plotted So That The Variation Of The Weight Of Reinforcement Can Be Clearly Distinct. So For This Reason The Reinforcements Present In The Slabs , Beams And Columns Are Being Calculated As Per The Intensity Of The Load Coming On Each Sections. So To Achieve This A Fixed Area Is Considered And All Of The Total Steel Present In The Superstructure Of The Building Is Estimated. As A Reason Of This The Aspect Ratio Of The Buildings Plays A Vital Role To Calculate The Required Weight Of Steel In The Building By Comparing It With The Aspect Ratio Graph Plotted.

***Keywords*—**Component, Formatting, Style, Styling, Insert (key words)

I. INTRODUCTION

General: In building construction mainly the amount of concrete and reinforcement is to be calculated. With the help of bar bending schedule the required weight of reinforcement can be calculated. But this is a very lengthy process. Thus to avoid this, our main goal is to provide a graph which represents both the weight of steel and the aspect ratio. This will make it easy to determine actually how much amount of steel is required in the superstructure slab,beam and column. Now a days in India there is a great works of high rise buildings are executed for this reason the calculation of steel required becomes more complicated. So the will become a great helping hand for the sake of calculation of steel.

II. RELATED WORK

In Alcan HG (2019) : Examining SIFCON's mechanical behaviours according to different fibber and matrix phase. Iranian Journal of Science and Technology, Transactions of Civil Engineering,
Gilani AM (2007). Various Durability Aspects of Slurry Infiltrated Fibre Concrete. PhD thesis, Middle East Technical University, Ankara, Turkey.

Kishor s. Sable[5], IJEIT Vol.2, Issue 1, July 2012

Madhuri K.Rathi[6], IJEIT Vol.2, Issue 1, July 2012

They have studied the effect of different of steel fibre and aspect ratio on mechanical properties of self compacted concrete.

In our project we are determining the amount of steel required in slab, beam and column in the superstructure to get a rough idea. This section of the project is first in its kind for this reason our group is have executed the research on it.

III. METHODOLOGY

Relevant Three building design are taken which are of same area. The area taken in this project 167.625m^2. Thus by changing the length and breath of that design the aspect ratio is varied.
Now in case 1 : The length taken is 15m and the breath is 11.175m, thus the aspect ratio is 1.34 .
Now the building is G+2 therefore the amount of steel required in the slab is : 10mm dia weight of reinforcement,
3960.48 x 7850 x π/4 x .010^2 = 2441.78kg
The amount of steel required for beam :
16mm dia weight of reinforcement = 1540.38kg 20mm dia weight of reinforcement = 601.71kg
6mm dia stirrup weight of reinforcement = 273.48kg
The amount of steel required for column:
16mm dia weight of reinforcement= 1391.71kg
6mm dia stirrup weight of reinforcement= 97.20kg
Therefore total weight of reinforcement in the superstructure of the building = 6346.26kg

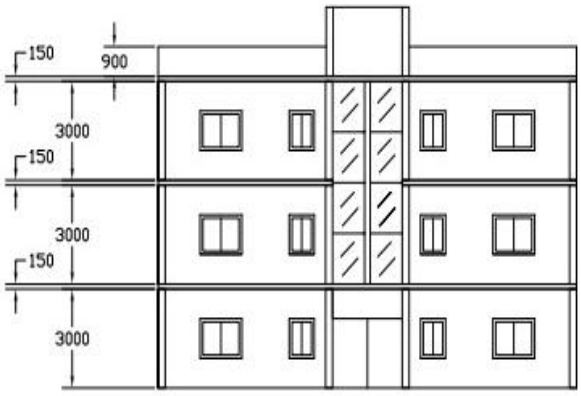

Fig. 1

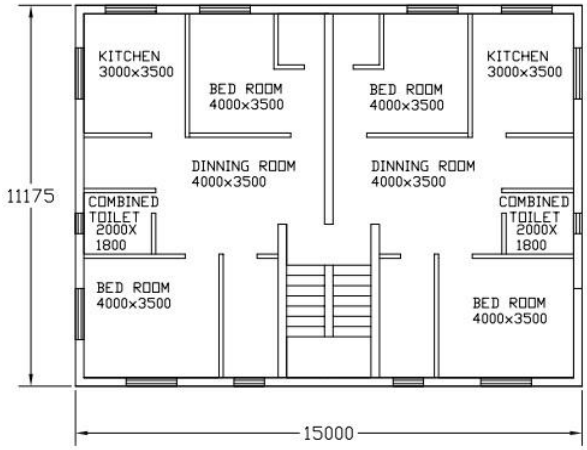

Fig. 2

Now in case 2 : the length taken is 14m and breadth is 12m. the aspect ratio is 1.16. now the building is G+2 so the amount of reinforcement required in slab using 10mm dia bars is:
3843.17 x 7850 x π/4 x 0.010^2=2369.45kg
The amount of steel required for beam:
16mm dia weight of reinforcement = 984.87kg
20mm dia weight of reinforcement= 1538.85kg
12mm dia weight of reinforcement=276.99kg
6mm dia stirrup weight of reinforcement= 310.29kg

The amount of steel required for column:
16mm dia weight of reinforcement= 1391.71kg
6mm dia stirrup weight of reinforcement= 97.20kg
Therefore total weight of reinforcement in the superstructure of the building = 6969.36kg
Now in case 3 : The length taken is 12.9m and breath is 12.9m thus the aspect ratio is 1 . Now the building is G+2 therefore the amount of steel required in the slab is: 10mm dia
13254.61 X 7850 X π/4 X 0.010^2 = 8171.96kg
The amount of steel required of beam :
16mm dia weight of reinforcement = 2198.7kg
20mm dia weight of reinforcement = 1717.8kg
6mm dia stirrup weight of reinforcement=381.2kg
The amount of steel required in column :
16mm dia weight of reinforcement = 1391.7kg
6mm dia stirrup weight of the reinforcement = 97.20kg
Therefore the total weight of reinforcement in the superstructure of the building = 13957.56kg

Now in case 4 : the length is taken is 15m and the breadth is 11.175m,thus the aspect ratio is 1.34.
now the building is G+4 therefore the amount of steel required in the slab is : 10mm dia weight of reinforcement,
6600.82X7850Xπ/4X.010^2=4069.65kg
The amount of steel required for beam :
16mm dia weight of reinforcement = 2567.3kg
20mm dia weight of reinforcement = 1002.85kg
6mm dia stirrup weight of reinforcement = 455.8kg
The amount of steel required for column:
16mm dia weight of reinforcement= 4614.54kg
6mm dia stirrup weight of reinforcement= 341.80kg
Therefore total weight of reinforcement in the superstructure of the building = 13051.94kg

Now in case 5 : the length taken is 14m and breadth is 12m. the aspect ratio is 1.16. now the building is G+4 so the amount of reinforcement required in slab using 10mm dia bars is:
6405.30 X 7850 X π/4 X 0.010^2= 3949.10kg
The amount of steel required for beam:
16mm dia weight of reinforcement = 1641.45kg
20mm dia weight of reinforcement= 2564.75kg
12mm dia weight of reinforcement= 461.65kg
6mm dia stirrup weight of reinforcement= 517.15kg
The amount of steel required for column:
16mm dia weight of reinforcement= 4614.54kg
6mm dia stirrup weight of reinforcement= 341.80kg
Therefore total weight of reinforcement in the superstructure of the building = 14090.44kg

Now in case 6 : The length taken is 12.9m and breath is 12.9m thus the aspect ratio is 1 . Now the building is G+4 therefore the amount of steel required in the slab is : 10mm dia
22091.026 X 7850 X π/4 X $.010^2$ = 13619.94kg
The amount of steel required of beam :
16mm dia weight of reinforcement = 3664.5kg
20mm dia weight of reinforcement = 2863kg
6mm dia stirrup weight of reinforcement= 635.45 kg
The amount of steel required in column :
16mm dia weight of reinforcement = 4614.54kg
6mm dia stirrup weight of the reinforcement = 341.80kg
Therefore the total weight of reinforcement in the superstructure of the building = 25739.23kg

IV. RESULTS AND DISCUSSION

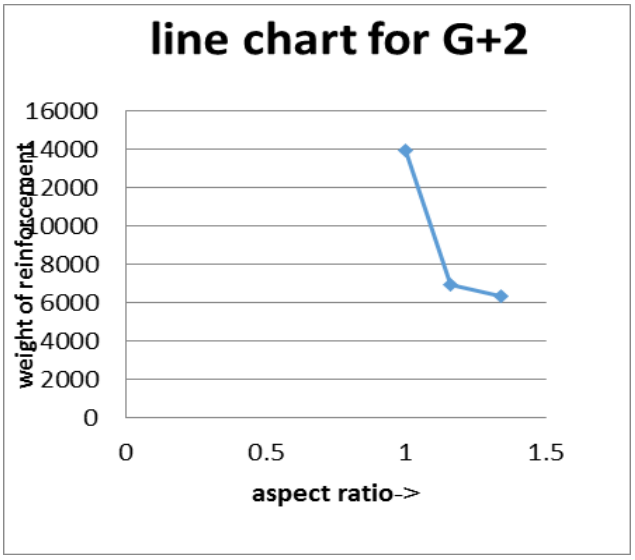

Fig. 3

It from the graph we are observing that if the aspect ratio is increased then the required weight of steel is decreased so it is in inverse proportion to each other. Thus due to this reason at aspect ratio =1 the required weight of steel is maximum that is 13958.56kg and at aspect ratio = 1.34 the required weight of steel minimum that is 6346.26kg.

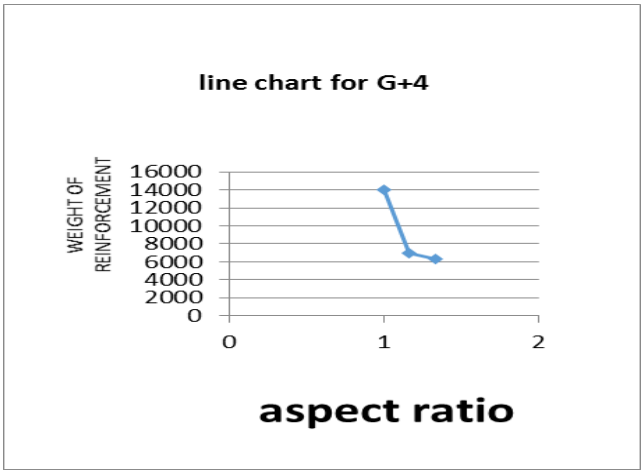

Fig. 4

From the graph we observing that by taking the fixed areas and by providing the respective aspect ratio mentioned in the previous chart , if the number of floors of the building is increased then also the required weight of steel is increased with decreasing aspect ratio and vice versa. Thus for G+4 building at aspect ratio =1 the required weight of steel is maximum which is 25739.23kg where as at aspect ratio 1.34 the required weight of steel is minimum which is 13051.94kg.

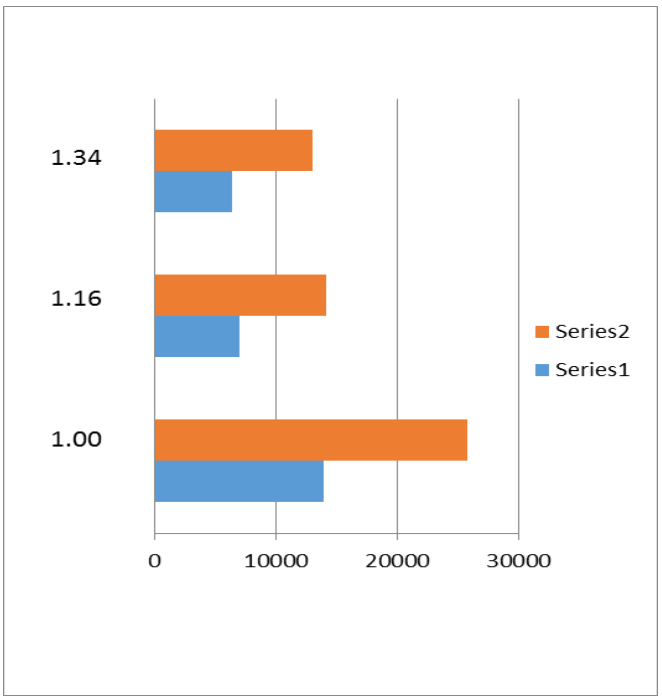

Fig. 5

Thus from this bar chart we get series 1 which elaborates the weight of steel for the G+2 buildings and the series 2 shows us the weight of the reinforcement for G+4 building. So from this we can compare the amount of reinforcement variation for the increase of further floors in the building.

The line chart and the bar chart of aspect ratio vs weight of reinforcement provides much more clear observation when compared with each other for a fixed area.

V. CONCLUSION AND FUTURE SCOPE

By this project report we came to a conclusion that it is preferable to keep the aspect ratio more than 1 to make the building design economical. So by this graph we can easily plot for which aspect ratio we should use what amount of total weight of steel in the superstructures of the whole building design. Moreover by this graph one can easily determine a rough idea about how much steel he required to construct the superstructure of the building .

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