CALCULATING QUANTITY OF STEEL BAR PLACED IN MESH FORM IN A CIRCULAR SLAB OR DOME

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Abstract- When steel reinforcement is placed in mesh form in circular concrete slab at base or domes at top in case of over head service reservoir or any other structure, it is difficult to estimate/measure the total quantity of steel that would be needed or placed. For the purpose of calculating the total length of the steel bars, at present, the practice is – the length of each bar is measured and then added up. This is tiresome and time consuming process. I have derived a mathematics formula with the help of which we can calculate in one line the quantity of total steel that will be needed. This will not only make it easy and time saving but also avoids any error in making entries and calculations.

I. INTRODUCTION

It very easy to calculate steel quantity in rectangular or square concrete slab of a building. We multiply number of bars in one direction by length of one bar. But in case of circular slab at base or circular dome at top of a structure like Over Head Service Reservoir, it is difficult to estimate/measure the total quantity of steel that would be needed or placed. For the purpose of calculating the total length of the steel bars, at present, the practice is – the length of each bar is measured and then added up. For example in Fig.1 the total length of steel bars is taken as equal to ab + cd + ef + gh and so on. This is tiresome and time consuming process. Error can also occur in long calculations. I have derived a formula with the help of which we can calculate in one line the quantity of total steel that will be needed or used in mesh of circular slab dome.

II. FORMULA

$L = \pi D^2/2s$

Where L = Total length of steel bar in m

D = Diameter of the circular slab/mesh in m

s = Spacing of steel on both directions in m

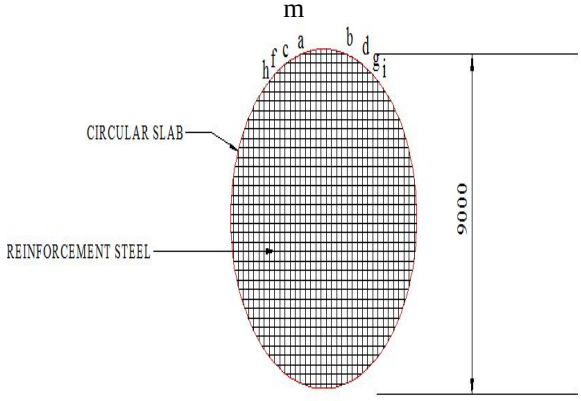


Fig. 1 Steel Mesh

III. DERIVATION OF FORMULA

Suppose there is a circular slab having steel in mesh form within diameter D. Diameter of mesh is approximately equal to the diameter of the slab. But we will take in calculation the diameter of the mesh only. Spacing of the steel in both direction is 's'. Steel bars have divided the whole area of slab in to many squares with side 's'.

Total area of circular mesh = $\pi D^2 / 4$

Area of one square with side 's' = s^2

Number of squares in the circular mesh

= Area of circular mesh/Area of one square

= $(\pi D^2 / 4)/ s^2$

Total length of steel bar in one square = 4 s

As each side 's' is shared by two squares, the length of steel bar in each square will be = 4 s / 2

= 2 s

Therefore total length of the steel in circular slab

= Number of squares x 2 s

= $(\pi D^2 / 4 s^2)$ x 2 s

= $\pi D^2 / 2 s$

IV. PRACTICAL ASPECTS

To check up the correctness of the formula either the length of each bar will be measured in the drawing or the length of each bar will be calculated geometrically with the formula

$$2\sqrt{h(D-h)}$$

(Where h is distance of steel bar from edge of mesh) and then add up so as to know the total steel and the result can be compared with the one calculate with the formula.

Suppose steel is provided at spacing 250 mm centre to centre in mesh having diameter 9 m. The lengths of steel bars in both directions will be as under:-

Length of steel bars going from top to bottom of the mesh	Length of steel bars going from left to right of the mesh
2.11	2.11
3.60	3.60
4.58	4.58
5.33	5.33
5.95	5.95
6.48	6.48
6.92	6.92
7.31	7.31
7.64	7.64
7.93	7.93
8.18	8.18
8.39	8.39
8.57	8.57
8.71	8.71
8.83	8.83
8.91	8.91
8.97	8.97
9.00	9.00
9.00	9.00
8.97	8.97
8.91	8.91
8.83	8.83
8.71	8.71
8.57	8.57
8.39	8.39
8.18	8.18
7.93	7.93
7.64	7.64
7.31	7.31
6.92	6.92
6.48	6.48
5.95	5.95
5.33	5.33
4.58	4.58
3.60	3.60
2.11	2.11
Total 254.83 m	Total 254.83 m

Total steel bar in mesh = 509.66 m

Total length of steel bar with the formula

$= \pi D^2 / 2 s$

$= \pi 9^2 / 2 \times 0.25$

$= 508.94$ m

which is approximately equal to the length actually calculated above. Thus exact quantity of steel can be worked out and neither waste will be there nor short quantity of steel has been arranged.

In case where spacing of steel bars is not same in both directions, then length of steel bar

$L = \pi D^2 (S_1 + S_2) / 4 S_1 S_2$

where S_1 is spacing of steel in one direction and S_2 in other direction.

In case of a spherical dome where spacing in both directions is same, then length of steel bar

$L = 4 \pi r h / s$

Where r is radius of dome

h is height of dome

s is spacing of steel in both direction

In case where the spacing of steel bar in both directions in the dome is not same,

then length of steel bar

$L = 2 \pi r h (S_1 + S_{2)} / S_1 S_2$

where S_1 is spacing of steel in one direction and S_2 in other direction.

CONCLUSION

With the help of this formula we can calculate the exact quantity of steel to be provided in mesh form in circular slab or dome in one line. If this formula is adopted, a field engineer will be able to do the calculations in very easy way and chances of error are very less. It will also save the lengthy paper work while estimating the steel for circular slab or dome.

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