Mathematical Statistician and Engineering Applications
ISSN: 2326-9865

Design of Reinforced Concrete Circular Slabs

[1]M. Vineetha, [2]K. Manisha, [3]A. Subba Rathnamma, [4]K. Nandhini

[1,2,3,4] UG Student, Department of Civil Engineering, Dr K V Subba Reddy College Of Engineering For Women, Kurnool, Andhra Pradesh, India

Article Info
Page Number: 514 - 518
Publication Issue:
Vol 71 No. 2 (2022)

Abstract

It is difficult to estimate the total quantity of steel required when steel reinforcement is installed in the form of mesh in a circular concrete slab at the base or domes at the top of an overhead service reservoir or any other structure. As a result, a significant amount of steel is wasted. Currently, the procedure for determining the total length of the steel bars is to measure each bar in the drawing and then add them up. The process is exhausting and takes a long time. We can calculate the total amount of steel required in a single line using a formula I have developed. This will not only make it simple and save time, but it will also prevent calculations from being incorrect and steel from being wasted due to an incorrect estimate. The bottom slab of an LNG in ground storage tank is made of thick reinforced concrete and has a depth of 7 to 10 meters. This paper discusses how size affects the shear strength of circular slabs to resist the pressure of groundwater uplift. Large reinforced concrete circular slabs subjected to distributed loads are the subject of experimental studies to test the effect of size on the shear strength of a thick reinforced concrete slab. As the slab's effective depth "d" increases, the reinforced concrete circular slab's shear strength gradually decreases without shear reinforcement. Experiments on large slabs revealed that the fourth root of the effective depth is inversely correlated with the size effect on the shear strength of a circular slab. Full and 85% design pressure were applied to bottom slabs with depths of 7.4 and 9.8 meters, respectively. The outcome demonstrated the reliability of the design method.

Article History
Article Received: *25 December 2021*
Revised: *20 January 2022*
Accepted: *24 February 2022*
Publication: *28 March 2022*

---

1. INTRODUCTION

The required quantity of steel for a building's rectangular or square concrete slab can be easily calculated. The length of the bar is multiplied by the number of bars in one direction. However, it is challenging to estimate the total amount of steel required for a structure like Over Head Service Reservoir that has a circular slab at the base or a circular dome at the top. Currently, the method for determining the total length of the steel bars is to measure and add up the lengths of each bar in the circular slab drawing. In Fig. 1, for instance, the total length of steel bars is calculated to be equal to ab, cd, ef, gh, and so on. The process is exhausting and takes a long time. Long calculations can also go wrong. If we arrange a large quantity, it will either be wasted or run out. The dimensions of the 140,000kl LNG underground tanks A,B) and Fig. 1 are shown, respectively, and I have derived a formula that enables us to calculate the total quantity of steel required for the mesh of the circular slab dome in a single line. 2 depicts how their re-bars are arranged. Dimensions of a 200,000 kl LNG in-ground tank are shown in Figure 3 and 4 shows how it's set up. The shear strength of circular slabs is discussed in this paper. The slab of a LNG underground or in-ground storage tank is made of thick concrete and has a depth of 7 to 0 meters. It resists the pressure of groundwater uplift. Experimental studies on the shear "A"""-LAA of large reinforced concrete circular slabs subjected to distributed were conducted in order to verify the size effect at thick reinforced concrete slab [Akiyama et al. 1996)]. As the slab's effective depth "d" increases, the shear strength of an unreinforced concrete circular slab gradually decreases. The relative shear strength of a circular slab was found to be inversely proportional to the fourth root of the effective depth in experiments on large slabs. To test the effect of thickness on the shear strength of concrete circular slabs, circular slabs were loaded up to shear under conditions that were simply supported. Figure depicts the cross sections of the fig 1.

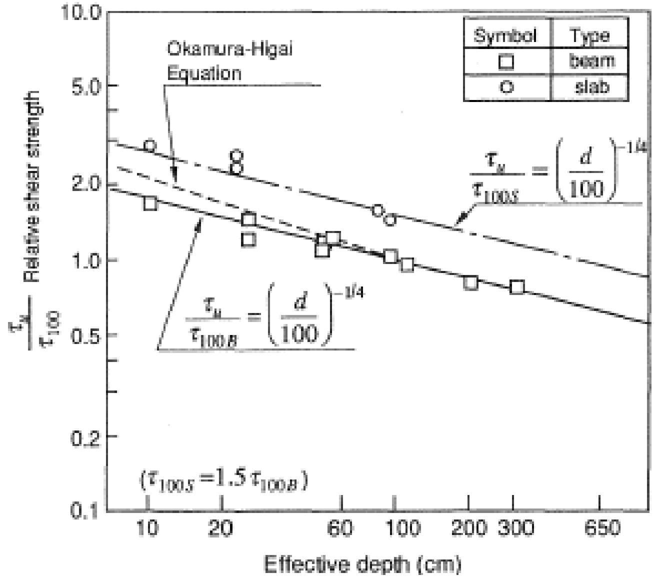


Fig.1 beam depth effect

2. LITERATUREREVIEW

In order to verify the efficacy of the circular slab design method, full and 85 percent design pressure were applied to shear-reinforced bottom slabs with depths of 7.4 and 9.8 meters.

The concrete's design compressive strength was 23.5 N lmm2, and the cross section's main reinforcement ratio was 0.6 to 0.8 percent. The cross sections of the slabs and the testing method are depicted in Figures. 1 to 4. Figure 9 depicts pressure versus displacement at the centers of 140,000kl LNG underground tanks. The shear reinforcement ratio was 0.15 to 0.2%. Reinforcement stress is shown in Figure 10. Figure 12 depicts the relationship between pressure and displacement at the center of a 200,000kl LNG in-ground tank. Figure 11 depicts Tank A's crack pattern. A 200,000kl LNG in-groundtank's crack pattern is depicted in Figure 13. These figures confirmed that the LNG underground tanks functioned as intended

- Utilizing (i) the method of segmental equilibrium and
- (ii) the method of virtual work, examine rectangular slabs with only three edges that are supported and free at the other edge,
- examine square slabs with forking yield patterns when the corners lack reinforcement, predict yield lines of fan pattern for slabs in the event that this may be a possibility,
- examine fan pattern yield lines to determine the collapse loads of triangular and circular slabs with different support conditions,
- examine fan pattern yield lines to determine the collapse loads of circular slabs clamp.

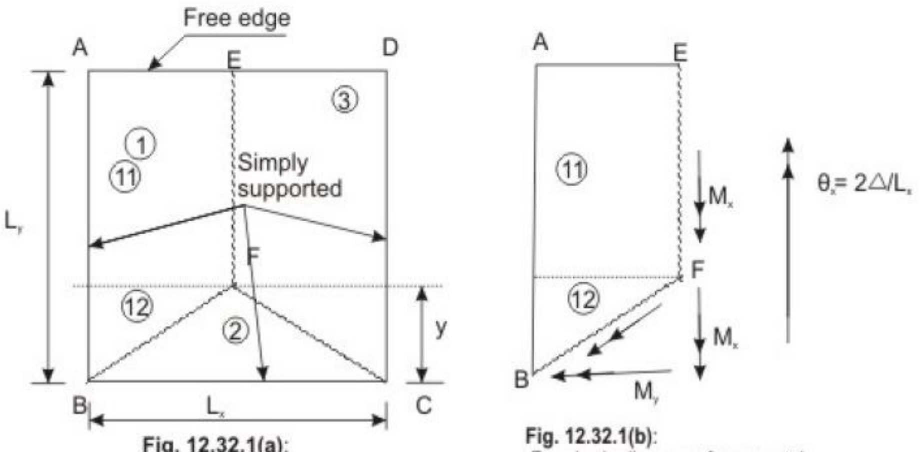


Fig. 12.32.1(a): Slab with yield pattern 1

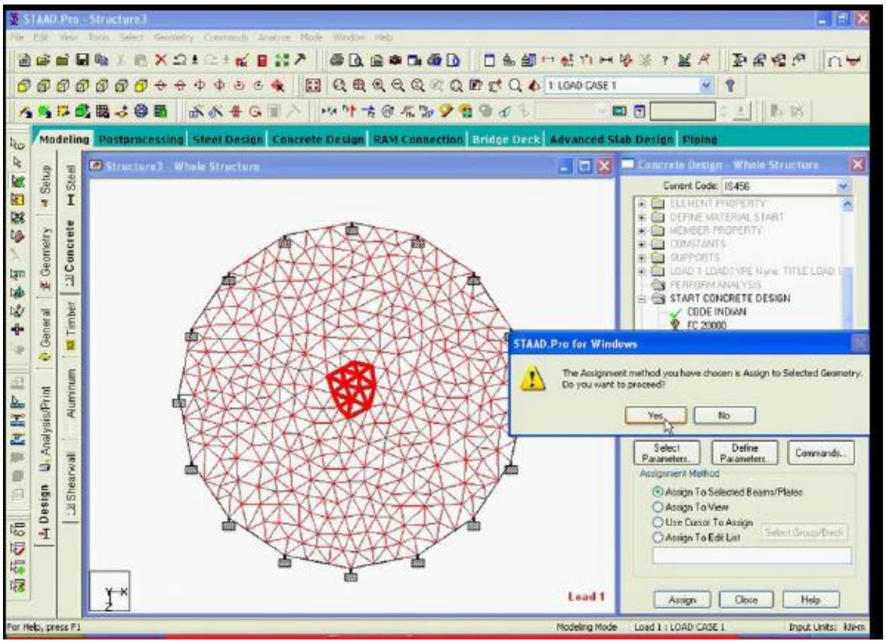
Fig. 12.32.1(b): Free body diagram of segment 1

Fig.2 Slab Pattern

3. PROPOSED SYSTEM

The author of the project employs ETABS, a computer software, to create four distinct shapes of the same area for a multistory building in accordance with IS-875, Part 3, and IS-1893, Part 1. In this paper, they looked at the 15, 30, and 35-story building. Displacement, base shear, overturning moment, acceleration, and time are well-studied and calculated parameters that affect high-rise buildings.

The study used STAAD Pro and ETABS to analyze and design rectangular plans with regular and irregular plans, including irregular multistory buildings with vertical geometry. The purpose of this study is to determine the advantages of ETABS over STAAD Pro. It has been observed that the ETABS software is simpler to use and produces results that are more precise than those produced by STAAD Pro. In their paper, a number of additional advantages of ETABS over STAAD Pro are discussed



Current Code: IS456

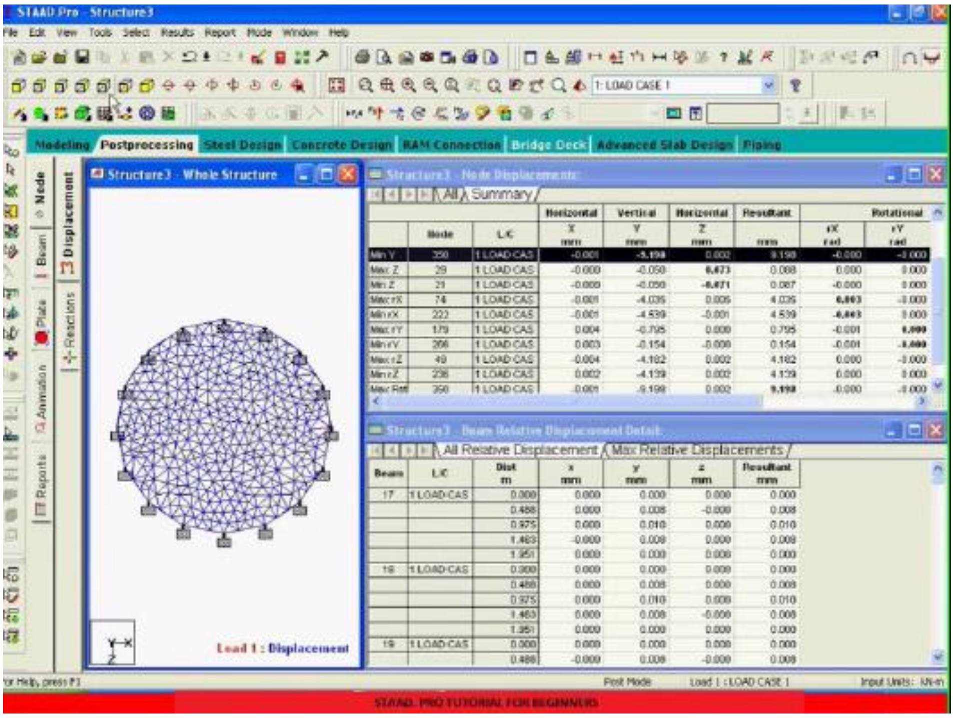
START CONCRETE DESIGN
CODE INDIAN
FC 20000

The Assignment method you have chosen is Assign to Selected Geometry.
Do you want to proceed?

● Assign To Selected Beams/Plates
○ Assign To View
○ Use Cursor To Assign
○ Assign To Edit List

For Help, press F1 | Modeling Mode | Load 1 : LOAD CASE 1 | Input Units: kN-m

Fig.3 Selection of triangular element for slab assigning



	Node	L/C	Horizontal X mm	Vertical Y mm	Horizontal Z mm	Resultant mm	Rotational rX rad	rY rad
Min Y	350	1 LOAD CAS	-0.001	-9.198	0.002	9.198	-0.000	-0.000
Max Z	29	1 LOAD CAS	-0.000	-0.050	0.473	0.088	0.000	0.000
Min Z	21	1 LOAD CAS	-0.000	-0.050	-0.471	0.087	-0.000	0.000
Max rX	74	1 LOAD CAS	-0.001	-4.035	0.005	4.035	0.003	-0.000
Min rX	222	1 LOAD CAS	-0.001	-4.539	-0.001	4.539	-0.003	0.000
Max rY	179	1 LOAD CAS	0.004	-0.795	0.000	0.795	-0.001	0.000
Min rY	266	1 LOAD CAS	0.003	-0.154	-0.000	0.154	-0.001	-0.000
Max rZ	49	1 LOAD CAS	-0.004	-4.182	0.002	4.182	0.000	-0.000
Min rZ	236	1 LOAD CAS	0.002	-4.139	0.002	4.139	0.000	0.000
Max Rst	350	1 LOAD CAS	-0.001	-9.198	0.002	9.198	-0.000	-0.000

Beam	L/C	Dist m	x mm	y mm	z mm	Resultant mm
17	1 LOAD CAS	0.000	0.000	0.000	0.000	0.000
		0.488	0.000	0.008	-0.000	0.008
		0.975	0.000	0.010	0.000	0.010
		1.463	-0.000	0.008	0.000	0.008
		1.951	0.000	0.000	0.000	0.000
18	1 LOAD CAS	0.000	0.000	0.000	0.000	0.000
		0.488	0.000	0.008	0.000	0.008
		0.975	0.000	0.010	0.000	0.010
		1.463	0.000	0.008	-0.000	0.008
		1.951	0.000	0.000	0.000	0.000
19	1 LOAD CAS	0.000	0.000	0.000	0.000	0.000
		0.488	-0.000	0.008	-0.000	0.008

For Help, press F1 | Post Mode | Load 1 : LOAD CASE 1 | Input Units: kN-m

Fig.4 Result summary

4.CONCLUSION

Full and 85% design pressure were applied to bottom slabs with depths of 7.4 and 9.8 meters, respectively. The outcomes demonstrated the reliability of the design approach. This formula allows us to precisely determine the quantity of steel that needs to be provided. in a single line as a mesh in a dome or circular slab. A field engineer will be able to perform calculations with ease and very little chance of error if this formula is used. Additionally, it will save time and paper when estimating the steel for a circular slab or dome. Using STAAD Pro, the volume of concrete and steel weight required for the design of a G+6 building obtained for various seismic zones. Concrete volume in cubic meters is shown in Table 4, and steel mass in Newtons is shown in Table 5 for various seismic zones calculated with STAAD Pro. Fig. While Fig. 18 depicts the concrete volume graph in cum, 19 depicts the Newtonian weight-to-fsteel graph used in the design of the G+6 building with STAADPro.

REFERENCES

1. Akiyama H., Goto S. and Nakazawa A. (1996) Shear Strength of Large Reinforced Concrete Circular Slabs under Uniformly Distributed Load, Proceedings of the Japan Concrete Institute, Vol. 18, No. 2, pp. 1097-1102 (in Japanese)
2. Iguro M., Shioya T., Nojiri Y. and Akiyama H. (1985) Experimental Studies on Shear Strength of Large Reinforced Concrete Beams under Uniformly Distributed Load, JSCE, Concrete Library International, No. 5, August, pp. 137-154
3. Iwaki R., Akiyama H., Okada T. and Shioya T. (1985) Shear Strength of Reinforced Concrete Circular Slabs, Proceedings of JSCE, No. 360N-3, August, pp. 155-164
4. JSCE (1991) Standard Specification for Design and Construction of Concrete Structures. Part 1 (Design)
5. Nakano M., Goto S., Nakazawa A. and Kuroda M. (1996) Water pressure test of actual bottom slabs of 140,000kl LNG under-ground tanks, JSCE Animal Convention, Vol. 6, pp. 528-529 (in Japanese)
6. Okamura H. and Higai T. (1980) Proposed Design Equation for Shear Strength of Reinforced Concrete Beams without Web Reinforcement, Proceedings of JSCE, No. 300, pp. 131- 141.
7. Sejima A., Nakano M., Kawamura Y., Sugino F. and Fukuda Y. (1996) Water pressure test of actual bottom slabs of 200,000kl LNG in ground tanks, JSCE Annual Convention, Vol. 6, pp. 530-531 (in Japanese)