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Design tables for isolated foundation for microwave tower of various heights and SBC.

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Abstract *—* ***The paper presents the study of tower foundations of reinforced concrete of different height with different SBC designed for wind forces in the zone V of Indian subcontinent with varying SBC 100KN/m2, 200KN/m2, 225KN/m2. 250 kN/m², 300 kN/m², 325 kN/m², 350 kN/m², 375 kN/m², 400 kN/m².The foundation types considered are; isolated footings under different allowable bearing pressure Values of the different type of soils. The study provides the requirement of structural quantities of the tower foundations in different SBC. The result of the study is useful for the design professionals and cost during design development and budget planning. The study also highlights the achievable low-cost in foundation costs through proper calculation of allowable bearing pressure of soils through adequate geotechnical investigations of the tower sites.***

Keywords- Microwave Tower Foundation, different SBC, Various Height

I. INTRODUCTION

In the present time the technology in communications has developed to a very large extent. The faster growth demands advances in the design and implementation of the microwave towers. There are different types of microwave towers present now-a-days in the cellular business. The present report covers the issues related to the types of towers, codal provisions for the microwave towers foundation design of the towers. Necessity of continuous communication is so real for human life. In the present century, this field has become significantly important and has been named communication time. Microwave towers have essential role in this industry. They support radio, television, and telephone antennas to convey telecommunication signals over long distances. In the case of emergency, these towers play an important role for conveying news from injured area to the release centers (medical services, firefighting, and police stations). Therefore, damage to them can meaningfully increase loses due to natural disasters. Also, infrastructures such as dams, electricity control stations, gas and fuel stations, etc. for their operation need these towers for transmitting their records and these towers are very key for such facilities. Therefore, the protection of these towers during natural disasters is of major position and accordingly the performance of such structures under these loadings should be properly valued. However, various types of microwave towers with different structural forms are available in the country and this study has been limited to Self-supporting towers, which are the most common type of microwave towers in this country.

The foundation is part of the structure which transfers the loads to the soil. Each structure demands the need to explain a problem of foundation. The foundations are classified into shallow and deep, which have important differences in terms of geometry, the performance of the soil, its structural functionality and its helpful systems. A shallow foundation is a structural member whose cross section is of large sizes with respect to height and whose function is to transfer the loads of a structure at depths relatively short, less than 4 m approximately with respect to the level of the surface of natural ground. Shallow foundations whose helpful systems generally do not present major difficulties, may be of various types according to their purpose like isolated footing, combined footing, strip footing or mat foundation. Among all above foundations select isolated types of foundations which are briefly discussed below.

Isolated Foundation

An isolated foundation is used to support the load on a single column. It is usually either square or rectangular in design. It represents the simplest, most economy type and most widely used footing. Whenever possible, square footings are provided so as to decrease the bending moments and shearing forces at their critical sections. Isolated foundations are used in case of light column loads, when columns are not closely spaced, and in case of good similar soil. Under the effect of upward soil pressure, the foundation bends in a dish shaped form. An isolated foundation must, therefore, be providing by two sets of reinforcement bars placed on top of the other near the bottom of the foundation. In case of property line restrictions, foundations may be designed for eccentric loading or combined footing is used as an alternative to isolated foundation. The isolated foundation essentially consists of bottom slab. These bottom Slabs can be flat, stepped or sloping in nature. The bottom of the slab is reinforced with steel mesh to resist the two internal forces namely bending moment and shear force. Figure shows square and rectangular isolated footings.

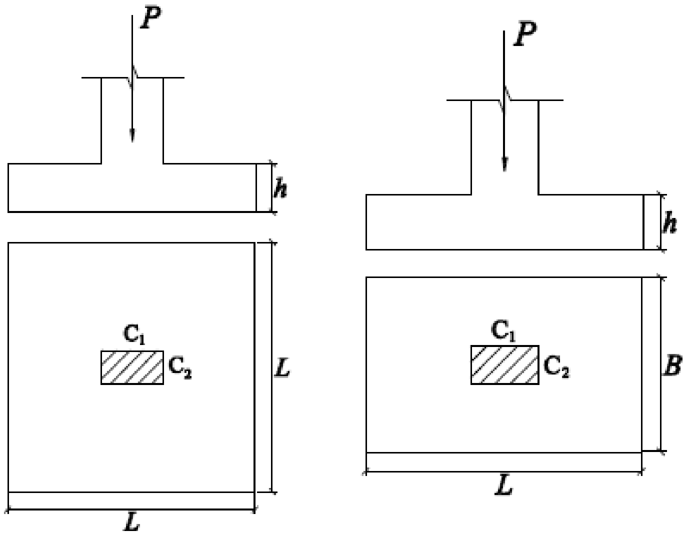


Figure (a) Square isolated foundation; (b) Rectangular isolated foundation

The structural design of foundations represents the union and the limit of structural design and soil mechanics. In the design of shallow foundations, the specific case of isolated footings are of three types in terms of the application of loads: 1) The footings topic to concentric axial load; 2) The footings subject to axial load and moment in one direction (unidirectional flexure); 3) The footings subject to axial load and moment in two directions (bidirectional flexure). The suggestion used in the classical model is to consider the pressures uniforms for the design, i.e., the same pressure at all points of contact in the footing with the soil, the design pressure is the maximum that occurs of at the four corners the footings rectangular.

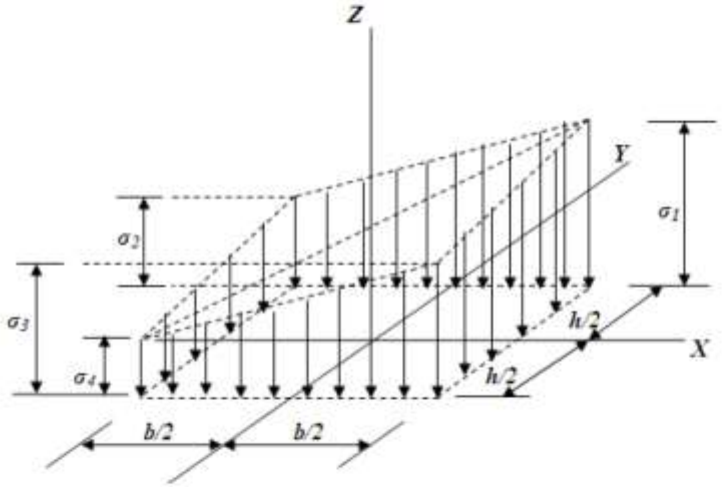


Figure. Pressures soil on the foundation

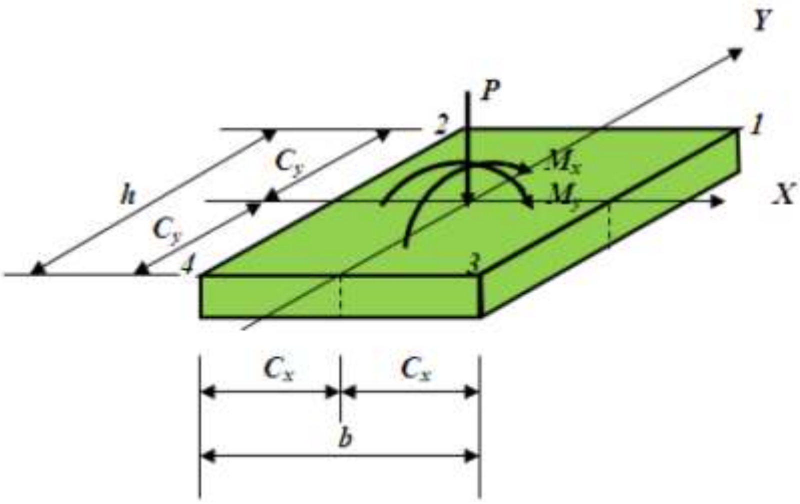


Figure. Isolated footing of rectangular form

II. MODAL FORMULATION

2.1 Problem Statement

In present work in order to design isolated footing for various S.B.C. is carried out for 25 m, 35 m, 40 m, 45 m heighted microwave tower.

Following types of structures are modeled

- 25 m heighted microwave tower.
- 35 m heighted microwave tower.
- 40 m heighted microwave tower.
- 45 m heighted microwave tower.

2.2 Geometrical Data for Microwave Tower

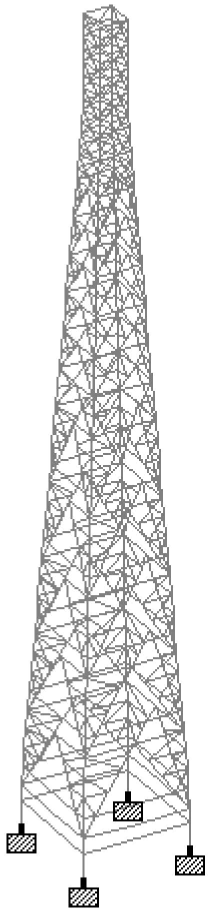
Table. Geometric Data for Tower

Height of tower	45 m	40 m	35 m	25 m
Height of slant portion	38 m	35 m	31 m	22 m
Height of straight portion at top of tower	7 m	5 m	4 m	3 m
Base width	5 m	5 m	5 m	5 m
Top width	1 m	1 m	1 m	1 m

2.3 Loading Data

- Earthquake load in X direction and Y direction
- Location : Bhuj
- Zone factor : V
- Soil Type : II
- Importance factor : 1
- Response reduction factor : 5
- Basic wind speed : 50 m/sec (for Zone 5)
- Terrain category : II
- Class : C
- Risk coefficient factor : 1.0

- Topography factor k3 : 1.0



2.4 Material Data for Microwave Tower's footing

Material Details

Material	Weight (kN/m3)	Modulus Of Elasticity (E) Mpa	Shear Modulus (G)Mpa	Poissons Ratio	Coeffi. Of Thermal Expansion 1/C
Concrete (fck=M25)	25	25000	10416.67	0.2	0.0000055
Steel (Fe-415)	76.9729	200000	76903.07	0.3	0.0000117

III. ANALYSIS AND RESULT

In this chapter, analysis of 25 m, 35 m, 40 m, 45 m heighted microwave tower is analyze using STAAD Pro. V8i.
The static analysis is carried out considering wind loads and earthquake loads on structures. Wind analysis of structure is performed as per IS: 875(III) -1987 and from the results of towers isolated footing design is carried out for the various heighted tower and for S.B.C. 100 kN/m^2, 200 kN/m^2, 225 kN/m^2, 250 kN/m^2, 300 kN/m^2, 325 kN/m^2, 350 kN/m^2, 375 kN/m^2, 400 kN/m^2.
Study of various heighted microwave tower's footing for various S.B.C. is carried out by using Excel spread sheet.

Table. Footing Design for 100 Kn/m^2

100 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	1.7 x 1.7 x 0.5	1050	1025	142.31	31.72
2	35	2.8 x 2.8 x 0.7	1470	1435	116.75	59.53
3	40	3.5 x 3.5 x0.8	1890	1845	106.85	70.52
4	45	3.9 x 3.9 x0.9	1983	1920	100.76	80.7

Table. Footing Design for 200 Kn/m^2

200 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	1.17x1.17 x 0.5	912	870	353.33	14.08
2	35	1.94x1.94x0.7	1107	1060	116.75	59.53
3	40	2.44x2.44x0.8	1296	1248	106.85	70.52
4	45	2.75x2.75x0.9	1890	1842	212.75	154.88

Table. Footing Design for 225 Kn/m^2

225 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	1.10x1.10x0.5	887	861	411.95	3.71
2	35	1.83x1.83x0.7	1087	1045	116.75	59.53
3	40	2.30x2.30x0.8	1235	1196	269.37	141.35
4	45	2.59x2.59x0.9	1818	1780	239.98	171.46

Table. Footing Design for 250 Kn/m^2

250 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	1.05x1.05x0.5	875	842	462.75	-6.59
2	35	1.74x1.74x0.7	1035	995	347.45	109.02
3	40	2.18x2.18x0.8	1195	1154	303.76	153.42
4	45	2.46x2.46x0.9	1770	1720	268.02	188.06

Table. Footing Design for 300 Kn/m^2

300 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	0.95x0.95x0.5	847	827	595.52	-38.23
2	35	1.66x1.66x0.7	997	960	388.06	113.47
3	40	2x2x0.8	1147	1107	368.94	174.24
4	45	2.24x2.24x0.9	1725	1695	327.99	222.08

Table. Footing Design for 325 Kn/m^2

325 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	0.92x0.92x0.5	805	778	646.01	-51.78
2	35	1.52x1.52x0.7	960	927	471.91	120.25
3	40	1.9x1.9x0.8	1050	1015	414.47	187.38
4	45	2.16x2.16x0.9	1689	1649	354.84	236.72

Table. Footing Design for 350 Kn/m^2

350 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	0.88x0.88x0.5	770	735	723.4	-73.93
2	35	1.47x1.47x0.7	920	896	517.48	122.07
3	40	1.84x1.84x0.8	1005	981	445.89	195.86
4	45	2.08x2.08x0x.9	1605	1575	385.11	252.83

Table. Footing Design for 375 Kn/m^2

375 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m²)		P Max (KN/m²)	P Min (KN/m²)
			Flexure Design	Other Direction		
1	25	0.86x0.86x0.5	737	709	767.15	-87.12
2	35	1.42x1.42x0.7	897	862	562.03	123.35
3	40	1.76x1.76x0.8	978	957	493.56	207.85
4	45	2x2x0.9	1570	1540	419.4	270.6

Table. Footing Design for 400 Kn/m^2

400 S.B.C						
Sr No.	Height (m)	Size (m)	Area of Reinforcement (m^2)		P Max (KN/m^2)	P Min (KN/m^2)
			Flexure Design	Other Direction		
1	25	0.83x0.83x0.5	708	675	840.18	-110.1
2	35	1.37x1.37x0.7	860	832	612.4	123.92
3	40	1.72x1.72x0.8	940	918	520.26	214.16
4	45	1.94x1.94x0.9	1504	1469	448.19	285.15

IV. CONCLUSION

- The quantity of concrete for isolated foundation is reduces as the SBC is increases from 100 to 400.
- As SBC is increasing from 100 to 200 the percentage of steel required is decreasing approximate about 25%.
- As SBC is increasing from 200 to 400 the percentage of steel required is decreasing approximate about 50%.
- Steel required for isolated footing is increasing as height of Tower is increase.
- As the solidity ratio increases it require more reinforce detailing.

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