Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 7, July-2016

Ready Reckoner 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/m^2, 300 kN/m^2, 325 kN/m^2, 350 kN/m^2, 375 kN/m^2, 400 kN/m^2,1000 kN/m²The 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.

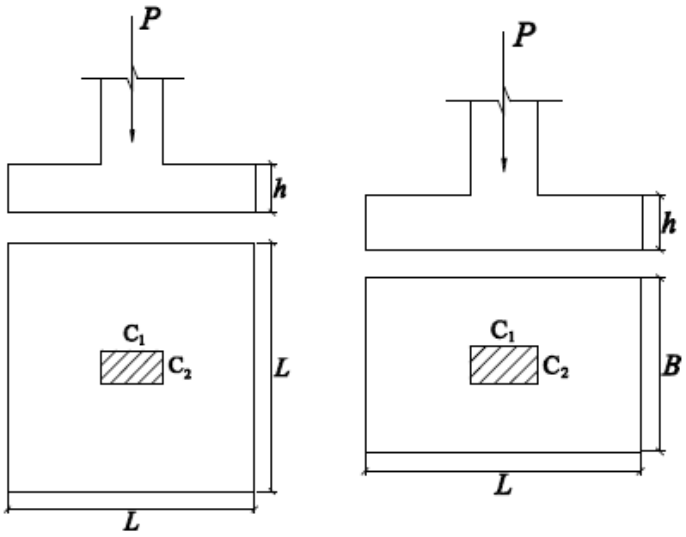


Figure (a) Square isolated foundation; (b) Rectangular isolated foundation

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.

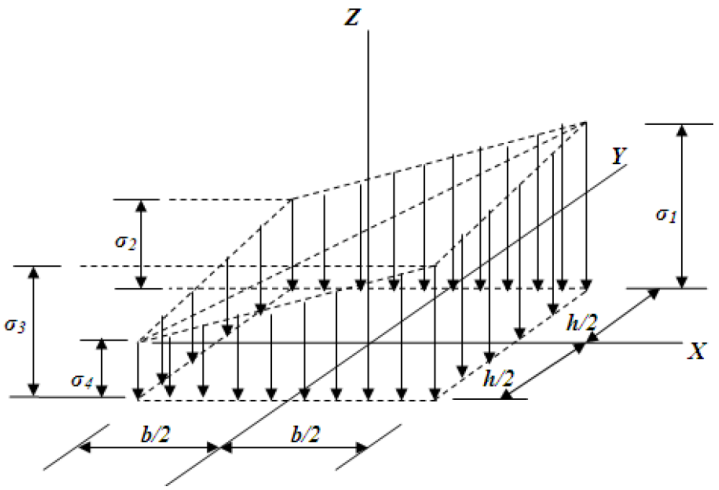


Figure. Pressures soil on the foundation

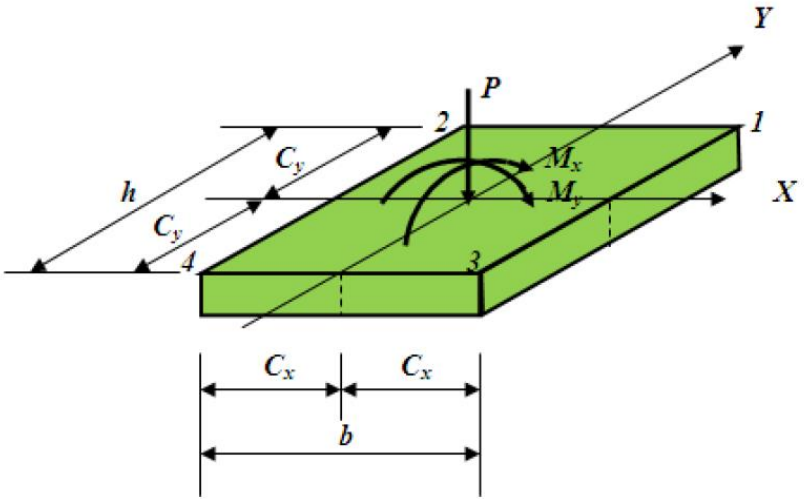


Figure. Isolated footing of rectangular form

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

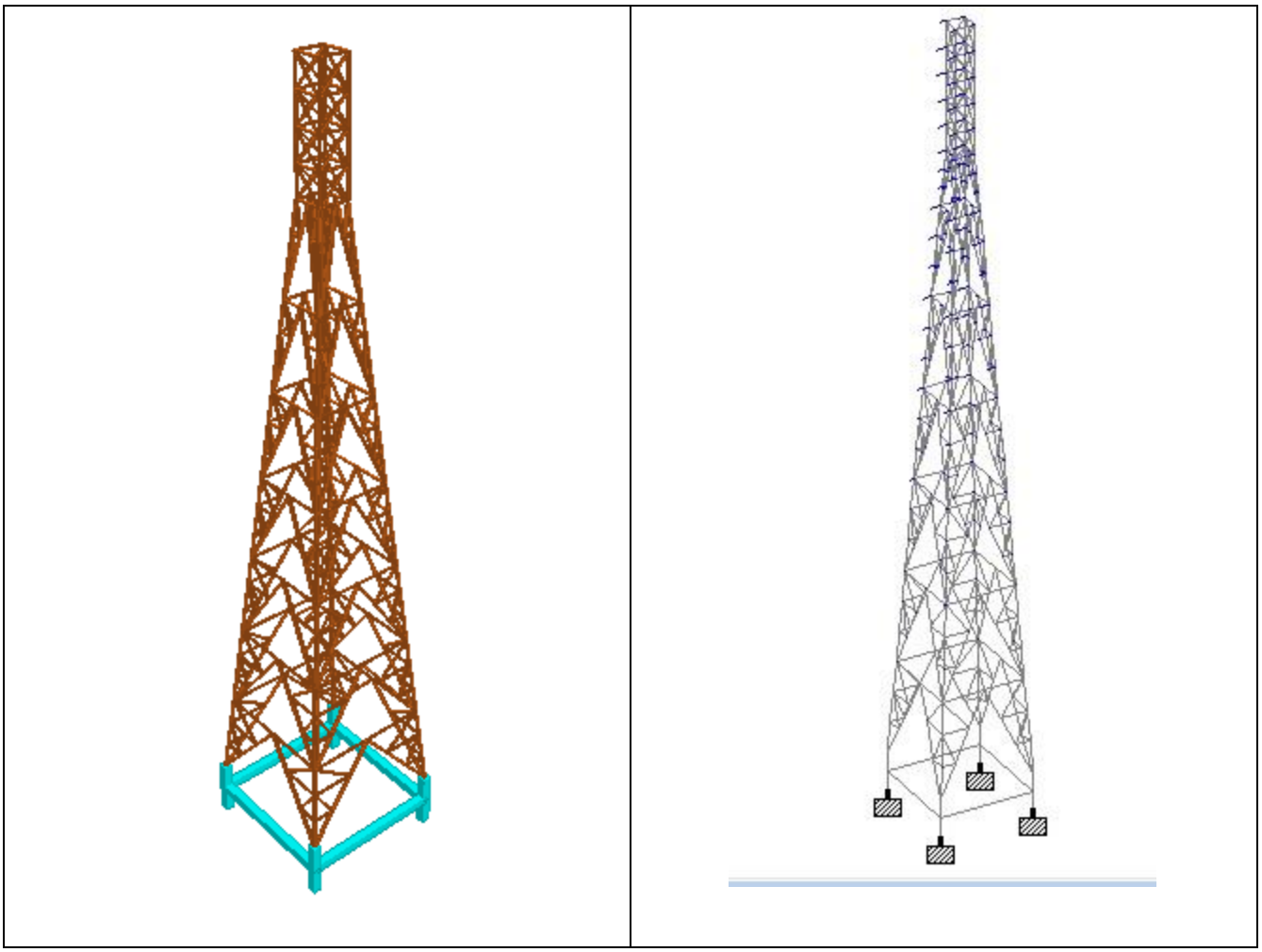
Table. Geometric Data for Tower

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.

Design Tables For 25m Height Microwave Tower

Sr No.	SBC (Kn/m²)	L (m)	B (m)	D(m)	Concrete (m³)
1	100	2	2	0.16	0.64
2	200	1.5	1.5	0.17	0.3825
3	225	1.42	1.42	0.17	0.342788
4	250	1.35	1.35	0.17	0.309825
5	275	1.3	1.3	0.175	0.29575
6	300	1.25	1.25	0.175	0.2734375
7	325	1.22	1.22	0.175	0.26047
8	350	1.18	1.18	0.175	0.24367
9	375	1.15	1.15	0.175	0.2314375
10	400	1.12	1.12	0.175	0.21952
11	1000	1.09	1.09	0.175	0.2079175

Sr No.	SBC (Kn/m²)	For L			For B		
		Bar Diameter (mm)	Spacing(mm)	No	Bar Diameter (mm)	Spacing (mm)	No
1	100	12	150	13	12	150	13
2	200	12	165	9	12	170	9
3	225	12	170	8	12	170	8
4	250	12	170	8	12	170	8
5	275	12	175	7	12	175	7
6	300	12	175	7	12	175	7
7	325	12	180	7	12	180	7
8	350	12	180	7	12	180	7
9	375	12	180	6	12	180	6
10	400	12	180	6	12	180	6
11	1000	12	185	6	12	185	6

Sr No.	SBC (Kn/m²)	Total L (m)	Weight (Kg)	Cost of steel (Rs.)	Cost of Concrete (Rs.)	Total cost (Rs.)
1	100	53.33333333	47.40740741	2465.185185	3520	5985.185185
2	200	26.87165775	23.885918	1242.067736	2103.75	3345.817736
3	225	23.72235294	21.08653595	1096.499869	1885.334	2981.833869
4	250	21.44117647	19.05882353	991.0588235	1704.0375	2695.096324
5	275	19.31428571	17.16825397	892.7492063	1626.625	2519.374206
6	300	17.85714286	15.87301587	825.3968254	1503.90625	2329.303075
7	325	16.53777778	14.70024691	764.4128395	1432.585	2196.99784
8	350	15.47111111	13.75209877	715.1091358	1340.185	2055.294136
9	375	14.69444444	13.0617284	679.2098765	1272.90625	1952.116127
10	400	13.93777778	12.3891358	644.2350617	1207.36	1851.595062
11	1000	12.84432432	11.41717718	593.6932132	1143.54625	1737.239463

Sr No.	SBC (Kn/m²)	L (m)	B (m)	D (m)	Concrete Quantity (m³)
1	100	3	3	0.3	2.7
2	200	2.25	2.25	0.305	1.5440625
3	225	2.1	2.1	0.305	1.34505
4	250	2.05	2.05	0.305	1.2817625
5	275	1.95	1.95	0.305	1.1597625
6	300	1.85	1.85	0.305	1.0438625
7	325	1.8	1.8	0.305	0.9882
8	350	1.75	1.75	0.31	0.949375
9	375	1.7	1.7	0.31	0.8959
10	400	1.65	1.65	0.31	0.843975
11	1000	1.15	1.15	0.3	0.39675

Sr No.	SBC (Kn/m²)	For L			For B		
		Bar Diameter	Spacing	No	Bar Diameter	Spacing	No
1	100	12	115	26	12	115	26
2	200	12	115	20	12	115	20
3	225	12	115	18	12	115	18
4	250	12	115	18	12	115	18
5	275	12	115	17	12	115	17
6	300	12	115	16	12	115	16
7	325	12	115	16	12	115	16
8	350	12	120	15	12	120	15
9	375	12	120	14	12	120	14
10	400	12	120	14	12	120	14
11	1000	12	125	9	12	125	9

Sr No.	SBC (Kn/m²)	Total L (m)	Weight (Kg)	Cost of steel (Rs.)	Cost of Concrete (Rs.)	Total cost (Rs.)
1	100	156.5217391	139.1304348	7234.782609	14850	22084.78261
2	200	88.04347826	78.26086957	4069.565217	8492.34375	12561.90897
3	225	76.69565217	68.17391304	3545.043478	7397.775	10942.81848
4	250	73.08695652	64.96618357	3378.241546	7049.69375	10427.9353
5	275	66.13043478	58.7826087	3056.695652	6378.69375	9435.389402
6	300	59.52173913	52.90821256	2751.227053	5741.24375	8492.470803
7	325	56.34782609	50.08695652	2604.521739	5435.1	8039.621739
8	350	51.04166667	45.37037037	2359.259259	5221.5625	7580.821759
9	375	48.16666667	42.81481481	2226.37037	4927.45	7153.82037
10	400	45.375	40.33333333	2097.333333	4641.8625	6739.195833
11	1000	21.16	18.80888889	978.0622222	2182.125	3160.187222

Sr No.	SBC (Kn/m²)	L (m)	B (m)	D (m)	Concrete Quantity (m³)
1	100	3.5	3.5	0.345	4.22625
2	200	2.47	2.47	0.34	2.074306
3	225	2.33	2.33	0.34	1.845826
4	250	2.21	2.21	0.34	1.660594
5	275	2.1	2.1	0.34	1.4994
6	300	2.01	2.01	0.33	1.333233
7	325	1.94	1.94	0.33	1.241988
8	350	1.85	1.85	0.33	1.129425
9	375	1.76	1.76	0.325	1.00672
10	400	1.7	1.7	0.325	0.93925
11	1000	1.11	1.11	0.29	0.357309

Sr No.	SBC (Kn/m²)	For L			For B		
		Bar Diameter (mm)	Spacing (mm)	No	Bar Diameter (mm)	Spacing (mm)	No
1	100	16	180	19	16	180	19
2	200	16	190	13	16	190	13
3	225	16	190	12	16	190	12
4	250	16	195	11	16	195	11
5	275	16	195	11	16	195	11
6	300	16	195	10	16	195	10
7	325	16	200	10	16	200	10
8	350	16	200	9	16	200	9
9	375	16	200	9	16	200	9
10	400	16	205	8	16	205	8
11	1000	16	230	5	16	230	5

Sr No.	SBC (Kn/m²)	Total L (m)	Weight (Kg)	Cost of steel (Rs.)	Cost of Concrete (Rs.)	Total cost (Rs.)
1	100	136.1111111	215.0891632	11184.63649	23244.375	34429.01149
2	200	64.22	57.08444444	2968.391111	11408.683	14377.07411
3	225	57.14631579	50.79672515	2641.429708	10152.043	12793.47271
4	250	50.09333333	44.52740741	2315.425185	9133.267	11448.69219
5	275	45.23076923	40.20512821	2090.666667	8246.7	10337.36667
6	300	41.43692308	36.83282051	1915.306667	7332.7815	9248.088167
7	325	37.636	33.45422222	1739.619556	6830.934	8570.553556
8	350	34.225	30.42222222	1581.955556	6211.8375	7793.793056
9	375	30.976	27.53422222	1431.779556	5536.96	6968.739556
10	400	28.19512195	25.06233062	1303.241192	5165.875	6469.116192
11	1000	10.71391304	9.523478261	495.2208696	1965.1995	2460.42037

Design Tables For 45m Height Microwave Tower

Sr No.	SBC (Kn/m²)	L (m)	B (m)	D (m)	Concrete Quantity (m³)
1	100	3.84	3.84	0.385	5.677056
2	200	2.8	2.8	0.425	3.332
3	225	2.7	2.7	0.395	2.87955
4	250	2.55	2.55	0.395	2.5684875
5	275	2.45	2.45	0.395	2.3709875
6	300	2.34	2.34	0.395	2.162862
7	325	2.3	2.3	0.395	2.08955
8	350	2.2	2.2	0.4	1.936
9	375	2.15	2.15	0.4	1.849
10	400	2.1	2.1	0.4	1.764
11	1000	1.4	1.4	0.39	0.7644

Sr No.	SBC (Kn/m²)	For L			For B		
		Bar Diameter (mm)	Spacing (mm)	No	Bar Diameter (mm)	Spacing (mm)	No
1	100	16	150	26	16	150	26
2	200	16	155	18	16	155	18
3	225	16	155	17	16	155	17
4	250	16	155	16	16	155	16
5	275	16	155	16	16	155	16
6	300	16	155	15	16	155	15
7	325	16	155	15	16	155	15
8	350	16	160	14	16	160	14
9	375	16	160	13	16	160	13
10	400	16	160	13	16	160	13
11	1000	16	160	9	16	160	9

Sr No.	SBC (Kn/m²)	Total L (m)	Weight (Kg)	Cost of steel (Rs.)	Cost of Concrete (Rs.)	Total cost (Rs.)
1	100	196.608	310.6891852	16155.83763	31223.808	47379.64563
2	200	101.1612903	89.92114695	4675.899642	18326	23001.89964
3	225	94.06451613	83.61290323	4347.870968	15837.525	20185.39597
4	250	83.90322581	74.58064516	3878.193548	14126.68125	18004.8748
5	275	77.4516129	68.84587814	3579.985663	13040.43125	16620.41691
6	300	70.65290323	62.80258065	3265.734194	11895.741	15161.47519
7	325	68.25806452	60.67383513	3155.039427	11492.525	14647.56443
8	350	60.5	53.77777778	2796.444444	10648	13444.44444
9	375	57.78125	51.36111111	2670.777778	10169.5	12840.27778
10	400	55.125	49	2548	9702	12250
11	1000	24.5	21.77777778	1132.444444	4204.2	5336.644444

IV. CONCLUSION

- Design tables for isolated square footing which can be used as ready reckoner are available as finally given in table.

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