CIVIL WORK ITEMS IN TELECOMMUNICATIONS

Shvan A. Mohammed

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INTRODUCTION

Telecommunications:

Telecommunications refers to the transmission of information over long distances through various technologies. This information can be in the form of voice, data, text, images, or video. It has revolutionized the way we communicate, interact, and conduct business, shrinking the world and bringing people closer than ever before.

Civil work items in telecommunications:

Civil work items in telecommunications encompass a wide range of activities involved in the construction, installation, and maintenance of telecommunications infrastructure.

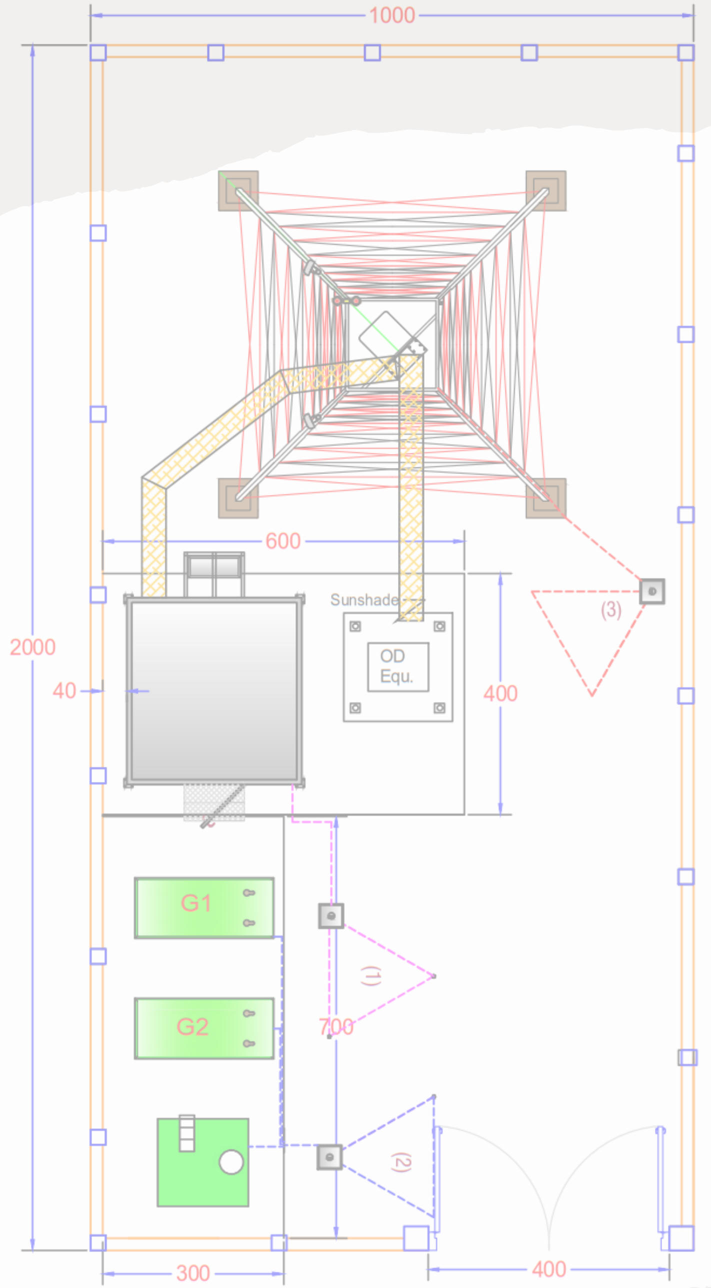
Civil work items and activities

ITEMS

- Concrete foundations
- Site Tower + Accessories
- Site Fence (Concrete block / Wire fence)
- Equipment Room / Cabinet
- Concrete slabs for power soluction

Activities

- Soil test or Load study
- Excavation works
- Tower installation
- Concrete and masonary works
- Health check and Tower maintenance



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TYPES OF TELECOMMUNICATION TOWER

Greenfield Towers (Self support towers, Monopole towers)

Self Supporting Towers are used for all telecommunication applications and comply with almost all types of customer demands. The standard self-supporting towers are angular or tubular with 3 or 4 legs, or monopole towers. Angular towers are mainly 4 leg towers manufactured from Angular profiles. Triangular towers are mainly fabricated with tubular 60° angular or polygonal leg members and angular or tubular bracing members. Monopole Towers are designed in polygonal and circular cross section as a single piece up to 12 meters in length and as multiple pieces.

Rooftop Towers (Poles, Guyed wire, Mast towers)

Roof Top Towers and Poles are usually installed on buildings in dense areas. They are supplied in triangular or square form as penetrating and non-penetrating type rooftop lattice towers varying from 3m to 21 m in height, or poles ranging from 2m to 12m in height. They can be fixed directly to the roof by means of chemical anchoring system, or anchors embedded in a rooftop foundation. Towers can also be designed with supports or as guyed masts.

TYPES OF TELECOMMUNICATION TOWER

COW Site Towers

Cell on Wheels (CoW) is a portable cell tower that is easily deployed and retrieved. It includes a cellular antenna, transceiver device, battery, and other necessary equipment required to provide a stable wireless mobile network as needed. All these platforms are mounted over vehicles such as trucks or trailers, which makes the entire setup portable or, as they say, “on-wheels.”

Camouflage Towers

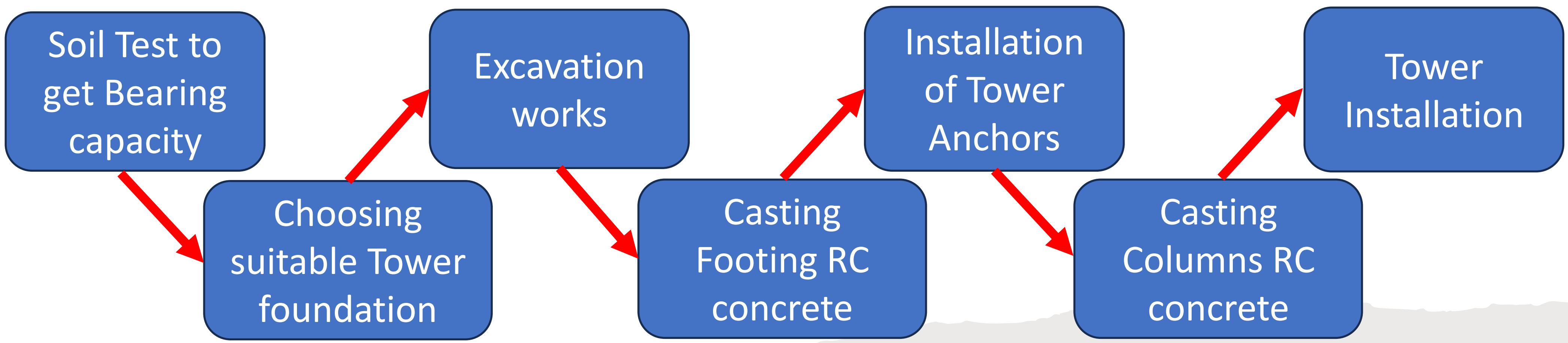
The Camouflage Cell Towers is to coordinate the communication tower with the surrounding natural environment, effectively solving the problem of difficult construction in scenic spots and other places.

TYPES OF TELECOMMUNICATION TOWER

Greenfield Towers (Self support towers, Monopole towers)

A self-supporting tower, also known as a free-standing tower, is a tower that does not require external support to stand upright. This type of tower is designed to be self-sufficient and able to withstand its own weight and the weight of the equipment it supports. Self-supporting towers are commonly used in areas where there is limited space or where it is not possible to use guy wires for support.

Steps of Installation:



TYPES OF TELECOMMUNICATION TOWER

condition, laboratory test results and Dynamic allowable bearing capacity of 105 kN/m^2

Steps of Tower Installation: Soil Test to get Bearing capacity

Borelog

Depth (m)	Graphic Log	Soil Description	Depth (m)	DCP cm/10 blows
0.5			0.5	
1.0		Darkish clay	1.0	11.0 cm
1.5			1.5	
2.0			2.0	6.0 cm
2.5			2.5	
3.0		Brown clay with little carbonate	3.0	6.0 cm
3.5			3.5	
4.0	End of pit		4.0	6.0 cm
4.5			4.5	
5.0			5.0	

DCP= Dynamic Cone Penetration Test

Photo of sampling

Test result & Recommendations

8. RECOMMENDATIONS

8.1 Type of footings

According to the proposed project, which is the communication tower, and depending on the loading condition and structural analysis with recommended value of allowable bearing capacity, either single column footing under each leg or raft foundation under all legs of the tower can be used.

8.2. Depth of Footings

It is recommended to place the footings at a sufficient depth of **1.50 m or more**.

8.3 Allowable Bearing Capacity

According to the sub-soil condition, laboratory test results and Dynamic Cone Penetration (DCP), **the allowable bearing capacity of 105 kN/m^2 (10.5 ton/m^2) (2.19 ksf)** can be considered in designing of the foundations.

8.4 Groundwater

No groundwater was encountered up to end of boring (4.0 m) below the ground surface. So no construction problems due to groundwater will be anticipated.

8.5. Expansive Soil

The cohesive soil in this site is classified as a medium expansive soil. Therefore, problem of swelling is anticipated. The following precautions are suitable for the situation of this site and needed to be taken during construction of the foundations:

1- **The foundation soil should be protected from wetting, especially if the construction is done during the winter. In this case the foundation structure should be cast as soon as possible after excavation of the soil, because increasing moisture content of the foundation soil before casting the foundation will cause heave of the soil, which causes the soil to be more compressible.**

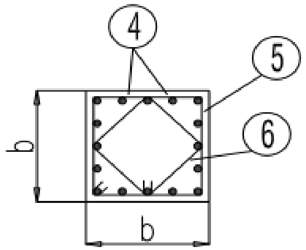
TYPES OF TELECOMMUNICATION TOWER

Steps of Tower Installation: Choosing suitable Tower foundation

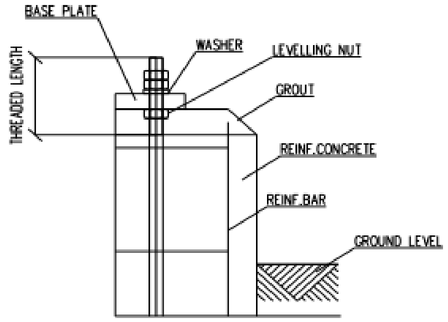
Pose No	Diameter	Detailed Dimensions	a (mm)	b (mm)	Length (mm)	For One Footing: Number	For One Footing: Weight (kg)	Total (4 Footings): Number	Total (4 Footings): Weight (kg)	Total Weight (kg)
1	Ø16	a b a	250	3250	3750	18 x 2	213	144	852	2274
2	Ø16	a b a	250	3250	3750	18 x 2	213	144	852	
3	Ø10	b a b a b	250	300	1400	6	5	24	21	
4	Ø20	a b	320	2250	2570	16	101	64	406	
5	Ø10	a b a b a a	500	50	2100	16	21	64	83	
6	Ø10	a a a b b a	354	50	1514	16	15	64	60	

S (m)	L (m)	b (m)	t_f (m)	t_s (m)	t_{cs} (m)	t_{pp} (m)	L_1 (m)	L_2 (m)
5.10	3.40	0.65	0.40	1.75	0.25	0.10	8.50	1.7

Excavation (m^3)	Reinforced Concrete (m^3)	Lean Concrete (m^3)	Reinforcement (kg)
116.6	21.9	5.2	2274



SECTION A-A

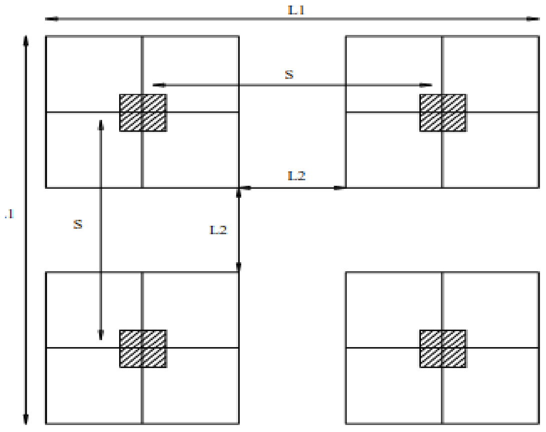


ANCHORAGE DETAIL

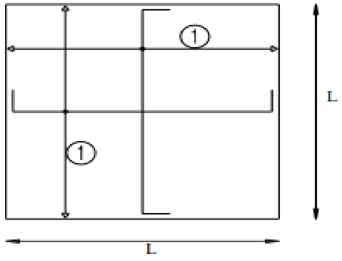
NOTES

1) Concrete clear cover will be taken as 75mm.
2) L1 and L2 are given according to the reinforced concrete, not plain concrete.
3) The allowable bearing capacity of the soil is 100kPa.
4) Material : Concrete = C25
   Reinforcement = S420

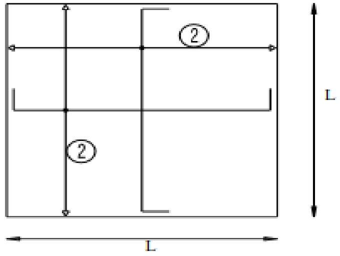
The allowable bearing capacity of the soil is 100kPa.



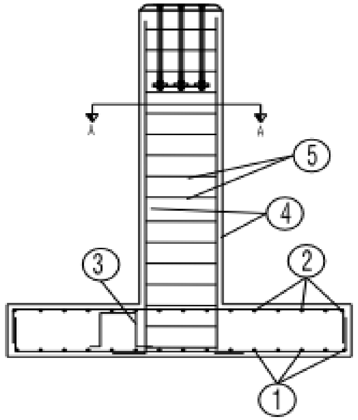
FOUNDATION PLAN



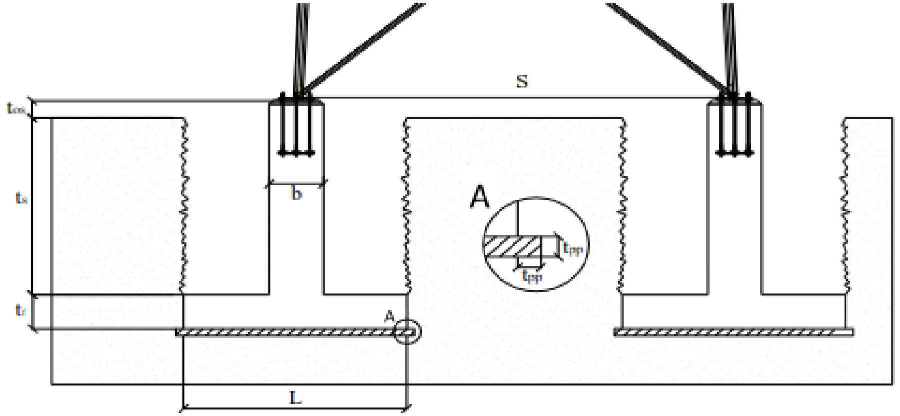
FOUNDATION BOTTOM REINFORCEMENT



FOUNDATION TOP REINFORCEMENT



REINFORCEMENT PLAN



FOUNDATION CROSS SECTION

TYPES OF TELECOMMUNICATION TOWER

Steps of Tower Installation: Excavation works

TYPES OF TELECOMMUNICATION TOWER

Steps of Tower Installation: **Casting Footing RC concrete**

1. Levelling footing base.
2. Casting Lean Concrete.
3. Renforcement works based on the drawings.
4. Installation of Anchor bolts with special template.
5. Casting footing Concrete.

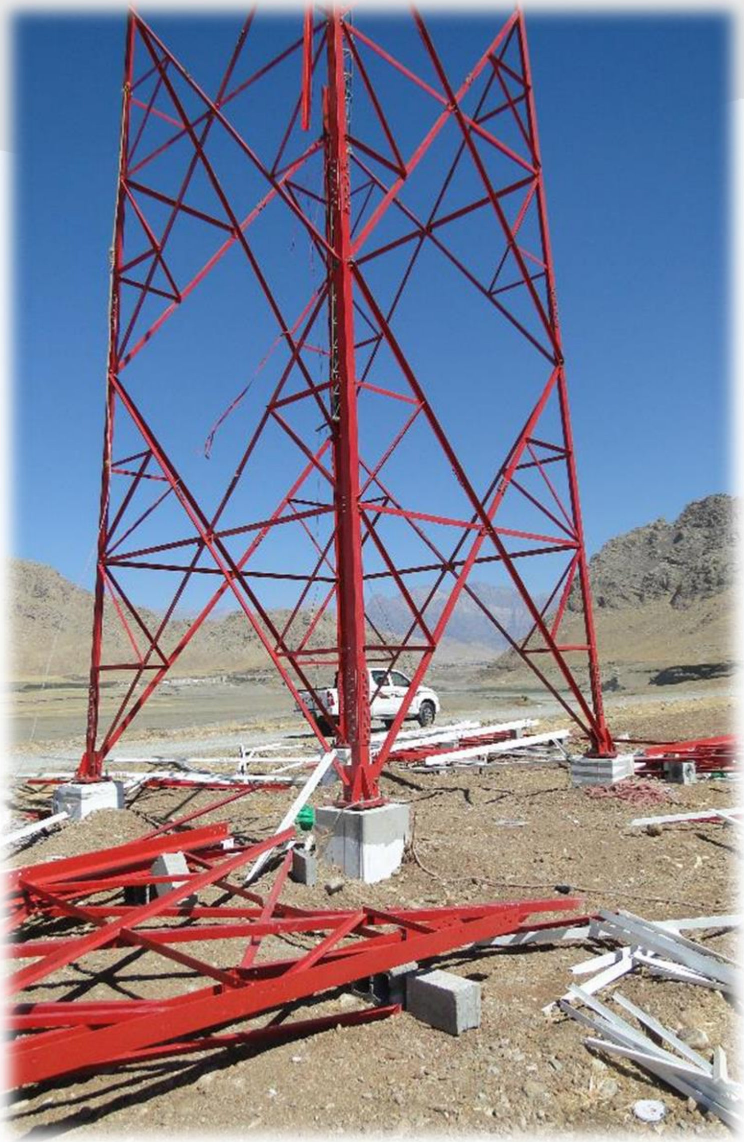
TYPES OF TELECOMMUNICATION TOWER

Steps of Tower Installation: **Casting Columns RC concrete**

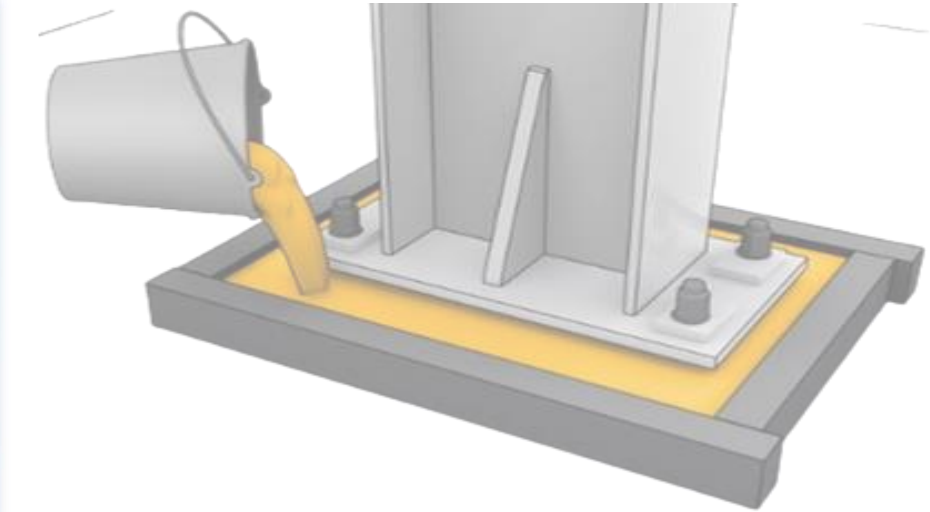
After backfillling, the footing will be ready for tower installation

TYPES OF TELECOMMUNICATION TOWER

Steps of Tower Installation: Tower Installation



Grouting of the remained space between the Column and tower base plate is necessary.



Special materials with high compressive strength need to be used for the grouting purpose.

Site Fence and other civil items:

Equipment shelter installation with cable run to the tower

Concrete pad for Equipment shelter 30 cm thick

Site Landiscaping and Gravel spreading with 5-10 cm

Barbed wire for site security

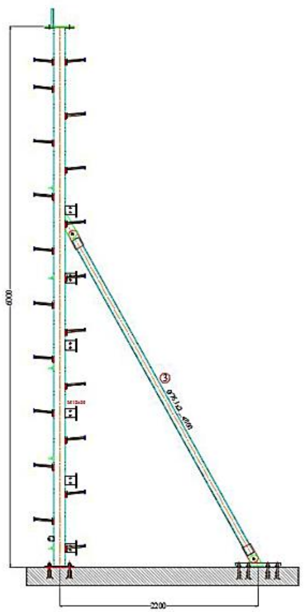
Site Fence

Health check and tower maintenance

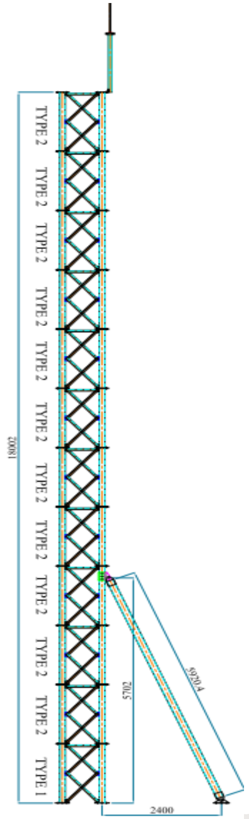
As the tower are steel structures and includes member and nodes which are mechanical connections, and wind load is the most critical load that effects tower stability, which need to be considered before installation of any additional item to the tower with considering the tower capacity against wind load.

Mainly towers can be classified as below, in the term of capacity against wind load
(this classification is in general view and can be changed based on the design requirement)

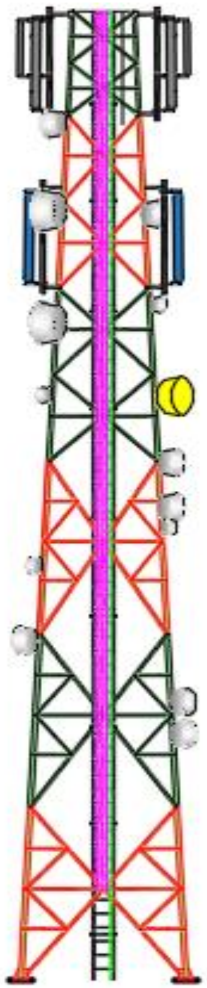
Tower type	Tower Height range in m	Capacity in m^2 on top of tower
Rooftop poles	3 – 9	1 - 3
Rooftop Towers	12 – 21	5
Self support Towers	24 – 100	5 - 25



Pole



RT Tower



Self support Tower

Health check and tower maintenance

How to Calculate Wind Load → Calculating Wind Load Using the Generic Formula

- ✓ The generic formula for wind load is **F = A x P x Cd** where **F** is the force or wind load, **A** is the projected area of the object, **P** is the wind pressure, and **Cd** is the drag coefficient. This equation is useful for estimating the wind load on a specific object,
- ✓ wind pressure P: **$P=0.613\ V^2$** where **V** is the speed of the wind in m/s
- ✓ Drag is the force that air exerts on the building, affected by the building's shape, the roughness of its surface, and several other factors. Engineers typically measure drag directly using experiments, but for a rough estimate you can look up a typical drag coefficient for the shape you are measuring.

•The standard drag coefficient for a long cylinder tube is 1.2 and for a short cylinder is 0.8. These apply to antenna tubes found on many buildings.
•The standard coefficient for a flat plate such as the face of a building is 2.0 for a long flat plate or 1.4 for a shorter flat plate.
•The drag coefficient has no units.

Health check and tower maintenance

Tower bolt check for tightening with Torque-meter

All the bolts of the tower structure need to be checked minumum one time yearly to know the degree of its tightening which can be measured with torque wrench.

The torque of each bolt can be determined based on the bolt material and the size of the bolt which can be found in below table:

Thread, d	Nominal Diameter, mm	Bolt (Hex) Head size, mm	Properity Class							Properity Class						
			4.6	4.8	5.6	5.8	6.8	8.8	10.9	4.6	4.8	5.6	5.8	6.8	8.8	10.9
			Recommended tightening torques, Nm							Recommended tightening torques, ft-lb						
M3	3	5.5														
M4	4	7														
M5	5	8														
M6	6	10														
M7	7	11														
M8	8	13	8	9	10	11	12	16	21	6	7	7	8	9	12	15
M10	10	17	16	17	20	21	24	32	42	12	13	15	15	18	24	31
M12	12	19	28	30	35	37	43	59	74	21	22	26	27	32	44	55
M14	14	22	45	47	56	59	68	94	118	33	35	41	44	50	69	87
M16	16	24	70	74	88	91	105	146	183	52	55	65	67	77	108	135
M18	18	27	97	102	121	126	145	200	252	72	75	89	93	107	148	186
M20	20	30	137	144	171	178	206	284	357	101	106	126	131	152	209	263
M22	22	32	186	196	234	243	280	388	485	137	145	173	179	207	286	358
M24	24	36	237	249	296	309	356	492	617	175	184	218	228	263	363	455
M27	27	41	348	365	435	452	520	720	902	257	269	321	333	384	531	665
M30	30	46	470	496	588	613	708	979	1,224	347	366	434	452	522	722	903
M33	33	50	642	675	802	834	961	1,331	1,668	474	498	592	615	709	982	1230
M36	36	55	824	864	1,028	1,071	1,235	1,709	2,142	608	637	758	790	911	1260	1580
M39	39	60	1,065	1,119	1,332	1,387	1,600	2,211	2,785	786	825	982	1023	1180	1631	2054

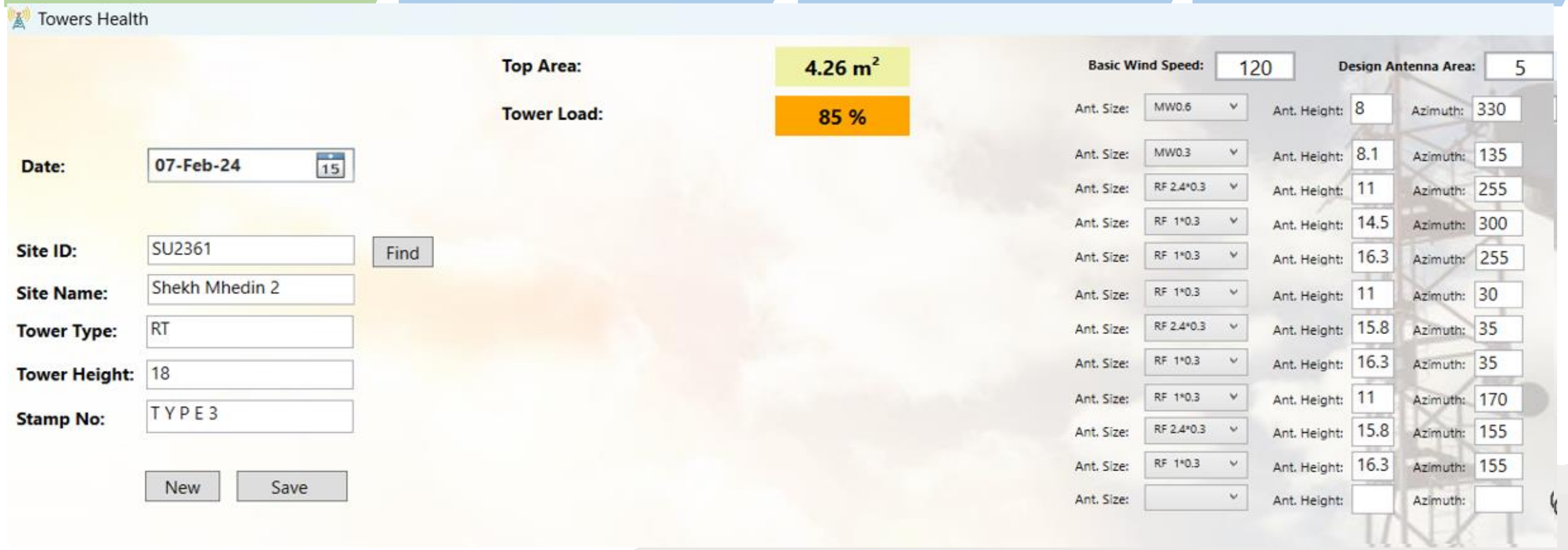
Health check and tower maintenance

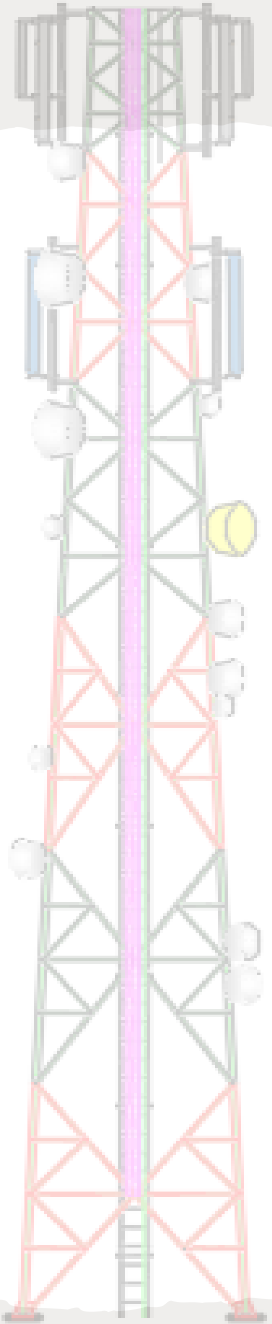
Tower checking for the load of installed equipment vs tower capacity

To Determine the load on tower that needs to be compared to the designe capacity of the site tower, it needs to collect below information and to be used to find the current load on the tower, then it needs to be converted to a load on the top of the tower, as the designed capacity of the tower considers that the euipments installed on top.

Tower information → Manfufacture tower stamp → Tower Height → Designed capacity

Installed Equip. information → Equip. Size → Equip. Height → Equip. Azimuth





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Thank You