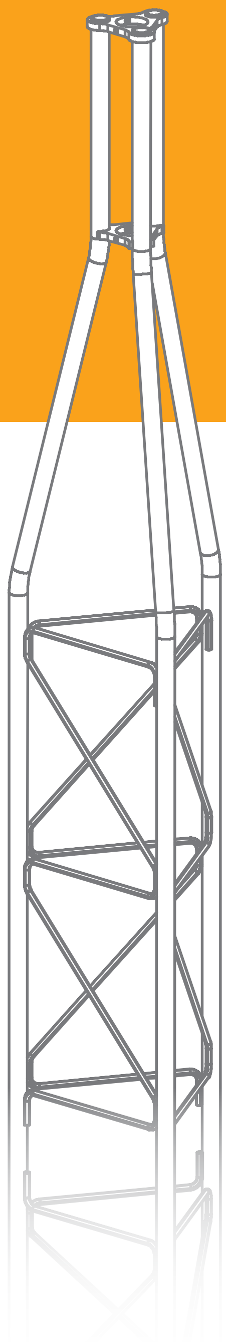
Televes®



M360

EN GUY WIRED TOWERS

Mounting instructions

www.televes.com

Televes®

WARNING

Trestle-tower installations should only be calculated and constructed by specialized professionals as these fall under their responsibility; the mounting instructions provided in this technical sheet are intended for information only, and the data given does not, in any way, affect the responsibility of the manufacturer who only guarantees his own products, provided that they are used under normal conditions.

It will be necessary to conduct a project to install the tower for each specific site, which should take into account both the individual stresses and the recalculation of foundations in accordance with the relevant geotechnical study.

The towers will be assembled by competent personnel and skilled in climbing, using all means of protection required to safeguard the security in vertical works. Remember that international legislation requires for any structure higher than 3m a climber safety device.

The use of Televes tower sections with non-Televes products may cause tower failure and even personal injury.

Televes is not responsible of the misused of its products.

1. Location

The calculations shall be made for a generic site, in conditions where the wind speed can reach 160 km / h, and considering an ice sleeve of 1 cm diameter for a wind speed of 75 Km/h.
It has also been considered acceptable a ground resistance of 1.5 Kg/cm^2 (normal compact ground).

Definitions:
Basic wind speed: The average speed of instantaneous speeds (peak gusts) measured at intervals of time T = 3s, in open exposure (exposure C) at the reference height Z = 10m which has a probability of being exceeded once in 50 years.
Exposure C: Is an open terrain with scattered obstacles which height is generally less than 9.1 m. This category includes flat, open country and grasslands and shorelines in hurricane-prone areas.

2. Regulations applied

The legislation that has been the basis for the calculation is as follows:

- Eurocodes 1, 2, 3
- Standard EHE-98 (Concrete)
- Standard TIA / EIA (1)-222-G.

3. The solution chosen

It has been considered standard steel structural tubes ST37-2, standard steel rods S275JR, and steel plate S235.
For the design, was chosen equal size of all sections of the tower in order to facilitate their manufacture and assembly on site.

4. Structural definition of the tower

The tower has a triangular base and is made up with standard sections of 3 m each.
Each section consists of:
- 3 tubular legs made of steel.
- Solid bracing rods, horizontal and inclined steel.

The horizontal section of the tower defines an equilateral triangle with side of 33 cm, which is the distance between legs.
Horizontal bracing rods are spaced 40 cm.
The lower section of the tower is pivoted on the base (see par. 12. - Technical Documentation).
The tower is guy wired with anchoring supports at 120 ° (see fig. 1)

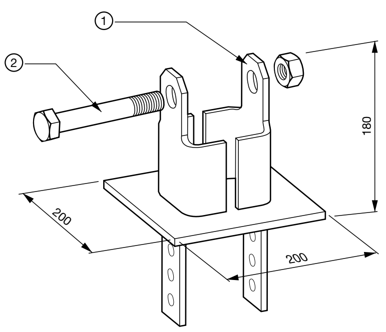
5. Tower mounting

Section by section mounting

This is done by fixing the lower section to the base and placing it in the upright position, ensuring that it is levelled. Next, are mounted the remaining intermediate sections, that should have the corresponding guy wires already fastened. The mounting process is carried out by climbing up the sections that have already been erected and then lifting the next section that is to be fixed with the adequate lifting equipment.
The climb up the trestle-tower should be carried out using the adequate safety measures (safety belt, anchorages, etc.) and no more than two consecutive sections should be erected without being secured by guy wires.
When two sections without guy wires have to be erected consecutively, auxiliary guy wires should be used to secure the sections while they are being mounted.
The tower should be continuously levelled via the adjustment of the guy wire tension and the use of the appropriate levelling equipment.

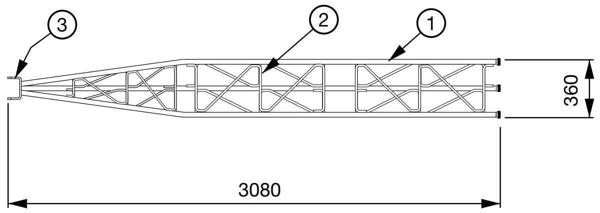
6.- Reference description

Reference	**3088**
Description	Pivoting base for towers M360
Material	(1) Steel S235, 8 mm thickness plate R_e min. 235 N/mm^2 R_n min. 340 N/mm^2 (2) Steel - M24.
Finishing	Galvanised 10 ± 1µm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Weight	5,6 Kg

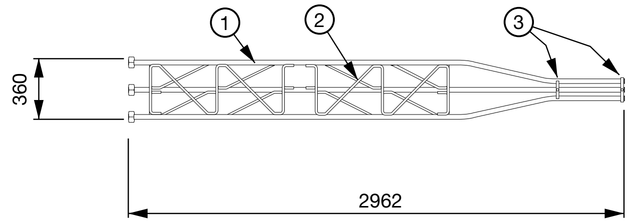


(1) TIA = Telecommunications Industry Association
EIA = Electronic Industrials Association 5.- TOWER MOUNTING

Reference	3086
Description	Lower section M360
Material	(1) Steel ST 37-2 Ø 30 x 2 mm thickness $R_{e\ min}$: 235 N/mm² - $R_{n\ min}$: 360/510 N/mm² (2) Steel S 275 JR Ø 9 mm $R_{e\ min}$: 275 N/mm² - $R_{n\ min}$: 410/560 N/mm² (3) Steel S235, 10 mm thickness plate $R_{e\ min}$: 235 N/mm² - $R_{n\ min}$: 340 N/mm²
Weight	25 Kg
Finish *	Galvanised 10 ± 1μm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,355 m² x 1,2 (coefficient) = 0,426 m²



Reference	3085
Description	Upper section tower M360
Material	(1) Steel ST 37-2 Ø 30 x 2 mm thickness $R_{e\ min}$: 235 N/mm² - $R_{n\ min}$: 360/510 N/mm² (2) Steel S 275 JR Ø 9 mm $R_{e\ min}$: 275 N/mm² - $R_{n\ min}$: 410/560 N/mm² (3) Steel S235, 10 mm thickness plate $R_{e\ min}$: 235 N/mm² - $R_{n\ min}$: 340 N/mm²
Weight	23 Kg
Finish *	Galvanised 10 ± 1μm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,333 m² x 1,2 (coefficient) = 0,40 m²



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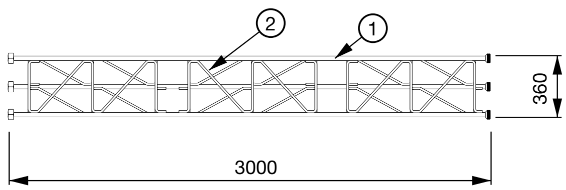
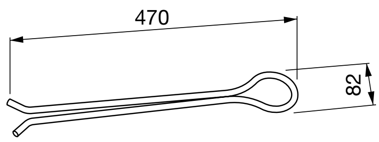
Reference	3087
Description	Middle section tower M360
Material	(1) Steel ST 37-2 Ø 30 x 2 mm thickness $R_{e\ min}$: 235 N/mm² - $R_{n\ min}$: 360/510 N/mm² (2) Steel S 275 JR Ø 9 mm $R_{e\ min}$: 275 N/mm² - $R_{n\ min}$: 410/560 N/mm²
Weight	25 Kg
Finish *	Galvanised 10 ± 1μm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,365 m² x 1,2 (coefficient) = 0,438 m²



Reference	3058
Description	Guy wire anchoring ring
Material	Steel S235 - Ø 10 mm
Weight	0,6 Kg



* These sections are available in the red and white aeronautical colors, to comply with the ICAO standards (International Civil Aviation Organisation).

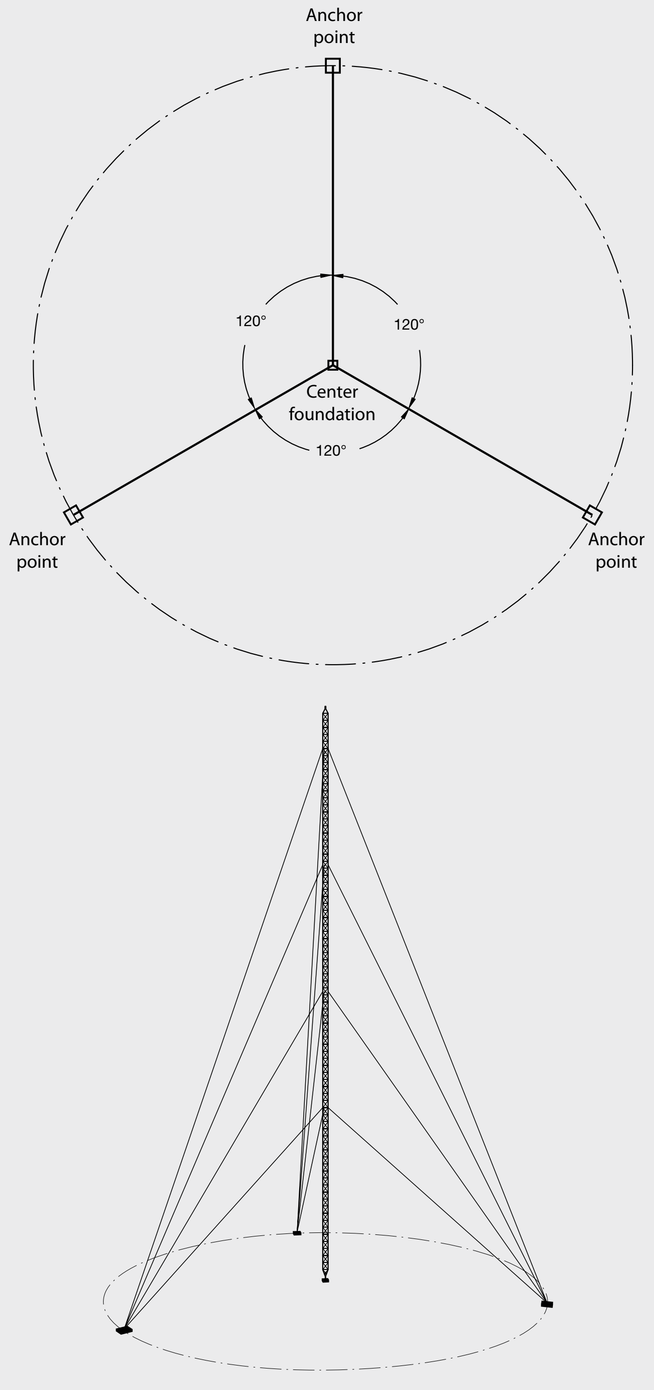
7. Foundations

The foundations (which are indicated just for guidance) are estimated for a soil resistance of 1.5 Kg/cm^2, although could be accepted a soil resistance of 1Kg/cm^2.

The concrete must have a minimum resistance of 15 N/mm2 (HA-25), and the work control level is estimated as reduced.

Each concrete footing will bear steel reinforcement on top and bottom..

Depending on the specific site, geotechnical study and level of control, the calculations should be reconsidered.



Arrangement of foundations

Fig. 1

The illustration is made just as an example.
Each facility will be subject to a customized assessment.

Foundation of the tower base

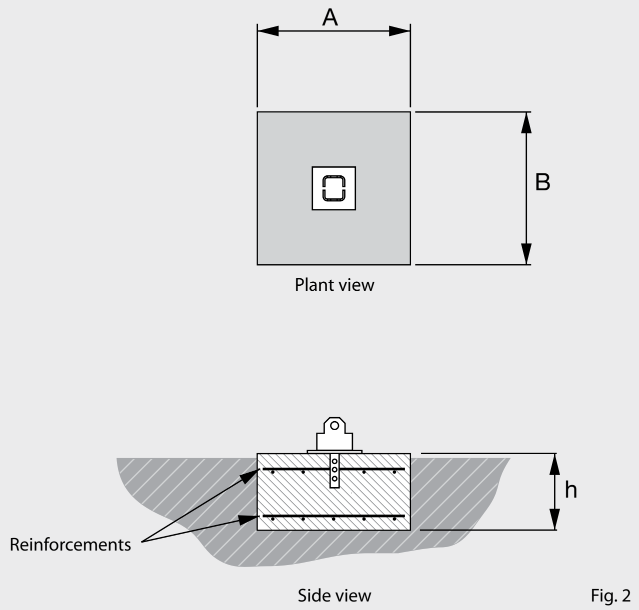
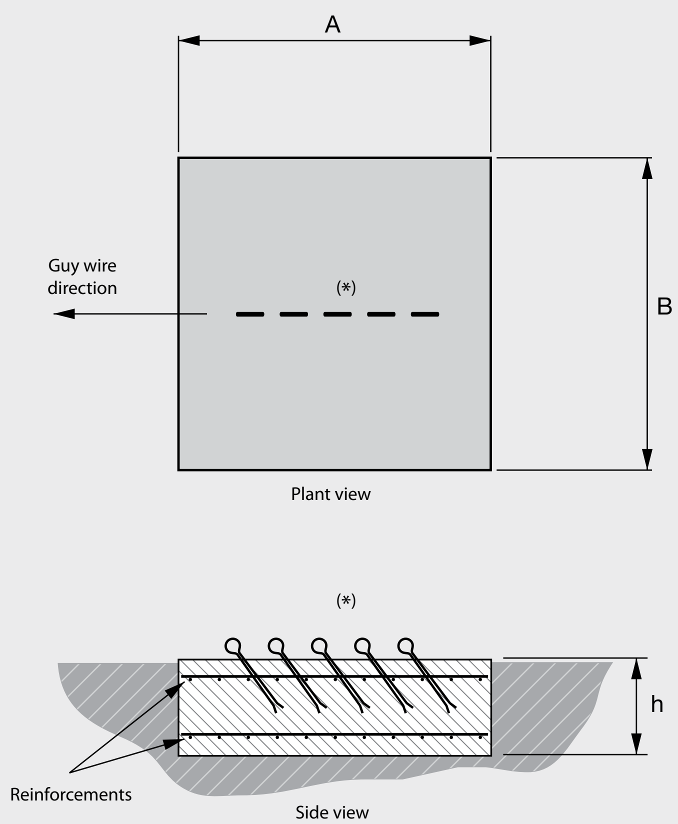


Fig. 2

Foundation for guy wire anchoring ring



(*) It wil be used an anchoring ring per guy wire

Fig. 3

Foundation details

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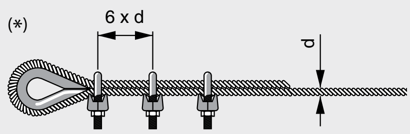
FOUNDATIONS CHART (just for guidance)								
Tower height (m)	Tower base foundation				Anchor ring foundation			
	Width "A" (cm)	Width "B" (cm)	Height "h" (cm)	Reinforcement	Width "A" (cm)	Width "B" (cm)	Height "h" (cm)	Reinforcement
8,5	40	40	30	-	110	110	70	5 Ø 16 c/20
11,5	40	40	30	-	110	110	70	5 Ø 16 c/20
14,5	40	40	30	-	110	110	70	5 Ø 16 c/20
17,5	40	40	30	-	120	120	80	5 Ø 16 c/20
20,5	50	50	35	-	130	130	90	6 Ø 16 c/20
23,5	50	50	35	-	140	140	95	6 Ø 16 c/20
26,5	60	60	40	2 Ø 16 c/20	150	150	100	7 Ø 16 c/20
29,5	60	60	40	2 Ø 16 c/20	160	160	110	7 Ø 16 c/20
32,5	70	70	50	3 Ø 16 c/20	170	170	115	7 Ø 16 c/20
35,5	70	70	50	3 Ø 16 c/20	180	180	120	8 Ø 16 c/20
38,5	80	80	55	3 Ø 16 c/20	190	190	130	8 Ø 16 c/20
41,5	80	80	55	3 Ø 16 c/20	190	190	130	8 Ø 16 c/20
44,5	80	80	55	3 Ø 16 c/20	200	200	135	8 Ø 16 c/20
47,5	80	80	55	3 Ø 16 c/20	200	200	135	8 Ø 16 c/20

8. Stucture (Sections & Guy wires)



The guy wire clamps must be readjusted later after the first wire pull.
The body of the guy wire clamp must be mounted over the live end of the cable and all of them in the same position, as shown in the figure.

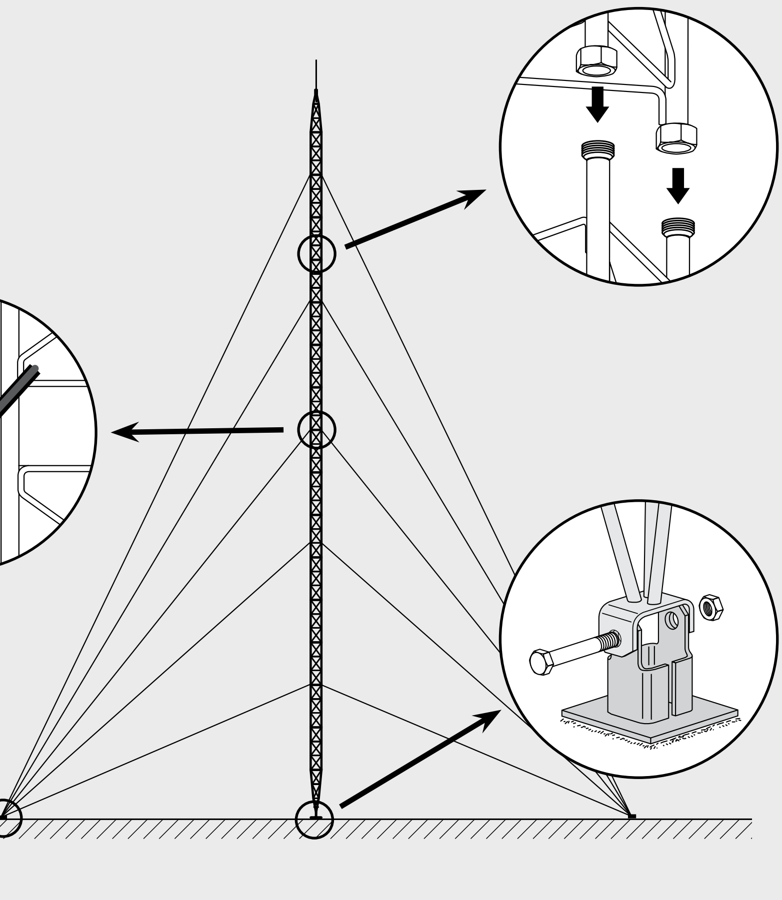


Fig. 4

- To avoid damaging the threaded joints between sections during handling, they are supplied with a nut attached to them. This nut is part of the fitting that joins and secures the sections each other.
- Once on erecting site and before mounting the tower, you must proceed to position these nuts in their proper place, on the opposite side of the section (see fig. 5).

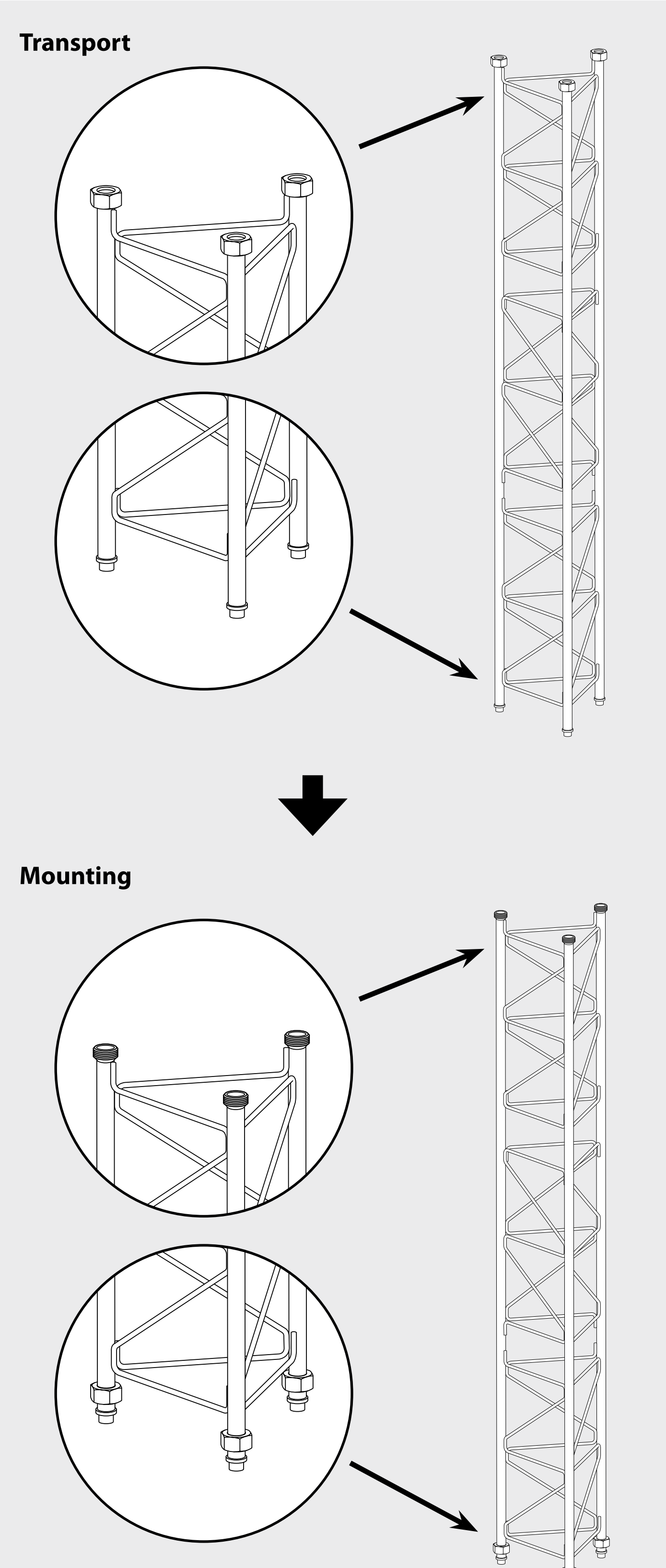


Fig. 5

Remove nuts from its current location.

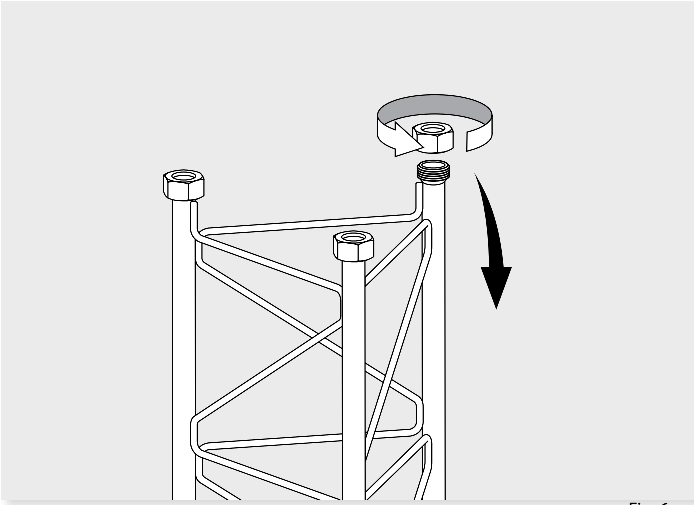


Fig. 6

Remove the allen screws and washers.

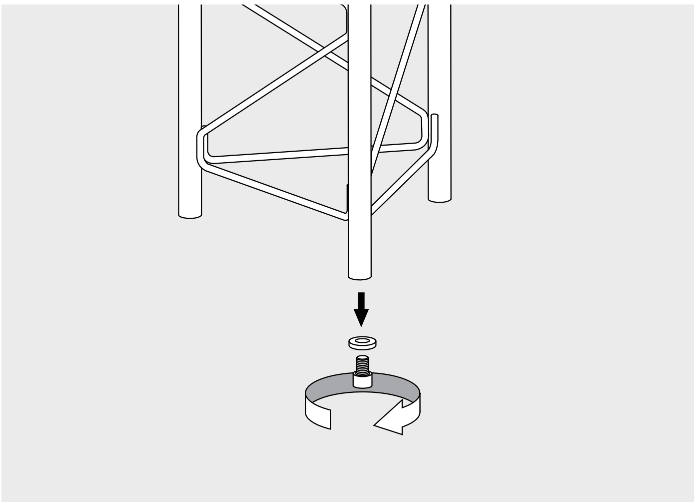


Fig. 7

Now, install the nuts, washers and allen screws at this end.

Torque: 400 Nm.

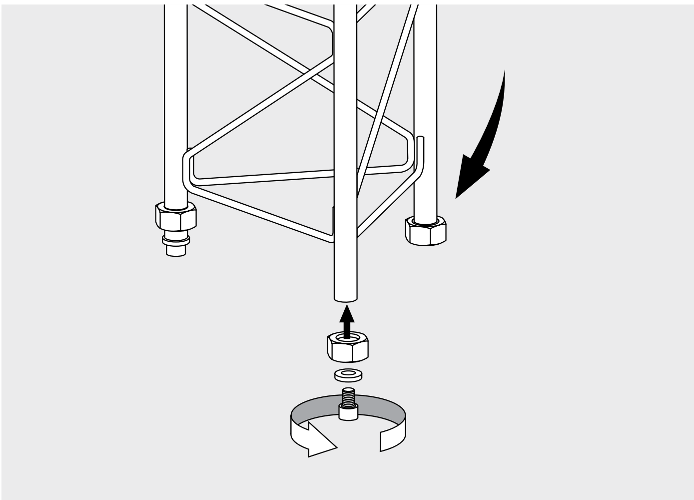


Fig. 8

9. Signaling

According to standards of the ICAO (International Civil Aviation Organization), the sections should be placed alternately in white and red aeronautical colors, being the ends of the tower in red, in order to be easily distinguished during the day.
The sections can be made by more than one element followed the same color, while maintaining the same ratio between the colors (red / white - red, red / white, white ... etc).
Towers that are in excess of 45m should also have a night lighting, consisting of three double red lights every 45m.

10. Important advice

In order to preserve the characteristics of the tower at a given site, it will require periodic inspection of the tension of the guy wires, and check tightness of bolts; for example, it is advisable do this between October 1 and January 1 of each year.
It is also recommended to check the whole structure after strong wind or ice storms or other extreme conditions.
Also, we recommend regular checking of the structure in areas of high concentration of salinity (shoreline areas) and areas with corrosive environments.

Will be discarded sections in which is appreciated deformations during transportation, assembly, dismantling or useful life of the tower.

It should be annual checks and repairs, if any, of all incidents reported.

- Misalignments and deformations.
- Check welds.
- Check painting.
- Check cable joints.
- Check cables.
- Cable tension (measurement *).

* The cable tension measure is subject to slight variations depending on the wind and temperature. Do not measure or adjust cables in high wind conditions.

11. How to measure guy wire tensions (Legislation)

This section provides guidelines to measure “in situ” the tension of the guy wires. There are two main methods: the direct and the indirect method.

Direct method (see figure 9)

A dynamometer (load cell) with an instrument for length adjustment, as a tensor, which is added to the guy wire system, and being attached to the turnstile just above it, and to the anchor point just below the turnstile.
Next, the turnbuckle is tensioned until the original turnstile begins to loosen. At this time, the dynamometer supports the entire load of the guy wire up the anchor point. Then, the tension of the guy wire can be measured directly on the dynamometer.
You can use this method to set the proper tension, adjusting the turnbuckle until you can read the proper tension on the dynamometer.
The control points are marked, one above the attachment point on the guy wire, and another on anchor point on the tower. This way, the control’ length can be measured. Then, remove the dynamometer and the turnbuckle; and the original turnstile is adjusted to maintain the previously measured length control.

Indirect methods

There are two common techniques for indirectly measuring the initial tension of the guy wires: the pulse method or oscillations (vibration) and the method of the intersection of the tangent or warping (geometric).

1. The pulse method (see figures 9 and 11)
Is applied a strong pull to the guy wire, near its anchor point, causing a wave or pulse that travels through the cable up and down. The first time that the pulse returns to the lower end of the guy wire, it starts a timer. Record the time it takes to return several times, and then the guy wire tension is calculated with the following formulas:

$$T_M = \frac{WLN^2}{5.94P^2}$$

$$T_A = \sqrt{\left(T_M - \frac{WV}{2L}\right)^2 + \left(\frac{WH}{2L}\right)^2}$$

where:
TA = Guy wire tension at the anchor, in newtons (N).
TM = Guy wire tension at the middle of its length, in newtons (N).
W = Total weight of the guy wire, including insulation, .. etc, in newtons(N).
L = Guy wire length, in meters (m).

$$L = \sqrt{H^2 + V^2}$$

H = Horizontal distance from the cable clamp on the tower and the guy wire anchor, in meters (m).
V = Vertical distance from the cable clamp on the tower and the guy wire anchor, in meters (m).
N = Number of complete oscillations or pulses measured in a period of P seconds.
P = Period of time measured in seconds, for N pulses or oscillations.

Instead of creating a pulse traveling up and down the cable winds, you can get the same result by making the cable winds swing freely from side to side while measuring the time to make N complete oscillations. The above formulas can also be used with this method.

2. Method of the intersection of the tangent or warping (see figure 10)
It is drawn an imaginary tangent line from the point where the guy wire end is anchored, towards the tower. This imaginary line intersects the tower at a given distance (intersection of the tangent) below the anchor point of the guy wire on the tower. This vertical distance between these two points is measured or estimated, and then the guy wire tension is calculated applying the formula:

$$T_A = \frac{WC\sqrt{H^2 + (V-I)^2}}{HI}$$

where:
C = Horizontal length measured from the anchor point of the guy wire on the tower to its center of gravity W, in meters (m).
I = Intersection of the tangent, in meters (m).

If the weight is distributed uniformly along the cable winds, C will be approximately equal to H/2. But, if the weight is not evenly distributed, the guy wire may be subdivided into segments, and following formula is applied.

$$T_A = \frac{S\sqrt{H^2 + (V-I)^2}}{HI}$$

where:

$$S = \sum_{i=1}^{N} W_i C_i$$

Wi = Weight of the segment **i**, in Newtons (**N**).
Ci = horizontal distance from the guy wire anchor point on the tower to the center of gravity of the segment, in meters (m).
N = number of segments.

If it is difficult to determine the point of intersection, it can be used the guy wire slope in its anchor point according to the following formula:

$$T_A = \frac{WC\sqrt{1+\tan^2\alpha}}{(V-H\tan\alpha)}$$

where:
α = guy wire angle on its anchor point (see figure 10)
$I = V - H\tan\alpha$

and

$$T_A = \frac{WC\sqrt{1+\tan^2\alpha}}{(V-H\tan\alpha)}$$

It can be substituted WC by S

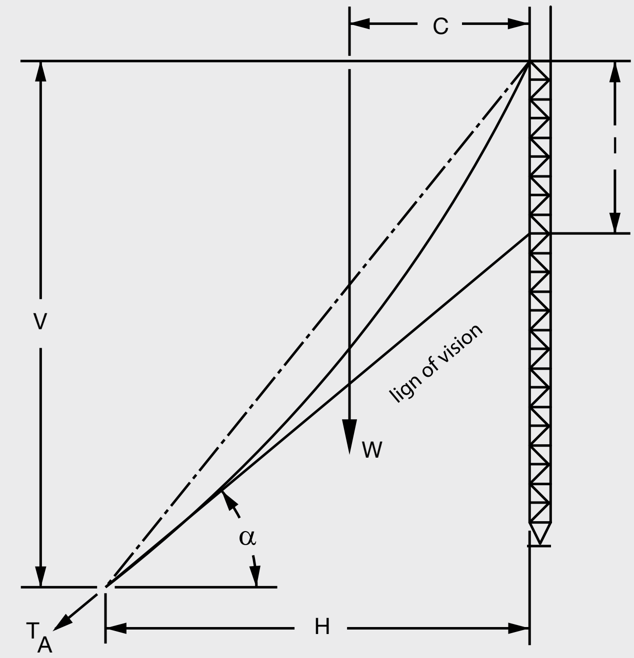
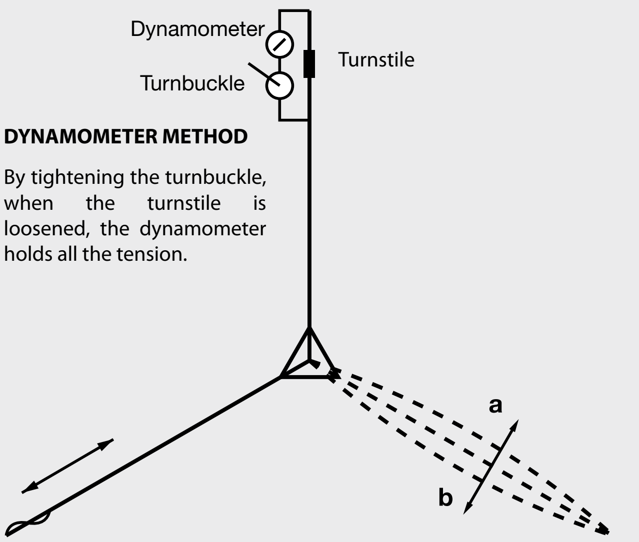


Fig. 10

Method of intersection of the tangents.



DYNAMOMETER METHOD

By tightening the turnbuckle, when the turnstile is loosened, the dynamometer holds all the tension.

PULSE METHOD

The pulse travels up and down the cable, **N** times within **P** seconds.

OSCILLATION METHOD

El cable oscillates **N** times from **a** to **b**, within **P** seconds.

Fig. 9

Method to measure the initial tension

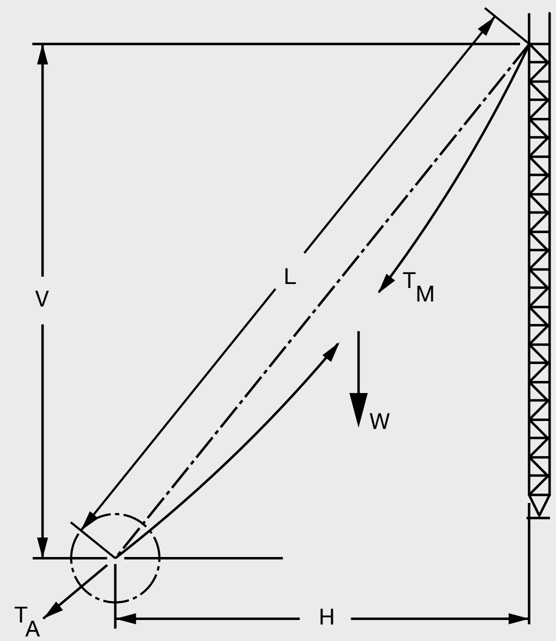


Fig. 11

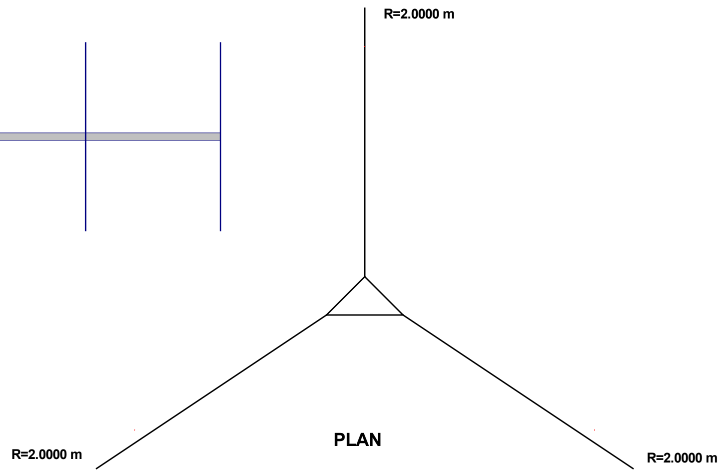
Ratio between the guy wire tension on its anchor point and on its half

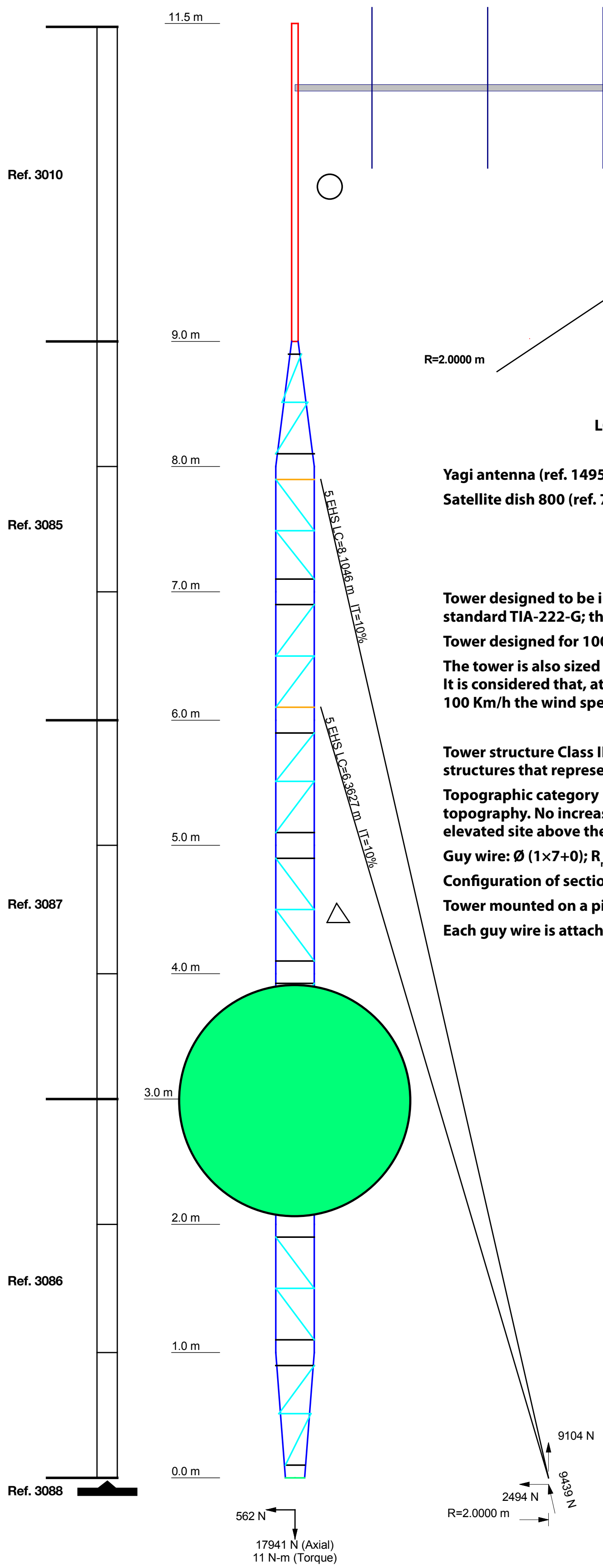
12. Technical information

Below are examples of mounting towers at various heights, calculated with specific software for the design of towers.

Note: For other mounting configurations (different heights, special conditions,... etc.), please request installation example.

Example of design for a tower of 11,5 m height.





LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

Satellite dish 800 (ref. 7901)

NOTES TO DESIGN THE TOWER

Tower designed to be installed in a wind loading area cathegory C (Exposure C), as per standard TIA-222-G; this is, flat, open country and grasslands.

Tower designed for 100 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 80 Km/h with a sleeve of ice 10 mm in diameter. It is considered that, at higher altitudes more ice. The deviations are taken into account over 100 Km/h the wind speed.

Tower structure Class II: Structures used for services that may be provided by other means or structures that represent a signicant hazard to human life and/or property.

Topographic category 1: Flat or rolling terrain with no abrupt changes in general topography. No increase in wind loading is required for this category. The height of the elevated site above the surrounding terrain is 0.0 m.

Guy wire: Ø (1×7+0); R_m > 17040 N; Initial tension: 10% R_m

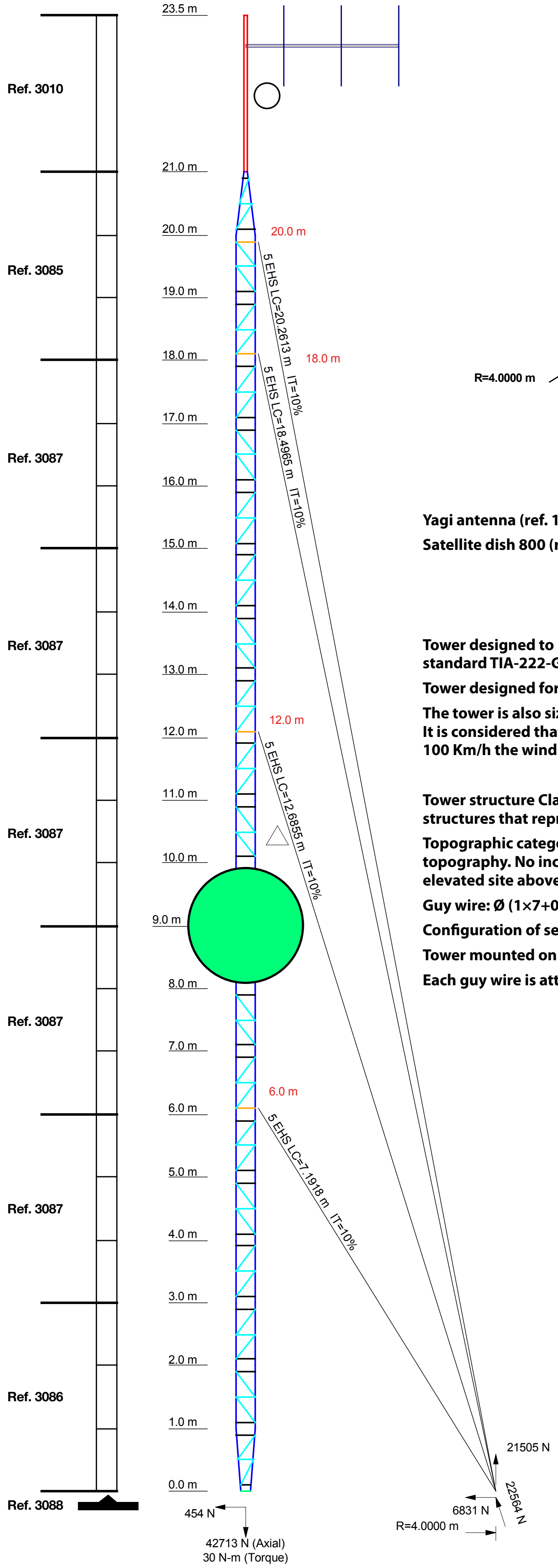
Configuration of sections: See references on the left margin.

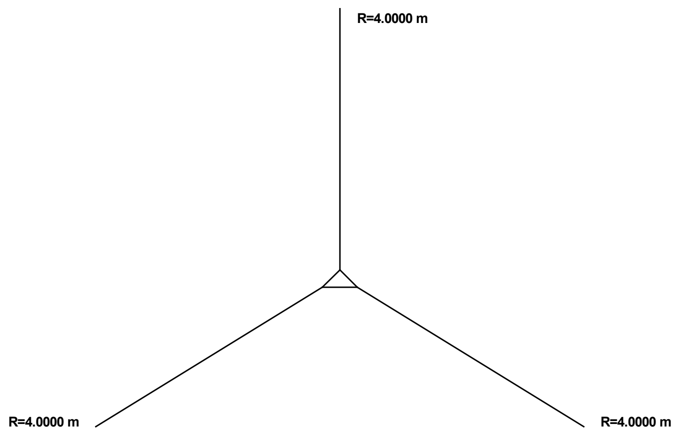
Tower mounted on a pivoting base, ref. 3056.

Each guy wire is attached to an anchor ring ref. 3058.

There are taken into account the reactions shown in the figure.

Example of design for a tower of 23,5 m height.





LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

Satellite dish 800 (ref. 7901)

NOTES TO DESIGN THE TOWER

Tower designed to be installed in a wind loading area cathegory C (Exposure C), as per standard TIA-222-G; this is, flat, open country and grasslands.

Tower designed for 100 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 80 Km/h with a sleeve of ice 10 mm in diameter. It is considered that, at higher altitudes more ice. The deviations are taken into account over 100 Km/h the wind speed.

Tower structure Class II: Structures used for services that may be provided by other means or structures that represent a signicant hazard to human life and/or property.

Topographic category 1: Flat or rolling terrain with no abrupt changes in general topography. No increase in wind loading is required for this category. The height of the elevated site above the surrounding terrain is 0.0 m.

Guy wire: Ø (1×7+0); R_m > 17640 N; Initial tension: 10% R_m

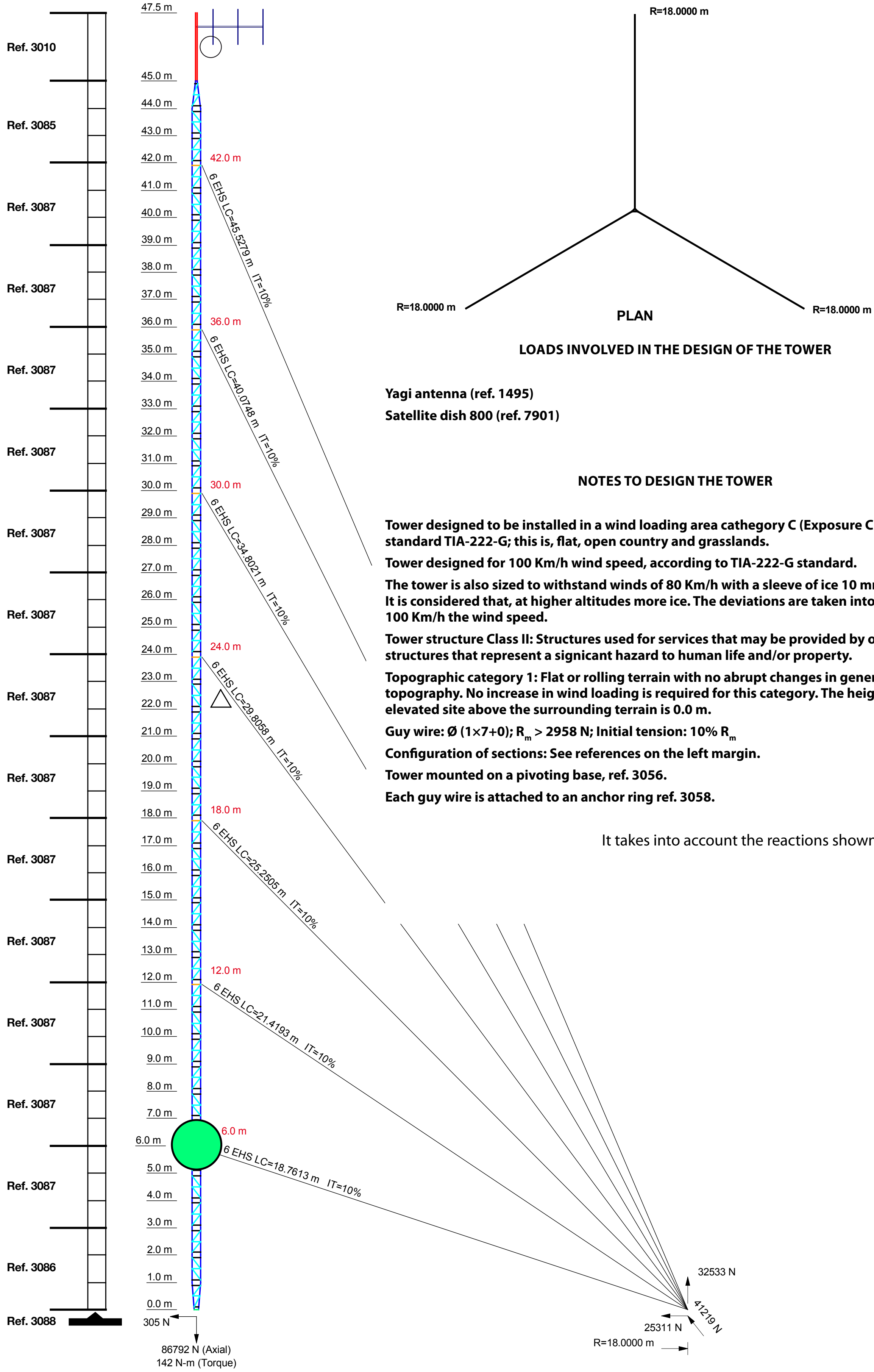
Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3056.

Each guy wire is attached to an anchor ring ref. 3058.

There are taken into account the reactions shown in the figure.

Example of design for a tower 47,5 m height.



PLAN

LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)
Satellite dish 800 (ref. 7901)

NOTES TO DESIGN THE TOWER

Tower designed to be installed in a wind loading area cathegory C (Exposure C), as per standard TIA-222-G; this is, flat, open country and grasslands.

Tower designed for 100 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 80 Km/h with a sleeve of ice 10 mm in diameter. It is considered that, at higher altitudes more ice. The deviations are taken into account over 100 Km/h the wind speed.

Tower structure Class II: Structures used for services that may be provided by other means or structures that represent a signicant hazard to human life and/or property.

Topographic category 1: Flat or rolling terrain with no abrupt changes in general topography. No increase in wind loading is required for this category. The height of the elevated site above the surrounding terrain is 0.0 m.

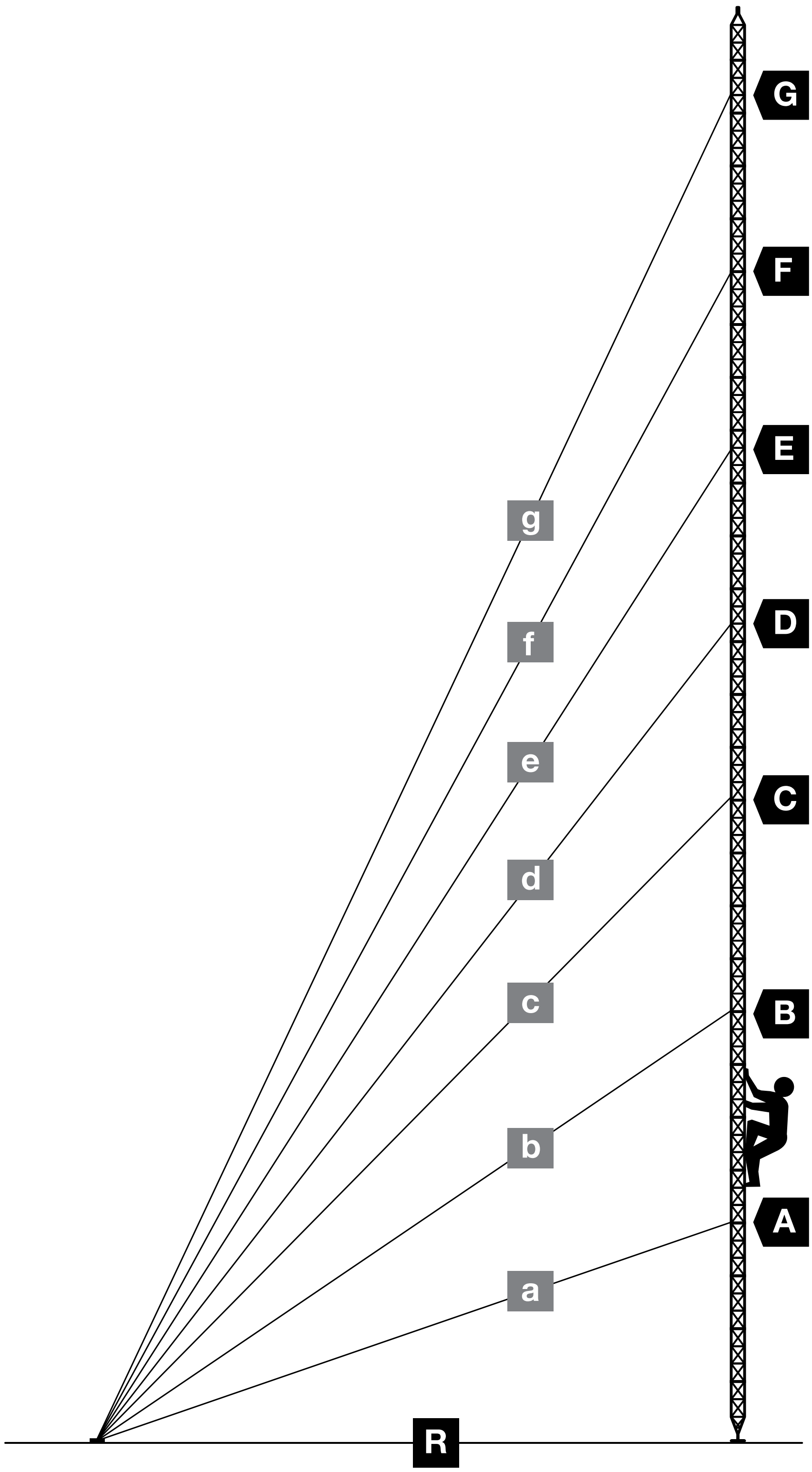
Guy wire: Ø (1×7+0); R_m > 2958 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3056.

Each guy wire is attached to an anchor ring ref. 3058.

It takes into account the reactions shown in the figure.


G
F
E
g
D
f
e
C
d
c
B
b
A
a
R

Tower height (m)			8,5		11,5		14,5		17,5		20,5		23,5	
			Qty	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.
COMPOSITION	Pivoting base M360		1	3088	1	3088	1	3088	1	3088	1	3088	1	3088
	Lower section M360		1	3086	1	3086	1	3086	1	3086	1	3086	1	3086
	Middle section M360		0	3087	1	3087	2	3087	3	3087	4	3087	5	3087
	Upper section M360		1	3085	1	3085	1	3085	1	3085	1	3085	1	3085
	Mast		1	3010	1	3010	1	3010	1	3010	1	3010	1	3010
	Guy wire anchor ring		3	3058	6	3058	6	3058	9	3058	9	3058	12	3058
ANCHORS	Height (en m) from base to points : A, B, C, D, E, F, G and H.	A	4,9		6,1		6,1		6,1		6,1		6,1	
		B	-		7,9		10,9		12,1		12,1		12,1	
		C	-		-		-		13,9		16,9		18,1	
		D	-		-		-		-		-		19,9	
		E	-		-		-		-		-		-	
		F	-		-		-		-		-		-	
		G	-		-		-		-		-		-	
	Distance (in m) between the center of tower base and guy wire anchor point	R	1,5		2		2,5		2,5		3,5		4	
GUY WIRES	No. of guy wires		1		2		2		3		3		4	
	Diameter Ø (mm)		5 (1x7+0)		5 (1x7+0)		5 (1x7+0)		5 (1x7+0)		5 (1x7+0)		5 (1x7+0)	
	Cable' breaking load ***Rm*** (N)		17652		17652		17652		17652		17652		17652	
	Total guy wire length, in meters (m), (theoretical diagonal).	a	5,07		6,36		6,40		6,52		6,93		7,19	
		b	-		8,11		11,14		12,32		12,544		12,68	
		c	-		-		-		14,01		17,22		18,49	
		d	-		-		-		-		-		20,27	
		e	-		-		-		-		-		-	
		f	-		-		-		-		-		-	
		g	-		-		-		-		-		-	
	Initial tension (N)		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***	

EN

26,5		29,5		32,5		35,5		38,5		41,5		44,5		47,5	
Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.
1	3088	1	3088	1	3088	1	3088	1	3088	1	3088	1	3088	1	3088
1	3086	1	3086	1	3086	1	3086	1	3086	1	3086	1	3086	1	3086
6	3087	7	3087	8	3087	9	3087	10	3087	11	3087	12	3087	13	3087
2	3085	1	3085	1	3085	1	3085	1	3085	1	3085	1	3085	1	3085
1	3010	1	3010	1	3010	1	3010	1	3010	1	3010	1	3010	1	3010
12	3058	15	3058	15	3058	18	3058	18	3058	21	3058	21	3058	21	3058
6,1		6,1		6,1		6,1		5,9		5,9		5,9		5,9	
12,1		12,1		12,1		12,1		11,9		11,9		11,9		11,9	
18,1		18,1		17,9		17,9		17,9		17,9		17,9		17,9	
22,9		24,1		23,9		23,9		23,9		23,9		23,9		23,9	
-		25,9		28,9		28,9		29,9		29,9		29,9		29,9	
-		-		-		31,9		34,9		35,9		35,9		35,9	
-		-		-		-		-		37,9		40,9		41,9	
6		7		8		9		10		12		15		18	
4		5		5		6		6		7		7		7	
5 (1x7+0)		5 (1x7+0)		6 (1x7+0)		6 (1x7+0)		6 (1x7+0)		6 (1x7+0)		6 (1x7+0)		6 (1x7+0)	
17652		17652		29580		29580		29580		29580		29580		29580	
8,42		9,14		9,91		10,71		11,45		13,20		15,94		18,76	
13,42		12,88		14,40		14,97		15,42		16,76		19		21,42	
19		19,34		19,53		19,95		20,41		21,45		23,23		25,25	
23,63		25,04		25,14		25,47		25,83		26,66		28,12		29,81	
-		26,78		29,94		31,17		31,47		32,15		33,37		34,80	
-		-		-		33,09		36,25		37,79		38,83		40,07	
-		-		-		-		-		39,69		43,5		45,53	
10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***		10% ***Rm***	

Guarantee

Televés S.A. offers a two year warranty from date of purchase to the EU countries. In countries not members of the EU, the legal guarantee is in effect at the time of sale. Keep proof of purchase to determine this date.
During the warranty period, Televes S.A. is responsible for the failures caused by defects in material or workmanship. Televés S.A. meet the warranty by repairing or replacing defective equipment.
Not included in the warranty is damage caused by improper use, wear, handling third party, catastrophes or any other cause beyond the control of Televes S.A.

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