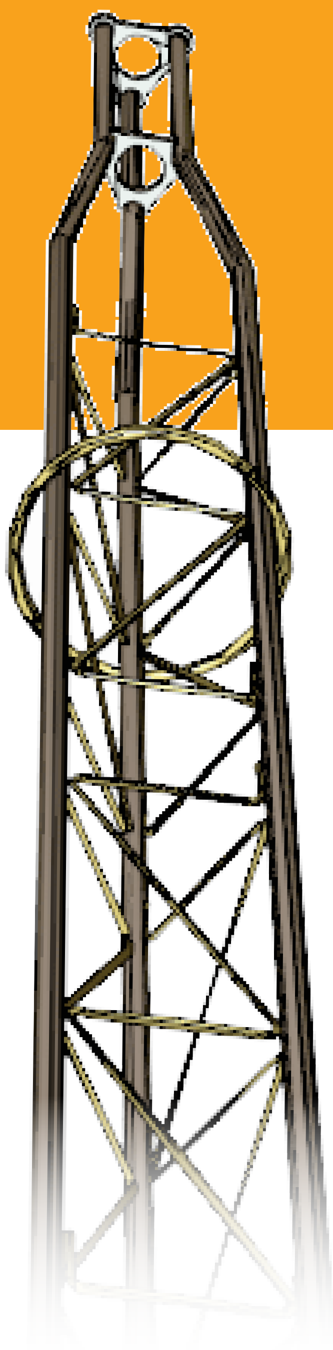
Televes®



M180

EN GUY WIRED TOWERS

Mounting Instructions

WARNING

Trestle-tower installations should only be calculated and constructed by specialised 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. Remenber 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:

- Standard NBE-EA-95 (Steel).
- Standard EHE-98 (Concrete).
- Norma TIA/EIA[(1)]-222-G.
- Norma NBE-MV-101.
- Eurocodes EN1990, EN1991, EN1993.

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:

- 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 16 cm, which is the distance between legs.
Horizontal bracing rods are spaced 30 cm.
The lower section of the tower is pivoted on the base (see par. 11. - Technical Documentation).
The tower is guy wired with anchoring supports at 120 ° (see fig. 2).

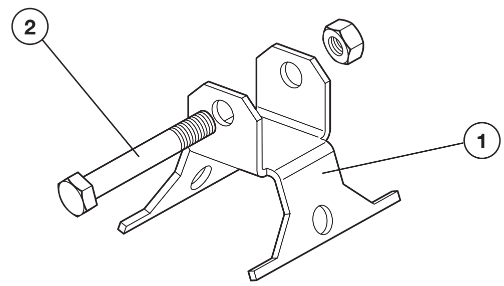
5. Tower mounting

Section by section mounting

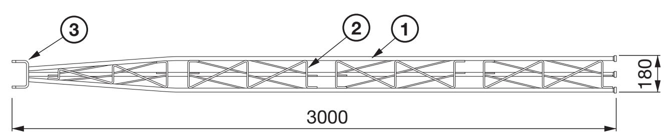
This is done by fixing the lower section to the base and placing it in the upright position, ensuring that it is levelled. Next, are mounted the remaining intermediate sections, that should have the corresponding guy wires already fastened. The mounting process is carried out by climbing up the sections 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	3048
Description	Pivoting base for tower M180
Material	(1) Steel F626 (S 235) 8 mm thickness plate. Re min. 235 N/mm2 Rn min. 340 N/mm2 (2) Steel - M24
Finishing	Galvanised 10 ± 1µm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Weight	5,6 Kg

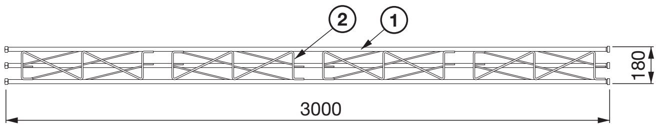


Reference	3037
Description	Low section M180
Material	(1) Steel ST 37-2 Ø 20 x 2 mm thickness. Re min. 235 N/mm^2 - Rn min. 360/510 N/mm^2 (2) Steel S 275 JR Ø 6 mm thickness. Re min. 275 N/mm^2 - Rn min. 410/560 N/mm^2 (3) Steel F626 (S 235) 10 mm thickness plate. Re min. 235 N/mm^2 - Rn min. 340 N/mm^2
Weight	12,8 Kg
Finishment *	Galvanised 10 ± 1µm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,27 m^2 x 1,2 (coefficient.) = 0,273 m^2

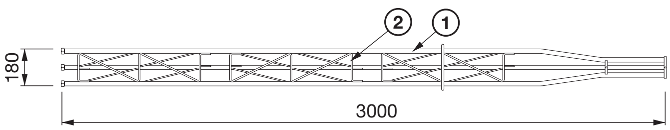


(1) TIA = Telecommunications Industry Association
EIA = Electronic Industrials Association

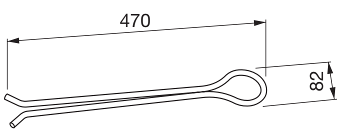
Reference	3031
Description	Middle section tower M180
Material	(1) Steel ST 37-2 Ø 20 x 2 mm thickness. Re min. 235 N/mm² - Rn min. 360/510 N/mm² (2) Steel S 275 JR Ø 6 mm Re min. 275 N/mm² - Rn min. 410/560 N/mm²
Weight	11,2 Kg
Finishing	Galvanised 10 ± 1μm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,236 m² x 1,2 coef. = 0,283 m²



Reference	3032
Description	Upper section tower M180
Material	(1) Steel ST 37-2 Ø 20 x 2 mm thickness. Re min. 235 N/mm² - Rn min. 360/510 N/mm² (2) Steel S 275 JR Ø 6 mm thickness. Re min. 275 N/mm² - Rn min. 410/560 N/mm²
Weight	11,4 Kg
Finishing	Galvanised 10 ± 1μm thickness + Bichromated + R.P.R. (Reactive Protection Process)
Surface facing the wind	0,227 m² x 1,2 coef. = 0,272 m²



Reference	3058
Description	Guy wire anchoring ring.
Material	Steel F621 - 10 mm Ø.
Weight	0,6 Kg



- To avoid damaging the threaded joints between sections during handling, they are supplied with a plastic plugs.
- Once on erecting site and before mounting the tower, you must proceed to remove all plugs(ver fig. 1)

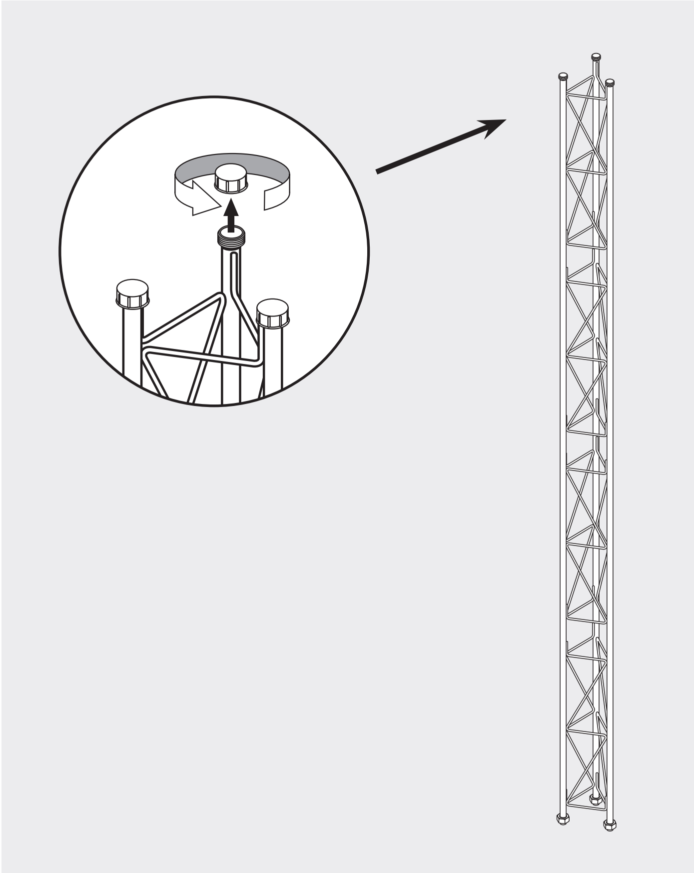


Fig. 1

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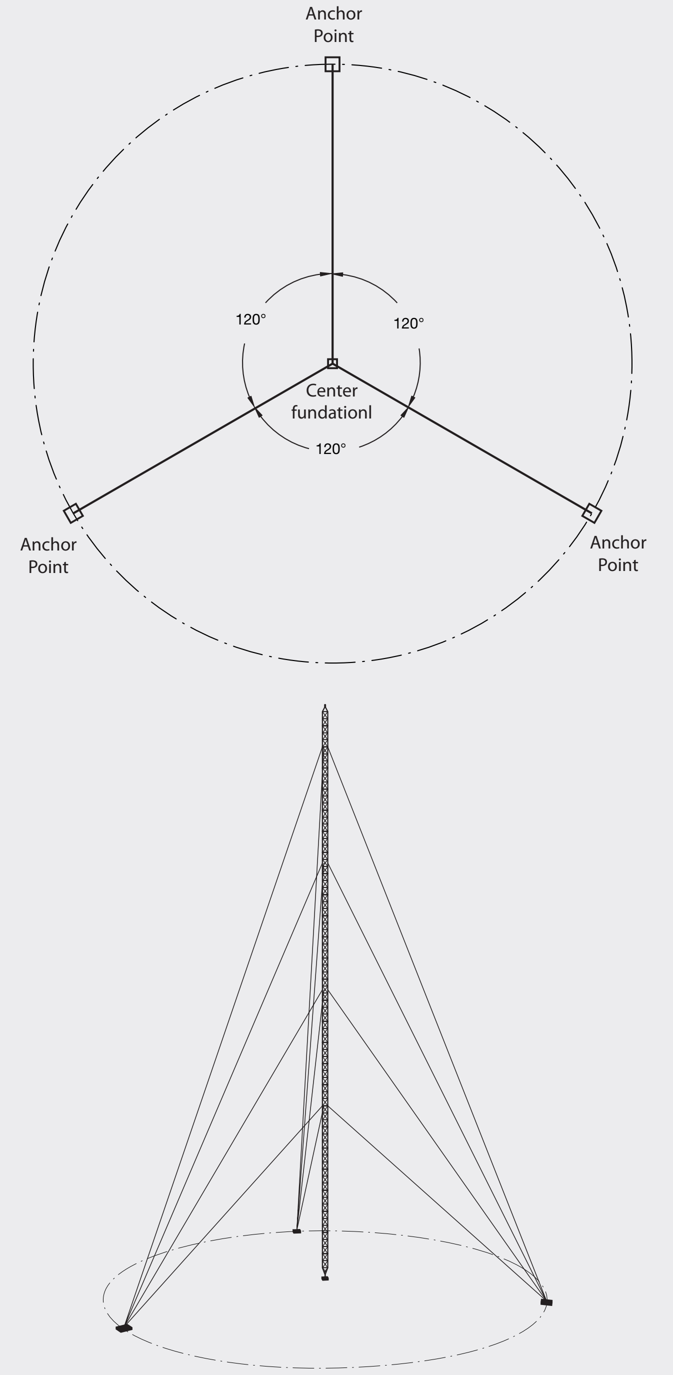
7. Foundations

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.



Arragement of Foundation

Fig. 2

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

Foundation of the tower base

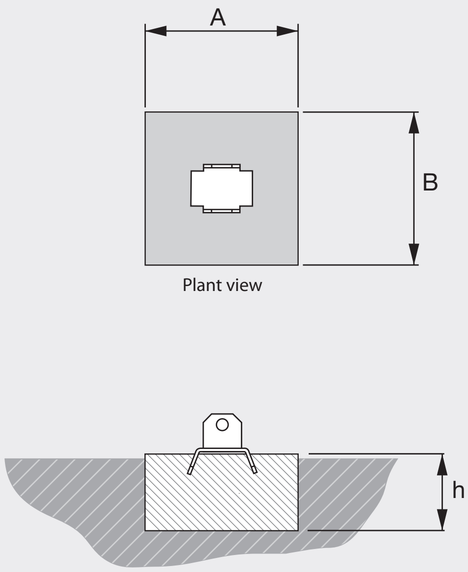
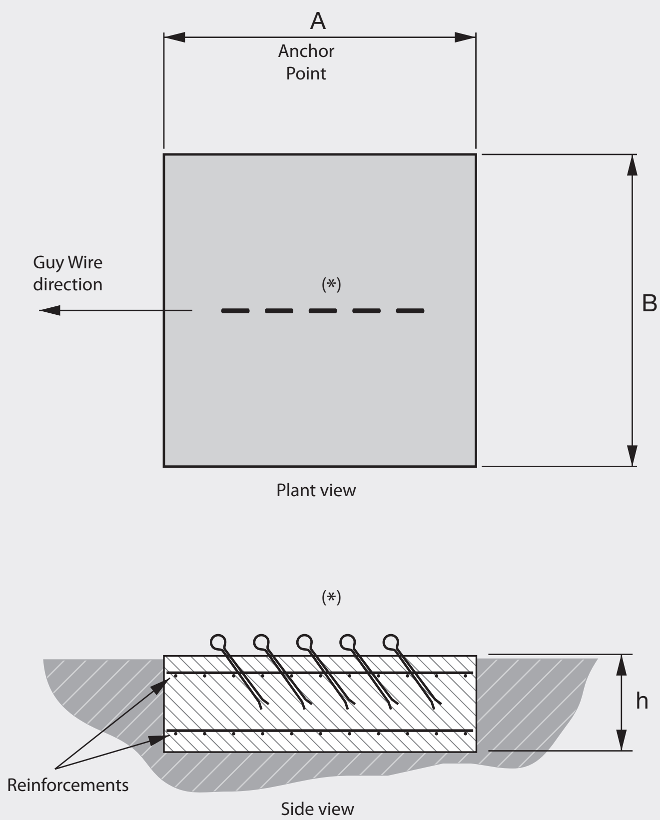


Fig. 3

Foundation for guy wire anchoring ring



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

Fig. 4

Foundation details

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FOUNDATIONS CHART (just for guidance)							
Tower Height (m)	Zapatas	**Tower base foundation**			**Anchor ring foundation**		
		"A" (cm)	"B" (cm)	"h" (cm)	"A" (cm)	"B" (cm)	"h" (cm)
26,5	Dimensions	50	50	33	150	150	100
	Reinforcement	-			7 Ø14 C/20		
23,5	Dimensions	40	40	27	130	130	87
	Reinforcement	-			6 Ø12 C/20		
20,5	Dimensions	40	40	27	120	120	80
	Reinforcement	-			6 Ø12 C/20		
17,5	Dimensions	40	40	27	110	110	73
	Reinforcement	-			6 Ø12 C/20		
14,5	Dimensions	40	40	27	100	100	67
	Reinforcement	-			5 Ø12 C/20		
11,5	Dimensions	40	40	27	90	90	60
	Reinforcement	-			5 Ø12 C/20		
8,5	Dimensions	40	40	27	80	80	53
	Reinforcement	-			4 Ø12 C/20		

8. Stucture (Sections & Guy wires)

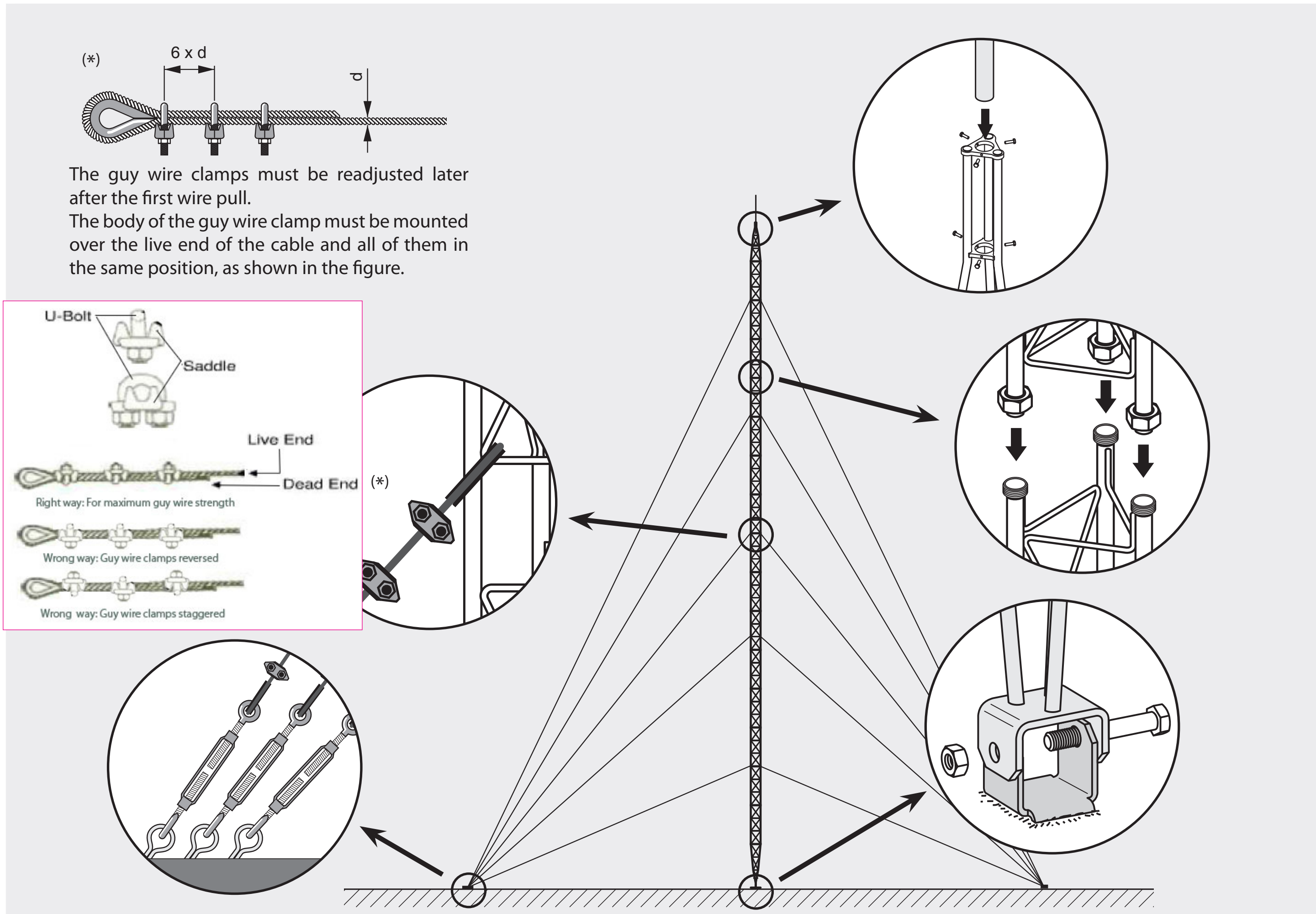


Fig. 5

9. 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.

10. 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 6)

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 7 and 8)
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 7)
$l = V - H \tan \alpha$
and

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

It can be substituted WC by S $l = V - H \tan a$

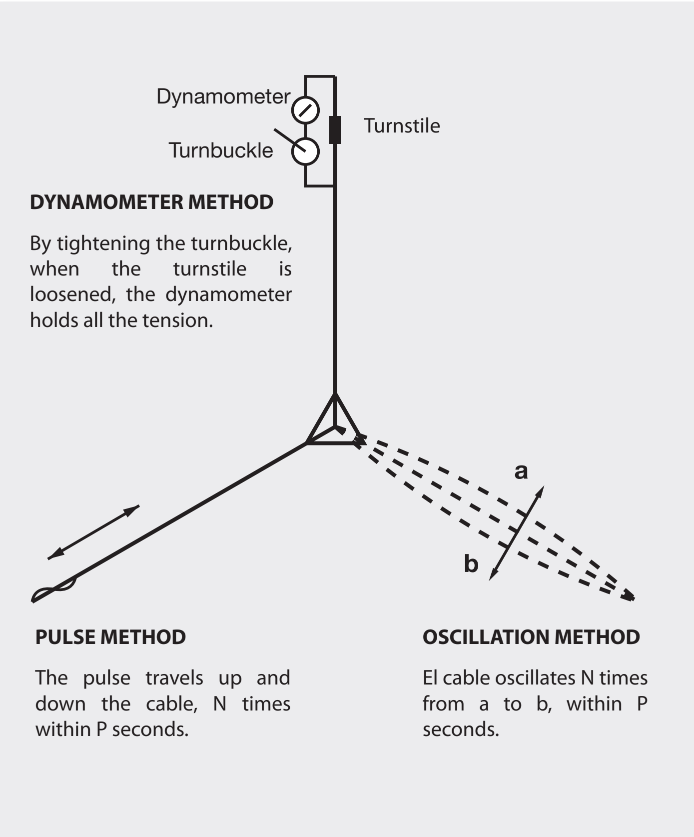


Fig. 6

Method to measure the initial tension

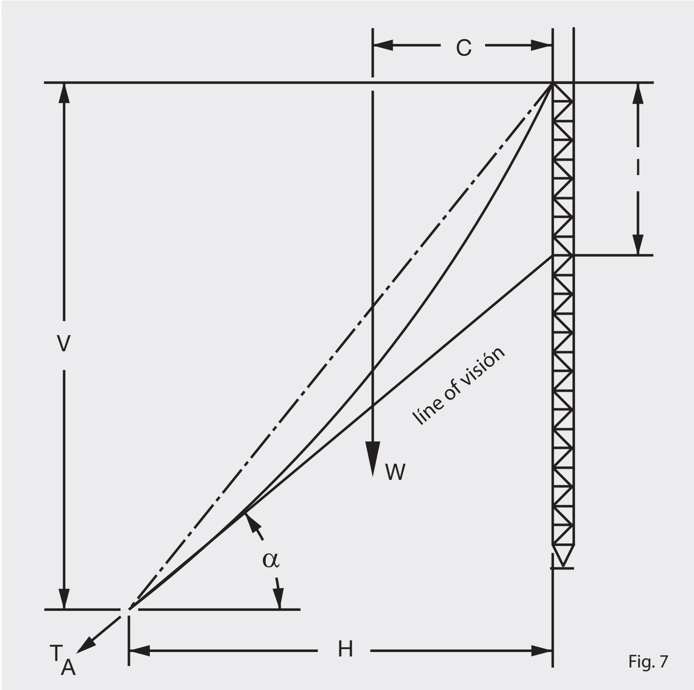


Fig. 7

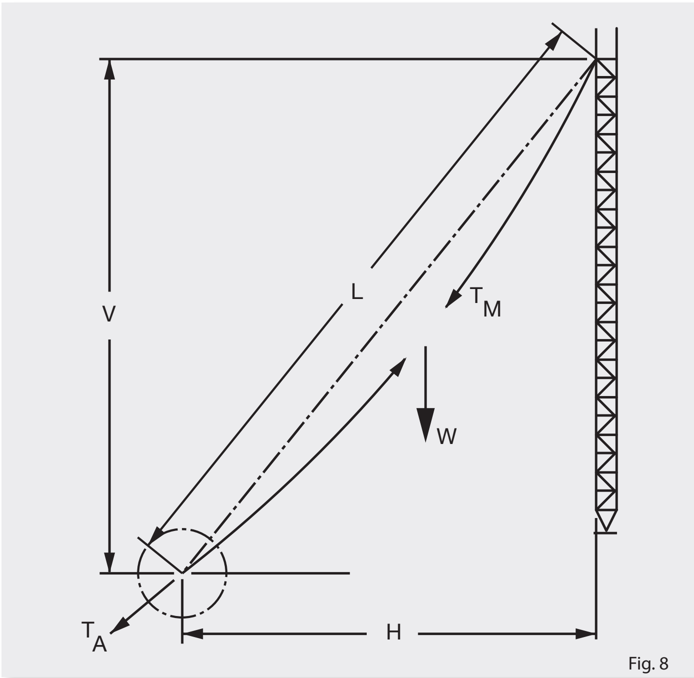


Fig. 8

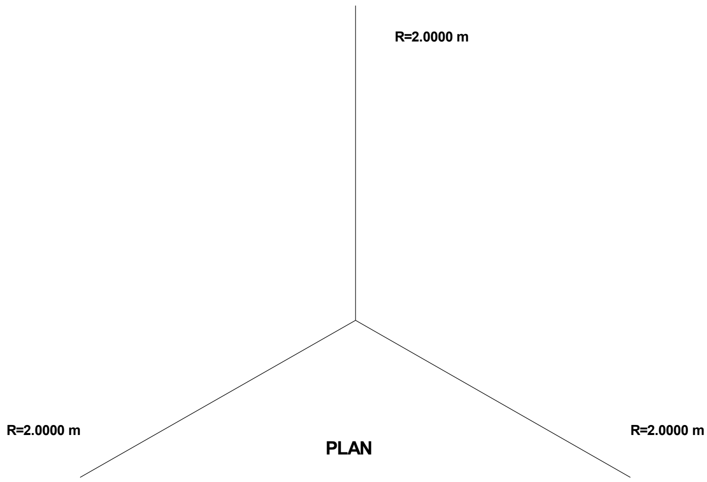
Ratio between the guy wire tension on its anchor point and on its half

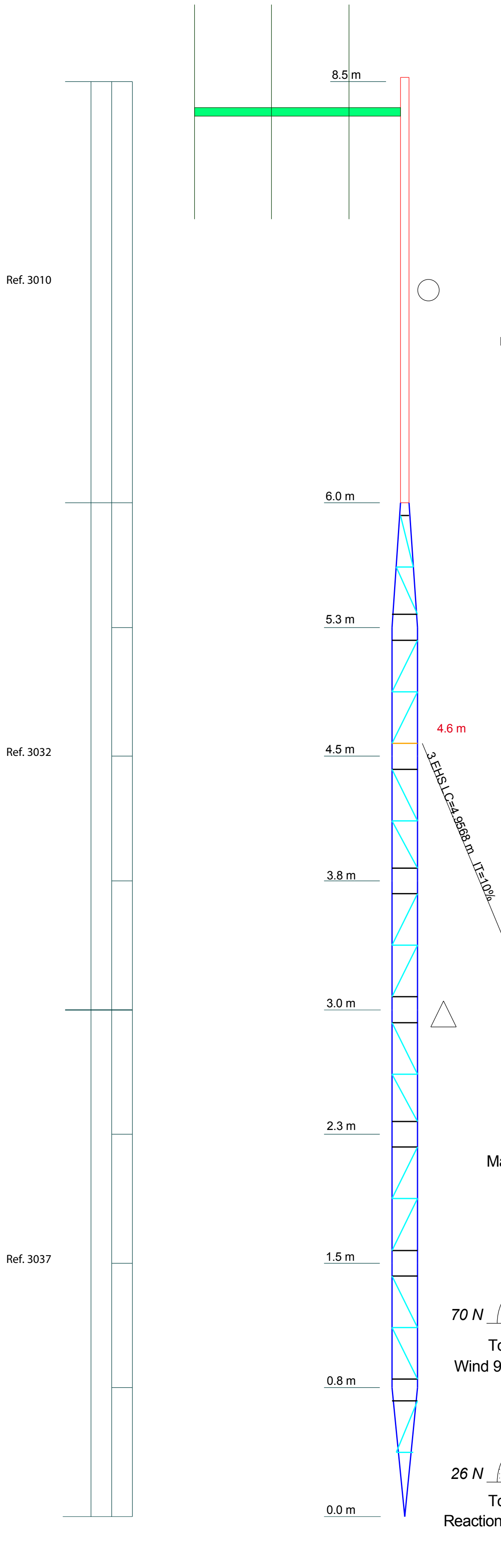
11. Technical information

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 8,5 m height.





LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

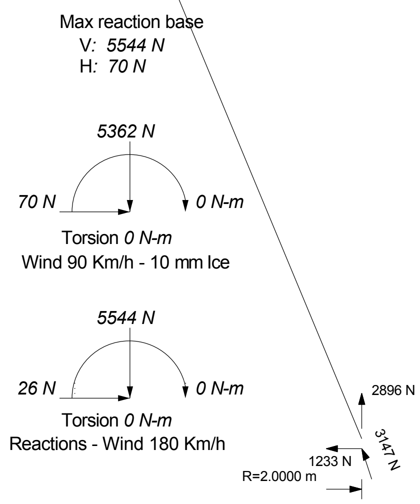
Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

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

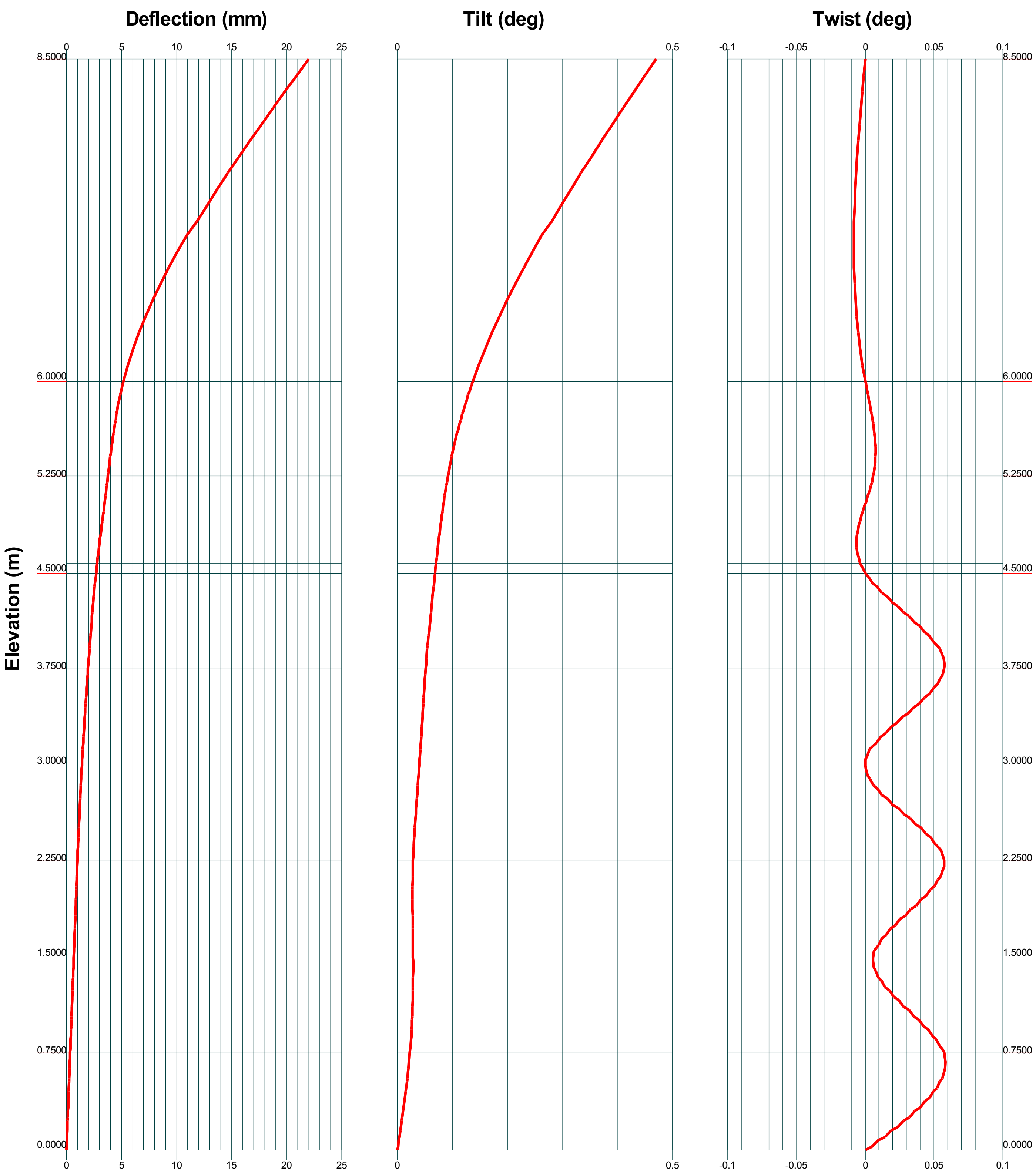
It takes into account the reactions shown in the figure.



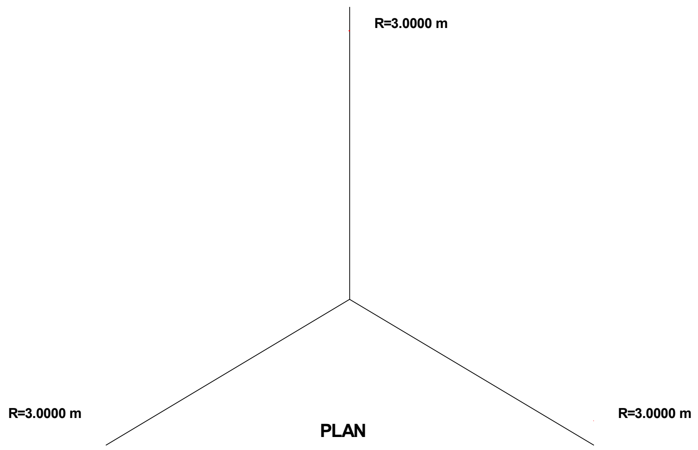
EN

TIA-222-G - Service - 100 Kph

Maximum Values



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



LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

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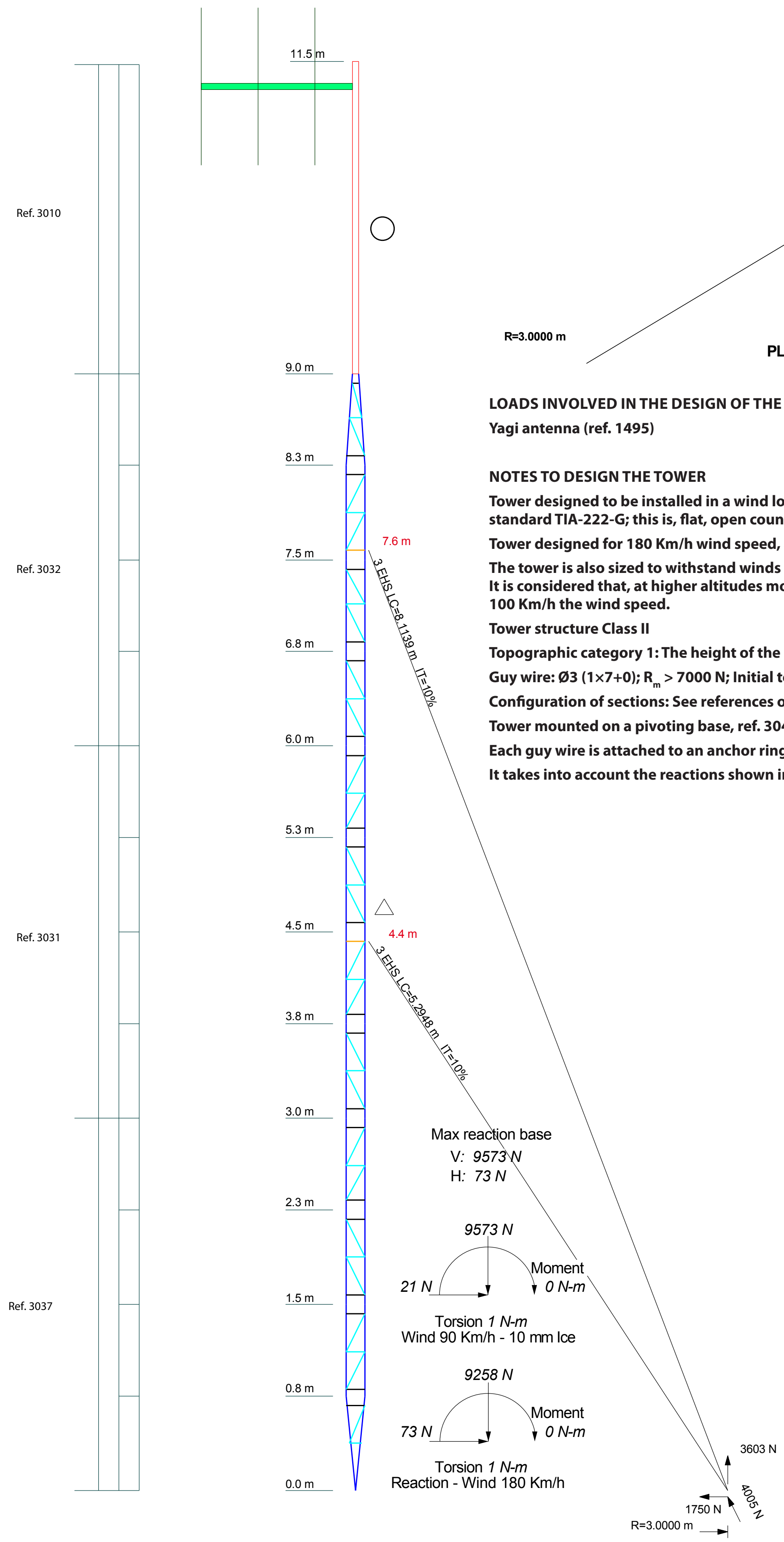
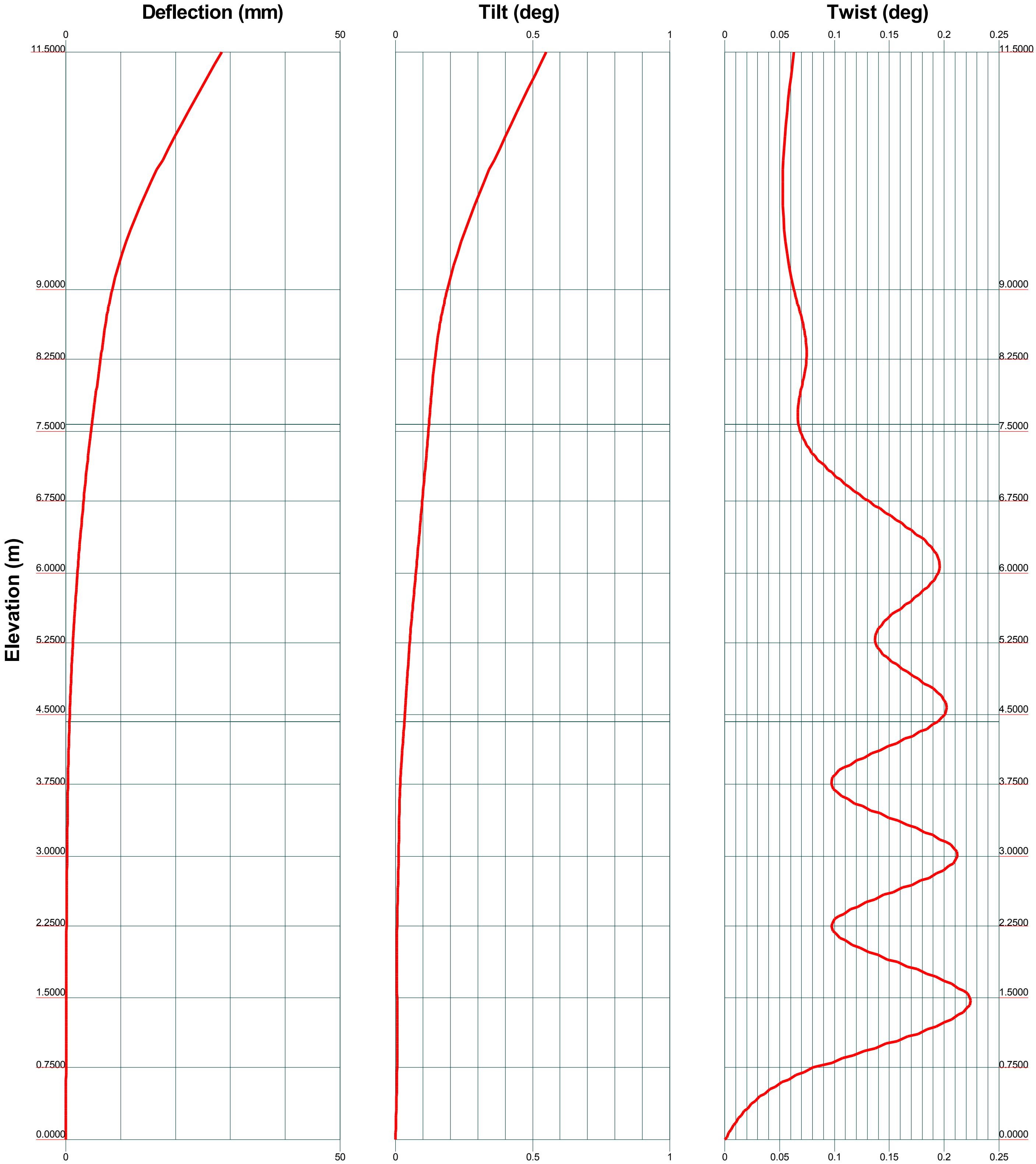
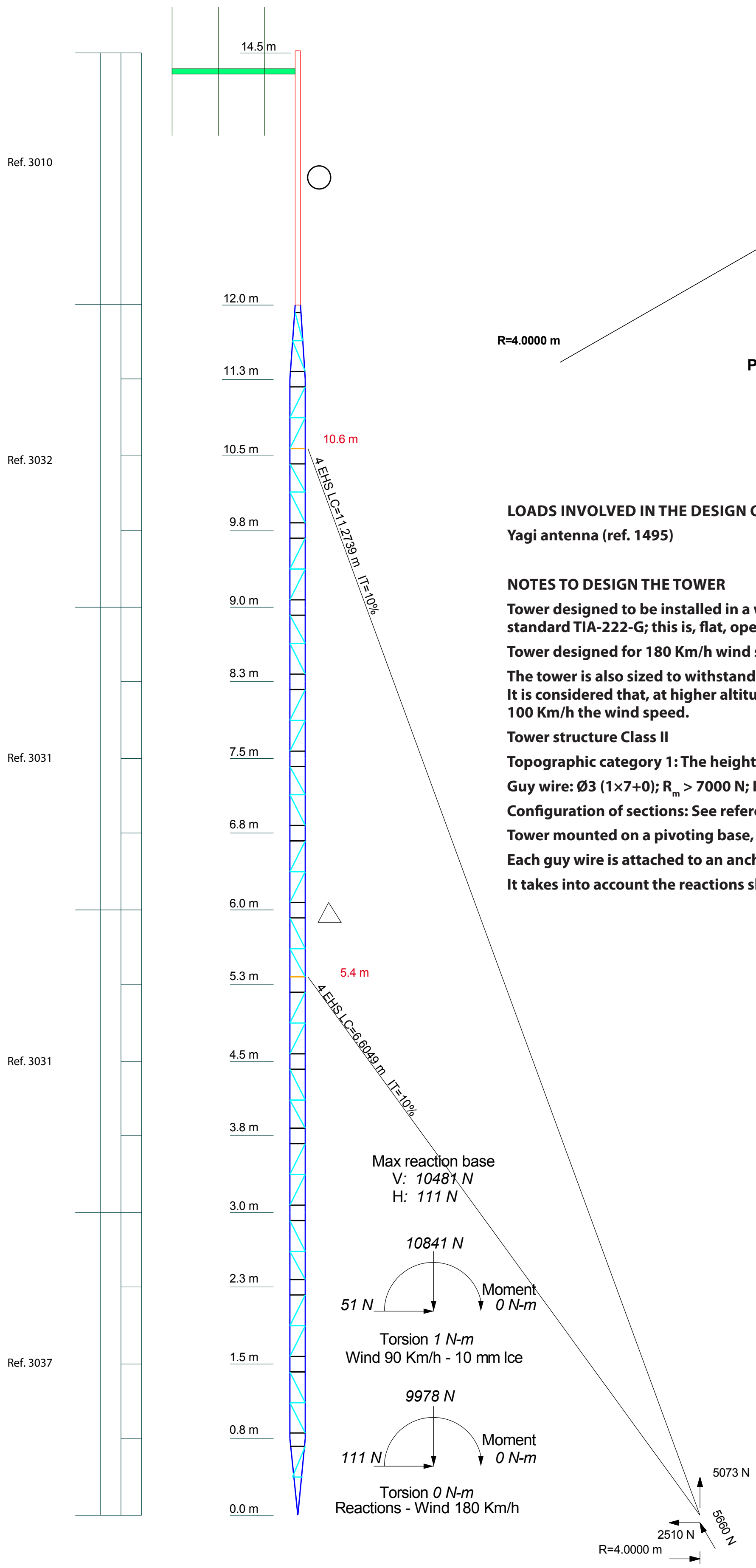


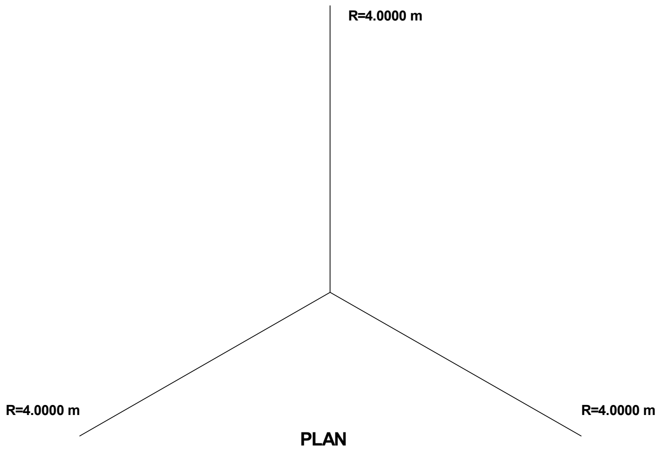
TIA-222-G - Service - 100 Kph

Maximun Values



Example of design for a tower 14,5 m height.





LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

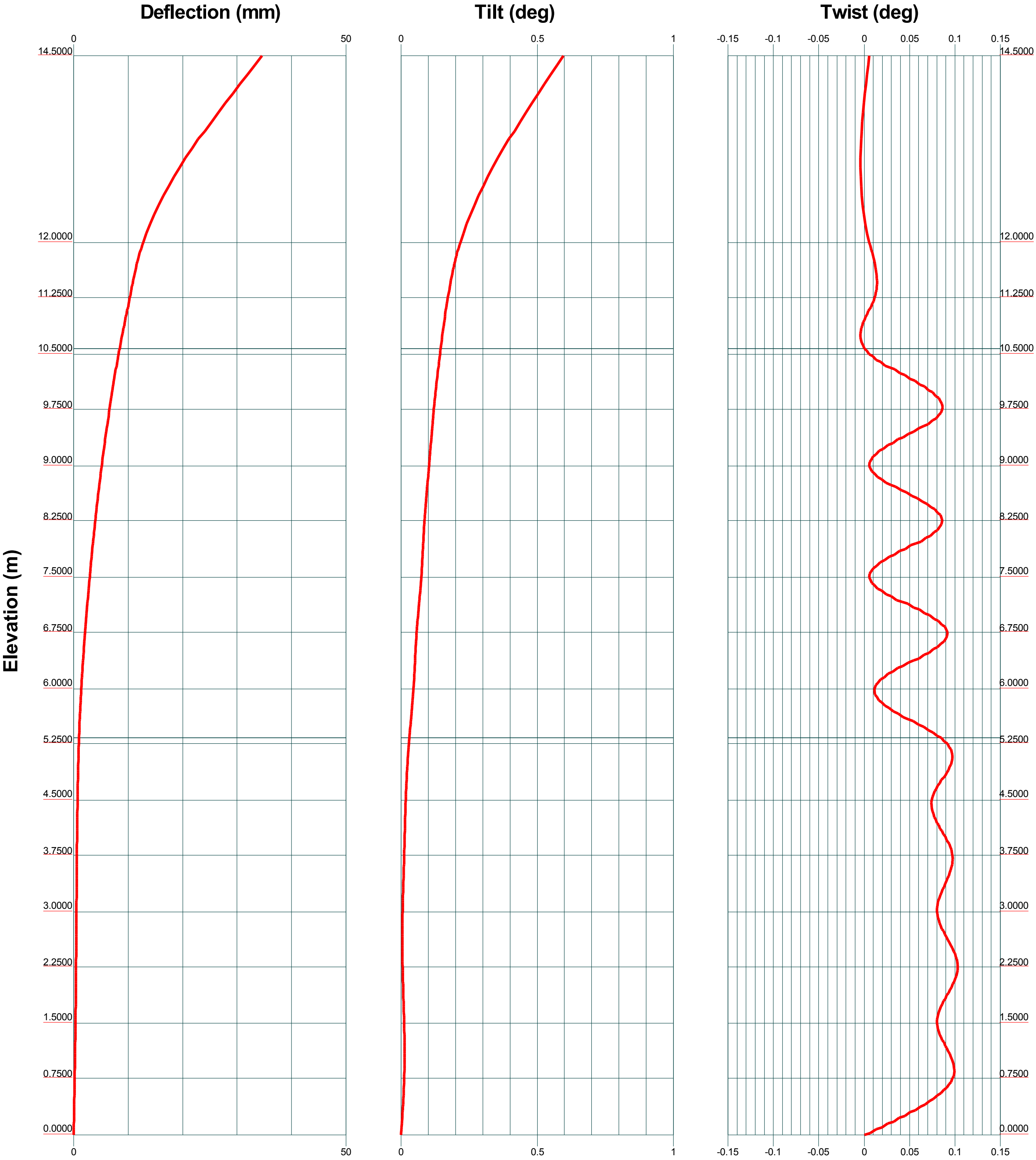
Each guy wire is attached to an anchor ring ref. 3058.

It takes into account the reactions shown in the figure.

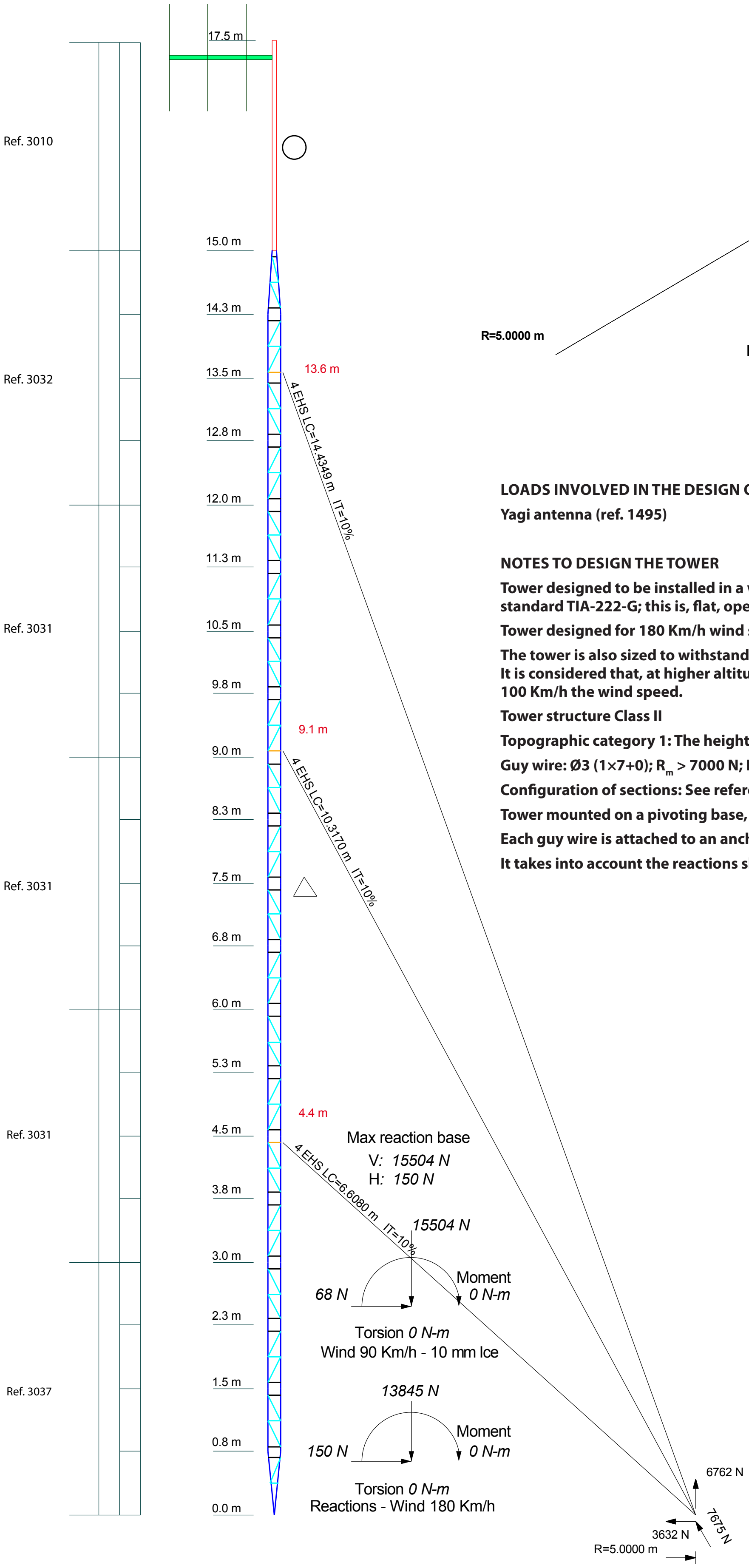
EN

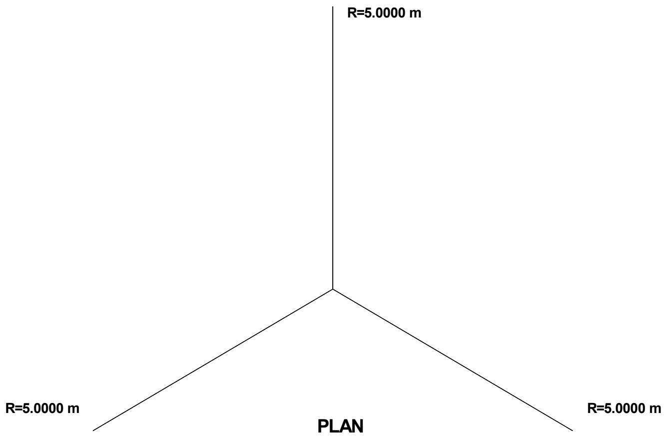
TIA-222-G - Service - 100 Kph

Maximum Values



Example of design for a tower 17,5 m height.





LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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Tower designed for 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

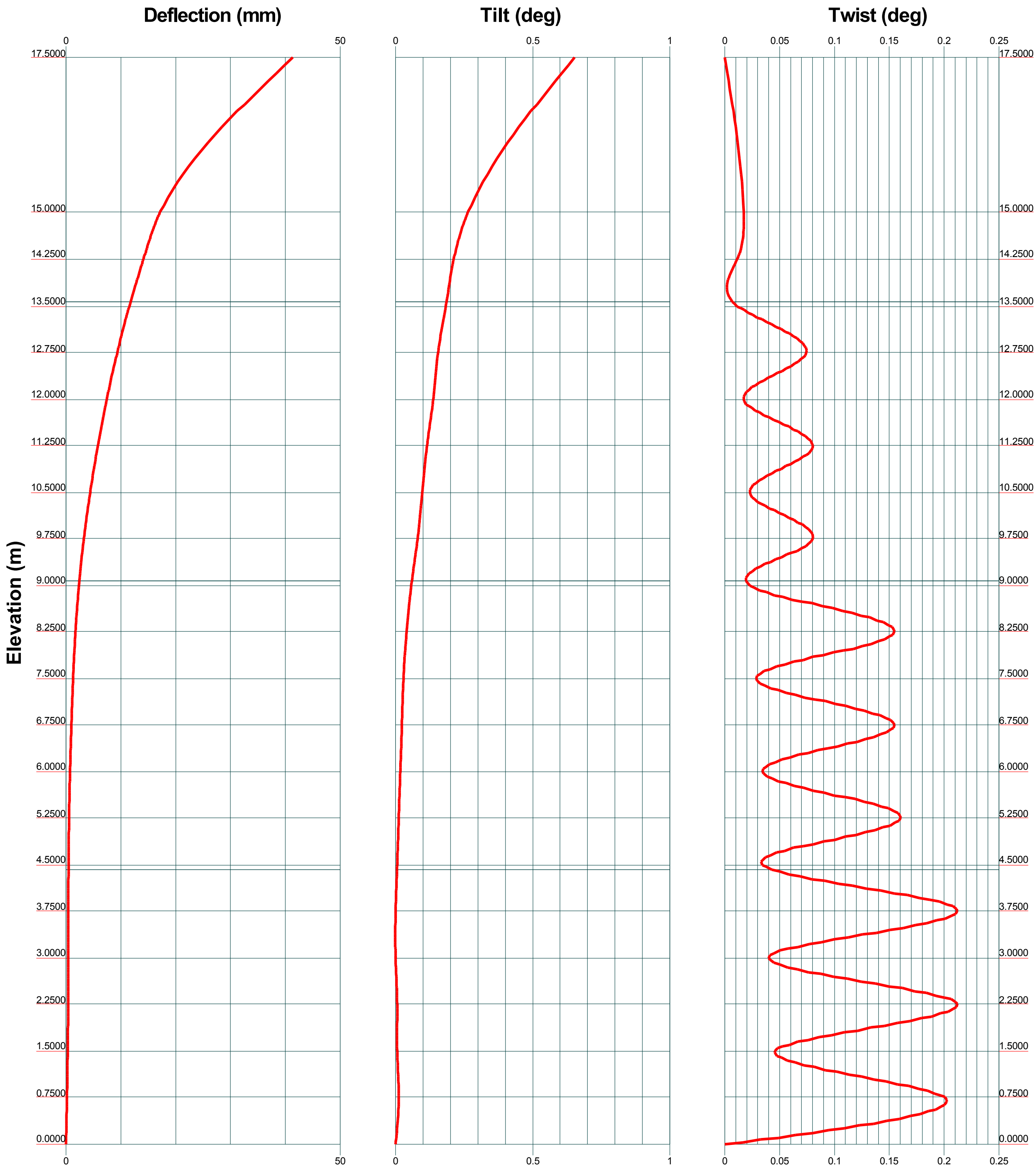
Each guy wire is attached to an anchor ring ref. 3058.

It takes into account the reactions shown in the figure.

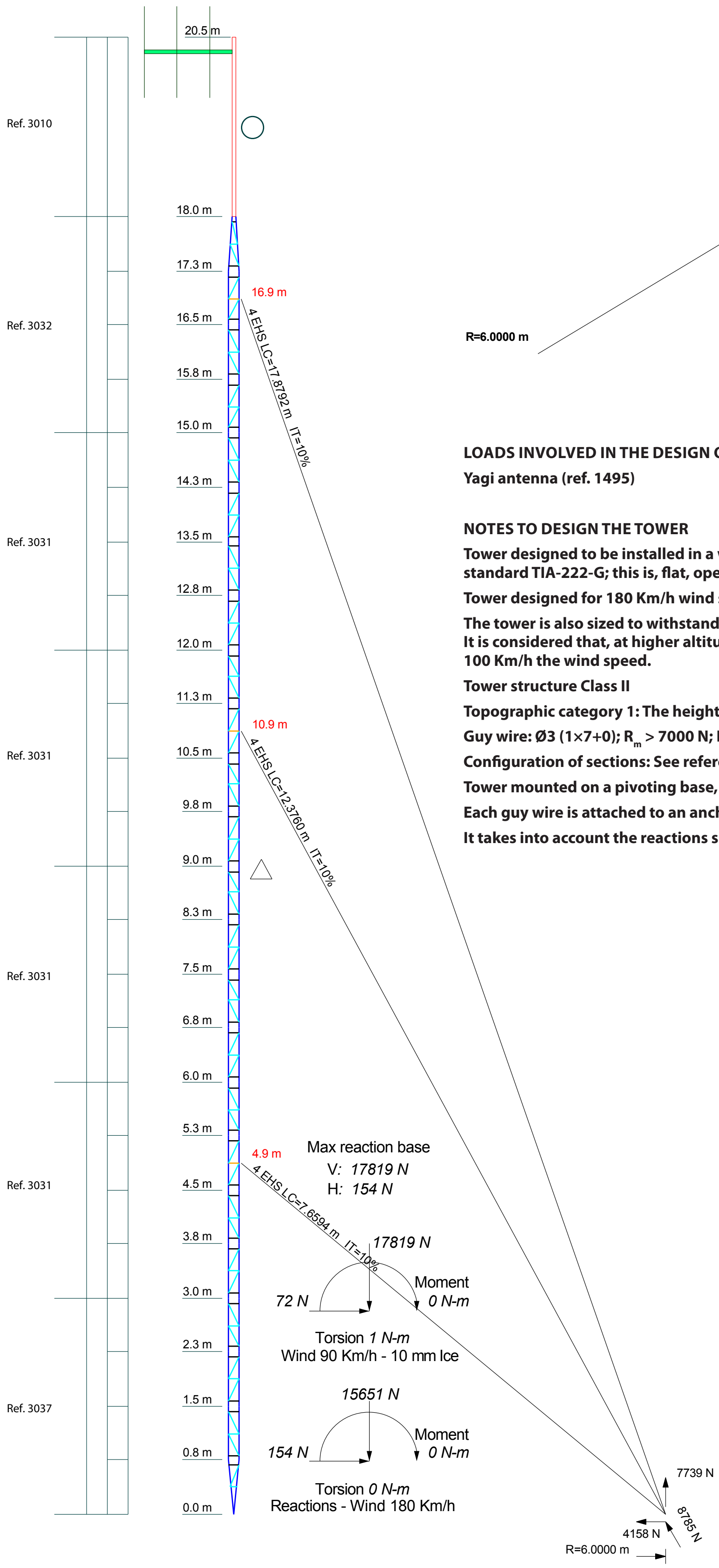
EN

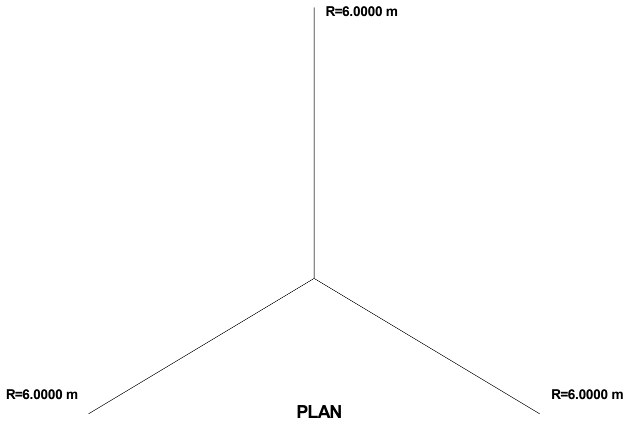
TIA-222-G - Service - 100 Km/h

Maximun Values



Example of design for a tower 20,5 m height.





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The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

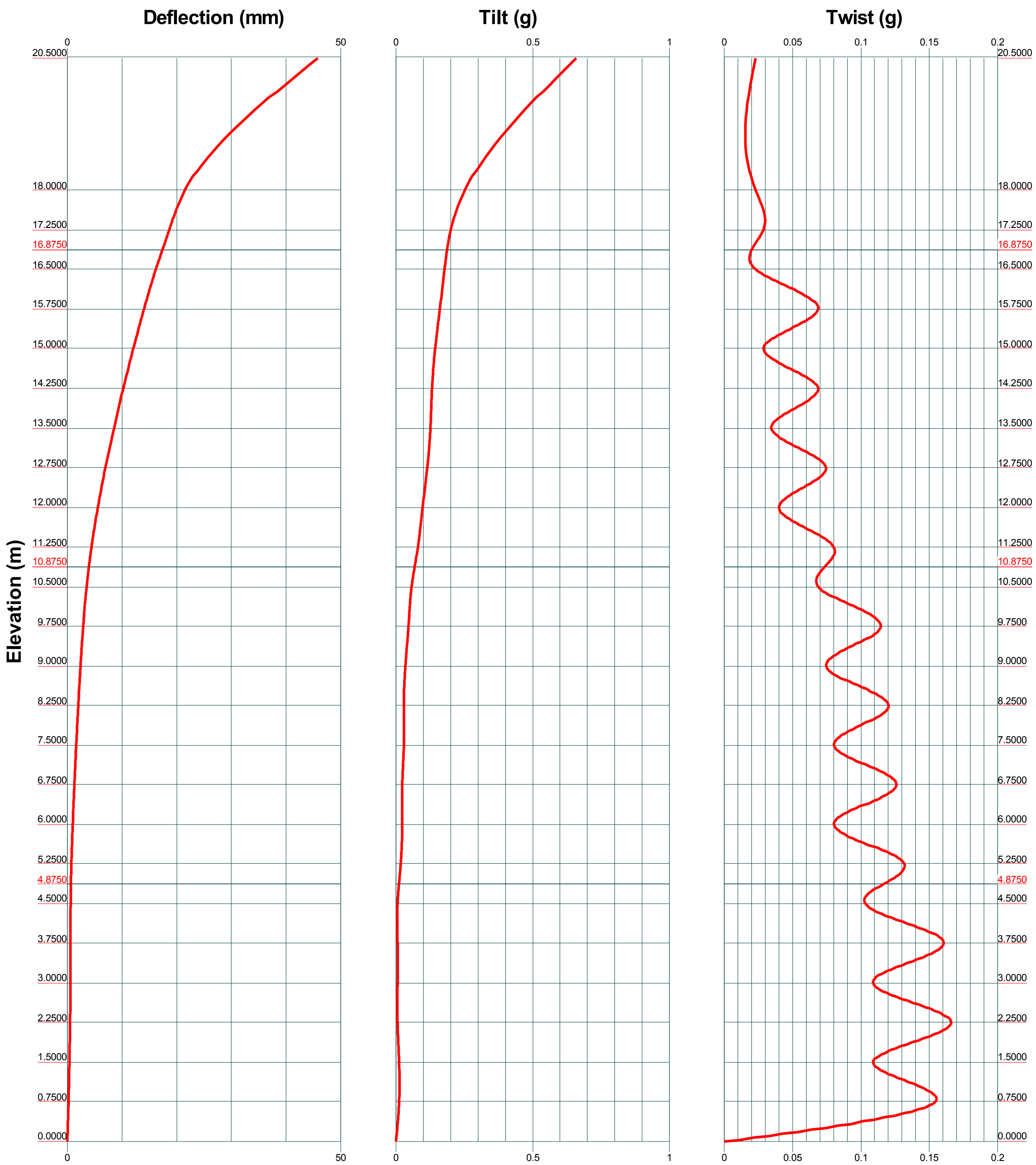
Each guy wire is attached to an anchor ring ref. 3058.

It takes into account the reactions shown in the figure.

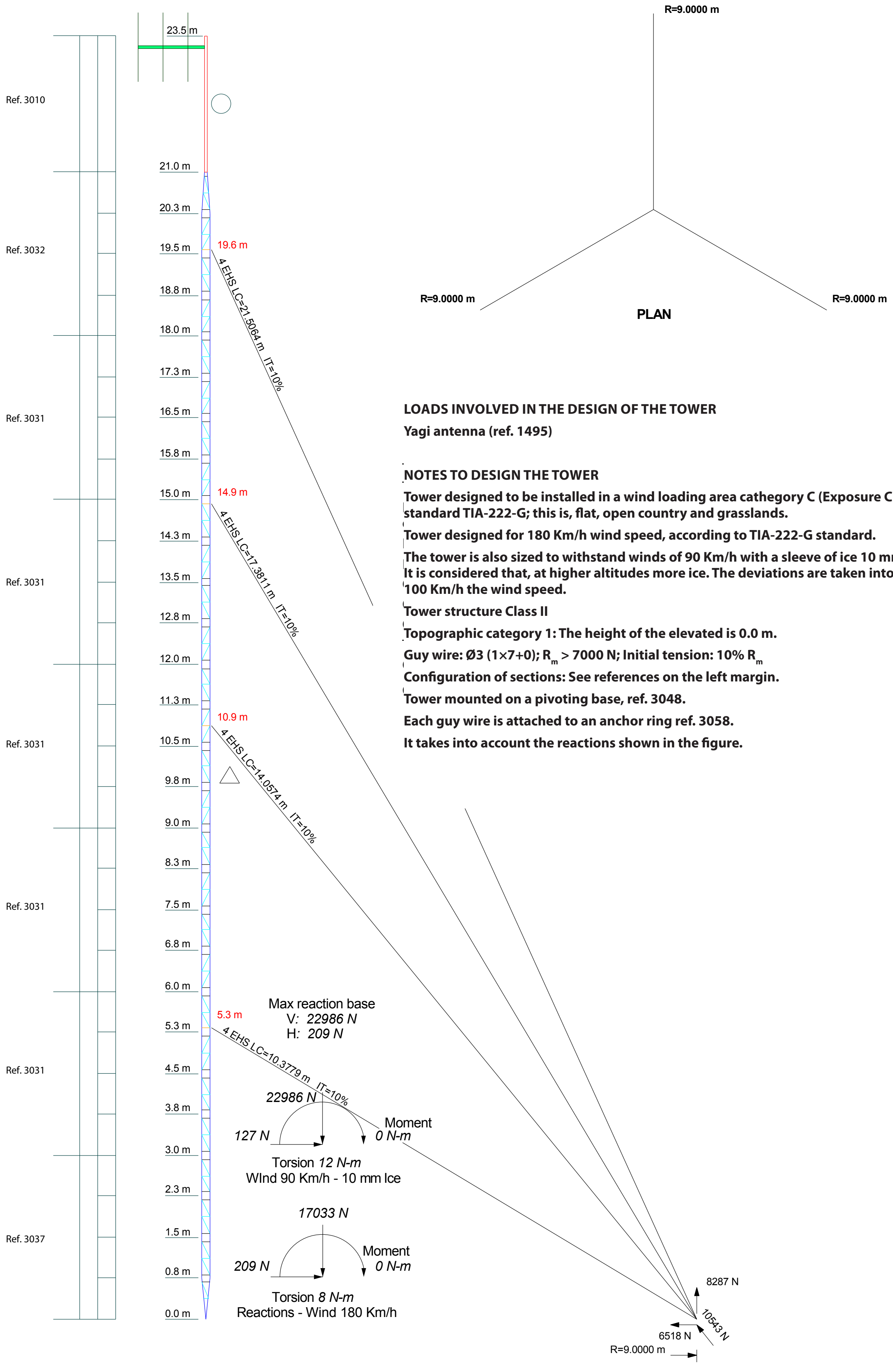
TIA-222-G - Service - 100 Kph

Maximum Values

EN



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



LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

Tower mounted on a pivoting base, ref. 3048.

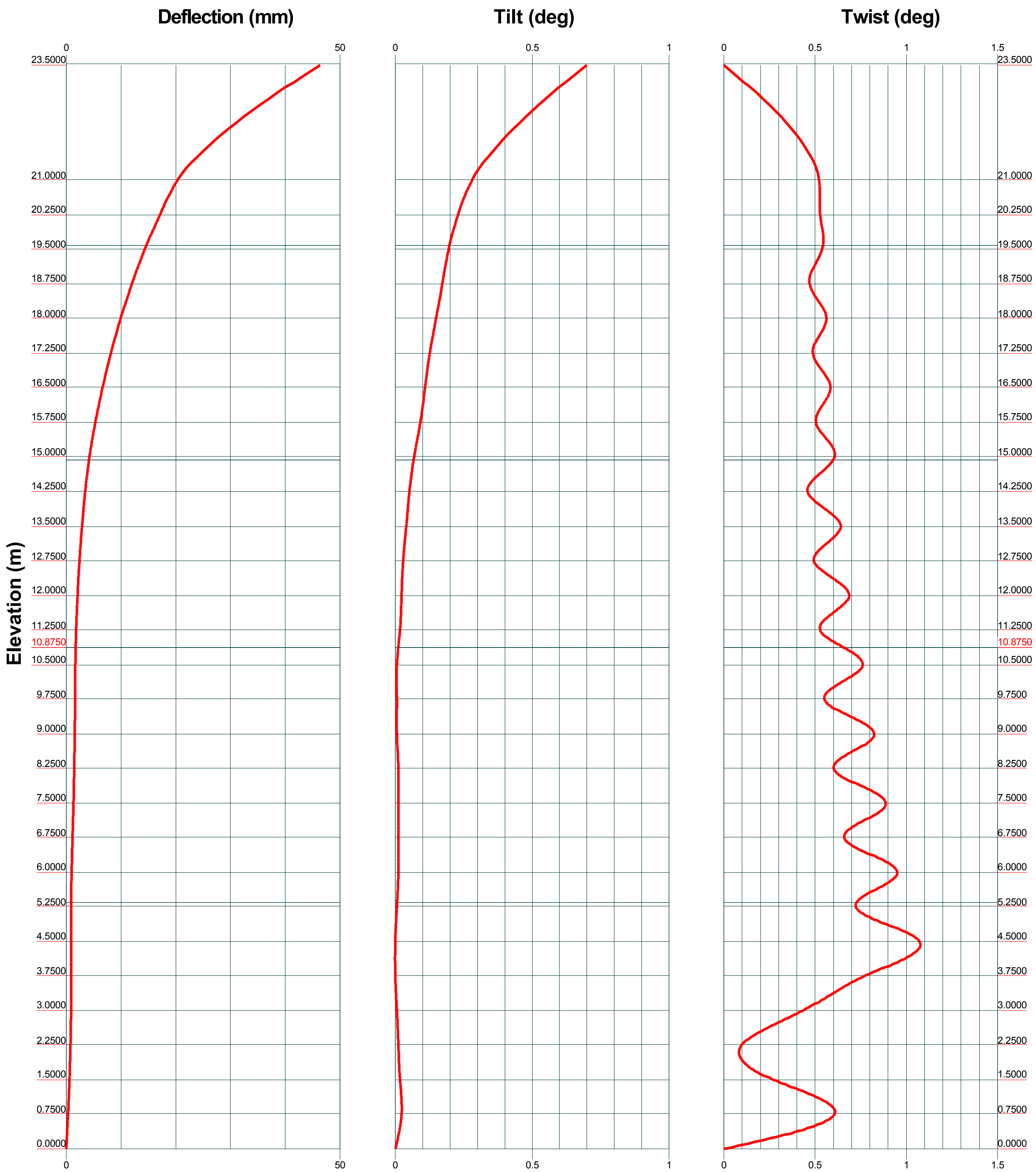
Each guy wire is attached to an anchor ring ref. 3058.

It takes into account the reactions shown in the figure.

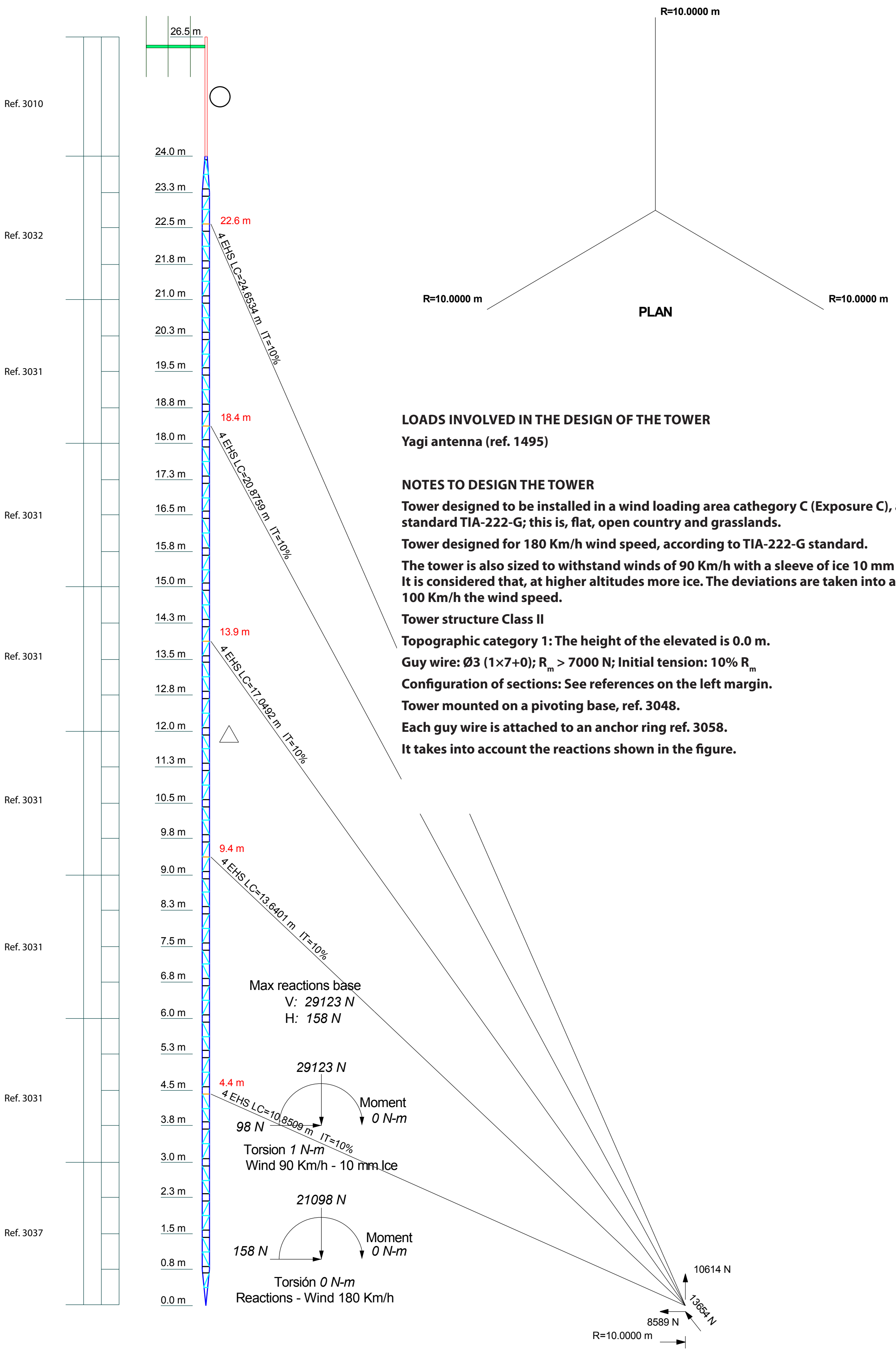
EN

TIA-222-G - Service - 100 Kph

Maximum Values



Example of design for a tower 26,5 m height.



LOADS INVOLVED IN THE DESIGN OF THE TOWER

Yagi antenna (ref. 1495)

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 180 Km/h wind speed, according to TIA-222-G standard.

The tower is also sized to withstand winds of 90 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

Topographic category 1: The height of the elevated is 0.0 m.

Guy wire: Ø3 (1×7+0); R_m > 7000 N; Initial tension: 10% R_m

Configuration of sections: See references on the left margin.

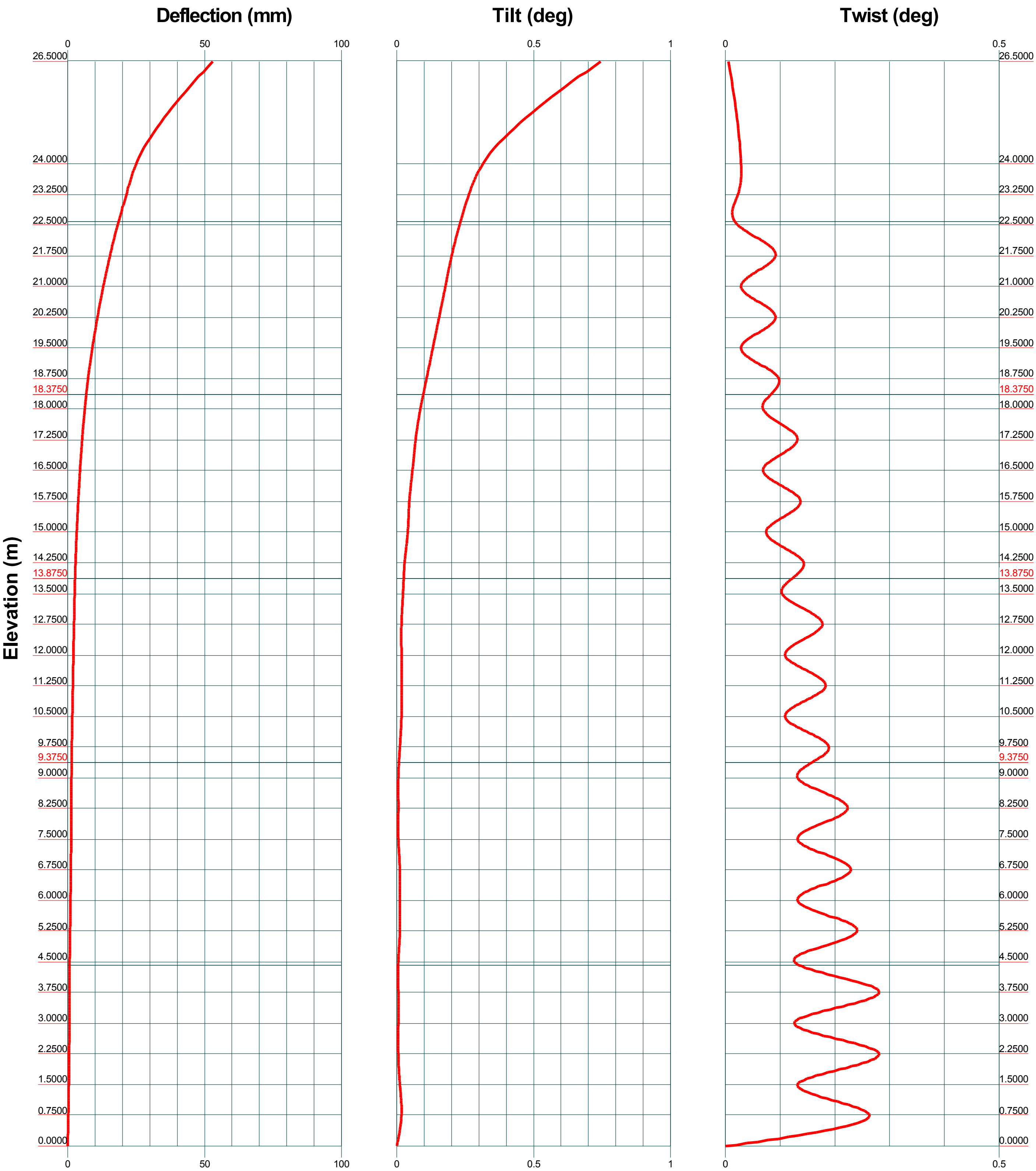
Tower mounted on a pivoting base, ref. 3048.

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

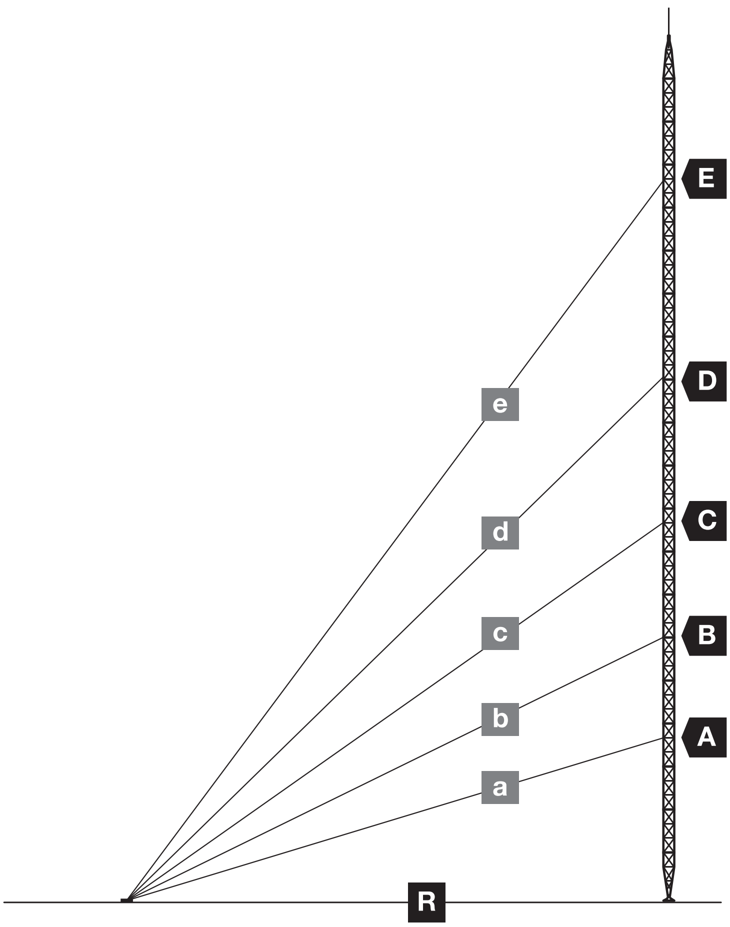
It takes into account the reactions shown in the figure.

TIA-222-G - Service - 100 Kph

Maximum Values



Tower height (m)			8,5		11,5		14,5		17,5		20,5		23,5		26,5	
COMPOSITION			Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.	Qty.	Ref.
	Pivoting base M180		1	3048	1	3048	1	3048	1	3048	1	3048	1	3048	1	3048
	Lower section M180		1	3037	1	3037	1	3037	1	3037	1	3037	1	3037	1	3037
	Middle section M180		-	-	1	3031	2	3031	3	3031	4	3031	5	3031	6	3031
	Upper section M180		1	3032	1	3032	1	3032	1	3032	1	3032	1	3032	1	3032
	Guy wire anchor ring		3	3058	6	3058	6	3058	9	3058	9	3058	12	3058	15	3058
	Mást 3 m		1	3010	1	3010	1	3010	1	3010	1	3010	1	3010	1	3010
ANCHORS	Height (en m) from base to points : A, B, C, D and E.	A	4,6		4,4		5,4		4,4		4,9		5,3		4,4	
		B	-		7,6		10,6		9,1		10,9		10,9		9,4	
		C	-		-		-		13,6		16,9		14,9		13,9	
		D	-		-		-		-		-		19,6		18,4	
		E	-		-		-		-		-		-		22,6	
	Distance (in m) between the center of tower base and guy wire anchor point	R	2		3		4		5		6		9		10	
GUY WIRES	N. of guy wires		1		2		2		3		3		4		5	
	Diámeter Ø (mm)		3 (1x7+0)		3 (1x7+0)		4 (1x7+0)		4 (1x7+0)		4 (1x7+0)		4 (1x7+0)		4 (1x7+0)	
	Cable' breaking load ***Rm*** (N)		7000		7000		10780		10780		10780		10780		10780	
	Total guy wire length, in meters (m), (theoretical diagonal).	a	5		5,3		6,7		6,7		8		10,4		10,9	
		b	-		8,2		11,3		10,4		12,4		14,1		13,7	
		c	-		-		-		14,5		17,9		17,4		17,1	
		d	-		-		-		-		-		21,6		21	
		e	-		-		-		-		-		-		24,7	
	Initial tension (N)		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, Televés 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 Televés SA

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