BADRY
High Masts

BADRY Lightning Protection Conical Masts

BADRY Lightning Protection Masts

Telescopic Lightning Protection Steel Conical Masts

Comply / STDs

NFPA-780 & LPI-175

EN 62561 & BS EN 62305

شركة البدرى لتصنيع الأعمدة والصوارى

إحدى شركات مجموعة البدرى للتنمية و الاستثمار

BADRY Poles High Masts Fabrications Co.

BADRY HIGH MASTS FABRICATION CO.

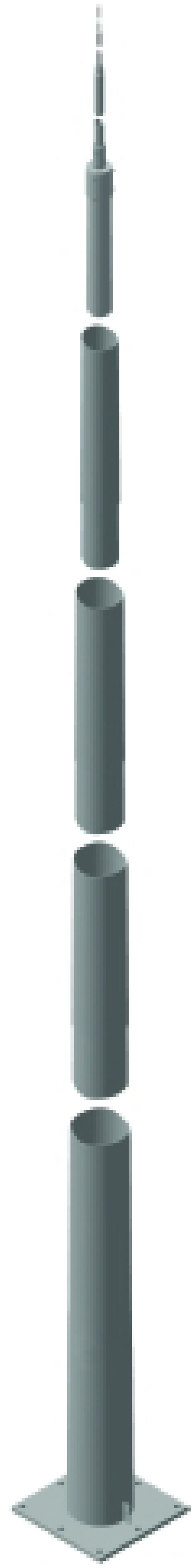
BADRY GROUP MEMBER

Code 036

BADRY Lightning Masts Div.

BADRY Lightning Protection Masts

Telescopic Lightning Protection Steel Conical Masts



The Plug-In Telescopic Lightning Conical Mast is an Air-termination (or catenary) mast for protecting special facilities such as substations, plants, free field PV systems, Ex systems, Rocket & Air Defense Sites, Satellite & Space sites and ammunition dumps against direct lightning strikes.

The Plug-In Telescopic Conical masts are erected in a bucket foundation (pre-fabricated) or an on-site concrete foundation with foundation basket (to be ordered separately).

This catenary / air termination mast system ensures that entire systems / areas are located in the protected volume (lightning protection zone 0) without installing horizontal air-termination / catenary systems (spanning cables). Reviewed designs could be used in Catenary Lightning Methods with supports for Overhead ground wires (lightning conductors).

The material of mast is steel acc. To EN 62561-(1+2), Coating would be hot dip galvanizing with zinc acc. To BS EN ISO 1461: 2009. And the separation distance s according to IEC/EN 62305-3 between the air-termination mast and the object to be protected must be observed. The air-termination masts are dimensioned according to Eurocode.

The lightning system will be according to the requirements of Standards;

- ✓ NFPA-780
- ✓ EN 62561, BS EN 62305
- ✓ LPI-175
- ✓ UL-96, UL-96A

Advantages of BADRY Telescopic Lightning Conical Mast System:

- Independent & Free / Self Standing Lightning Protection Masts
- Supports & Connectors for Overhead ground wires (Lightning Conductors)
- Excavation work can be completed in advance
- Optional prefabricated bucket foundation or design for on concreate
- Erection in on-site concrete foundations with foundation basket (concrete curing time to be observed for scheduling and erection)
- Additional flange plate for fast mounting & adjustable threaded Anchor Bolts
- Maximum Deflection 4% of height @ factored loading
- Detailed mounting instructions
- Verifiable statics (upon request)
- Easily installations within plug in conical segments

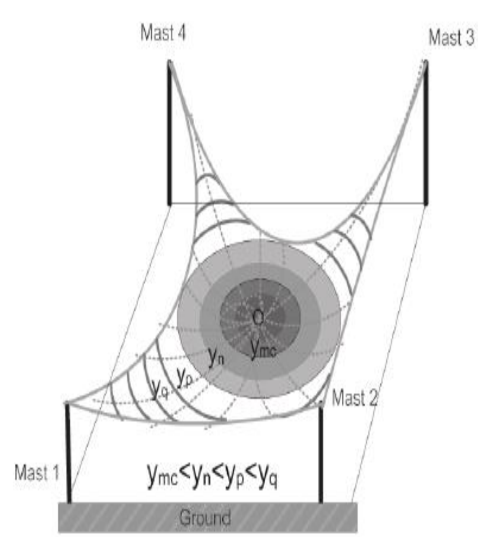
Components of BADRY Telescopic Lightning Conical Mast System:

- Conical Mast Shaft Segments; ASTM A595 / St 355JR Acc. To EN10025
- Welding Acc. To AWS D1.1
- Optional Polygon section with A shape and 12 or 16 faced
- Base plate, Anchor Bolts; St 235JR Acc. To EN10025
- Finishes tZn; Hot Dip Galvanized ASTM A-123 / BS EN ISO 1461:2009
- Bond stress between Anchor bolts & concreate = 1 N / mm^2
- Flange base plate with connection lug for earth connection hole
- Tolerance are acc. To Class B
- Optional Lightning Rods, Overhead Conductors, Supports and Foundation
- Foundation has to be effected on good bearing soil with an admissible soil loading of at least 200 kN/m^2.

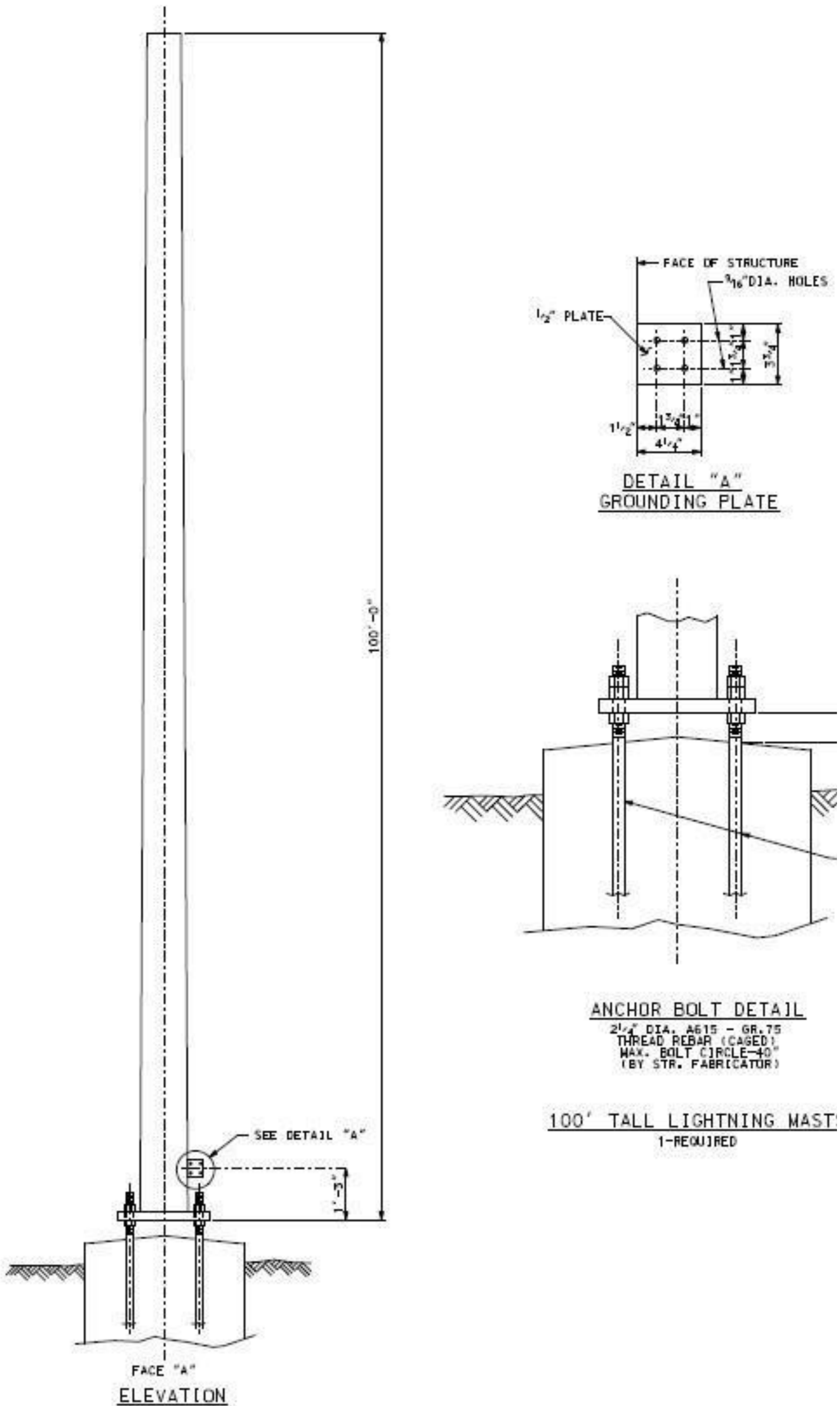
Design Wind Speed:

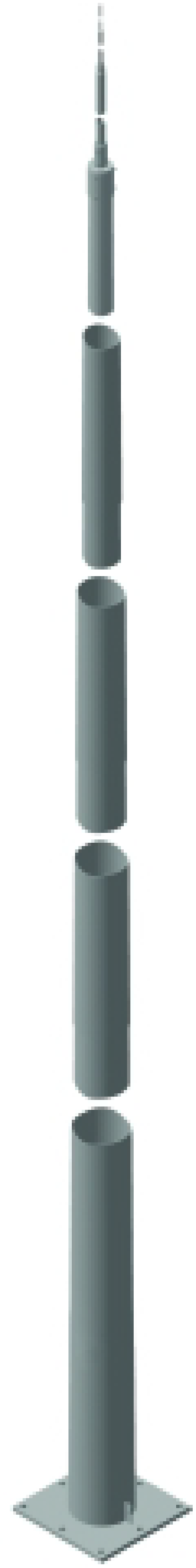
- Standard 0. Normal Design 100 Km/Hr
- Optional 1, Ultimate Design 125 Km/Hr
- Optional 2, Ultimate Design 150 Km/Hr
- Optional 3, Ultimate Design 200 Km/Hr

The shape of protection zone, say zone A is likewise valley basin as shown in opposite figure showing the protection zone against lightning formed by catenary lightning method and four lightning masts of conical type and 10mm overhead ground wires.



Telescopic Lightning Protection Steel Conical Masts





Self-Standing Conical Lightning Mast Up to 100 ft Height

Telescopic Lightning Protection Steel Conical Masts

BADRY Design Specification Notes:

1- **High Mast Design is Acc. To BADRY Fixed High Mast "Lightning Protection", Mast Design and Tolerance are as per AASHTO 2009**

2- **H. MAST Design Wind Velocity Schedule:**

A. Ultimate Limit State = 120 Km/Hr.

B. Service Ability Limit State = 80% of Ultimate

3- **High Mast Material Schedule:**

A. Shaft: EN 10027-1; S355J0 (Min. Yield Strength = 400 N/mm2), SHAFT MATERIAL ST37 ACC. TO DIN 17100, EN 10027-1 S355 JO OR EQUL.

B. Base Plates & Flange Plates: Acc. To EN 10027-1; S355J0 or EQUL

C. Anchor. Bolts: ST37 / ST52 Acc. To DIN 17100, EN 10027-1 S355 JO OR EQUL

D. Threaded Portion of ANCHOR BOLTS electroplated Acc. To ASTM S633

E. NUTS MATERIAL Acc. To GR.6, SS TO JIS G3101 / AISI GRADE3 OR EQUL.

F. Others: MATERIAL: ST37 ACC. TO DIN 17100, EN 10027-1 S355 JO, SS400 TO JIS G3101 or EQUL. The Caged Ladder with Safety Rings is bolted

4- **Welding Acc. To AWS D1.1**

5- **High Mast Finish:**

A. All steel parts are Hot Dip Galvanized Acc. To BS EN Galvanizing is a Before Fabrication Stage Code

B. PRE-GALVANZ OR PRIMARY PAINTED, ACC. BS729 / EN ISO 1461 OR EQUL.

6- All Dimensions are in Millimeter's, Unless otherwise stated

7- This MAST DESIGN is based on limited information assumed to BADRY - Site details provided here are reproduced only as a visualtion aid, field deviations may significant affect predicted performance and aren't BADRY responsibility.

8- Critical site information should be obtained from the contractor and/or specifier responsible for the project.

BADRY Telescopic Lightning Protection Steel Conical Masts	
Mast Part No.	BADRY TLPM-C-20M-0X-CF
Mast Height	20 MT / 65 FT
Material	St/tZn (STD; EN 62561-1,2)
Mast segments / Thick	3 or 4 Seg -- 3 / 4 MM THK
Max. gust wind speed	X; 0(100 km/h), 1(125 km/h), X; 2(150 km/h), 3(200 km/h),
Dimensions of Base Plate	500 X 500 MM / 8 X Ø28 mm
Dimensions of Dia Open	? 300 Bottom / ? 80 Top - MM
Anchor Bolts	AB 8 X M24
On-site concrete foundation	1600 x 1600 x 1000 MM
Weight (Approximate)	400 KG

BADRY Telescopic Lightning Protection Steel Conical Masts	
Mast Part No.	BADRY TLPM-C-25M-0X-CF
Mast Height	25 MT / 82 FT
Material	St/tZn (STD; EN 62561-1,2)
Mast segments / Thick	4 or 5 Seg -- 4 / 5 MM THK
Max. gust wind speed	X; 0(100 km/h), 1(125 km/h), X; 2(150 km/h), 3(200 km/h),
Dimensions of Base Plate	550 X 550 MM / 8 X Ø30 mm
Dimensions of Dia Open	? 350 Bottom / ? 90 Top - MM
Anchor Bolts	AB 8 X M26
On-site concrete foundation	1800 x 1800 x 1000 MM
Weight (Approximate)	500 KG

Self-Standing Conical Lightning Mast 30M

BADRY Telescopic Lightning Protection Steel Conical Masts	
Mast Part No.	BADRY TLPM-C-30M-0X-CF
Mast Height	30 MT / 100 FT
Material	St/tZn (STD; EN 62561-1,2)
Mast segments / Thick	5 or 6 Seg -- 5 / 6 MM THK
Max. gust wind speed	X; 0(100 km/h), 1(125 km/h), 2(150 km/h), 3(200 km/h),
Dimensions of Base Plate	600 X 600 MM / 8 X Ø32 mm
Dimensions of Dia Open	? 400 Bottom / ? 100 Top - MM
Anchor Bolts	AB 8 X M28
On-site concrete foundation	2000 x 2000 x 1000 MM
Weight (Approximate)	600 KG

Mechanical Design of Overhead Ground Wire in Catenary Lightning Method

Overhead Conductor Wires Sag

It is crucial that conductors are under safe tension. If the conductors are too stretched between supports in an attempt to save conductor material, the stress in the conductor may reach critical value and in some cases the conductor may break due to excessive tension. In order to secure conductor safe tension, they are not completely stretched but are allowed to have a dip or sag. The difference in level between support points and the conductor lowest point is called sag. Figure 23 (a) presents a conductor suspended between two equi-level supports A and B. The conductor is not completely stretched but is allowed to have a dip. The conductor lowest point is O and the sag is S. The following items can be noted:

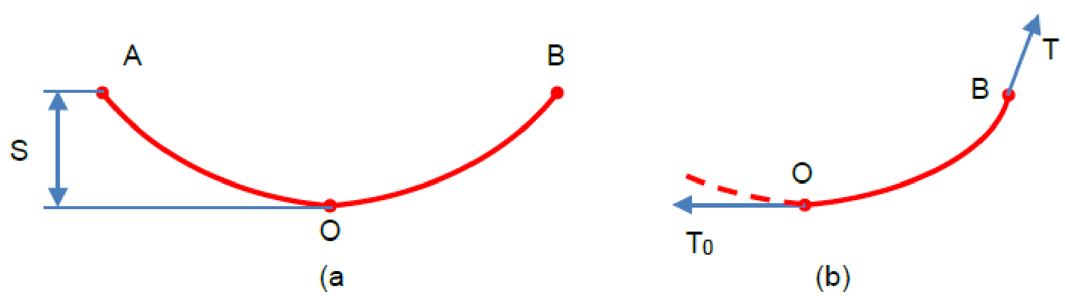


Figure 23. Conductor suspension between two supports

- When the conductor is suspended between two supports at the same level, it forms the shape of catenary. Nevertheless, if the sag is very small in comparison with the span, then sag-span curve is like a parabola.

- The tension at any point on the conductor acts tangentially. Therefore, tension TO at the lowest point O acts horizontally as presented in Figure 23 (b).

- The horizontal tension component is constant throughout the wire length.

- The tension at supports is roughly equal to the horizontal tension acting at any point on the wire. Therefore, if T is the tension at the support B, then T=TO.

Sag and tension of the conductor

This is an important point in the overhead line mechanical design. The conductor sag needs to be maintained to a minimum in order to decrease the required conductor material and to avoid extra pole height for sufficient clearance above earth level.

It is also preferable that conductor tension is low to avoid the conductor mechanical failure and to allow the use of less strong supports. Nevertheless, low conductor tension and minimum sag cannot be achieved. It is because low sag means a tight wire and high tension, whereas a low tension means a loose wire and increased sag. Hence in reality, a compromise in made between the two.

Sag Calculation

In an overhead line, the sag has to be adjusted so that tension in the conductors is within safe boundaries. The tension is governed by conductor weight, wind effects, ice loading and temperature changes. It is a common practice to maintain conductor tension less than 50% of its ultimate tensile strength.

For example, minimum safety factor in respect of conductor tension needs to be 2. We shall now find sag and conductor tension when (a) supports are at equal levels and (b) supports are at different levels.

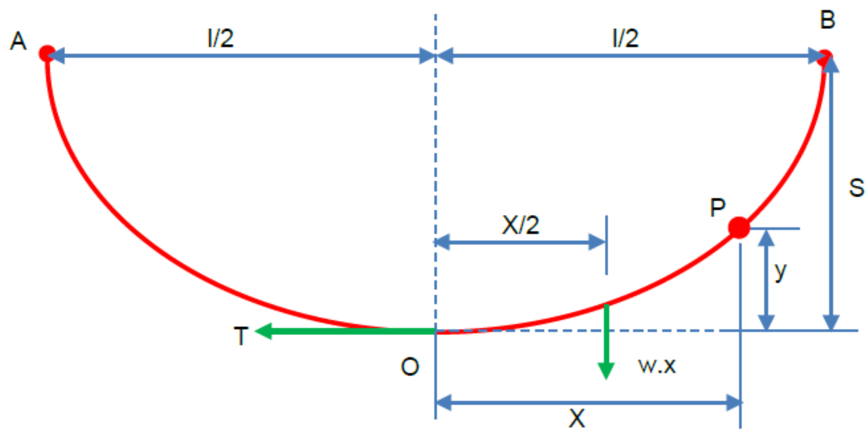


Figure 24. Conductor between two equilevel supports

- When supports are at same levels. Consider a conductor between two equi-level supports A and B with O as the lowest point as presented in Figure 24. It can be shown that lowest point will be at the mid-span. Consider:

l=Span length
w=Weight per conductor unit length
T=Tension in the conductor.

Consider a point P on the conductor. Considering the lowest point O as the origin, let the co-ordinates of point P be x and y. Assuming that the curvature is so small that curved length is equal to its horizontal projection (for example, OP=x), the two forces acting on the portion OP of the conductor are:
(a) The conductor weight wx acting at a distance x/2 from O.
(b) The tension T acting at O.
Equating the moments of above two forces about point O, we find:

$$Ty = wx \times \frac{x}{2}$$

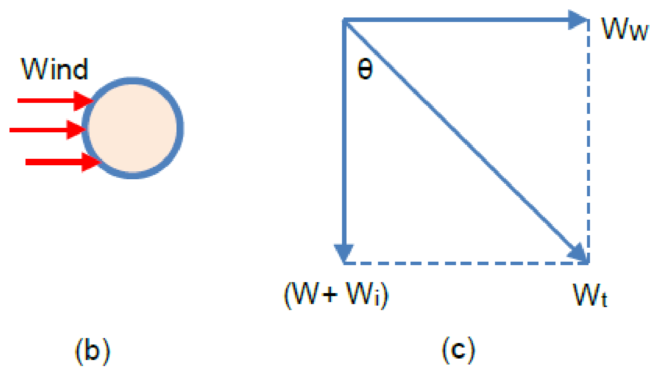
$$y = \frac{wx^2}{2T}$$

The maximum dip (sag) is expressed by the value of y at either of the supports A and B. At support A, x=l/2 and y=S

Sag, $S = \frac{w(l/2)^2}{2T} = \frac{wl^2}{8T}$

Wind loading effect

The above equations for sag are correct only in still air and at normal temperature when the conductor is acted only by its weight only. Nevertheless, in real life a conductor may have simultaneously exposed to wind pressure. The force due to the wind is assumed to act horizontally for example, at right angle to the conductor projected surface. Therefore, the complete force on the conductor is the vector sum of horizontal and vertical forces as presented in Figure 26 (c).



Wind effect on the conductor

Overall weight of conductor per unit length is:

$$w_t = \sqrt{(w + w_i)^2 + (w_w)^2}$$

Where

w - conductor weight per unit length (conductor material density x volume per unit length)

w_i - ice weight per unit length (density of ice x volume of ice per unit length)

w_w - wind force per unit length (wind pressure per unit area x projected area per unit length)

When the conductor has wind and ice loading, the following points have to be considered:
- The conductor sets itself in a plane at an angle to the vertical where

$$\tan\theta = \frac{w_w}{w + w_i}$$

- The sag in the conductor is expressed as:

$$S = \frac{w_t l^2}{2T}$$

Therefore, S represents the slant sag in a direction making an angle to the vertical. If no specific mention is made in the problem, then slant slag is found by using the above equation.

- The vertical sag=Scosθ

Calculation Remarks:

$$Working\ tension,\quad T = \frac{Ultimate\ strength}{Safety\ factor}$$

Working tension, $T = \frac{Breaking\ stress \times conductor\ area}{safety\ factor}$

Slant Sag, $S = \frac{Vertical\ sag}{\cos\theta}$

$$S = \frac{w_t l^2}{8T}$$

$$T = \frac{w_t l^2}{8S}$$