TELECOMMUNICATION TOWERS & CAMOUFLAGE SOLUTIONS CATALOGUE
Monopole Towers

These towers are used for the cellular radio base stations and radio nodes where high antenna loads are not required. Advantages of this technical solution include reduced visual impact, modularity of accessory components, shorter construction time and smaller costs compared to the traditional lattice structures.

GENERAL DESCRIPTION

SUPPORTING STRUCTURE is composed of individual mounting elements which are then joined by the slip-on system or flange joints. Profiles are of polygonal or circular type and the first tower segment is, with the help of the flanges and anchor bolts, connected to the foundation.

FOUNDATION ANCHOR BOLTS are made up of steel rods which are cast in the reinforced concrete foundations and positioned by template included in the supply.

CLIMBING LADDERS are anchored just outside of the pole tower and can be equipped with a safety climbing system.

TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>H (m)</th>
<th>Pole shafts</th>
<th>Max. weight of a pole shaft (kg/m)</th>
<th>Shape of cross connection</th>
<th>Connection joints</th>
<th>Tower gross weight (kg)</th>
<th>Twist &amp; sway of the tower top (°)</th>
<th>Total number of panel and dish antennas (A+MW)</th>
<th>Number of working platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTK30</td>
<td>30</td>
<td>3</td>
<td>11.68</td>
<td>polygonal</td>
<td>slip-on</td>
<td>11,100.0</td>
<td>1.0</td>
<td>9A+3MW</td>
<td>2</td>
</tr>
<tr>
<td>TTK36</td>
<td>36</td>
<td>4</td>
<td>10.60</td>
<td>polygonal</td>
<td>slip-on</td>
<td>12,950.0</td>
<td>1.72</td>
<td>9A+3MW</td>
<td>2</td>
</tr>
</tbody>
</table>

* Panel antenna dimension (A) is 2.5°x0.3m while link antenna diameter (MW) is 0.6m

WIND LOADS

Basic wind speed resistance is equivalent to 30m/s. Characteristics used for the calculation: ice thickness 0.02m

MATERIALS

All used materials comply with the requirements of the European Standards (EURONORM).

Structural parts:
S355JO (JUS EN 10025-1)
S235JR62 (JUS EN 10027-1)

Nuts and bolts: quality 8.8

CORROSION PROTECTION

All steel materials are protected by hot-dip galvanizing in accordance with the current standards.
LATTICE TOWERS

These towers present foundation fixed self-supporting console systems. They are designed as segmented, spatial, rectangular or triangular base steel lattices with partially variable and partially constant cross section. In cases of special exploitation circumstances, it is possible to acquire a desirable tower height by removing parts (segments) from the top or from the bottom of the tower. These constructions are useful in many ways and can be used efficiently for radio centers or any other situation which requires mounting a large number of panel and dish antennas. Konsing Group offers 3 basic types of lattice towers which can be modified according to the customer’s needs.

FOUNDATION ANCHOR BOLTS are made of steel rods which are cast in the reinforced concrete foundations and positioned by template included in the supply.

CLIMBING LADDERS are anchored just inside of the pole tower and can be equipped with a safety climbing system.

VERTICAL CABLE TRAY is positioned close to the climbing ladder along the whole length of the tower.

PLATFORMS are available in different shapes and sizes (triangular, square). They are built from steel elements which are then bolted onto the tower construction.

ANTENNA MOUNTS are integral part of a supporting platform structure which can hold panel and dish antennas.

LIGHTNING & GROUNDING PROTECTION and LIGHTS Towers are equipped with appropriate system of lightning and grounding protection and tower lightning system according to the technical requirements or customers request.

GENERAL DESCRIPTION

SUPPORTING STRUCTURE is composed of prefabricated mountable elements, mutually connected with flanges, while the connection between nodal plates and the fillings is achieved through welding nodal plates to the legs of the tower. Main and secondary diagonal elements are made of steel pipe profiles, while secondary horizontal elements are made of angular L profiles.

<table>
<thead>
<tr>
<th>Type</th>
<th>Basic wind speed</th>
<th>H - Height</th>
<th>Poles/sets</th>
<th>Mass weight of a platform (kg)</th>
<th>Ice thickness</th>
<th>Shape of cross connection</th>
<th>Twist &amp; sway of the tower top</th>
<th>Total gross weight (kg)</th>
<th>Total number of dish antennas</th>
<th>Number of working platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>K 30-19 HD</td>
<td>19</td>
<td>30</td>
<td>5</td>
<td>6,0</td>
<td>2</td>
<td>triangular</td>
<td>0,430</td>
<td>2xØ20,6m (25m)</td>
<td>2xØ21,2m (25m)</td>
<td>2xØ22,4m (22m)</td>
</tr>
<tr>
<td>K 30-35 HD</td>
<td>35</td>
<td>30</td>
<td>5</td>
<td>6,0</td>
<td>5</td>
<td>quadratic</td>
<td>0,306</td>
<td>1xØ21,8m (28,5m)</td>
<td>1xØ21,2m (25m)</td>
<td>1xØ21,2m (19,5m)</td>
</tr>
<tr>
<td>K 36-35 HD</td>
<td>35</td>
<td>36</td>
<td>6</td>
<td>6,0</td>
<td>5</td>
<td>quadratic</td>
<td>0,412</td>
<td>1xØ21,8m (34,5m)</td>
<td>3xØ21,2m (32m)</td>
<td>1xØ21,8m (32m)</td>
</tr>
</tbody>
</table>

*Antenna height is given in the brackets

Table 2 - Technical Specifications

TECHNICAL SPECIFICATIONS

STRUCTURE CALCULATION

The structure calculation was performed according to current Serbian standards and regulations.

WIND LOADS

Basic wind speed resistances for different types of lattice towers are given in Table 2. Characteristics used for the calculation:

- Ice thickness: 0.02m and 0.05m
- Basic wind speed: 19 m/s, 35 m/s, 36 m/s

MATERIALS

All used materials comply with the requirements of the European Standards (EURONORM).

Structural parts:

- S355 J0 (JUS EN 10027-1)
- Tower legs (hot finished seamless pipes)

Nuts and bolts: qty. 10.9 (high tension bolts)

Welds: according to the technical requirements and standards

CORROSION PROTECTION

All steel materials are protected by hot-dip galvanizing in accordance with the current standards.

Scheme 2 – Model Comparison
Camouflage Towers

These towers are used for cellular radio base stations in urban areas where there is a need to reduce their visual impact on the environment. Konsing Group offers an efficient solution in the form of artificial tree that is functional like any other regular telecommunication tower. Their main advantages include reduced environmental impact and modularity of accessory components.

**GENERAL DESCRIPTION**

**SUPPORTING STRUCTURE** is composed of individual polygonal or circular poles made up of several shafts kept together by slip-on joints. Shafts are covered with material very similar to the tree bark. Base shaft is flange connected to the foundation with anchor bolts.

**FOUNDATION ANCHOR BOLTS** are made up of steel rods which are cast in the reinforced concrete foundations and positioned by template included in the supply.

**CLIMBING LADDERS** are anchored outside or inside of the pole tower and can be equipped with safety climbing system.

**FEEDERS & CABLE** run down through the inside of the trunk.

**ANTENNA MOUNTS** are integral part of a supporting structure.

**LIGHTNING & GROUNDING PROTECTION** and LIGHTS

Towers are equipped with appropriate system of lightning and grounding protection and tower lightning system according to the technical requirements or customers request.

<table>
<thead>
<tr>
<th>Type</th>
<th>Height</th>
<th>Pole shafts</th>
<th>Max. height of pole shaft</th>
<th>Shape of cross section</th>
<th>Connection joints</th>
<th>Total gross weight (kg)</th>
<th>Total &amp; way of the lower top</th>
<th>Total weight of tree trunk (mm)</th>
<th>Total number of panel antennas (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial pine tree h=20m</td>
<td>20</td>
<td>2</td>
<td>11,41</td>
<td>polygonal</td>
<td>slip-on</td>
<td>6060,00</td>
<td>1,32</td>
<td>18,8 / 30,4</td>
<td>6A=2MW</td>
</tr>
<tr>
<td>Artificial pine tree h=30m</td>
<td>30</td>
<td>3</td>
<td>11,98</td>
<td>polygonal</td>
<td>slip-on</td>
<td>11900,00</td>
<td>1,41</td>
<td>25,0 / 44,0</td>
<td>6A=2MW</td>
</tr>
</tbody>
</table>

*Dimension of the panel antenna (A) is 2,9*0,3m while diameter of the link antenna (MW) is 1,2m.

Antenna load (in the calculation) is treated as a vertical load only due to the coverage effect that tree top has on the antenna.

**TECHNICAL SPECIFICATIONS**

**STRUCTURE CALCULATION**

The structure calculation was performed according to current Serbian standards and regulations.

**WIND LOAD**

Basic wind speed resistance is equivalent to 30m/s. Characteristics used for the calculation: ice thickness 0.02m.
Assembly Towers with Ballasts

This model enables fast and easy installation on the earth and the existing structures. Also, they have steel ropes and sprits that strengthen the lattice mount.

**GENERAL DESCRIPTION**

**BASE FRAME** of the structure consists of steel platforms for bearing cabinets and concrete ballasts. Ballasts are made of prefabricated concrete elements, which enable quick and easy installation and un-installation without the need for heavy machinery.

**CLIMBING LADDERS** are anchored to the outside of the tower and can be equipped with safety climbing system.

**VERTICAL CABLE TRAY** is positioned along the whole length of the tower.

**ANTENNA MOUNTS** are integral part of a supporting structure which can hold panel and dish antennas.

**LIGHTNING & GROUNDING PROTECTION** and **LIGHTS**

Towers are equipped with appropriate system of lightning and grounding protection and tower lightning system according to the technical requirements or customers request.

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### TECHNICAL SPECIFICATIONS

**STRUCTURE CALCULATION**

The structure calculation was performed according to current Serbian standards and regulations.

**WIND LOADS**

Basic wind speed resistances are given in Table 4. Characteristics used for the calculation:

- Ice thickness: 0.02m

**TWIST & SWAY OF THE TOWER TOP**

Number and type of antennas that can be placed on the pole as well as maximum twist and sway are given in Table 4.

**MATERIALS**

All used materials comply with the requirements of the European Standards (EURONORM).

- Structural parts: S235 JRG2 (JUS EN 10027-1)
- Nuts and bolts: qly. 10.9 (high tension bolts)

**CORROSION PROTECTION**

All steel materials are protected by hot-dip galvanizing in accordance with the current standards.

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### TECHNICAL DATA

<table>
<thead>
<tr>
<th>Type</th>
<th>Basic wind speed</th>
<th>H</th>
<th>Pole parts</th>
<th>Max. length of a pole part</th>
<th>Shape of cross connection</th>
<th>Connection parts</th>
<th>Total gross weight</th>
<th>Twist &amp; sway of the tower top</th>
<th>Total number of dish antennas</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTK20-19</td>
<td>19</td>
<td>20</td>
<td>5</td>
<td>4.0</td>
<td>quadratic</td>
<td>flange</td>
<td>5099.5</td>
<td>0.237</td>
<td>6xA 1.3m (19m) 2xØ0.3m (10m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Antenna height is given in the brackets
**Commercial Towers**

These towers have a rectangular, spatial lattice structure with a constant cross section. Thanks to radio transparent covering, which can be mounted over the structure, it is possible to add a commercial feature to the object.

**GENERAL DESCRIPTION**

**SUPPORTING STRUCTURE** is 25m high and consists of 5 mounting segments which are mutually connected with flanges. First four segments have a classical secondary filling, while the last one is designed as a frame with main vertical and secondary horizontal elements. Main elements have steel pipe profiles, while secondary filling elements have angular L profiles.

**FOUNDATION ANCHOR BOLTS** are made up of steel rods which are cast in the reinforced concrete foundations and positioned by template included in the supply.

CLIMBING LADDERS are secured to the inside of the structure and can be equipped with safety climbing system.

VERTICAL CABLE TRAY is positioned close to the climbing ladder along the whole length of the tower.

ANTENNA MOUNTS are integral part of a supporting structure which can hold panel and dish antennas.

RADIO TRANSPARENT COVERING PANELS are used on last (top) segment of the tower while other four segments are covered with steel panels.

**TECHNICAL SPECIFICATIONS**

**STRUCTURE CALCULATION**

The structure calculation was performed according to current Serbian standards and regulations.

**WIND LOADS**

Basic wind speed resistance is equivalent to 35m/s. Characteristics used for the calculation: ice thickness 0.025m

**TWIST & SWAY OF THE TOWER TOP**

Maximum twist and sway at the top of the pole is 0.57°.

**MATERIALS**

All used materials comply with the requirements of the European Standards (EURONORM).

Structural parts:
- S355JO (JUS EN 10027-1)
- S235JR G2 (JUS EN 10027-1)
Nuts and bolts: quality 8.8

**CORROSION PROTECTION**

All steel materials are protected by hot-dip galvanizing in accordance with the current standards.

**WEIGHT of SUPPORTING STRUCTURE** is 13061.82 kg and weight of steel panels is 1526.40 kg.

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**Mobile Towers**

These towers are shelter equipped antenna supporting structures which allow fast and easy installation and are mostly used when there is a need for temporary radio base stations and emergency networks.

**GENERAL DESCRIPTION**

**SUPPORTING STRUCTURE** consists of specific shape mountable parts which enable telescopic unpacking of the tower. The tower is equipped with fast mounting mechanism with steel ropes and can be erected either manually or with the help of an engine. This unique system gives a possibility for very easy and fast installation which can be done in less than 2 hours. Firm structure support is possible thanks to the link between the construction and the container. Additional support is provided with the specially constructed steel ballasts which can be filled with sand or local earth. This feature greatly simplifies transport and mounting of the entire system.

ANTENNA MOUNTS are integral part of the supporting structure and they can accept panel and dish antennas with an ease.

LIGHTNING & GROUNDING PROTECTION and LIGHTS

Towers are equipped with appropriate system of lightning and grounding protection and tower lightning system according to the technical requirements or customers request.

Currently a 24m tower height option is available, but a 30m can be implemented if the customer requests it.
Camouflage Solutions

Reducing an environmental impact which telecommunication towers have on their environment is becoming more and more important issue in their design and construction. This especially implies on rooftop locations which are usually located in urban and industrial areas. Konsing offers a wide range of products that are purposely designed for solving these types of problems.

Besides the obvious advantage of these solutions it is important to emphasize their easy assembly – disassembly construction. They are made up of high quality and firm composite materials resistible to all weather conditions and coated with commercial or decorative foliage based on the customer’s request. End products are tested by the renowned material testing companies and the radio transparency results are shown on diagrams 1, 2, 3 and 4. Based upon the customer’s request, it is possible to provide detailed test results for the different antenna types and material thickness.

Konsing has developed several standard solutions but, if the non standard request emerges, it is possible to make all desired modifications. These solutions include artificial chimneys with round or quadratic base as well as panel coatings whose purpose is to hide antennas and all auxiliary equipment.

GENERAL DESCRIPTION

SUPPORTING STRUCTURE is composed of steel mountable parts which are then fixed to the support elements of an existing object. The system is comprised of main supporting structure for antenna and auxiliary equipment mounting and secondary supporting structure for composite foliage mounting.

FOLIAGE MATERIAL is made up from special plastic mass so that continuous equipment functioning is maintained.

ACCESS AND MAINTENANCE of the equipment has been achieved in multiple ways thanks to the revision openings whose purpose is for smaller interventions on the equipment or through simple demounting of the complete panel for potential system change.

ANTENNA AND CABLE CARRIERS as well as all the associated equipment are integral part of the construction and have been installed inside of the foliage area covering. Thanks to the architecture of the system, the uninterrupted ventilation and air circulation is achieved through the foliage and, thanks to that, an efficient equipment functioning.

LIGHTNING & GROUNDING PROTECTION and LIGHTS Towers are equipped with appropriate system of lightning and grounding protection and tower lightning system according to the technical requirements or customers request.

Diagram 1: VSWR Measurement with Antenna K742236 without the use of Camouflage Covering
Band 1.7-2.2GHz

Diagram 2: VSWR Measurement with Antenna K742236 with the use of 3.5mm Camouflage Covering
Band 1.7-2.2GHz

Diagram 3: Isolation Measurement between RF ports of Antenna K742236 without the use of Camouflage Covering
Band 1.7-2.2GHz

Diagram 4: Isolation Measurement between RF ports of Antenna K742236 with the use 3.5mm Camouflage Covering
Band 1.7-2.2GHz
Camouflage Solutions

**TECHNICAL SPECIFICATIONS**

**STRUCTURE CALCULATION**
The structure calculation was performed according to current Serbian standards and regulations.

**WIND LOADS**
Basic wind speed resistances for these towers are variable and the product can be used independently of the wind categorization.

**ANTENNA NUMBER AND TYPES**
Number and types of antennas that can be mounted inside of the foliage is conditioned with the minimal antenna distance from the foliage area. Products that are in Konsing series production are designated for mounting one to three antennas and all of the auxiliary equipment.

Based upon the investor’s request, it is possible to produce solutions that can hold greater number of antennas in accordance to the carrying capacity of the object which must hold all of the equipment. Mounting of link antennas is not included inside the foliage masking area.

**MATERIALS**
All used materials comply with the requirements of the European Standards (EURONORM).

Structural parts: 5235 JRGZ (JUS EN 10027-1)

**CORROSION PROTECTION**
All steel materials are protected by hot-dip galvanizing in accordance with the current standards.

- **POLIKON K1**
- **POLIKON C1**
- **POLIKON C3**
- **POLIKON M4**

**Table 5 - Technical Data for Camouflaged Solutions**

<table>
<thead>
<tr>
<th>CAMOUFLAGE TYPE</th>
<th>BASE LAYOUT</th>
<th>Antenna Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polikon K1</td>
<td>Square</td>
<td>1</td>
</tr>
<tr>
<td>Polikon K3</td>
<td>Square</td>
<td>3</td>
</tr>
<tr>
<td>Polikon C1</td>
<td>Circle</td>
<td>1</td>
</tr>
<tr>
<td>Polikon C3</td>
<td>Circle</td>
<td>3</td>
</tr>
<tr>
<td>Polikon M4</td>
<td>Triangle</td>
<td>4</td>
</tr>
</tbody>
</table>

**Scheme 7 – view of the basic solutions**

**Picture 7 - Polikon K1**

**Picture 8 - Polikon C1**

**Picture 9 - Polikon M4**