Instructions for building the foundation and erection of the tower

Wyssen Avalanche tower LS12-5
Wyssen Mini-avalanche tower LS6-5
Safety Information

This manual contains information that must be observed for your personal safety, the safety of other persons and for the prevention of material damage. Such information is highlighted by a warning triangle and displayed depending on the degree of risk in the following manner.

- **Danger**
  Danger indicates that death or severe bodily injury will occur if the corresponding safety measures are not taken.

- **Caution**
  Caution with a warning triangle indicates that mild or moderately severe injury can occur if the corresponding safety measures are not taken.

- **Caution**
  Caution without a warning triangle indicates that material damage can occur if the corresponding safety measures are not taken.

- **Tip**
  Indicates useful or necessary user information.

Intended Use

The Avalanche tower LS12-5/Mini-avalanche tower LS6-5 is used to trigger avalanches prophylactically by blasting. This is to safeguard avalanche-endangered installations, ski slopes, buildings, transport routes etc. where uncontrolled avalanches could lead to injury or damage to persons or property.

The intended use of this equipment is solely for the controlled release of avalanches and may only be operated by trained personnel in accordance with the regulations and after precise assessment of the current situation with regard to residual risks.

The installation is only to be used in conjunction with other devices and components that are recommended or approved by Wyssen Avalanche Control AG.

The proper and safe operation of the product requires correct transportation, assembly, storage as well as careful operation and maintenance.
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Description of the tower</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Building and installing the foundation</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Tower installation</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>Recommended literature</td>
<td>34</td>
</tr>
<tr>
<td>5</td>
<td>Annex</td>
<td>34</td>
</tr>
</tbody>
</table>
Inhaltsverzeichnis

1 Description of the tower ........................................................................................................ 6
   1.1 General Information ........................................................................................................... 6
   1.2 Dimensions and weights .................................................................................................. 6
   1.3 Maximum forces on the tower and foundation ............................................................... 6

2 Building and installing the foundation ................................................................................. 6
   2.1 General Information ........................................................................................................... 6
   2.2 Earthing ............................................................................................................................. 7
   2.3 Layout and dimensions ..................................................................................................... 7
   2.4 Foundation by Rock Anchors or Micro Piles ................................................................. 8
   2.4.1 Foundation for rock ....................................................................................................... 9
   2.4.2 Foundation for loose material .................................................................................... 9
   2.5 Length of anchors and diameter of drill holes ............................................................... 10
   2.5.1 Assessment and differentiation of the soil types ......................................................... 10
   2.5.2 Rock anchors ............................................................................................................... 11
   2.5.3 Micropiles .................................................................................................................. 11
   2.5.4 Tension relief anchor ................................................................................................. 12
   2.5.5 Marmot damage .......................................................................................................... 13
   2.5.6 Record book and confirmation of execution ................................................................ 14
   2.5.7 Material required for construction of the foundation (excluding general building tools) ................................................................................................................................. 15
   2.5.8 Important when leaving the construction site - preparatory work for assembly .......... 17

3 Tower installation .................................................................................................................. 18
   3.1 Placement of the complete tower ..................................................................................... 18
   3.1.1 Centres of gravity of the Avalanche tower LS12-5 ...................................................... 18
   3.1.2 Centres of gravity of the Mini-avalanche tower LS6-5 ................................................ 19
   3.2 Placement of the pedestal of the 2-part tower ............................................................... 20
   3.3 Placement of the top pieces of the 2-part tower ............................................................. 21
   3.3.1 Suspension points of the Avalanche tower LS12-5 .................................................... 21
   3.3.2 Suspension points of the Mini-Avalanche Tower LS6-5 .............................................. 22
   3.4 Earthing the tower .......................................................................................................... 24
   3.5 Mounting the safety cable on the LS12-5 ....................................................................... 24
   3.6 Installing the tension relief anchor .................................................................................. 25
   3.7 Aligning the erection jib on the LS12-5 .......................................................................... 27
   3.8 Aligning the platform on the LS6-5 ............................................................................... 28
   3.9 Mounting the magazine-box on the LS6-5 ..................................................................... 29
   3.10 Materials and tools for erecting the tower .................................................................... 30
   3.10.1 Delivered by Wyssen Avalanche Control AG with the LS12-5 and LS6-5 .................... 30
   3.10.2 Additionally delivered by Wyssen Avalanche Control AG with the LS6-5 .................. 31
   3.10.3 Required materials and tools from the assembly firm/client /builder ....................... 32
   3.11 Weight of the towers ...................................................................................................... 33
   3.11.1 LS12-5 Weights ......................................................................................................... 33
   3.11.2 LS6-5 Weights ........................................................................................................... 33

4 Recommended literature ........................................................................................................ 34

5 Annex .................................................................................................................................... 34
   5.1 Links ................................................................................................................................. 35
   5.2 DYWIDAG GEWI®-Pile System ..................................................................................... 36
   5.3 DYWIDAG Soil nail ......................................................................................................... 40
   5.4 Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in loose material ................................................................. 43
   5.5 Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in rock .......... 44
1 Description of the tower

1.1 General Information

The supporting tower of the LS12-5/LS6-5 avalanche/mini-avalanche towers is designed to hold the charge magazine, from which explosive charges are dropped and ignited by remote control, in order to release avalanches artificially. Since the system is installed in potential avalanche slopes, the tower is exposed to the forces of snow and avalanche pressure if it is not located on a prominent elevation. These instructions apply to the LS12-5 avalanche tower and the LS6-5 mini-avalanche tower. The pictures used relate to the LS12-5 avalanche tower, but also apply analogously to the LS6-5 mini-avalanche tower. Here the towers are only described without the magazine-boxes.

1.2 Dimensions and weights

The standard tower consists of two parts. A 5m high pedestal and a head end in lengths of 3, 5 and 7m. Thus the heights of the mast can be 8m, 10m or 12m.

The separate parts of the tower can be flown in either individually or as an assembled unit. The weights of the individual towers are given in tables 3.11.1 and 3.11.2. They can thus be flown by almost any operating transport helicopter. The base plate is fixed with four vertical rock anchors or micropiles as well as a horizontal anchor, if required, on the upper slope side to relieve the shear forces. A concrete pedestal with a minimal surface area of 1m x 1m serves as a foundation.

1.3 Maximum forces on the tower and foundation

In order to check the resistance of the present construction method to avalanches, various avalanche scenarios were tested and for each scenario, the pressure on the tower was calculated. The resistance to avalanches was tested with the aid of the calculations carried out and static analyses.

The tests showed that the impact of avalanches could be absorbed to a certain degree by the blasting installations, without any damage occurring to the equipment. However, it was also shown that very large avalanches could damage or destroy avalanche towers. Particularly for possible avalanches that reach speeds of over 25m/sec.

In addition to the impact of the flowing avalanche, there is also a powder avalanche impact on the whole avalanche tower. In this case, a more precise testing by Wyssen Avalanche Control AG is necessary.

2 Building and installing the foundation

2.1 General Information

The commissioned builder is responsible for building and installing the foundation. It is absolutely necessary to comply with the details described in these instructions. Basically, the appropriate Swiss Guidelines for avalanche protection structures in the release zone, the ONR 24806 (Austria) and the current relevant national guidelines have to be considered when constructing or using rock anchors/micropiles. Any deviations in the details given in this document are to be reported to the manufacturer. The present instructions are based on the above-mentioned guidelines; however, in some cases modifications have been made to increase safety.
2.2 Earthing

The tower must be adequately earthed in order to protect the machine and persons.

Switzerland:
In the case of loose earth such as humus, sand or loose rock, the builder lays three radially-arranged earthing straps with a cross-section of 3mm x 30mm and a length of at least 25m (in total at least 75m), and which are well earthed. The earthing straps must all have a hole of Ø 13 mm at one end for fixing onto the foot of the tower. In the case that the tower location is predominantly on hard and compact rock, further assessments concerning earthing must be carried out by the Wyssen Avalanche Control Company.

Austria:
The tower must be adequately earthed in order to protect the machine and persons. The four vertical rock anchors/piles and also the shear-relief anchor are used as earthing protectors against lightning. At locations where the soil conditions make it possible to lay horizontal earthing systems (radial earthing conductor), three radially-arranged earthing straps are laid with a cross-section of 3mm x 30mm and a length of at least 25m. The horizontal earthing conductors (radial earth conductors) are connected by an earthing ring at a distance of approximately 5m from the tower. The placement is made deep enough, so that no dynamic forces can have any effect when conducting lightning current and the soil around the laid earthing conductors is sufficiently conductive. The earthing straps are connected to the tower base section (pedestal) so that they can conduct lightning. A sign is mounted at eye level on the pedestal concerning step and touch voltage for persons compliant with ÖVE/ÖNORM EN 62305-3 (see operating instructions Item 2.1 Presentation of safety notices).

The earthing/lightning conductor installation is subjected to an initial test, which is then repeated every three years. The test results are recorded in the inspection records and are kept available for any possible inspection by the authorities.

2.3 Layout and dimensions

The dimensions that are essential for the fitting to the base plate are shown in the figure below. It is important that the surface of the concrete base is exactly horizontal. The concrete may not protrude above the template.

*Depth according to Foundation Instructions Chapter 2.5
2.4 Foundation by Rock Anchors or Micro Piles

If not otherwise specified, the foundation by rock anchors and micropiles consists of a horizontal base whose side edges correspond with the line of the main slope lying underneath it. Four vertical anchors, a template as an anchor bond and an anchor for relief of shear forces. The drill holes must be prepared at the designated location in the terrain with the assistance of the pre-delivered template. After installation of the anchor/micropiles, the template is accurately aligned in the horizontal position and supported on the four anchor nuts.

After the location under the template has been thoroughly cleaned and loose stones have been removed, shutter boards can be prepared and pre-mixed dry concrete poured in under the template. After pouring the concrete, it should be vibrated thoroughly. Care must be taken to ensure the complete template sits over the base and that no cement protrudes, so that a good, even surface is guaranteed for the foot of the tower.

Caution
Allow for sufficient space for the shear-relief anchor (see pictures in Chapter 2.3)
### 2.4.1 Foundation for rock

If the rock is sold, the concrete foundation is to be constructed with a thickness of 30cm according to the figure above.

### 2.4.2 Foundation for loose material

If the rock is loose, the concrete foundation is to be constructed with a thickness of 60cm. The anchoring depth of 30cm must be complied with.

The spacings $a$ and $b$ for the micropile boreholes and the shear-relief anchor are to be ensured according to the previous chapter. The reinforcement cover $c$ is completed as follows:
- $c = 40\text{mm}$ generally
- $c = 50\text{mm}$ on prepared subsoil
- $c > 90\text{mm}$ on unprepared subsoil
2.5 Length of anchors and diameter of drill holes

In order that the maximum anchor strength can be attained in the vertical direction, the minimum anchor lengths must be compliant with according to the table below.

**Tip**
The forces generated that act on the tower and also the anchor bars are calculated by Wyssen Avalanche Control AG or their authorised representative, so that the dimensions (Ø) and usable anchor length can be determined.

<table>
<thead>
<tr>
<th>Type of anchor</th>
<th>Soil conditions</th>
<th>Usable anchor length in the earth</th>
<th>Drill hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock anchors</td>
<td>rock largely free of fissures</td>
<td>min. 3.0 m</td>
<td>min. 52 mm</td>
</tr>
<tr>
<td>Micropile / self-drilling anchor*</td>
<td>Medium soil</td>
<td>min. 5.0 m</td>
<td>min. 90 mm</td>
</tr>
<tr>
<td></td>
<td>Poor soil</td>
<td>min. 8.0 m</td>
<td>min. 90 mm*</td>
</tr>
</tbody>
</table>

*Drill hole Ø70mm possible for coated anchor

Definition of poor soil:
Loose soil, non-cohesive, non-binding fine material (e.g. moist, clayey weathered products that only allow poor interlocking with the anchor and the soil), and scree.

Definition of medium soil:
Densely packed with cohesive fine material (e.g. coarse scree blocks with some parts of binding fine material, dry gravel sand).

2.5.1 Assessment and differentiation of the soil types

The following characteristic pull-out resistances of the soil, taken from the Swiss Guidelines for avalanche protection structures, are adopted for pre-dimensioning the anchor lengths. The final specification of the anchor lengths takes place on location by establishing the pull-out resistances during assessment of the soil by the contracting company/geologists.
2.5.2  Rock anchors

Provided that sound rock is found in the subsoil, the foundation can be started with rock anchors. The following requirements must be observed:

- The drill-hole diameters must be at least 1.5 times greater than the anchor diameter.
- The minimum grout cover of the anchor must be 10mm (corrosion protection).
- The anchor lengths must be specified corresponding to the maximum forces and the rock quality. The first half metre in the rock may not be included in the calculation. The minimum working length of the anchors is 3.0m.
- The anchor bar is to be centred in the drill hole.
- Before injecting grout into the drill hole, it must first be cleaned by blowing out.
- A suitable anchor grout is to be used that is low-shrinkage and is capable of swelling.
- The drill hole must be filled with grout from the bottom, so that the anchor bar is grouted full-face and without air pockets.

2.5.3  Micropiles

Micropiles are used for medium or poor soils, and are particularly sensitive to shear forces, since in contrast to rock, such forces cannot be absorbed by the relocated soil. The following requirements must be observed:

- The minimum drill-hole diameter is 90mm.
- The maximum mesh width of the net stockings is 10mm; if possible, however, the use of a stocking should be avoided.
- The grout cover of the anchor member must be at least 20mm.
- The anchor lengths must be specified corresponding to the maximum forces and the soil quality. The first half metre in the soil may not be included in the calculation. The minimum working length of the anchors is 5m.
- The anchor is to be centred in the drill hole.
- The drill hole must be filled with grout from the bottom, so that the anchor bar is grouted full-face and without air pockets.
- If larger anchor diameters have to be utilised due to the geology, then adapters have to be used in the area of the foundation.
- A suitable anchor grout is to be used that is low-shrinkage and is capable of swelling.
2.5.4 Tension relief anchor

The tension relief anchor must be set up according to the instructions in chapter 2.3. An additional jig (Art. No. 411.416) may be obtained from the Wyssen Company for drilling the tension relief anchor. The anchor bar must be centred in the drill hole, which can be achieved by using a spacer or centring components. The anchor must be installed according to the drawing below. The minimum length of an anchor is 6m. The final length will be decided upon by Wyssen Avalanche Control AG.

If a reinforced tower is utilised, a minimum free working length of 1m is to be included for the anchor. This is achieved by overlaying a PVC tube beforehand with a marginally larger diameter than the anchor. The 700mm-long PVC tube must be flush with the earth and reach into the interior.
### 2.5.5 Marmot damage

If there is a probability of damage by marmots, installation of wire netting should be examined. The construction is carried out according to the diagrams.
2.5.6 Record book and confirmation of execution

A record book with the Company’s stamp and signature, containing at least the details listed below, is to be drawn up and presented to the client.

General Information:
- Name and address of the contracting company
- Name of the builder on location
- Execution date

Anchor data:
- Number and diameter
- Usable anchor length
- Situation and inclination of each anchor

Drilling:
- Drilling process
- Borehole length and diameter
- Known drilling obstacles
- Sketch of the subsoil properties encountered while drilling

Grouting:
- Type of cement
- Cement consumption
- W/C ratio
- Additives
- Type of injection
- Temperature and weather conditions

Tip
In addition to the record sheet, a confirmation of the execution is to be handed over in which the contacting company confirms that the foundation and assembly has been carried out in accordance with the present instructions and the state of the art. Templates can be requested from the Wyssen Avalanche Control Company.
## 2.5.7 Material required for construction of the foundation (excluding general building tools)

<table>
<thead>
<tr>
<th>Number</th>
<th>Article/art.no.</th>
<th>Dimensions</th>
<th>Comments</th>
<th>Supplier Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pc</td>
<td>Template Art.no.411.412 for GEWIØ32 or Art.no.411.412_GEWI40 for GEWIØ40</td>
<td>l\times w\times d: 1000 \times 1000 \times 6 \text{ mm}</td>
<td>1000 \times 1000 \times 6 \text{ mm}</td>
<td>Weight: 25 kg</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Anchor Rod</td>
<td>nominal-Ø: Length: Project related</td>
<td>Project related</td>
<td>Weight:</td>
</tr>
<tr>
<td>8 pcs</td>
<td>Anchor nut</td>
<td>nominal-Ø: Length: 60 mm</td>
<td>ditto anchor bar</td>
<td>Weight:</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Lock nut</td>
<td>nominal-Ø: Length: 30 mm</td>
<td>ditto anchor bar</td>
<td>Weight:</td>
</tr>
<tr>
<td>3 pcs</td>
<td>Earthing strap</td>
<td>Switzerland, other countries: Cross-section: 3\times 30 \text{ mm} 3\times 25 \text{ m (total min. 75 m)} galvanised steel or copper</td>
<td>3\times 30 \text{ mm} 3\times 25 \text{ m (total min. 75 m)} galvanised steel or copper</td>
<td>Austria:</td>
</tr>
<tr>
<td></td>
<td>Ankermörtel</td>
<td>Quantity according to supplier's details and depth of anchor</td>
<td>Quantity according to supplier's details and depth of anchor</td>
<td>e.g. Avalanche defence mortar from Sakret</td>
</tr>
<tr>
<td></td>
<td>Dry concrete</td>
<td>For base quantity dependent on terrain</td>
<td>For base quantity dependent on terrain</td>
<td></td>
</tr>
<tr>
<td>2 pcs</td>
<td>Reinforcing grid</td>
<td>l\times b: 1000 \times 1000 \text{ mm}</td>
<td>1000 \times 1000 \text{ mm}</td>
<td>diameter: 8 mm, mesh width 150 mm</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>For drilling and flushing</td>
<td>For drilling and flushing</td>
<td></td>
</tr>
</tbody>
</table>

### Additional material for the shear-relief anchor (horizontal anchor)

<table>
<thead>
<tr>
<th>Number</th>
<th>Article/art.no.</th>
<th>Dimensions</th>
<th>Comments</th>
<th>Supplier Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pc</td>
<td>Drilling jig shear-relief anchor 411.416</td>
<td>l\times w\times h: 940\times 480 \times 380 \text{ mm}</td>
<td>940\times 480 \times 380 \text{ mm}</td>
<td>Weight: 30 kg</td>
</tr>
<tr>
<td>1 pc</td>
<td>Anchor rod</td>
<td>nominal-Ø: Length: Project related</td>
<td>Project related</td>
<td>Weight:</td>
</tr>
<tr>
<td>1 pc</td>
<td>PVC tube</td>
<td>nominal-Ø: Length: Project related</td>
<td>Project related</td>
<td>Weight:</td>
</tr>
</tbody>
</table>
Prepared concrete formwork with anchor bars and reinforcement
2.5.8 **Important when leaving the construction site - preparatory work for assembly**

After completion, the foundation must be left so that the tower can be assembled without any further preparation.

- An anchor nut and lock nut must be prepared for each anchor rod.
- The thread must be clean, so that the nut can be freely threaded by hand.
- There must be no surplus material on the base that is higher than the template.
- Tension relief anchor-relief anchor rods must be sawn off flush with the template.
- The construction site must be left clean.

Finished foundation
(In the illustration the anchor and lock nuts on the anchor bar are missing as well as two earthing straps)
3 Tower installation

3.1 Placement of the complete tower

It is very important that material and tools required according to tables 3.11.1 and 3.11.2 are placed ready at the foundation before placing the tower.

The elements of the two-part tower can be transported either individually or as an assembled unit. When transporting by helicopter, these are suspended from a single point for easier assembly, and flown to the installation location. At least 2 men and 1 flight assistant are necessary for receiving the tower and aligning it over the foundation anchor rods.

The flight assistant ensures communication with the helicopter and gives instructions to the pilot.

Caution: All details concerning the centres of gravity apply only to the respective illustrated tower, i.e. without placement of the magazine-box.

3.1.1 Centres of gravity of the Avalanche tower LS12-5

Caution: Flying with an installed magazine-box is strictly forbidden. This must take place separately. For transportation of the LS12-5 magazine-box, approval must be requested from the appropriate authorities (CH: BAZL/AT Austro Control) and a training course must be completed at the Wyssen Avalanche Control Company.
3.1.2 Centres of gravity of the Mini-avalanche tower LS6-5

Caution
All details concerning the centres of gravity apply only to the respective illustrated tower platform without placement of the magazine-box.

Tower 8 m

Tower 10 m

Tower 12 m
3.2 Placement of the pedestal of the 2-part tower

The weight of the tower’s pedestal is given in table 3.11.1 for the LS12-5 and in table 3.11.2 for the LS6-5. After the tower pedestal has been set down, the 4 U washers that are fixed to the tower with wire (for SwissGewi ND32 the washers with Ø40mm hole (Art. no.411.413-ND32) and for ND40 the washers with Ø47mm hole (Art.no.411.413_GEWI40)) must be fitted with at least one anchor nut onto each anchor rod and tightened by hand, before the helicopter completely releases its load.

Afterwards the nuts can be tightened with the torque wrench (for anchor bar NDØ32mm: 1400-1600Nm or for anchor bars ND 40mm: 1600-1800Nm). Then the half nuts can be locked in place.

Finally, the anchor head piece is protected with a bandage impregnated with an anti-corrosion compound.
3.3 Placement of the top pieces of the 2-part tower

3.3.1 Suspension points of the Avalanche tower LS12-5

The weights of the above towers are given in table 3.11. 1.

Caution: All details concerning the centres of gravity apply only to the respective illustrated tower, i.e. without placement of the magazine-box.

The tower top piece is brought by helicopter to the pedestal. For precise positioning, the conical pins are guided into the corresponding feed holes in the pedestal. On the uphill side, at least 4 M-20 bolts must be fully tightened by hand before the helicopter pilot can release the load.

Following this, an M20 bolt with two washers and a nut must be fitted in each hole of the connection flange and tightened with the torque wrench to 450Nm.

To make assembly easier, the platform is not pre-assembled with the head piece of the 5m tower and the head piece of the 7m tower. The screws (2x SW13 required) are already in the fixation points, and after assembly, the platform must be fitted into the designated location.
3.3.2  Suspension points of the Mini-Avalanche Tower LS6-5

Suspension points of the Mini-Tower head pieces 3 m and 5 m

Mini-Tower head piece 3 m

Suspension points of the Mini-Tower head piece 7 m

Mini-Tower head piece 7 m (consisting of intermediate piece 2 m + head piece 5 m)
The weights of the above towers are also given in table 3.11.2. According to table 3.11.2, the 7m tower head piece together with the platform weighs more than 900kg. A more powerful helicopter is needed for transporting this. Separating the platform and the head piece is not recommended, because the threads could be damaged during assembly. As can be seen, one grating must be dismantled from the platform in order to fix the transport cable to the suspension point.

![Detail with dismantled middle grating](image)

**Suspension points of the platform**

When the platform is flown by helicopter separately, 3 gratings have to be disassembled. The fixaction has to be done according the pictures below. The disassembled gratings have to be fixed on the railing. The weights of the platform is also given in table 3.11.2.

![Suspension points of the platform](image)

**Caution**

Flying with an installed magazine-box is strictly forbidden. This must take place separately and never with a live charge; this is always mounted on location.
3.4 Earthing the tower

After the tower has been bolted correctly and securely to the foundation as specified in chapter 3, the earth straps as described in chap. 2.2 are connected with the foot of the tower. The straps are bolted to the holes provided on the foot of the tower with three M12x30mm bolts, nuts and spring washers.

3.5 Mounting the safety cable on the LS12-5

In order to mount the safety cable, procedure must be followed as shown in the following illustrations. For this purpose, a cable fixed with a lock ring must be clipped in beforehand at the top and with the thimble provided at the bottom. The ringbolt below is screwed through the borehole in the ladder. The safety cable is locked with the cable clamps to the appropriate length.
3.6 Installing the tension relief anchor

The tension relief anchor (if present) must be removed from the foot of the tower (SW65 and SW46) after assembling the pedestal and head piece of the tower, in order to slide it over the anchor bar. The anchor plate with the concave-milled face must be aligned in the direction of the tower, so the ball nut can be properly assembled. Subsequently the tension relief anchor is mounted to the foot of the tower with bolts, U washers and Nyloc nuts, and mounted to the anchor bar with the ball nut (SW60 ND32 SwissGewi/SW65 ND40 SwissGewi).

(Anchor bar NDØ32mm: 1400-1600Nm or for anchor bars ND 40mm: 1600-1800Nm).

After tightening the ball nut, this is fixed with the locking plate and wire, and the locking plate can be rotated or turned depending on the position of the ball nut.
Tension relief anchor
3.7 **Aligning the erection jib on the LS12-5**

The assembly mandrel is lubricated ex works with a cold-resistant grease. If due to transportation and installation the grease layer no longer covers the whole surface, the mandrel must be re-greased.

After the tower has been correctly and securely bolted to the foundation, the assembly erection jib must be aligned exactly perpendicular. For this, the four M30 hex nuts at the top of the tower, between the top plate of the tower and the bottom plate of the assembly erection jib, have to be loosened a little. The inclination of the mandrel can be set with the adjusting nuts between the plates. See illustration below. It is important that the erection jib is exactly perpendicular, so that no jamming occurs when placing and removing the magazine with the helicopter. Afterwards the hex nuts can be tightened with the torque wrench (765 Nm).

**Caution**
The protective foil on the tip of the tower must be removed after alignment.
3.8  Aligning the platform on the LS6-5

After the tower has been correctly and securely bolted to the foundation as described in Chap. 3.1, the platform must be aligned exactly perpendicular. For this, the four M30 hex bolts at the top of the tower, between the top plate of the tower and the bottom plate of the assembly erection jib, have to be loosened a little. The inclination of the platform can be set with the adjusting nuts between the plates. See illustration below, Afterwards the hex nuts can be tightened with the torque wrench (765 Nm).

The gratings on the platform may have to be dismantled for better accessibility.

The gratings also have to be fitted and fastened. The gratings are fixed with at least two retaining clamps per grating.

Details for aligning the platform

Retaining clamp detail
3.9 Mounting the magazine-box on the LS6-5

After the platform has been aligned and tightened, the magazine-box can be placed on the mounting bracket.

**Caution**
Flying the platform with an installed magazine-box is strictly forbidden. This must take place separately.

The weight of the magazine-box is given in table 3.11.2. The magazine-box may only be lifted up by using the two attachment points. Shackles are recommended for this purpose.

**Warning**
If the magazine-box is freestanding, the maintenance door must always remain closed! Otherwise, there is a risk of tipping over!

Mounting of the magazine-box to the platform jib is done using 4 M20 hex bolts underneath the base of the box. The washers and Nyloc bolts provided are to be used for this purpose.

**Warning**
The load may only be uncoupled from the helicopter when at least two bolts have been inserted. Otherwise, there is a risk of tipping over!
### 3.10 Materials and tools for erecting the tower

#### 3.10.1 Delivered by Wyssen Avalanche Control AG with the LS12-5 and LS6-5

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Dimension</th>
<th>Art.no. / Remarks / Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 pcs</td>
<td>Washer</td>
<td>for GEWI Ø 32 Ø120 mm x Ø 40 mm</td>
<td>Art.no. 411.413 (SwissGewi Ø32) or Art.no. 411.413_GEWI40 (SwissGewi Ø40)</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Washer</td>
<td>for GEWI Ø 40 Ø120 mm x Ø 47 mm</td>
<td></td>
</tr>
<tr>
<td>12 pcs</td>
<td>High tensile sets of bolts</td>
<td>M 20 x 95 mm (SW 32)</td>
<td>Art. no. 4160M20X95 Hex bolt with nut and 2 washers for connecting the tower pedestal and head piece at the flange</td>
</tr>
<tr>
<td>1 pc</td>
<td>Tension relief anchor</td>
<td></td>
<td>Art.no. 411.430B with ball nut Art. no. 411.444-ND32 (SW 60) or Art.no. 411.444-ND40 (SW 65) and locking plate Art.no. 411.434-ND32 or Art.no. 411.434-ND40</td>
</tr>
<tr>
<td>1 pc</td>
<td>Bolts</td>
<td>Ø 44 x 212 mm (SW 65)</td>
<td>Art.No. 411.439A for tension relief anchor</td>
</tr>
<tr>
<td>1 pc</td>
<td>Nyloc nut</td>
<td>M 36, DIN 985 (SW 55)</td>
<td>Art.no. 4521M36 for tension relief anchor</td>
</tr>
<tr>
<td>2 pcs</td>
<td>Galvanised steel wire Ø 2 mm</td>
<td>600 mm</td>
<td>Art.no. 4655ø02x600 for securing the locking plate on the tension relief anchor</td>
</tr>
<tr>
<td>3 pcs</td>
<td>Hex bolt</td>
<td>M 12 x 30 mm (SW 19)</td>
<td>Art.no. 4150M12X030 For fastening the earth straps</td>
</tr>
<tr>
<td>3 pcs</td>
<td>Hex nut</td>
<td>M 12 (SW 19)</td>
<td>Art.no. 4513M12 for fastening the earth straps</td>
</tr>
<tr>
<td>3 pcs</td>
<td>spring washer</td>
<td>M12 high tension spring washer DIN 128 A</td>
<td>Art.no. 4623M12 for fastening the earth straps</td>
</tr>
<tr>
<td>1 pc</td>
<td>Immoos Climbing protection kit</td>
<td>7 m, 9 m, 11 m or 13 m</td>
<td>Art.no. 5580Steigschutz-07M Art.no. 5580Steigschutz-09M Art.no. 5580Steigschutz-11M Art.no. 5580Steigschutz-13M</td>
</tr>
<tr>
<td>1 pc</td>
<td>Fall arrester</td>
<td></td>
<td>Art.no. 5580FBIMMOOS Fall arrester for climbing the tower. (1 pc per customer)</td>
</tr>
</tbody>
</table>
### Additional material for the LS6-5

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Diameter</th>
<th>Length</th>
<th>Art.no.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 pcs</td>
<td>Hex bolt</td>
<td>M20x170mm (SW 30)</td>
<td></td>
<td>4151M20X170</td>
<td>For mounting the magazine-box</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Nyloc hex nut</td>
<td>M20</td>
<td></td>
<td>4521M20</td>
<td>For mounting the magazine-box</td>
</tr>
<tr>
<td>8 pcs</td>
<td>U washer</td>
<td>M20</td>
<td></td>
<td>4602M20</td>
<td>For mounting the magazine-box</td>
</tr>
<tr>
<td>1 pc</td>
<td>Lightning protection rod</td>
<td>Ø15 mm x 2800 mm</td>
<td></td>
<td>481.7400A</td>
<td></td>
</tr>
<tr>
<td>2 pcs</td>
<td>Mounting plate</td>
<td>Flach 30/6 x 80 mm</td>
<td></td>
<td>481.744.2</td>
<td>For mounting the lightning protection rod</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Hex bolt</td>
<td>M8x65 mm (SW 13)</td>
<td></td>
<td>4151M08X065</td>
<td>For mounting the lightning protection rod</td>
</tr>
<tr>
<td>4 pcs</td>
<td>Nyloc hex nut</td>
<td>M8 (SW 13)</td>
<td></td>
<td>4521M08</td>
<td>For mounting the lightning protection rod</td>
</tr>
<tr>
<td>8 pcs</td>
<td>U washer</td>
<td>M8</td>
<td></td>
<td>4602M08</td>
<td>For mounting the lightning protection rod</td>
</tr>
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</table>
### 3.10.3 Required materials and tools from the assembly firm/client /builder

<table>
<thead>
<tr>
<th>Number</th>
<th>Article</th>
<th>Dimension</th>
<th>Comments/Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 pc</td>
<td>Flat / ring spanner or Striking box wrench</td>
<td>SW 55/50, SW 60</td>
<td>Anchor nut and lock nut SwissGewi ND32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Anchor nut and lock nut SwissGewi ND40</td>
</tr>
<tr>
<td>2 pcs</td>
<td>Flat / ring spanner</td>
<td>SW 32</td>
<td>Tower pedestal and head piece flange connection</td>
</tr>
<tr>
<td>1 pc</td>
<td>Torque wrench with socket</td>
<td>Up to 460Nm SW 32</td>
<td>Tower pedestal and head piece flange connection</td>
</tr>
<tr>
<td>1 pc</td>
<td>Torque wrench with socket</td>
<td>Up to 1800Nm SW 46/55/60/65</td>
<td>Anchor nut SwissGewi ND32 (SW55) or ND40 (SW60) Tension relief anchor ball nut SwissGewi ND32 SW60 or ND40 (SW65) Erection jib (SW46)</td>
</tr>
<tr>
<td>1 pc</td>
<td>Flat spanner</td>
<td>SW 46</td>
<td>Aligning and mounting the erection jib</td>
</tr>
<tr>
<td>1 pc</td>
<td>Ring spanner or striking box wrench</td>
<td>SW 46</td>
<td>Aligning and mounting the erection jib</td>
</tr>
<tr>
<td>2 pcs</td>
<td>Flat / ring spanner</td>
<td>SW 19</td>
<td>Fastening the earth straps</td>
</tr>
<tr>
<td>2 pcs</td>
<td>Flat / ring spanner</td>
<td>SW 13</td>
<td>Mounting Immoos climbing protection kit and platform</td>
</tr>
<tr>
<td>1 pc</td>
<td>Cordless drill</td>
<td></td>
<td>Fastening the earth straps</td>
</tr>
<tr>
<td>1 pc</td>
<td>Metal drill</td>
<td>Ø 13 mm</td>
<td>Fastening the earth straps</td>
</tr>
<tr>
<td>1 pc</td>
<td>Metal cutting saw</td>
<td></td>
<td>For cutting the earth straps on the tower to length</td>
</tr>
<tr>
<td>1 pc</td>
<td>Cable shears/ wire rope cutter</td>
<td></td>
<td>For cutting the climbing protection kit to length</td>
</tr>
<tr>
<td>1 pc</td>
<td>Spirit level</td>
<td>ca. 60 cm</td>
<td>Aligning the erection jib</td>
</tr>
<tr>
<td>1 pc</td>
<td>Hammer</td>
<td>min. 1 kg</td>
<td>Tightening and loosening bolts</td>
</tr>
<tr>
<td>1 pc</td>
<td>Insulating tape</td>
<td></td>
<td>For shortening the climbing protection kit</td>
</tr>
<tr>
<td>1 pc</td>
<td>KABA key</td>
<td>SR 100</td>
<td>For KABA padlock on the tower Art.no.5271KABA-AP310321</td>
</tr>
<tr>
<td>as required</td>
<td>Bandage for corrosion inhibitor</td>
<td></td>
<td>Corrosion inhibiting wrapping of the anchor head</td>
</tr>
</tbody>
</table>

**Additional material for the LS6-5**

| 2 pcs | Flat / ring spanner | SW 20 | Mounting the magazine-box |
| 1 pc  | Crowbar             | ca. 60 cm | Aligning the magazine-box |

**Additional material for tension relief anchor**

| 1 pc  | Flat / ring spanner | SW 65 | Bolzen Zugentlastungsanker |
| 1 pc  | Flat / ring spanner or striking box wrench | SW 60, SW 65 | SwissGewi ND32 ball nut SwissGewi ND40 ball nut |
| 1 pc  | Pliers              |       | for fastening the safety wire |
| 1 pc  | Flat / ring spanner | SW 55 | Lock nuts for M36 bolts |
3.11 Weight of the towers

For transportation of the tower by helicopter, not only the effective weights are crucial, but also the air temperature and the height above sea-level. Precise details can be obtained from the respective helicopter transport company.

Caution
The weights given in the table refer to the current tower products; for older tower versions, the weight can deviate from those in the following table.
Information can be requested from the Wyssen Avalanche Control Company.

3.11.1 LS12-5 Weights

<table>
<thead>
<tr>
<th>Art. no.</th>
<th>Design type</th>
<th>Total tower length</th>
<th>Individual weight</th>
<th>Weight with mandrel</th>
<th>Total weight incl. pedestal, mandrel and disks etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>411.401-14V</td>
<td>Tower pedestal 5m</td>
<td>approx. 890 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>411.403</td>
<td>Tower top piece 3m with locking door</td>
<td>8 m</td>
<td>approx. 350 kg</td>
<td>approx. 520 kg</td>
<td>approx. 1'450 kg</td>
</tr>
<tr>
<td>411.405</td>
<td>Tower top piece 5m with locking door</td>
<td>10m/12m</td>
<td>approx. 485 kg</td>
<td>approx. 665 kg</td>
<td>approx. 1'580 kg</td>
</tr>
<tr>
<td>411.402 &amp; 411.405</td>
<td>Tower top piece 7m with locking door (consisting of intermediate piece 2m + head piece 5m)</td>
<td>12 m</td>
<td>approx. 725 kg</td>
<td>approx. 895 kg</td>
<td>approx. 1'820 kg</td>
</tr>
<tr>
<td>411.402</td>
<td>Tower extension 2m (intermediate piece)</td>
<td>12 m</td>
<td>approx. 240 kg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.11.2 LS6-5 Weights

<table>
<thead>
<tr>
<th>Art. No.</th>
<th>Design type</th>
<th>Total tower length</th>
<th>Individual weight</th>
<th>Weight with platform</th>
<th>Total weight incl. pedestal, platform and disks etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>411.401-14V</td>
<td>Tower pedestal 5m</td>
<td>approx. 890 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>411.403</td>
<td>Tower top piece 3m with locking door</td>
<td>8 m</td>
<td>approx. 350 kg</td>
<td>approx. 710 kg</td>
<td>approx. 1'600 kg</td>
</tr>
<tr>
<td>411.405</td>
<td>Tower top piece 5m with locking door</td>
<td>10m / 12m</td>
<td>approx. 485 kg</td>
<td>approx. 845 kg</td>
<td>approx. 1'750 kg</td>
</tr>
<tr>
<td>411.402 &amp; 411.405</td>
<td>Tower top piece 7m with locking door (consisting of intermediate piece 2m + head piece 5m)</td>
<td>12 m</td>
<td>approx. 725 kg</td>
<td>approx. 1085 kg</td>
<td>approx. 1'980 kg</td>
</tr>
<tr>
<td>411.402</td>
<td>Tower extension 2m (intermediate piece)</td>
<td>12 m</td>
<td>approx. 240 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>481.7000</td>
<td>Platform</td>
<td></td>
<td></td>
<td></td>
<td>approx. 360 kg</td>
</tr>
<tr>
<td>481.6000</td>
<td>Magazine-Box LS6-5</td>
<td></td>
<td></td>
<td></td>
<td>approx. 440 kg</td>
</tr>
</tbody>
</table>
4  Recommended literature


ÖNORM-Regel 24806: Permanent technical avalanche protection - dimensioning and constructive design

5  Annex

5.1  Links....................................................................................................................................................................................... 35
5.2  DYWIDAG GEWI®-Pile System ..................................................................................................................................... 36
5.3  DYWIDAG Soil nail............................................................................................................................................................. 40
5.4  Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in loose material ......................................................... 43
5.5  Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in rock........................................................................... 44

Caution
The current Internet documentation from the respective manufacturers is given in the Annexes. At the time of publication (7.2017) of this document.
5.1  Links

General Infos:
www.wyssenavalanche.com  (Infos and Instructions)

Anchor data:
www.dywidag-systems.com  (anchor material International)
5.2 DYWIDAG GEWI®-Pile System

GEWI® Pile System

Basic Concept
GEWI® and GEWI® Plus Piles are micropiles in accordance with DIN 4128 and EN 14199. Usually, they are not tensioned and act as a passive foundation system. A GEWI® Threadbar is inserted into a borehole with a maximum diameter of 300mm and centered using a spacer. Afterwards, the borehole is filled or pressure grouted with cement mortar from the bottom up. The grout simultaneously serves for transferring forces to the soil by skin friction and as standard corrosion protection (SCP). Like in solid construction, the alkaline environment of the surrounding cement stone coverage is used for protecting the reinforcing steel. If the cement stone cover does not offer sufficient protection in case of aggressive foundation soil or ground water the GEWI® Pile is also available with double corrosion protection (DCP). The steel tendon is clad in a plastic corrugated sheathing and the annular space is grouted at the factory.

This design is especially used in case of tensile forces, for example in permanent uplift control, because cracks in the coverage can decrease the passivation effect of the cement stone.

Fields of Application
- Foundation
- Uplift control
- Baseplates
- Positional stability
- Dam construction

Key Features
- Threadbars with proven coarse GEWI® Thread that is suitable for on-site use – threadability even in extreme conditions
- Thread along the entire length
- Lengths can be flexibly adjusted on site
- Approved for absorbing tensile, compression, and alternating loads
- Excellent force / borehole ratio
- Space saving installation
- Compact, light equipment
- Various steel grades
  - Robust, weldable GEWI® Bar
  - GEWI® Plus Bars for ultimate wear

As GEWI® and GEWI® Plus Piles are skin friction piles, they can transfer compression, tensile, and alternating loads. Thanks to the specially developed DYWIDAG Thread and system components, no adaptations need to be made to the foundation system. Only the pile head design and the couplers must be varied. By definition, test loads are carried out at micropiles in order to prove the aptitude of the chosen system for the conditions on site as well as the quality of execution.

For transferring extremely high loads, several individual piles (usually three) can be combined in a borehole, providing that the borehole diameter is chosen sufficiently wide.

Additional Information
## Technical Data

### GEWI® Pile System

#### GEWI® Pile B500B & S555/700

<table>
<thead>
<tr>
<th>Nominal diameter (\varnothing) [mm]</th>
<th>Yield strength / tensile strength (f_{y,k}/f_{u,k}) [N/mm²]</th>
<th>Cross-sectional area (A) [mm²]</th>
<th>Load at yield (F_{y,k}) [kN]</th>
<th>Ultimate load (F_{u,k}) [kN]</th>
<th>Weight [kg/m]</th>
<th>Weight DCP [kg/m]</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>500/550</td>
<td>314</td>
<td>157</td>
<td>173</td>
<td>2.47</td>
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<td>25</td>
<td>500/550</td>
<td>491</td>
<td>245</td>
<td>270</td>
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<td>7.0</td>
<td>○</td>
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<td>28</td>
<td>500/550</td>
<td>616</td>
<td>308</td>
<td>330</td>
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<td>32</td>
<td>500/550</td>
<td>804</td>
<td>402</td>
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<td>21.0</td>
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<td>63.5</td>
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#### GEWI® Plus Pile S670/800

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<th>Nominal diameter (\varnothing) [mm]</th>
<th>Yield strength / tensile strength (f_{y,k}/f_{u,k}) [N/mm²]</th>
<th>Cross-sectional area (A) [mm²]</th>
<th>Load at yield (F_{y,k}) [kN]</th>
<th>Ultimate load (F_{u,k}) [kN]</th>
<th>Weight [kg/m]</th>
<th>Weight DCP [kg/m]</th>
<th>Approval</th>
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<tr>
<td>25</td>
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<td>393</td>
<td>3.05</td>
<td>7.0</td>
<td>△</td>
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<tr>
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<td>670/800</td>
<td>616</td>
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<td>493</td>
<td>4.83</td>
<td>8.6</td>
<td>△</td>
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<tr>
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<td>474</td>
<td>565</td>
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<td>645</td>
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<td>670/800</td>
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<td>△</td>
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<td>57.5</td>
<td>670/800</td>
<td>2,597</td>
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<td>2,122</td>
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<td>75</td>
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<td>3,534</td>
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<td>43.5</td>
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</tr>
</tbody>
</table>

#### GEWI® Pile B500B Multibar

<table>
<thead>
<tr>
<th>Nominal diameter (\varnothing) [Number x (\varnothing)]</th>
<th>Yield strength / tensile strength (f_{y,k}/f_{u,k}) [N/mm²]</th>
<th>Cross-sectional area (A) [mm²]</th>
<th>Load at yield (F_{y,k}) [kN]</th>
<th>Ultimate load (F_{u,k}) [kN]</th>
<th>Weight [kg/m]</th>
<th>Weight DCP [kg/m]</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 x 32</td>
<td>500/550</td>
<td>2,413</td>
<td>1,206</td>
<td>1,327</td>
<td>18.9</td>
<td>28.5</td>
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</tr>
<tr>
<td>3 x 40</td>
<td>500/550</td>
<td>3,770</td>
<td>1,885</td>
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<tr>
<td>3 x 50</td>
<td>500/550</td>
<td>5,890</td>
<td>2,945</td>
<td>3,240</td>
<td>46.2</td>
<td>63.0</td>
<td>○</td>
</tr>
<tr>
<td>2 x 40</td>
<td>500/550</td>
<td>2,513</td>
<td>1,257</td>
<td>1,382</td>
<td>19.7</td>
<td>27.2</td>
<td>○</td>
</tr>
<tr>
<td>2 x 50</td>
<td>500/550</td>
<td>3,927</td>
<td>1,963</td>
<td>2,160</td>
<td>30.8</td>
<td>42.0</td>
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<tr>
<td>1 x 40 &amp; 1 x 50</td>
<td>500/550</td>
<td>3,220</td>
<td>1,610</td>
<td>1,771</td>
<td>25.3</td>
<td>34.6</td>
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○ Germany: Z-32.1-2 Ø 20 - 50mm GEWI® Pile
× Germany: Z-32.1-9 Ø 53.5mm GEWI® Pile
△ Austria: BMVIT 327.120/0017-II/ST2/2007 Ø 25 - 63.5mm GEWI® Plus Pile

### Additional Information

German Approval DIBt Z-32.1-2 / DIBt Z-32.1-9 / Austrian Approval BMVIT 327.120/0017-II/ST2/2007
GEWI ™ Pile System

Standard Corrosion Protection (SCP)
- Corrosion protection by cement stone coverage
- Service life independent of environmental conditions and direction of load
- Compression pile: permanent use (more than 100 years) in minor corrosiveness
- Can be used up to 2 years (DW,...) or up to 50 years (EN,...) in low aggressivity if used as a tension and fanning load pile
- Can be supplied spray or hot-dip galvanized
- Spacers center the tendon in the borehole and ensure the necessary coverage
- A variety of pile head variations can be supplied depending on applications
- Approved GEWI ™ System components

Examples for Pile Head Variations

Fields of Application
- Foundation
- Baseplates
- Reinforcement
- Underpinnings
- Mainly compression loads

GEWI ™ Multibar assembly
- Used for extreme loads
- Reaction piles for test loading
- Larger boresholes

Additional Information
GEWI* Pile System

Double Corrosion Protection (DCP)
- Double Corrosion Protection (DCP) achieved by grouted corrugated sheathing with controlled crack width
- Permanent use (more than 100 years) - independent of corrosiveness and direction of load
- Can be fitted with DYWIDAG post-injection system
- Slender system - small borehole
- A variety of pile head variations can be supplied depending on applications
- Approved GEWI* System components

GEWI* Multibar assembly
- Excellent system effectiveness
- Double corrosion protection

Fields of Application
- Uplift control
- Foundation
- Baseplates
- Reinforcement
- Underpinnings

Double Anchor Piece

Staggered Anchors

Coupler Connection

Staggered Coupler Connections

Additional Information
5.3 DYWIDAG Soil nail

DYWIDAG Soil Nails

Basic Concept

DYWIDAG Soil Nailing is a passive system for stabilizing slopes and sidehill cuts or rock as well as for stabilizing construction pit walls if deformations are irrelevant.

The load-bearing system significantly differs from ground anchors (actively tensioned) and tensile piles. In the case of soil nailing, the load-bearing capacity of the complete soil is increased because it is consolidated by the soil nails.

The soil is nailed into secure areas of the slope located further inside the hill. Consequently, tensile and shear forces act on the nails. In order to achieve this effect, the nails can only be placed at certain, limited distances towards each other. The nails do not act individually, but as a complete nailing system.

For stabilizing the slope front, a slope face must be realized that is connected to the nails guaranteeing tensile strength. Shotcreting construction, precast concrete elements, mesh or geotextiles can be used for this type of slope face. If the slope is only slightly inclined, it can be revegetated afterwards to achieve a pleasing appearance.

GEWI® Threadbars that are centered using spacers are installed into the boreholes. Afterwards, the borehole is filled with cement mortar from the bottom up along its complete length. The grout creates a force-fit connection via bond with the threadbar and skin friction inside the borehole.

Proof of this connection and the individual load-bearing capacity of a nail is provided by test loads and regular approval tests. Fabric tubes can be used for sealing the borehole walls in case of fragmented rock or if soil is extremely permeable.

Fields of Application

- Slope stabilization
- Embankment stabilization
- Excavations without special requirements
- Rock stabilization
- Fixation of rock fall mesh
- Avalanche barriers
- Fixation

Key Features

- Threadbars with proven coarse GEWI® Thread that is suitable for on-site use – threadability even in extreme conditions
- Thread along the entire length – lengths can be flexibly adjusted on site
- Excellent force / borehole ratio
- Various steel grades
  - Robust, weldable GEWI® Bar
  - GEWI® Plus Bars for ultimate wear
- For increasing skin friction, GEWI® and GEWI® Plus Piles can be equipped with a posterior grouting system
- The system permits flexible adaptation to different embankment and slope face conditions

Additional Information

Approval Germany DBt Z-20.1-106 / Approval Austria BMVIT-327.120/0022-II/STZ/2006
# DYWIDAG Soil Nails

## Technical Data

### GEWI ™ Soil Nail / Rock Bolt, B500B & S555/700 Threadbar

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### GEWI ™ Plus Soil Nail / Rock Bolt, S670/800 Threadbar

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### DYWIDAG Prestressing Steel Rock Bolts

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○ Germany: Z-20.1-106 DYWIDAG Soil Nailing System
× Austria: BMVIT-327.120/0022-III/ST2 / GEWI ™ Plus Soil Nail
△ Germany: Z-20.1-17 Permanent DYWIDAG Bar Anchor

### Additional Information

German Approval DBT Z-20.1-106 / Austrian Approval BMVIT-327.120/0022-III/ST2/2006
DYWIDAG Soil Nails

DCP Soil Nail / Permanent Soil Nail
- Permanent use (more than 100 years)
- Double Corrosion Protection (DCP) achieved by factory grouted corrugated sheathing along the entire soil nail length with controlled crack width
- Different slope faces are possible such as shotcrete construction, precast concrete elements, mesh or sheet pile walls
- Different designs are available for angle compensation

Fields of Application
- Slope stabilization
- Embankment stabilization
- Excavations without special requirements
- Rock stabilization
- Fixation of rock fall mesh
- Avalanche barriers
- Fixation

Short Term Soil Nail / Temporary Soil Nail
- Temporary use of up to two years
- Extended use after prior agreement of involved experts
- Galvanized version available
- Different slope faces are possible such as shotcrete construction, precast concrete elements, mesh or sheet pile walls
- Different designs are available for angle compensation

Fields of Application
- Temporary slope stabilization
- Temporary embankment stabilization
- Stabilisation of states of construction
- Excavations without special requirements

Additional Information
German Approval DIBt Z 201-106 / Austrian Approval BWVT 327,120/0022-II/ST2/2006
5.4 Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in loose material

FOUNDATION OF WYSSEN AVALANCHE TOWER CAST-IN-PLACE CONCRETE FOUNDATION, TYPE LOOSE MATERIAL

The erection of the base plate onto the concrete foundation is to be executed according to Wyssen Avalanche Control instructions.

Foundation anchoring depth min. 30cm

The spacings a and b for the micropile boreholes and the shear-relief anchor as well as anchor diameters and connections are to be executed according to Wyssen Avalanche Control instructions. Micropiles and the shear-relief anchor are to be installed according to AWN GR details.

The surface of the concrete foundation must be exactly horizontal. Cleanly trowel the surface incl. triangular ledge inlays 30/30mm along the foundation edges.

corresponding iron strip: FD_6_b_EL

<table>
<thead>
<tr>
<th>Dimensioning</th>
<th>Type of concrete / type of formwork</th>
<th>Steel quality</th>
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</thead>
<tbody>
<tr>
<td>The length of anchor L is dependent on the project specific characteristic values of the soil. Ra.k is to be determined with pull-out trials according to SIA 267/1. Length of anchor L for micropile and shear-relief anchor according to AWN GR details. Steel quality and diameter according to details of the system supplier.</td>
<td>Foundation from cast-in-place concrete according to SN EN 206-1, (NPK concrete type D) C25/30, XF2 (CH)</td>
<td>Reinforcing steel B 500 B</td>
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</tbody>
</table>

Reinforcement cover:
- c = 40 (mm) generally
- c = 50 (mm) on prepared subsoil
- c = 90 (mm) on unprepared subsoil
5.5 Foundation of Avalanche tower LS12-5 / Mini-avalanche tower LS6-5 in rock

FOUNDATION OF WYSSEN AVALANCHE TOWER
CAST-IN-PLACE CONCRETE FOUNDATION, TYPE ROCK

The spacings a and b for the micropile boreholes and the shear-relief anchor as well as anchor diameters and connections are to be executed according to Wyssen Avalanche Control instructions. Micropiles and the shear-relief anchor are to be installed according toAWN GR details.

The surface of the concrete foundation must be exactly horizontal. Cleanly trowel the surface incl. triangular ledge inlays 30/30mm along the foundation edges.

corresponding iron strip: FD_6_a_EL

<table>
<thead>
<tr>
<th>Dimencioning</th>
<th>Type of concrete / type of formwork</th>
<th>Steel quality</th>
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<tr>
<td>The length of anchor L is dependent on the project-specific characteristic values of the soil. Raxk is to be determined with pull-out trials according to SIA 267/1. Length of anchor L for micropile and shear-relief anchor according toAWN GR details Steel quality and diameter according to details of the system supplier.</td>
<td>Foundation from cast-in-place concrete according to SN EN 206-1. (NPK concrete type D) C25/30, XFZ (CH) Formwork: type 2 triangular ledge inlays Reworking of the surface (high spots)</td>
<td>Reinforcing steel B 500 B Reinforcement cover: c = 40 [mm] generally c = 50 (mm) on prepared subsoil c ≥ 90 (mm) on unprepared subsoil</td>
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