

## DYWIDAG Tie Rods





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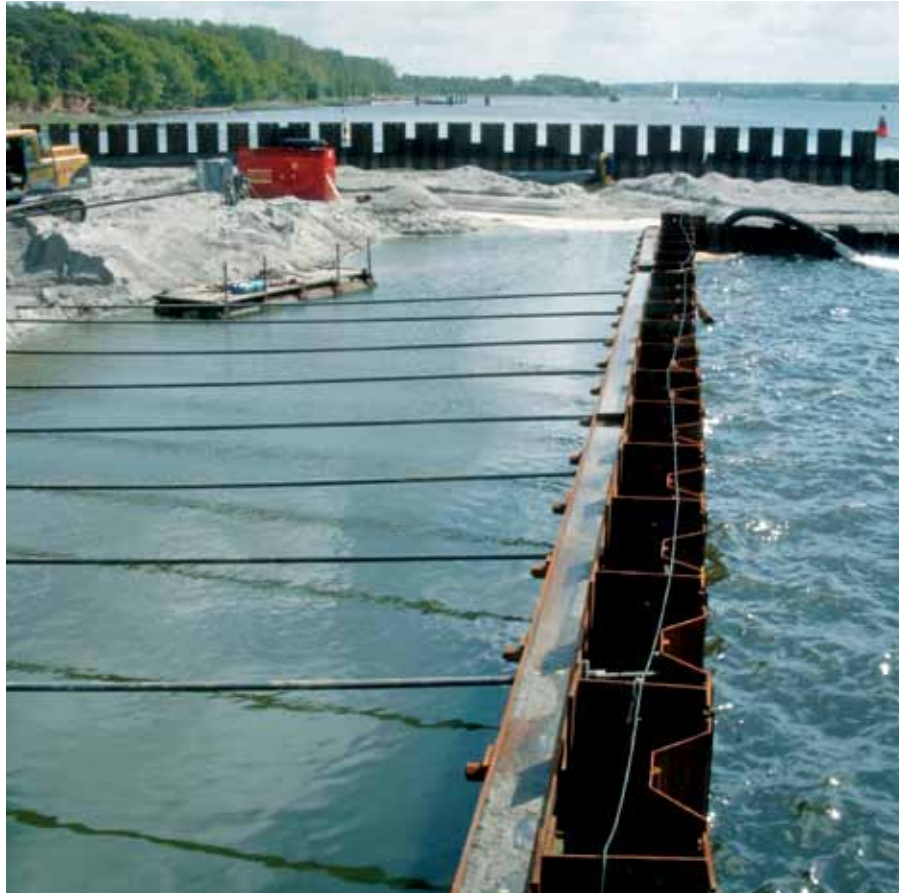


## DYWIDAG Threadbar Tie Rods

Tie Rods produced from *GEWI*® Steel Threadbars can be used for a variety of marine applications. Construction of marine bulkheads for various docking facilities have, for many years, benefited from the use of DYWIDAG Tie Rods. Facilities such as barge and ship docks as well as offshore service bases have found the system to be a cost effective alternative to large diameter S355 Tie Rods with upset threads.

Tie Rods produced from *GEWI*® Steel Threadbars offer various economical and technical advantages:

- Easy handling because of a hot rolled coarse thread over the entire length
- Up to almost 50% less weight than bars from S355
- No threadability or assembly problems resulting from damaged or dirty threads, because of the coarse DYWIDAG threadform
- DYWIDAG Tie Rods can be ordered longer than necessary to accommodate the minor misalignments which normally occur on sheet piling. They can easily be cut to the desired length eliminating need to cut and re-weld upset rods to the accommodate length changes.



### Tie Rods based on *GEWI*® Steel Threadbars

| Nominal Diameter<br>(mm) | Steel Grade<br>(N/mm <sup>2</sup> ) | Cross-Sectional Area<br>(mm <sup>2</sup> ) | Yield Load<br>(kN) | Ultimate Load<br>(kN) |
|--------------------------|-------------------------------------|--|--------------------|-----------------------|
| 20                       | 500/600                             | 314  | 157                | 188                   |
| 25                       | 500/550                             | 491  | 246                | 270                   |
| 28                       | 500/550                             | 616  | 308                | 339                   |
| 32                       | 500/550                             | 804  | 402                | 442                   |
| 40                       | 500/550                             | 1,257                                      | 628                | 691                   |
| 50                       | 500/550                             | 1,963                                      | 982                | 1,080                 |
| 63.5                     | 555/700                             | 3,167                                      | 1,758              | 2,217                 |



- Continuous coarse left hand thread
- Weldable
- Wide range of accessories available
- Approved double corrosion protection in accordance with EN 1537 can be applied
- No susceptibility to stress crack corrosion or hydrogen induced embrittlement
- Approved by many construction authorities worldwide
- Conformance with DIN 488
- General conformance with BS 4449
- Stock lengths 11.8m, other lengths on request, full strength couplers used for longer lengths.

## Corrosion Protection

An important element in the long term durability of tie rod installation is corrosion protection.

For DSI's GEWI® Threadbar system, various corrosion protection systems are available, depending on site conditions and degree of exposure.

Possible solutions are:

- Sacrificial corrosion in accordance with EN 14199, EAU or other specifications. See also table below
- The well known DYWIDAG Double Corrosion Protection (DCP) in accordance with EN 1537
- Hot dip galvanizing in accordance with AS/NZS 4680
- Epoxy coating
- Tar coating
- Denso wrapping



### Sacrificial surface corrosion in accordance with EN 14199

| Required design working life                  | 5 years | 25 years | 50 years | 75 years | 100 years |
|---|---------|----------|----------|----------|-----------|
| Undistributed natural soils                   | 0.00    | 0.30     | 0.60     | 0.90     | 1.20      |
| Polluted natural soils and industrial grounds | 0.15    | 0.75     | 1.50     | 2.25     | 3.00      |
| Aggressive natural soils                      | 0.20    | 1.00     | 1.75     | 2.50     | 3.25      |
| Non-compacted and non-aggressive fills        | 0.18    | 0.70     | 1.20     | 1.70     | 2.20      |
| Non-compacted and aggressive fills            | 0.50    | 2.00     | 3.25     | 4.50     | 5.75      |



## GEWI® Steel Waling Tie Rods

Waling bolts are needed to connect a standard sheet pile wall or a modular sheet pile wall to a load distributing waling.

The required length of the waling bolts depends on the height of the sheet pile profile, the width of the waling, the plate thickness and the nut length.

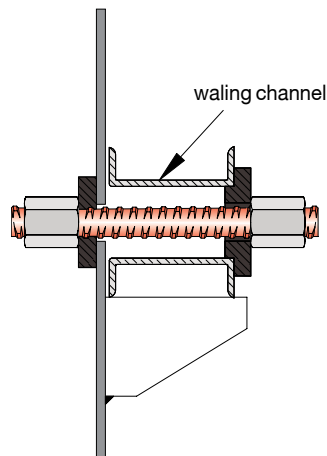
To align sheet pile walls, waling bolts can also be prestressed.

Features and advantages:

- Continuous coarse left hand thread
- Can be cut to any length
- Weldable (for welded connections, e.g. for landside walings)

### GEWI® Steel waling bolts with two nuts

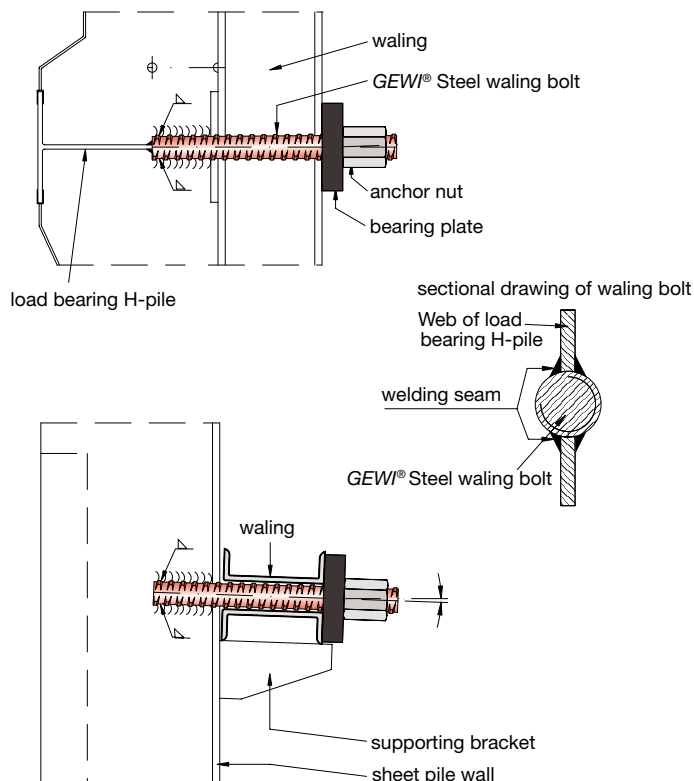
- Waling bolt in accordance with German EAU (E184)
- Front plate for sheet piling troughs of U-shaped and Z-shaped sheet piles
- Rear plate with supporting bracket
- Double bolts in sheet piling troughs of Z-shaped sheet piles
- Waling bolts shall not have bar diameters of less than 32 mm



### Dimensions of nuts for GEWI® Threadbar waling bolts

| BarNut  | AF (mm) | H (mm) |
|---------|---------|--------|
| 32 55   | 60      |        |
| 40 65   | 70      |        |
| 50 80   | 85      |        |
| 63.5100 | 115     |        |

### Example for a connection of a landside waling to a modular wall with a GEWI® Steel waling bolt welded in position (inclination also possible)



## DYWIDAG Tie Rods with Strand Tendons

Horizontal strand tendons offer an alternative to common bar tie rods. These strand tendons have been developed for use in prestressed concrete and can also be used for marine applications, similarly to their use as unbonded post-tensioning system.

Features and advantages:

- Very high steel grades, thus low weight
- Well proven for prestressed concrete for decades
- Almost any user-defined lengths can be manufactured, due to storage and transport of coiled tendons
- High flexibility, thus easy installation also under limited work space and no danger of damage due to settlements
- Wide variety of strand configuration from 2 - 37 strands
- Direct influence on possible deformations due to high possible prestressing loads



### Mechanical properties

There are two different types of strands which can be used for the horizontal strand tendons for marine applications.

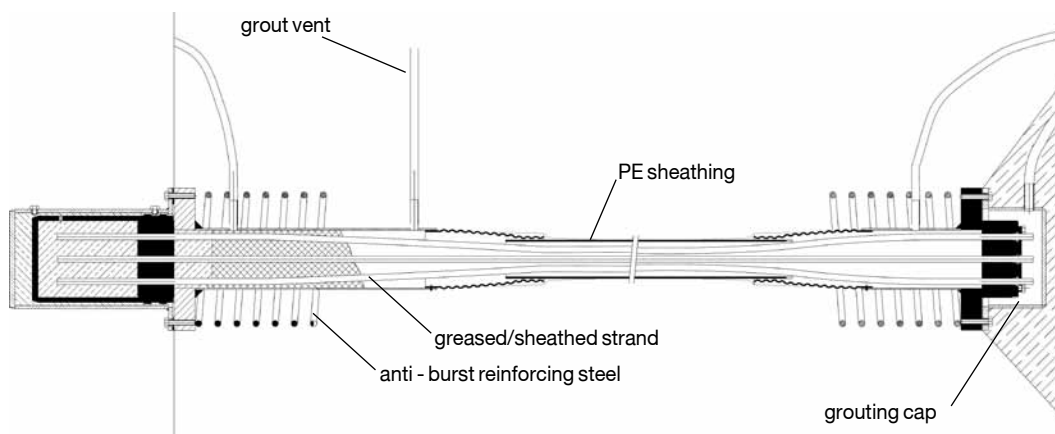
| Size (mm) | Steel Grade        | Cross-Sectional Area (mm <sup>2</sup> ) | 0.1% Yield Load (kN) | 0.2% Yield Load (kN) | Ultimate Load (kN) | Weight (kg/m) |
|-----------|--------------------|---|----------------------|----------------------|--------------------|---------------|
| 15.2      | Super Grade        | 143                                     | 205                  | 212                  | 250                | 1.122         |
| 15.2      | Extra High Tensile | 143                                     | 214                  | 222                  | 261                | 1.122         |

Example: a strand tendon with 37 strands, extra high tensile grade has an ultimate load of 9,657kN.

### Corrosion protection

To ensure the durability of tie rods with horizontal strand tendons, they have to be protected against corrosion. The single strands are greased and sheathed individually.

After stressing of the horizontal strand tendons, the tendons are injected with cement grout as with permanent strand anchors in accordance with EN 1537. All exposed steel parts of the tie rod must be protected with an approved product such as hot dip galvanising and two-part marine grade epoxy.



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