

## DYWIDAG Geotechnical Product Range



**Proven Quality**

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**Punctual Supply**

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**Excellent Service**

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The origins of DYWIDAG-Systems International (DSI) date back to the founding of Dyckerhoff & Widmann AG (DYWIDAG) in 1865, and thus, back to the beginning of industrial construction. As a recognized market leader in Geotechnics in Germany and Europe, DSI offers all established systems in specialized civil engineering. The product range includes ground anchors, micropiles and soil and rock bolts. *GEWI®* and *GEWI® Plus* Threadbars that are threadable along their entire lengths, tensioning bars, DYWI® Drill Hollow Bars and prestressing steel strands that are used as load-bearing tendons.

Thanks to our long-term experience in the development, approval, production and application of geotechnical products, we can guarantee you as our clients high quality products and systems that fulfill the highest standards of quality.

As leaders in innovation, we have been offering you a comprehensive product range of technically sophisticated solutions for decades. We promote new technical developments and research projects. Global patent applications are proof of our leading position and form the foundation of our successful work – to your benefit.

Customized special solutions and adaptations of our products are developed by competent and experienced engineers in our technical specialist departments just-in-time in a practice-oriented way.

As permanent members in the relevant committees of experts and standards, we continuously advance technical developments as well as the safety and application of our products and systems. Wherever required, we also offer support for approvals in individual cases and for applications and designs that meet newly introduced European norms. In addition, we also provide technical expertise and reports.

We maintain a large variety of building-authority approvals and are continuously expanding our comprehensive product range.





## About Us

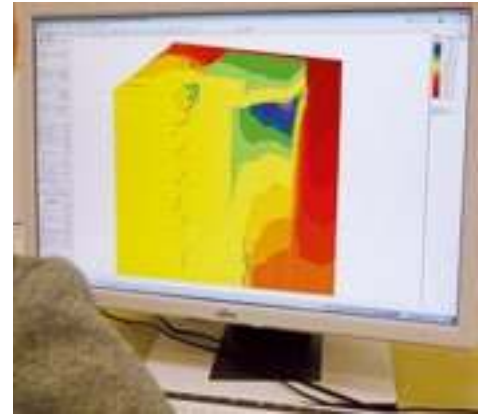
Furthermore, we provide complete equipment technology for a safe and trouble-free installation. We rent and sell equipment such as tensioning jacks, grout mixers and torque equipment with corresponding accessories. As a matter of course, our comprehensive services also include the professional calibration, maintenance and repair of the equipment as well as project specific special solutions.

We provide advice to participating planners and engineers during project execution and we are happy to assist you with CAD drawings and dimensioning aids. On demand, we train site personnel on site and support our clients during installation, test loading and approval testing.

Our highly qualified and experienced employees provide competent, quick and reliable support throughout your project.

At our facility in Pasching/Linz, Austria, we produce all our high-quality hollow bars for self-drilling systems under the brand name DYWI® Drill for civil engineering and tunneling.

## DSI - Your independent System Supplier and competent Partner for Civil Engineering.





### Excavations

Large and deep excavations are becoming more and more important especially in intra-urban areas, and ground anchors have proven themselves particularly useful in this extremely challenging civil engineering application. Very often, they are the only way to support excavations. Furthermore, anchors are often the most economical solution in comparison to steel or concrete cross braces: Unrestricted access to the excavation, uninterrupted and obstruction-free crane operation, no risk of buckling and almost limitless options in terms of anchor forces.

If required, ground anchors can be removed from the soil after completing civil engineering work in order not to interfere with subsequent site activities. Due to their being an active system, ground anchors are tensioned so that deformations of the excavation confinement are actively managed. Controlled load application is ensured before excavation is begun so that construction work is safe for all parties involved as well as for adjacent buildings. In excavations where deformations are irrelevant, passive systems such as soil nails or tension piles can be used.

- Bar and Strand Anchors
- GEWI® Soil and Rock Bolts
- DYWI® Drill Soil and Rock Bolts



### Slope Stabilization and Sidehill Cuts

The development and expansion of infrastructure – and, more specifically, the construction of high-speed corridors

– poses significant requirements in terms of route planning. The expansion of motorways by adding more lanes often requires comprehensive earth work and results in high, steep embankments in the cut slopes and hills. The faces of slope stabilization structures – e.g. shotcrete construction or walls consisting of prefabricated concrete segments – are often anchored in the soil using soil nails.

Rock fall protection mesh can also be fixed to the rock using this technique. Soil nailing stabilizes and consolidates the complete soil. The entire soil wedge including the slip circle is nailed and secured against tilting, sliding, gliding, shear failure and loss of position. Passive Systems are usually used in this case because deformations of the supporting system are irrelevant in most cases – the soil nails are only loaded when movements in the slope or at the face start. At full load, the earth pressure is completely absorbed and transferred by the solid nails.

If deformations are important in slope stabilization projects, an active system such as ground anchors can be chosen.

- GEWI® Soil and Rock Bolts
- DYWI® Drill Soil and Rock Bolts
- Bar and Strand Anchors



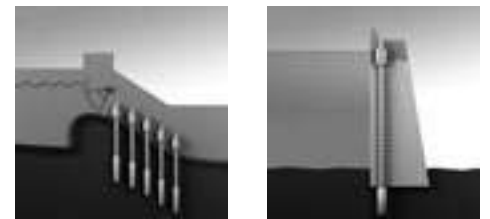
### Foundations and Underpinning

Individual foundations, strip foundations and foundation slabs are increasingly stabilized by micropiles that transfer loads safely and sustainably into the load-bearing soil. The fact that they can be installed by very small space saving drilling equipment is one of the decisive reasons for using micropiles in such structures. Micropile foundations can be used wherever access is difficult;

this includes narrow basements, the space underneath bridge decks or where installation from pontoons is necessary. The light weight and the ensuing required ground level also play a part. A posterior reinforcement and strengthening of foundations or load redistribution can thus be carried out quickly and easily.

This is achieved by the excellent relation between the borehole diameter and the transferred force. When used as skin friction piles, micropiles with their unmatched high steel ratio can transfer forces in boreholes up to 300mm in diameter and in depths of 80m and more into the subsoil. Additionally, GEWI® and GEWI® Plus Piles can transfer tensile, compressive and alternating loads. Thus, construction stages or crane foundations can be anchored or founded without any problems.

- GEWI® and GEWI® Plus Piles



### Hydraulic, Power Plant and Embankment Construction

New criteria for assessment and higher maximum water levels pose higher requirements for retaining walls and dams. Existing structures must comply with completely new requirements for stability caused by higher freezing pressures, updated earthquake load zones and new requirements in terms of impermeability and position stability or stability against overturning.

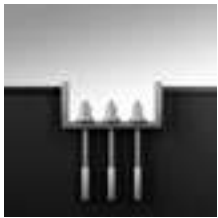
For reinforcing and simultaneous rehabilitation, this challenging increase in load bearing capacity can often be reached by a massive anchoring of the dam structure. In this case, boreholes are drilled vertically from the dam crest, and the dam wall is anchored at the bottom using ground anchors. Lift-off suction power can also be overcome by anchoring overflow structures and stilling basins permanently into the soil using anchors or tensile piles.

## Fields of Application

Depending on water levels, different load conditions can also be safely absorbed by anchors (in case of tensile load only) or micropiles (even for alternating loads) at retaining dams.

Caissons consisting of driven sheet piles are built for cofferdams or new quays. They are assembled at the head using tie rod systems and thus stabilized against uplift during sand filling and against subsequent loads resulting from dead weight and traffic.

- Soil and Rock Bolts
- Bar and Strand Anchors
- GEWI® and GEWI® Plus Piles
- Tie Rods

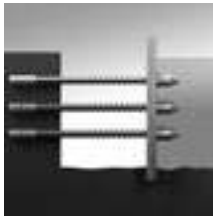


### Uplift Control

Uplift occurs in a large variety of foundation structures independent of the existing water level or by variable superimposed loads. The bottom slab of construction excavations (underwater concrete or high-pressure injection slabs) must be secured temporarily during the period of construction. This also applies to trough structures such as descending tunnel entrances for subway construction. Tensile piles are increasingly used as an economic alternative to mass concrete. If position accuracy is particularly important – for instance, during the construction of dry docks – tensioned anchors can be used. The principle advantage of this system construction method results from shortened construction times due to less excavation work and a reduction of bottom slab thicknesses.

However, alternating loads can result from pile uplift control such as inspection work in settling basins. In cases like these, loads can be economically changed from compression to tension without any problems

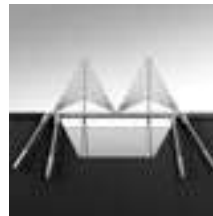
- GEWI® and GEWI® Plus Piles
- Bar and Strand Anchors



### Tie Rods and Braces

Tie rod systems are used in all cases in which two or more points of a structure must be stabilized relative to one another. Earth filled dams that are laterally stabilized by driven sheet piles are stabilized by tiebacks at the head. Stabilizing cross ties with remarkable tensile force capacity can also be realized. Drifting horizontal forces in individual or strip foundations can also be transferred using tie rods.

- DYWIDAG GEWI®, GEWI® Plus and Y1050H prestressing steel Threadbar
- Strands



### Anchoring of Tensile Loads

Tensile loads in soil can be economically tied back using ground anchors or tensile piles. Large, heavy and noticeable counter balances or retaining structures can be eliminated because tensile loads are directly transferred into the soil so that only unobtrusive transition structures and connections remain at the surface. Depending on the characteristics of the load-bearing soil strata, and the method of excavation, different varieties of civil engineering systems can be chosen. The characteristics of the ground used for anchorage are also irrelevant - whether rock, non-cohesive soils such as sand or gravel, cohesive soils such as clay or silt, organic soils with and without groundwater or even permafrost and Antarctic ice - DYWIDAG Systems have permanently

proven their aptitude in terms of function and economy.

- GEWI® and GEWI® Plus Piles
- Bar and Strand Anchors
- GEWI® Soil and Rock Bolts
- DYWI® Drill Soil and Rock Bolts



### Stability against Overturning

Structures that are at risk of tipping such as masts, towers or wind generators can be permanently stabilized using micropiles. As a fully grouted, passive system, micropiles can accommodate tensile, compression and alternating loads. To minimize settlements, deformations and movements, actively tensioned ground anchors can also be used to transfer tensile forces. Anticipated compression forces are absorbed via a stiff shallow foundation or via additional compression piles. Thus, a build-up of forces and movements can be minimized or prevented. The structures can even be further reinforced at a later stage if the foundation shows early stages of overload or if exterior impact is more severe (wind, earthquakes, snow, etc.).

- Bar and Strand Anchors
- GEWI® and GEWI® Plus Piles



# DYWIDAG Threadbar Anchors

## Basic Concept

DYWIDAG Threadbar Anchors are an actively tensioned ground anchor system and correspond to DIN 4125 and EN 1537 regulations. Due to the active tensioning, anticipated deformations of the system and deformations at the civil engineering measure are minimized or entirely eliminated. This applies both to temporary structures (e.g. temporary pit support systems) and permanent tie backs.

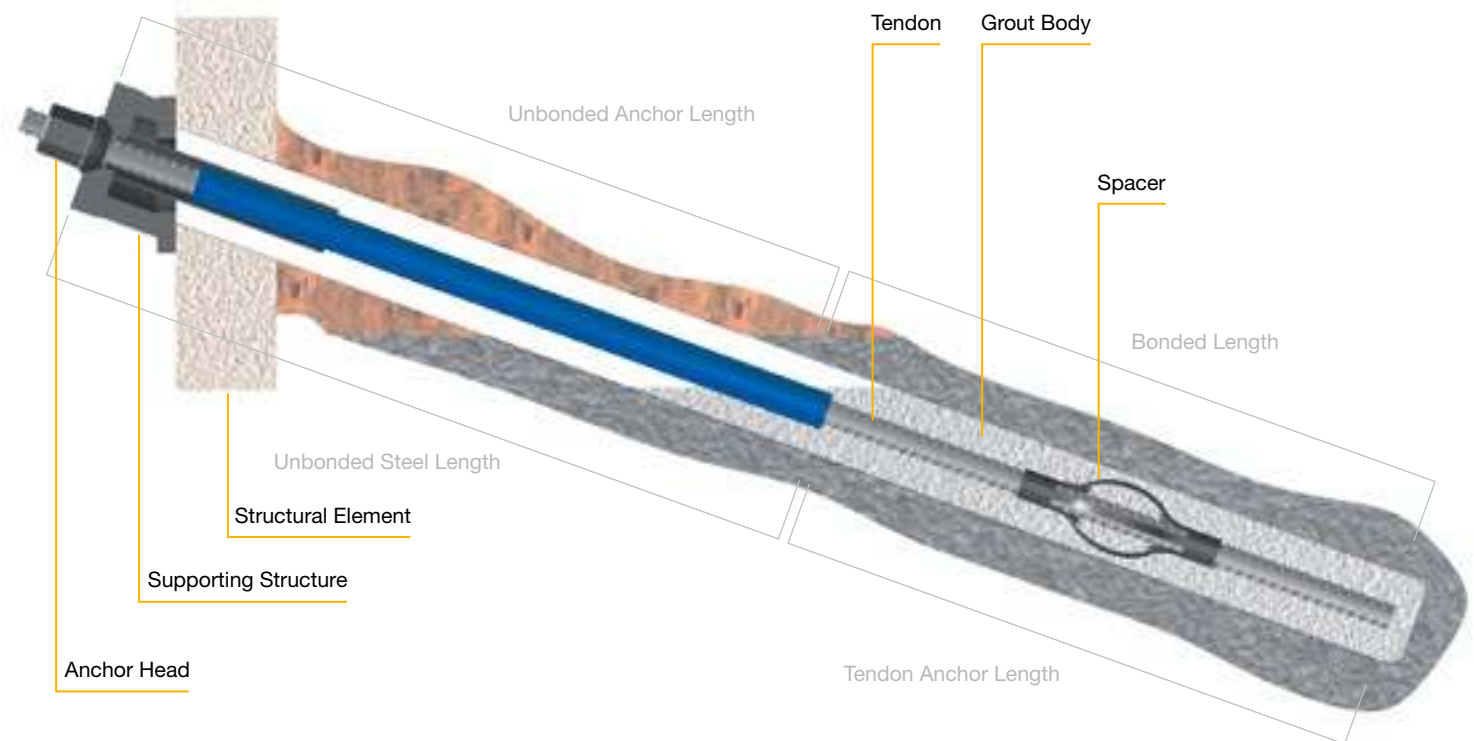
By definition, an anchor consists of three main components:

- **Bonded length:** The anchor is fixed in the borehole using grout (cement mortar) and can transfer the forces to the load-bearing soil via bond and skin friction
- **Unbonded length:** The bar is uncoupled from the borehole using a plain tube (sheathing) so that it can freely extend in the unbonded length. This way, tension can be applied to the anchor system
- **Anchor head:** The anchor head transfers the anchor force to the substructure and thus to the structure that needs to be anchored

Once the grout has sufficiently hardened, the load bearing capacity of each anchor is tested during an approval test.

If required, anchors can be supplied retensioned or detensionable. Permanent control of anchor forces can be realized by installing load cells. Alternatively, permanent controls can also be carried out at the anchor head or in the borehole using the contactless force measuring system DYNA Force® that has been specially developed together with DSI.

## Bar Anchor Drawing



## Fields of Application

- Intra-urban construction
- Excavations (deformation resistant)
- Tiebacks
- Rock and slope stabilization
- Uplift control
- Positional stability
- Dam construction
- Ascending anchors

## Key Features

- Threadbars with proven coarse *GEWI*® Thread that is suitable for on-site use along the entire length; lengths can be adjusted on site without any problems using the appropriate accessories and equipment
- Various steel grades
  - High quality tensioning bars for a good force / borehole ratio
  - Robust, weldable *GEWI*® Bar
  - *GEWI*® Plus Bars for highest wear
- Variable anchor head and angle compensation designs
- Easy handling: tensioning, retensioning or detensioning thanks to screwable anchorage
- Easy overhead installation – for instance in cavern roofs – due to the high rigidity of the bar system

## Additional Information

German Approval DIBt Z-20.1-17 / DIBt Z-34.11-225 / Austrian Approval BMVIT-327.120/0053-IV/ST2/2011 / BMVIT-327.120/0034-II/ST2/2005



# DYWIDAG Threadbar Anchors

## Technical Data

### DYWIDAG Y1050H Prestressing Steel

Nominal diameter $\varnothing$ [mm]	Yield strength / tensile strength $f_{p0.1k}/f_{pk}$ [N/mm <sup>2</sup> ]	Cross- sectional area <b>A</b> [mm <sup>2</sup> ]	Load at yield <b>F<sub>p0.1k</sub></b> [kN]	Ultimate load <b>F<sub>pk</sub></b> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
26.5	950/1,050	552	525	580	4.48	7.4	○ ×
32	950/1,050	804	760	845	6.53	9.8	○ ×
36	950/1,050	1,018	960	1,070	8.27	12.3	○ ×
40	950/1,050	1,257	1,190	1,320	10.21	14.0	○ ×
47	950/1,050	1,735	1,650	1,820	14.10	20.0	×

### GEWI® B500B Threadbar

Nominal diameter $\varnothing$ [mm]	Yield strength / tensile strength $f_{p0.2k}/f_{tk}$ [N/mm <sup>2</sup> ]	Cross- sectional area <b>A</b> [mm <sup>2</sup> ]	Load at yield <b>F<sub>yk</sub></b> [kN]	Ultimate load <b>F<sub>tk</sub></b> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
32	500/550	804	402	442	6.31	9.5	
40	500/550	1,257	628	691	9.86	13.6	△
50	500/550	1,963	982	1,080	15.41	21.0	△
63.5	555/700	3,167	1,758	2,217	24.86	32.4	△

### GEWI® Plus S670/800 Threadbar

Nominal diameter $\varnothing$ [mm]	Yield strength/ tensile strength $f_{p0.2k}/f_{tk}$ [N/mm <sup>2</sup> ]	Cross- sectional area <b>A</b> [mm <sup>2</sup> ]	Load at yield <b>F<sub>yk</sub></b> [kN]	Ultimate load <b>F<sub>tk</sub></b> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
18	670/800	254	170	204	2.00	5.4	□
22	670/800	380	255	304	2.98	6.5	□
25	670/800	491	329	393	3.85	7.0	□
28	670/800	616	413	493	4.83	8.6	□
30	670/800	707	474	565	5.55	9.0	□
35	670/800	962	645	770	7.55	11.3	□
43	670/800	1,452	973	1,162	11.40	15.8	□
57.5	670/800	2,597	1,740	2,077	20.38	30.0	□
63.5	670/800	3,167	2,122	2,534	24.86	32.4	□
75	670/800	4,418	2,960	3,534	34.68	43.5	□

- Germany: Z-20.1-17 DYWIDAG Threadbar Anchor Y1050H Prestressing Steel  
 × Austria: BMVIT-327.120/0053-IV/ST2/2011 DYWIDAG Threadbar Anchor Y1050H Prestressing Steel  
 △ Germany: Z-34.11-225 DYWIDAG GEWI® Bar  
 □ Austria: BMVIT-327.120/0034-II/ST2/2005 DYWIDAG GEWI® Plus Threadbar

### Anchor Head for Permanent Anchors



### Anchor Head with Angle Compensation



### Additional Information

German Approval DIBt Z-20.1-17 / DIBt Z-34.11-225 / Austrian Approval BMVIT-327.120/0053-IV/ST2/2011 / BMVIT-327.120/0034-II/ST2/2005

# DYWIDAG Threadbar Anchors

## Permanent Anchors

- Long-lasting system for permanent use (more than 100 years)
- Approved, Double Corrosion Protection (DCP) achieved by grouted corrugated sheathing with controlled crack width
- Anchor components in accordance with ETA 05/0123 (bar post-tensioning system)
- Approved, permanently sealed anchor head design with robust gaskets and caps
- Various corrosion protection coatings for head components depending on intended use

## Fields of Application

- Permanent tiebacks
- Uplift control
- Positional stability
- Dam construction
- Rock and slope stabilization

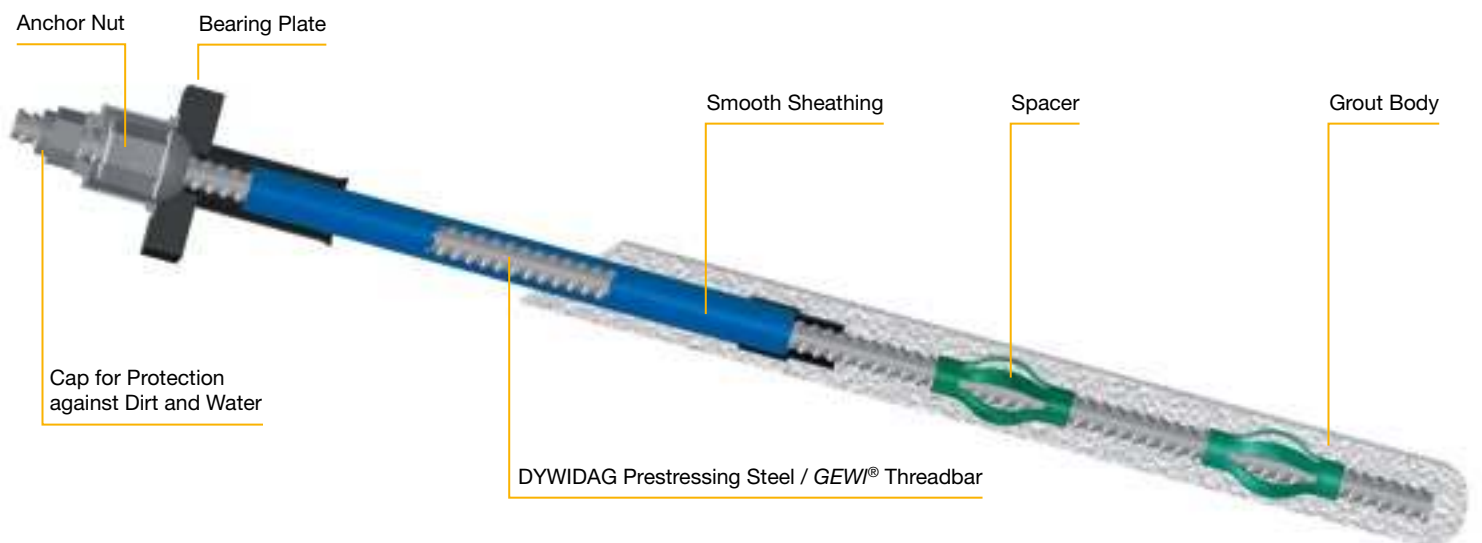


## Temporary Anchors

- Temporary system for preliminary use of up to two years
- Extended use after prior agreement of involved experts
- Approved anchor components in accordance with ETA 05/0123 (Bar Post-Tensioning System)

## Fields of Application

- Excavations
- Temporary tiebacks
- Stabilization of states of construction



## Additional Information

German Approval DIBt Z-20.1-17 / DIBt Z-34.11-225 / Austrian Approval BMVIT-327.120/0053-IV/ST2/2011 / BMVIT-327.120/0034-II/ST2/2005



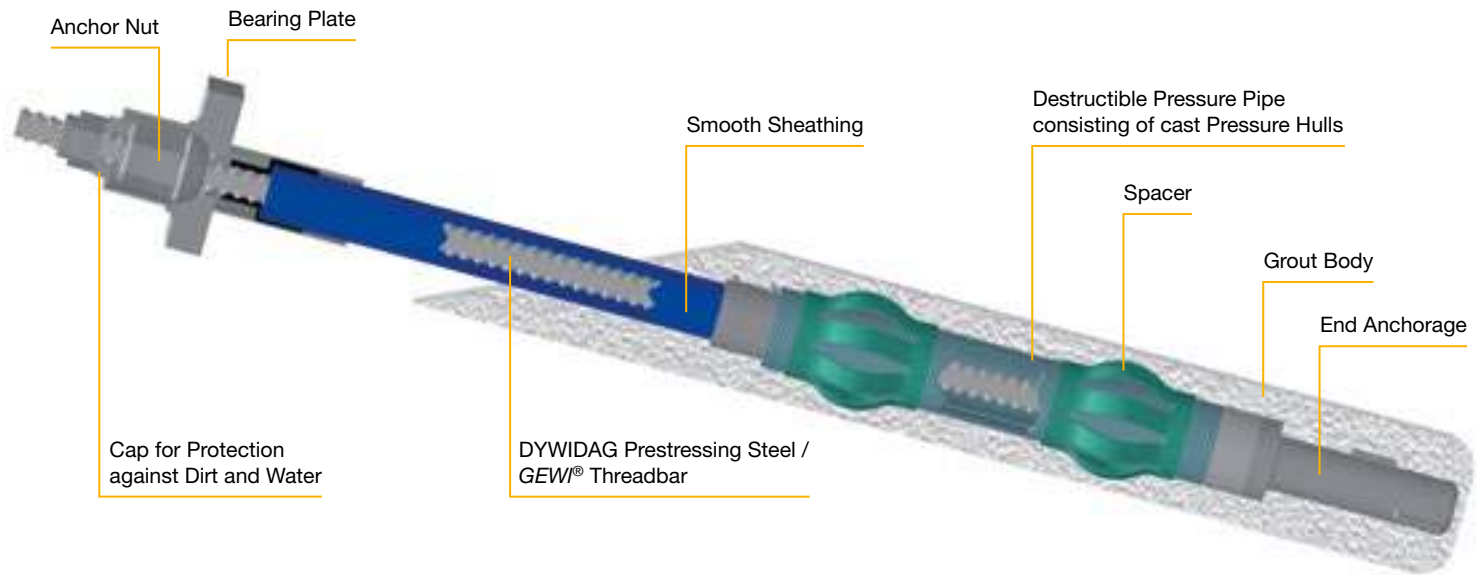
# DYWIDAG Threadbar Anchors

## Temporary Bar Anchor with Completely Removable Tendon

- Completely removable anchor – the cast compression bodies with predetermined breaking points are the only thing that remains in the soil. They do not obstruct civil engineering work carried out at a later stage (pile driving, excavation, TBM etc.)
- Easy and safe anchor removal: The steel tendon is unscrewed from the end anchorage
- Pressure pipe consisting of patented cast hulls ensures transfer of forces from the tendon to the borehole grout
- Pressure pipe lengths can be adapted to soil conditions on site

## Fields of Application

- Excavations
- Temporary tiebacks
- Stabilization of states of construction

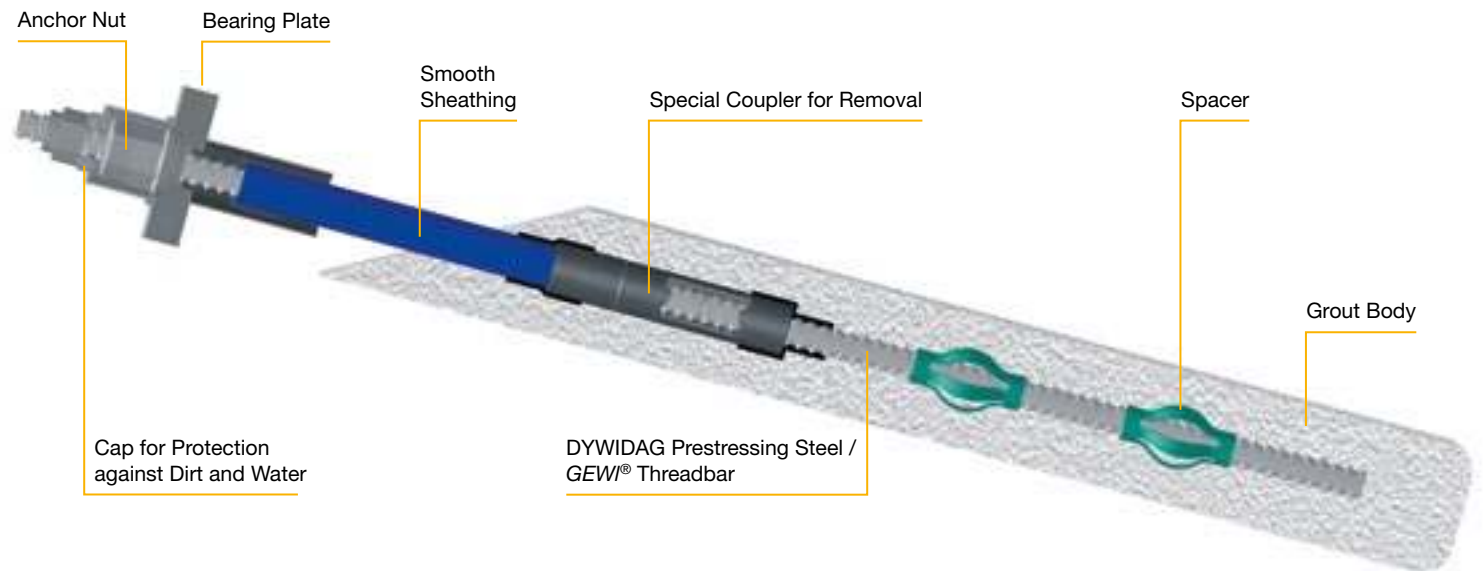


## Temporary Anchor with Removable Free Length

- Partly removable anchor – free length can be removed
- Easy and safe anchor removal: The steel tendon can be unscrewed from the special coupler in the transition from bonded length to unbonded length
- Slender system – small boreholes can be realized

## Fields of Application

- Excavations
- Temporary tiebacks
- Stabilization of states of construction



## Additional Information

German Approval DIBt Z-20.1-17 / DIBt Z-34.11-225 / Austrian Approval BMVIT-327.120/0053-IV/ST2/2011 / BMVIT-327.120/0034-II/ST2/2005

## Construction of a Rock Fall Gallery, Austria



**Owner** Federal State of Tyrol, Federal Road Administration, Austria +++ **Contractor** Joint Venture, consisting of Alpine, Hilti & Jehle, Austria  
+++ **Engineers** IBPA Engineers Passegger-Autengruber ZT-GmbH, Austria



**DSI Unit** DYWIDAG-Systems International GmbH, Austria

**DSI Services** Production and Supply

**DSI Products supplied** 168, double corrosion protected Ø 63.5mm *GEWI® Plus* Piles and of Ø 50mm *GEWI® Plus* Micropiles in lengths of 8 and 15m

## *GEWI® Plus* Tie Bars Support Retaining Walls, Great Britain



**Owner** Tesco Stores Limited and Network Rail, both Great Britain +++ **Contractor** Costain Group PLC, Great Britain +++  
**Engineers** Engineering Peter Brett Associates LLP, Great Britain



**DSI Unit** DYWIDAG-Systems International Ltd., Great Britain

**DSI Services** Production, Supply and Installation

**DSI Products supplied** 108, Ø 57.5mm *GEWI® Plus* Tie Bars; 60, Ø 43mm *GEWI® Plus* Tie Bars; 336, Anchor Plates with Wedges and Domed Nuts



## Rehabilitation of a Dry Dock using DYWIDAG Bar Anchors, France



**i** **Owner** DCNS, Lorient, France +++ **Contractor** SEMEN TP, France  
**DSI Unit** DSI-Artéon, France  
**DSI Services** Production, Supply, Installation and Technical Support  
**DSI Products supplies** 32, Ø 75mm DYWIDAG Bar Anchors; 6, Ø 40mm DYWIDAG Bar Anchors; 33, preassembled Ø 40mm DYWIDAG Bar Anchors; rental of equipment

## Retaining Walls of Transbrasiliana Highway stabilized using DYWIDAG Bar Anchors, Brazil



**i** **Owner** City of Columbus/Ohio, USA +++ **Main Contractor** Kokosing Construction Co. Inc., Columbus, OH, BBS Corporation, Columbus, OH, J.H.C. Denver Co.  
**DSI Unit** Protendidos DYWIDAG Ltda., Brazil  
**Protendidos DYWIDAG Services** Production and Supply  
**Protendidos DYWIDAG Products** 37,130m, permanent, epoxy coated Ø 32mm DYWIDAG Bar Anchors with accessories

# DYWIDAG Strand Anchors

## Basic Concept

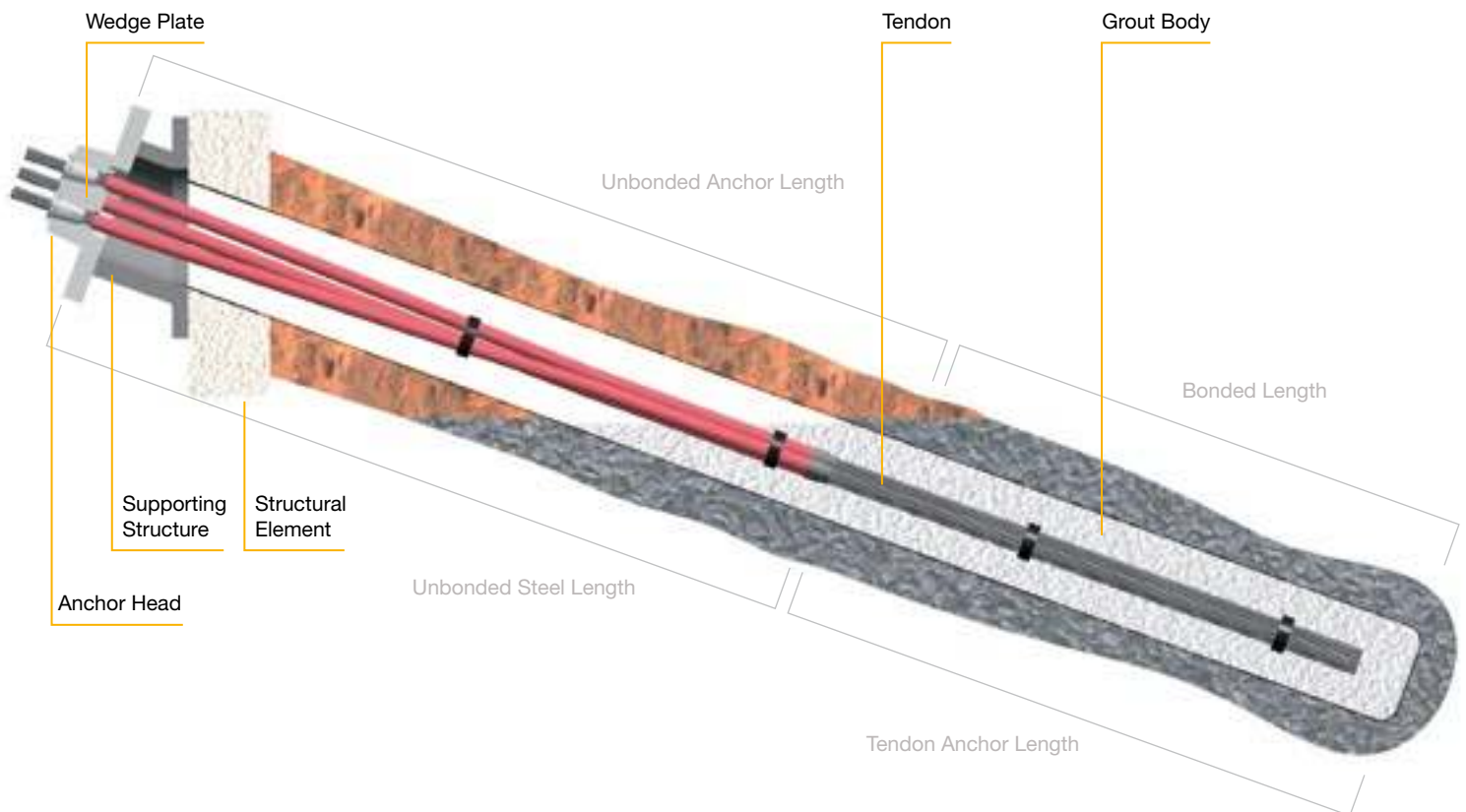
DYWIDAG Strand Anchors are an actively tensioned ground anchor system and correspond to DIN 4125 and EN 1537 specifications. Tensioning minimizes or eliminates anticipated deformations of the system and deformations at the civil engineering measure. This applies both to temporary structures (e.g. pit support systems) and permanent tie backs. The strand anchors are produced with double corrosion protection (DCP): each individual strand is covered by corrosion protection compound and inserted into an individual duct in the factory. As long as the grout used for anchoring is load-bearing, the anchor force is unlimited because the number of strands that can be combined in the anchorage is variable at will.

By definition, an anchor consists of three main components:

- **Bonded length:** The anchor is fixed in the borehole using grout (cement mortar) and can transfer the forces to the load-bearing soil via bond and skin friction
- **Unbonded length:** Each strand is uncoupled from the borehole using individual ducts so that it can freely extend in the unbonded length. This way, tension can be applied to the anchor system
- **Anchor head:** The anchor head transfers the anchor force to the substructure and thus to the structure that needs to be anchored

Once the grout has sufficiently hardened, the load bearing capacity of each anchor is tested during an approval test.

If required, anchors can be supplied retensioned or detensionable. Permanent control of anchor forces can be realized by installing load cells. Alternatively, permanent controls can also be carried out at the anchor head or in the borehole using the contactless force measuring system DYNA Force® that has been specially developed together with DSI.



## Fields of Application

- Excavations (deformation resistant)
- Tiebacks
- Uplift control
- Positional stability
- Rock stabilization

## Key Features

- Large degree of flexibility: Force, length, transport, installation
- There are practically no restrictions in terms of length – 150m
- Small pack size for transportation
- Amount of required space is very small during installation
- Retensioning or detensioning thanks to exterior thread at the wedge plates
- Permanent strand anchor can be supplied in many variations (standard, EI-Iso, TWIN-Corr)

## Additional Information

German Approval DIBt Z-20.1-53 / DIBt Z-20.1-64 / Austrian Approval BMVIT-327.120/0054-IV/ST2/2011



# DYWIDAG Strand Anchors

## Technical Data

### DYWIDAG Prestressing Steel, 140 mm<sup>2</sup> Ø 15.3 mm (0.6") Strand

Number	Cross-sectional area A [mm <sup>2</sup> ]	Weight [kg/m]	Y1770 Standard			Y1860 High Grade		
			Load at yield F <sub>p0,1k</sub> [kN]	Ultimate load F <sub>pk</sub> [kN]	Approval	Load at yield F <sub>p0,1k</sub> [kN]	Ultimate load F <sub>pk</sub> [kN]	Approval
1	140	1.09	218	248	○	230	260	
2	280	2.19	437	496	○ × △	459	521	△
3	420	3.28	655	743	○ × △	689	781	△
4	560	4.37	874	991	○ × △	918	1,042	△
5	700	5.47	1,092	1,239	○ × △	1,148	1,302	△
6	840	6.56	1,310	1,487	○ × △	1,378	1,562	△
7	980	7.65	1,529	1,735	○ × △	1,607	1,823	△
8	1,120	8.74	1,747	1,982	○ × △	1,837	2,083	△
9	1,260	9.84	1,966	2,230	○ × △	2,066	2,344	△
10	1,400	10.93	2,184	2,478	○ × △	2,296	2,604	△
11	1,540	12.02	2,402	2,726	○ × △	2,526	2,864	△
12	1,680	13.12	2,621	2,974	○ × △	2,755	3,125	△
13	1,820	14.21	2,839	3,221	○ × △	2,985	3,385	△
14	1,960	15.30	3,058	3,469	○ × △	3,214	3,646	△
15	2,100	16.40	3,276	3,717	○ × △	3,444	3,906	△
16	2,240	17.49	3,494	3,965	○ × △	3,674	4,166	△
17	2,380	18.58	3,713	4,213	○ × △	3,903	4,427	△
18	2,520	19.67	3,931	4,460	○ × △	4,133	4,687	△
19	2,660	20.77	4,150	4,708	○ × △	4,362	4,948	△
20	2,800	21.86	4,368	4,956	○ × △	4,592	5,208	△
21	2,940	22.95	4,586	5,204	○ × △	4,822	5,468	△
22	3,080	24.05	4,805	5,452	○ × △	5,051	5,729	△

### DYWIDAG Prestressing Steel, 150 mm<sup>2</sup> Ø 15.7 mm (0.62") Strand

Number	Cross-sectional area A [mm <sup>2</sup> ]	Weight [kg/m]	Y1770 Standard			Y1860 High Grade		
			Load at yield F <sub>p0,1k</sub> [kN]	Ultimate load F <sub>pk</sub> [kN]	Approval	Load at yield F <sub>p0,1k</sub> [kN]	Ultimate load F <sub>pk</sub> [kN]	Approval
1	150	1.17	234	266	○	246	279	
2	300	2.34	468	531	○ × △	492	558	△
3	450	3.52	702	797	○ × △	738	837	△
4	600	4.69	963	1,062	○ × △	984	1,116	△
5	750	5.86	1,170	1,328	○ × △	1,230	1,395	△
6	900	7.03	1,404	1,593	○ × △	1,476	1,674	△
7	1,050	8.20	1,638	1,859	○ × △	1,722	1,953	△
8	1,200	9.38	1,872	2,124	○ × △	1,968	2,232	△
9	1,350	10.55	2,106	2,390	○ × △	2,214	2,511	△
10	1,500	11.72	2,340	2,655	○ × △	2,460	2,790	△
11	1,650	12.89	2,574	2,921	○ × △	2,706	3,069	△
12	1,800	14.06	2,808	3,186	○ × △	2,952	3,348	△
13	1,950	15.24	3,042	3,452	○ × △	3,198	3,627	△
14	2,100	16.41	3,276	3,717	○ × △	3,444	3,906	△
15	2,250	17.58	3,510	3,983	○ × △	3,690	4,185	△
16	2,400	18.75	3,744	4,248	○ × △	3,936	4,464	△
17	2,550	19.92	3,978	4,514	○ × △	4,182	4,743	△
18	2,700	21.10	4,212	4,779	○ × △	4,428	5,022	△
19	2,850	22.27	4,446	5,045	○ × △	4,674	5,301	△
20	3,000	23.44	4,680	5,310	○ × △	4,920	5,580	△
21	3,150	24.61	4,914	5,576	○ × △	5,166	5,859	△
22	3,300	25.78	5,148	5,841	○ × △	5,412	6,138	△

- Germany: Z-20.1-53 SUSPA Rock Anchors
- × Germany: Z-20.1-64 SUSPA Compact Anchors
- △ Austria: BMVIT-327.120/0054-IV/ST2/2011

## Additional Information

German Approval DIBt Z-20.1-53 / DIBt Z-20.1-64 / Austrian Approval BMVIT-327.120/0054-IV/ST2/2011

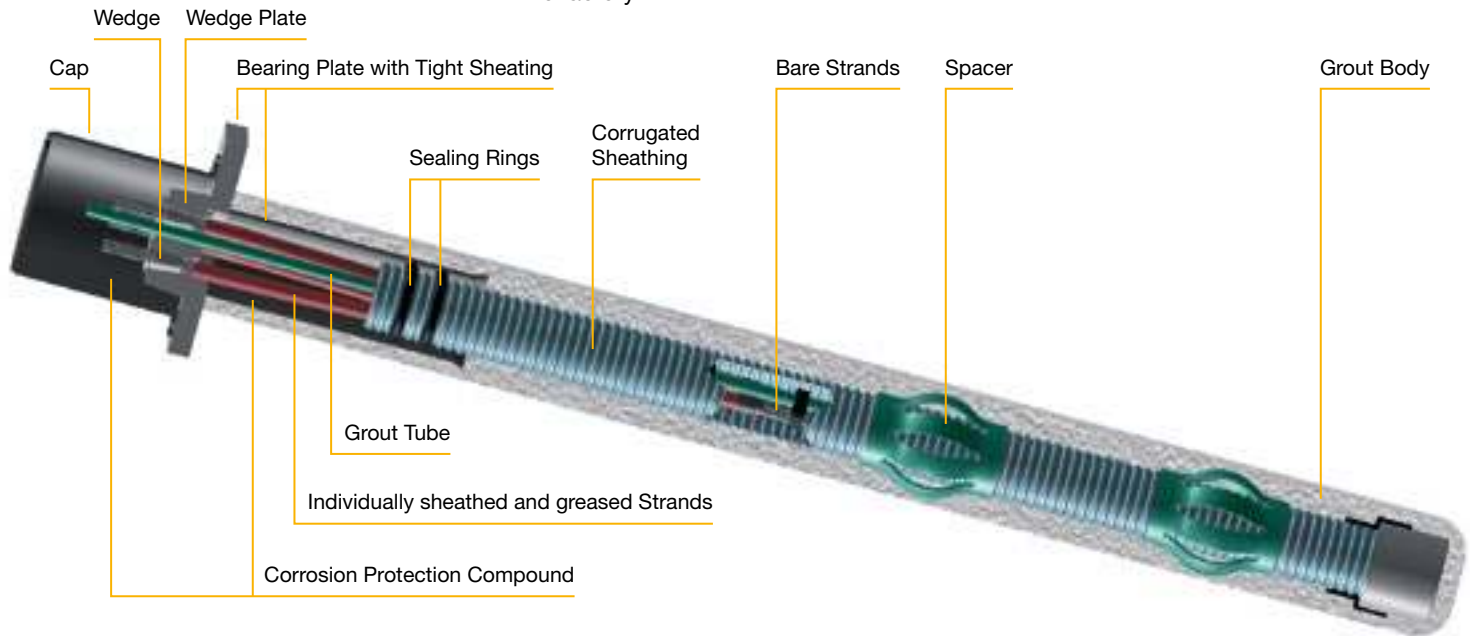
# DYWIDAG Strand Anchors

## Permanent (DCP) Anchors

- Long-lasting system for permanent use (more than 100 years)
- DYWIDAG Strand Post-Tensioning System Anchor components
- Bonded length can be pregrouted at the factory – partial grouting is also possible
- Approved, Double Corrosion Protection (DCP) achieved by strands that are greased, individually sheathed and covered by one corrugated sheathing at the factory

## Fields of Application

- Permanent tiebacks
- Uplift control
- Positional stability
- Rock stabilization

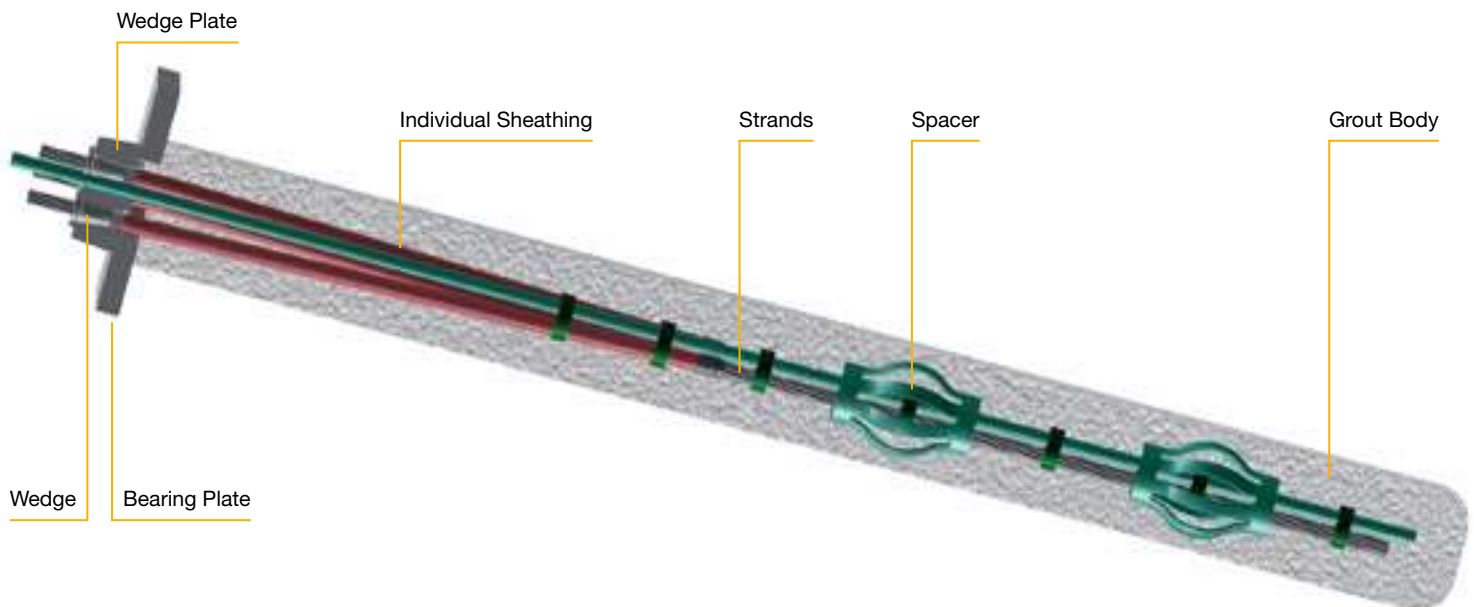


## Temporary Anchor

- Temporary System for preliminary use of up to two years
- Extended use after prior agreement of involved experts
- Individual sheathing can be tightly sealed to the anchor head
- DYWIDAG Strand Post-Tensioning System Anchor components
- Can be designed for pressing water

## Fields of Application

- Excavations
- Temporary tiebacks
- Stabilization of states of construction



## Additional Information

German Approval DIBt Z-20.1-53 / DIBt Z-20.1-64 / Austrian Approval BMVIT-327.120/0054-IV/ST2/2011

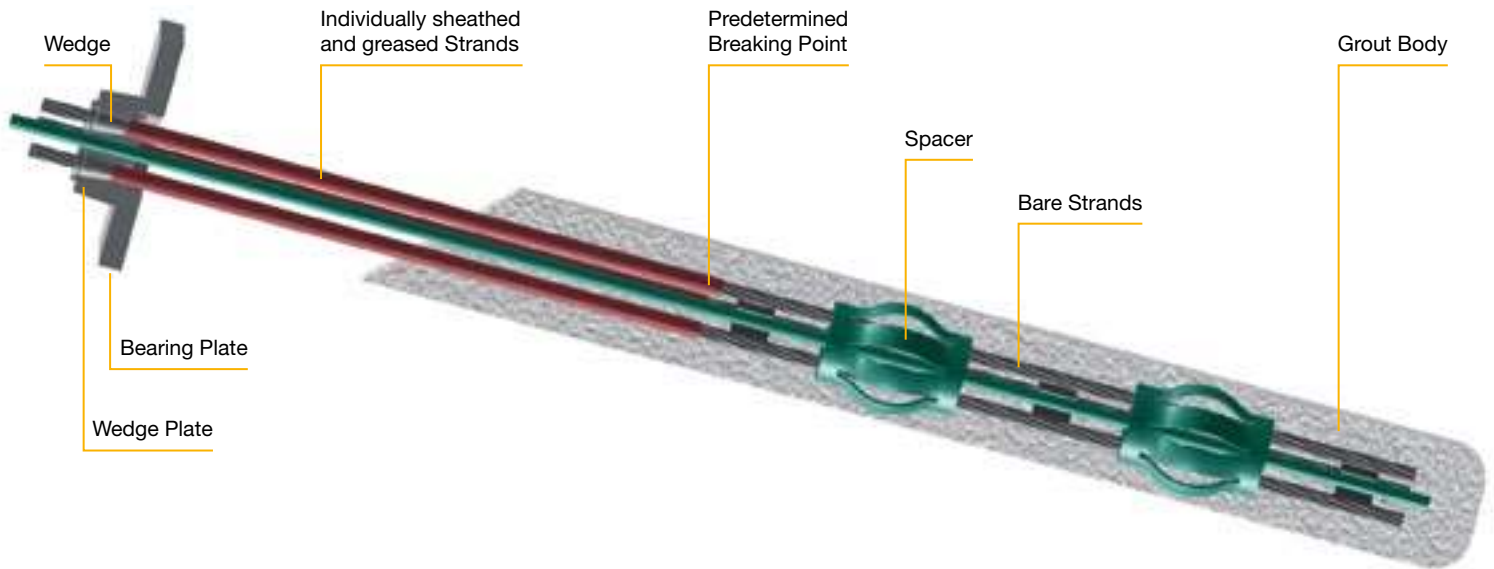
# DYWIDAG Strand Anchors

## Temporary Anchor with Removable Free Length

- Anchor is partly removable – only the bonded length remains in the soil
- Slender system – high forces despite small boreholes
- Predetermined breaking point at each strand in the transition from bonded to free length – weakened strand
- Individually sheathed, greased strands in the free length ensure trouble-free removal
- Special equipment for removing broken strands

## Fields of Application

- Excavations
- Temporary tiebacks
- Stabilization of states of construction
- Intra-urban construction

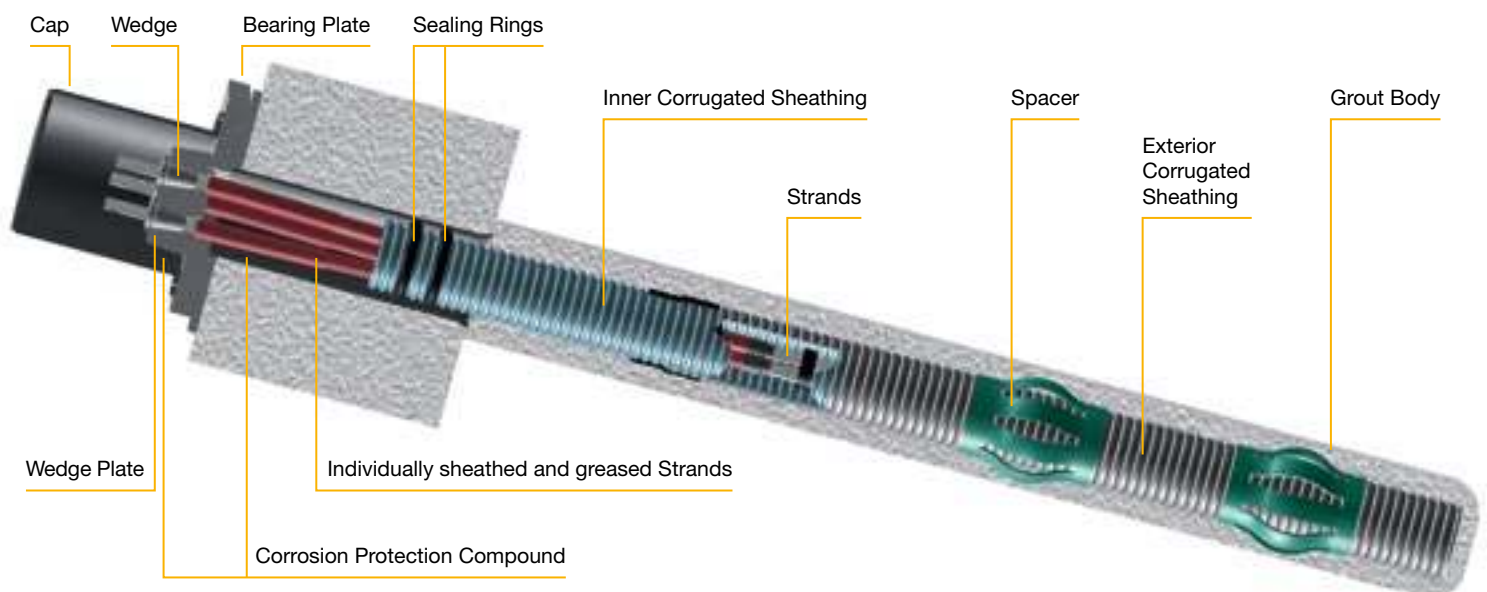


## Permanent Anchor with Double Sheathing - TWIN-Corr System

- Long-lasting system for permanent use (more than 100 years)
- Double Corrosion Protection (DCP) achieved by strands that are greased, individually sheathed and covered by one corrugated sheathing at the factory
- Additional protection of the bonded length by a second, concentric corrugated sheathing – two plastic sheathings in the bonded length as well

## Fields of Application

- Permanent tiebacks
- Uplift control
- Positional stability
- Rock stabilization



## Additional Information

German Approval DIBt Z-20.1-53 / DIBt Z-20.1-64 / Austrian Approval BMVIT-327.120/0054-IV/ST2/2011



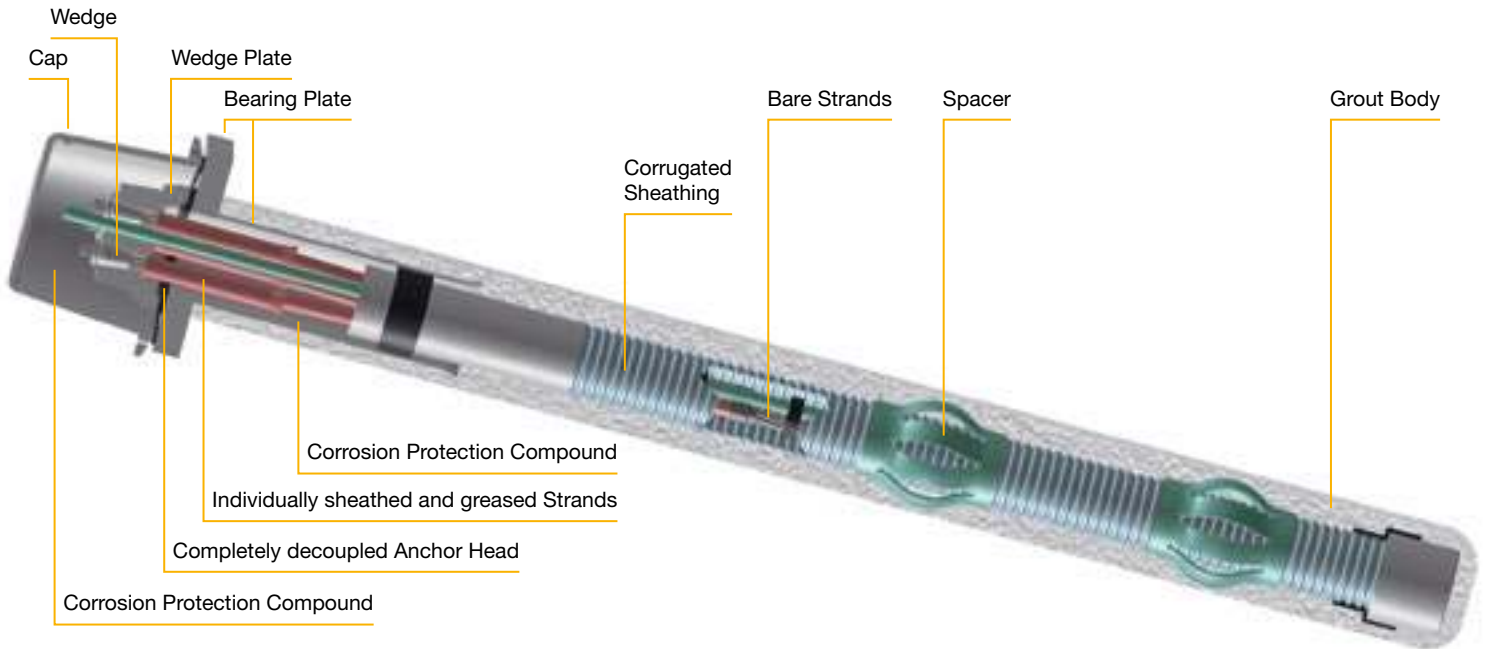
# DYWIDAG Strand Anchors

## Electrically Testable Permanent Anchors – EI-Iso System

- Long-lasting system for permanent use (more than 100 years)
- By uncoupling the anchor head and the tendon from the anchor plate, a resistance test from the anchor to the soil can be carried out – the intactness of the corrosion protection sheathing can be tested permanently and at any point of time by resistance tests
- Fulfills SIA requirements
- Special design also applicable for stray currents (railway)

## Fields of Application

- Permanent tiebacks
- Uplift control
- Positional stability
- Rock stabilization
- Applicable for stray currents

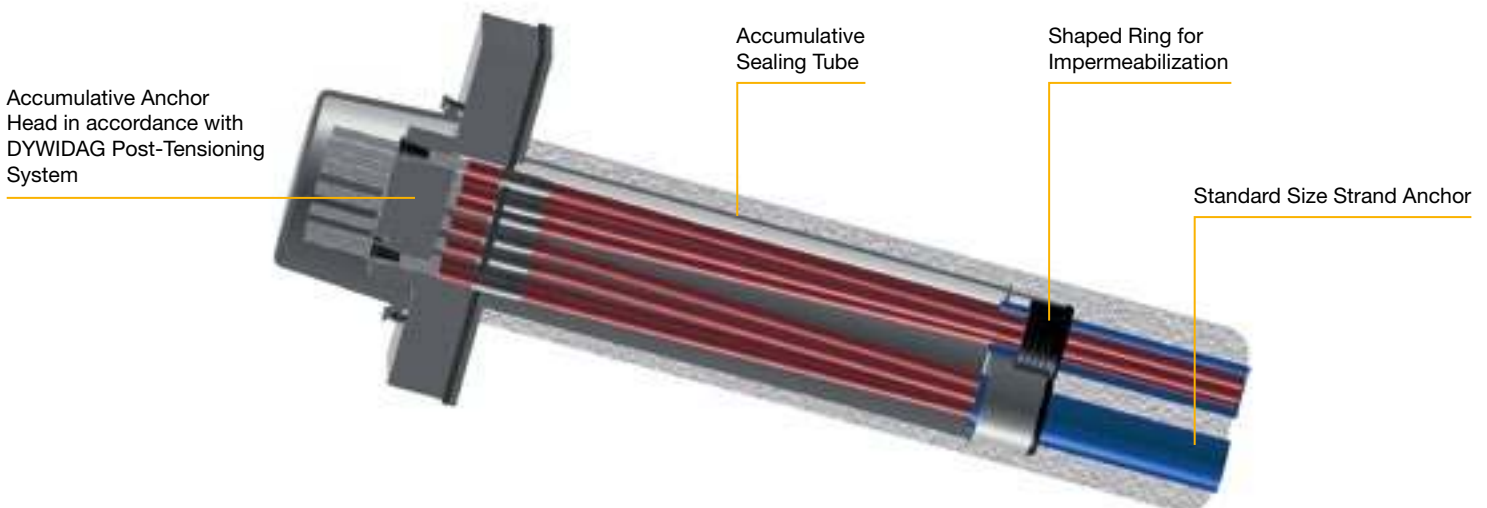


## Permanent Anchors with Multiple Head

- Long-lasting system for permanent use (more than 100 years)
- Several standardized permanent strand anchors can be bundled and anchored in one borehole – the transition to the anchor head is specially designed so that all strands end in a single anchorage
- Thanks to the preassembly of standard types in the factory, larger sizes can be manufactured quickly and easily
- High standards of quality
- Patented DYWIDAG System

## Fields of Application

- Dam reinforcement
- Permanent tiebacks
- Uplift control
- Positional stability
- Rock stabilization
- Peak performance anchor



## Additional Information

German Approval DIBt Z-20.1-53 / DIBt Z-20.1-64 / Austrian Approval BMVIT-327.120/0054-IV/ST2/2011

## First Use of DYWIDAG Strand Anchors in Bukarest, Romania



**Owner** Raiffeisen Evolution, Austria +++ **Contractor** STRABAG SRL, Romania +++ **Subcontractor** Drilling Work Züblin SRL, Romania +++ **Engineers** Dipl.-Ing. Kurt Ströhle ZT GmbH, Austria; STROEHLE ENGINEERING SRL, Romania +++ **Executing Company** Züblin Romania SRL, Romania



**DSI Unit** DYWIDAG-Systems International GmbH, Austria  
**DSI Services** Production, Supply, Installation, Test Installation, Technical Support  
**DSI Products supplied** 3,765m, replaceable DYWIDAG Strand Anchors, 7-0.62"; 151m, DYWIDAG Strand Anchors, 9-0.62", with 16 anchor heads, 5 load cells with 1,250kN; rental of the complete tensioning equipment

## New Ways for Europe: Pan-European Corridor 5, Slovenia



**Owner** DARS d.d., Ljubljana, Slovenia +++ **Contractor** SCT d.d., Ljubljana, Slovenia



**DSI Unit** DYWIDAG-Systems International GmbH, Headquarter Operations, Germany  
**DSI Services** Production and Supply  
**DSI Products supplied** 850, Type 4-0.62" Electrically Isolated Permanent DYWIDAG Strand Anchors with 3 or 4 strands and Type 7-0.62" anchors with 5 strands; grouting and stressing equipment



## Stabilization of Pier 70, A10 Tauern Motorway, Austria



**i** Owner ASFINAG BAU MANAGEMENT GMBH, Austria +++ Engineers SCHIMETTA CONSULT, Austria

**DSI Unit** DYWIDAG-Systems International GmbH, Austria

**DSI Services** Production and Supply

**DSI Products supplied** 10, 8-0.62" Permanent DYWIDAG Strand Anchors, length: approx. 80m

## DYWIDAG Strand Anchors stabilize Europe's largest Harbor in Rotterdam, Netherlands



**i** Owner Havenbedrijf Rotterdam N.V. (Port of Rotterdam), Netherlands +++ General Contractor PUMA JV, consisting of Koninklijke Boskalis Westminster N.V. and Van Oord N.V., both Netherlands +++ Subcontractor Quay Walls BAVO JV, consisting of BAM Civiel B.V. and Van Hattum en Blankenvoort, both Netherlands +++ Architect Quay Walls BAM Infraconsult B.V., Netherlands

**DSI Unit** DYWIDAG-Systems International B.V., Netherlands

**DSI Services** Design, Production, Supply and Installation

**DSI Products supplied** 360, unbonded horizontal DYWIDAG Strand Anchors (500t) with MA Anchorages



## Strengthening of Roanoke Rapids Dam using DYWIDAG Strand Anchors and DYNA Force® Sensors, USA



**Owner** Dominion North Carolina Power, USA +++ **General Contractor** Brayman Construction Corporation, USA +++  
**Engineers** HDR/DTA, Inc., USA

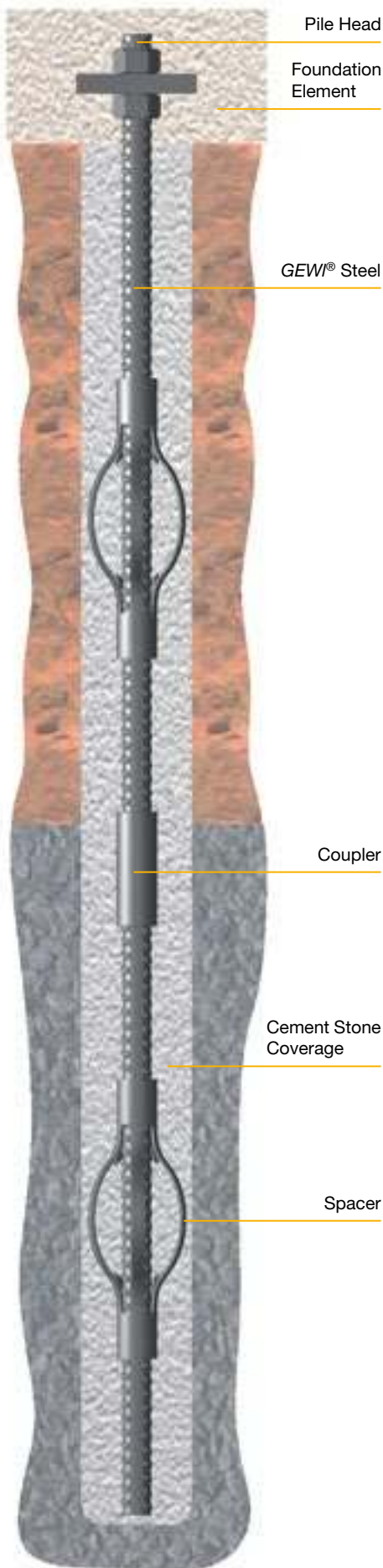
**i** **DSI Unit** DYWIDAG-Systems International USA Inc., BU Geotechnics, USA  
**DSI Services** Production and Supply  
**DSI Products supplied** restressable, epoxy coated 30-0.6" DYWIDAG Strand Anchors; 15 DYNA Force® Sensors

## Permanent DYWIDAG Strand Anchors for Changuinola Dam, Panama



**Owner** AES Changuinola S.A., Panama +++ **General Contractor** Changuinola Civil Works Joint Venture CCWJV, consisting of: E. Pihl & Søn A.S. and MT Højgaard A/S, both Denmark; Alstom GmbH, Germany +++ **Anchor Designer** MD & G Engineers, South Africa

**i** **DSI Unit** DYWIDAG-Systems International USA Inc., BU Geotechnics, USA  
**DSI Services** Production, Supply and Technical Support  
**DSI Products supplied** 43, restressable, double corrosion protected (DCP) 12-0.6" DYWIDAG Strand Anchors; 48, DYNA Force® Sensors; equipment



## 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
- For increasing skin friction, GEWI® and GEWI® Plus Piles can be equipped with a posterior grouting system
- Optimum load transfer in concrete structures via the anchoring elements
- Especially small pile distances can be realized using special splitting reinforcement
- Multibar assembly is possible when subject to extreme loads

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 developed 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

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

# GEWI® Pile System

## Technical Data

### GEWI® Pile B500B & S555/700

Nominal diameter Ø	Yield strength / tensile strength f <sub>0,2k</sub> /f <sub>tk</sub>	Cross- sectional area A	Load at yield F <sub>yk</sub>	Ultimate load F <sub>tk</sub>	Weight	Weight DCP	Approval
[mm]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
20	500/550	314	157	173	2.47	5.9	○
25	500/550	491	245	270	3.85	7.0	○
28	500/550	616	308	339	4.83	8.6	○
32	500/550	804	402	442	6.31	9.5	○
40	500/550	1,257	628	691	9.86	13.6	○
50	500/550	1,963	982	1,080	15.41	21.0	○
63.5	555/700	3,167	1,758	2,217	24.86	32.4	×

### GEWI® Plus Pile S670/800

Nominal diameter Ø	Yield strength / tensile strength f <sub>0,2k</sub> /f <sub>tk</sub>	Cross- sectional area A	Load at yield F <sub>yk</sub>	Ultimate load F <sub>tk</sub>	Weight	Weight DCP	Approval
[mm]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
25	670/800	491	329	393	3.85	7.0	△
28	670/800	616	413	493	4.83	8.6	△
30	670/800	707	474	565	5.55	9.0	△
35	670/800	962	645	770	7.55	11.3	△
43	670/800	1,452	973	1,162	11.40	15.8	△
57.5	670/800	2,597	1,740	2,077	20.38	30.0	△
63.5	670/800	3,167	2,122	2,534	24.86	32.4	△
75	670/800	4,418	2,960	3,534	34.68	43.5	

### GEWI® Pile B500B Multibar

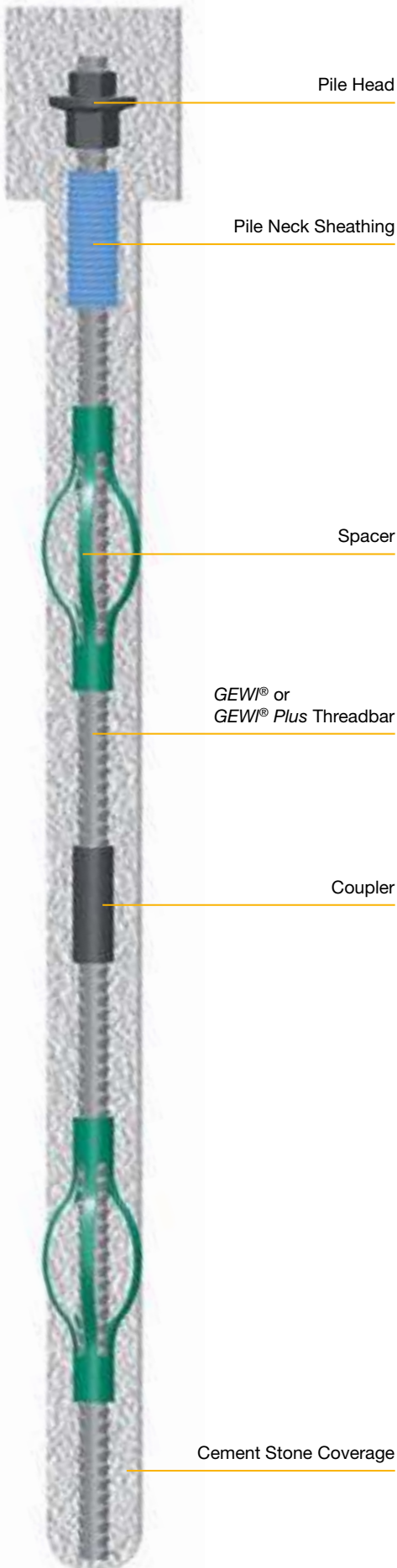
Nominal diameter Ø	Yield strength / tensile strength f <sub>0,2k</sub> /f <sub>tk</sub>	Cross- sectional area A	Load at yield F <sub>yk</sub>	Ultimate load F <sub>tk</sub>	Weight	Weight DCP	Approval
[Number x Ø]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
3 x 32	500/550	2,413	1,206	1,327	18.9	28.5	○
3 x 40	500/550	3,770	1,885	2,073	29.6	40.8	○
3 x 50	500/550	5,890	2,945	3,240	46.2	63.0	○
2 x 40	500/550	2,513	1,257	1,382	19.7	27.2	○
2 x 50	500/550	3,927	1,963	2,160	30.8	42.0	○
1 x 40 & 1 x 50	500/550	3,220	1,610	1,771	25.3	34.6	○
2 x 40 & 1 x 50	500/550	4,477	2,238	2,462	35.1	48.2	○
1 x 40 & 2 x 50	500/550	5,184	2,592	2,851	40.7	55.6	○

- Germany: Z-32.1-2 Ø 20 - 50mm GEWI® Pile  
 × Germany: Z-32.1-9 Ø 63.5mm GEWI® Pile  
 △ Austria: BMVIT-327.120/0017-II/ST 2/2007 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





## 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 (DIW...) or up to 50 years (EN...) in low aggressivity if used as a tension and for rotating 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

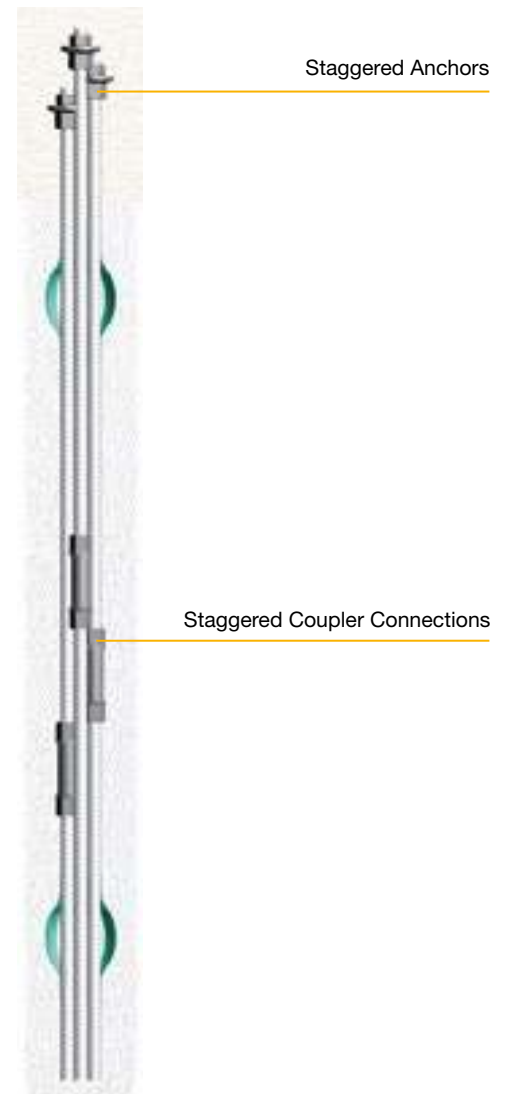


## Fields of Application

- Foundation
- Baseplates
- Reinforcement
- Underpinings
- Mainly compression loads

## GEWI® Multibar assembly

- Used for extreme loads
- Reaction piles for test loading
- Larger boreholes



## Additional Information

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

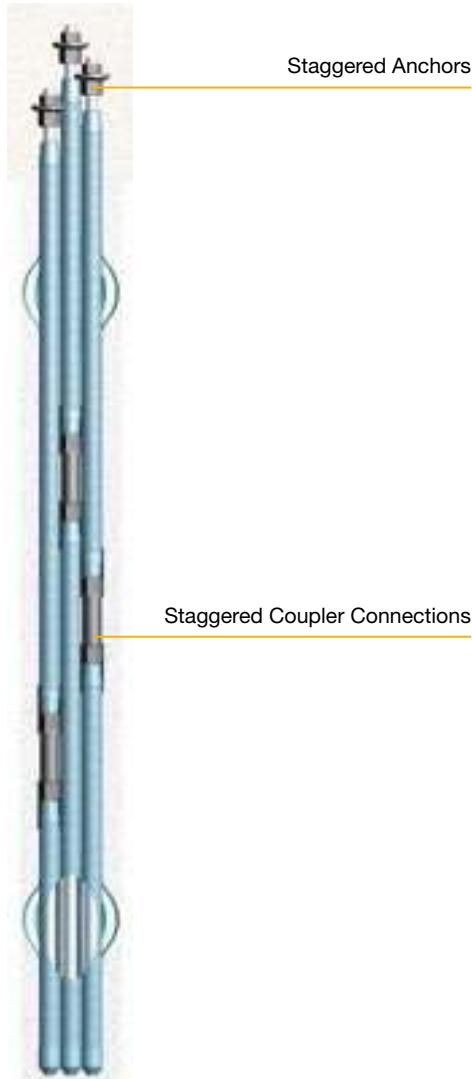
# GEWI® Pile System

## 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



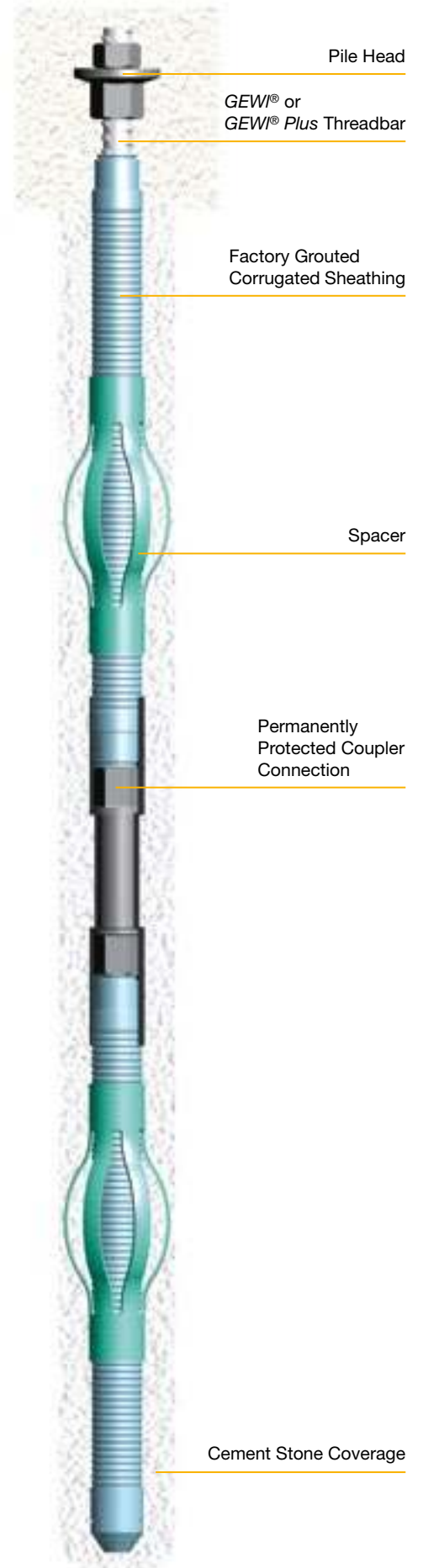
## Fields of Application

- Uplift control
- Foundation
- Baseplates
- Reinforcement
- Underpinnings

## Double Anchor Piece



## Coupler Connection



## Additional Information

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

## **GEWI® Plus Piles stabilize Commercial Harbor: Kaiserschleuse Bremerhaven, Germany**



**Owner** Bremenports GmbH & Co. KG, Bremerhaven, Germany +++ **Client** Neidhardt Grundbau GmbH, Hamburg, Germany +++  
**Contractor** JV, consisting of Hochtief Construction AG, August Prien Bauunternehmung (GmbH & Co. KG), STRABAG AG and Gustav W. Rogge, all of them Bremen and Bremerhaven, Germany



**DSI Unit** DYWIDAG-Systems International GmbH, LU West, Germany  
**DSI Services** Production and Supply  
**DSI Products supplied** approx. 770, Ø 63.5mm **GEWI® Plus** Piles, half of which were Double Corrosion Protected

## **GEWI® Piles used for Important Train Connection from Munich to Verona, Austria**



**Owner** ÖBB Infrastruktur Bau AG, Austria +++ **Client** Strabag AG Dir. IE, Austria +++ **Contractor** ZÜBLIN Spezialtiefbau Ges.m.b.H., Austria



**DSI Unit** DYWIDAG-Systems International GmbH, Austria  
**DSI Services** Production and Supply  
**DSI Products supplied** 1,910, **GEWI®** Piles; 1,394, DYWIDAG Strand Anchors with 3 to 9 strands



## DSI Supplies Permanent **GEWI®** Anchors for Suspension Bridge in Oman



**Owner** Ministry of Regional Municipalities & Water Resources, Ruwi, Oman +++ **Contractor** STRABAG Oman LLC, Muscat, Oman +++  
**Engineers** Schlaich Bergemann und Partner, Stuttgart, Germany



**DSI Unit** DYWIDAG-Systems International GmbH, LU West, Germany  
**DSI Services** Production, Supply, Installation and Test Installation  
**DSI Products supplied** 64, Ø 50mm permanent **GEWI®** Anchors

## Permanent **GEWI®** Anchors stabilize modern Power Plant in Incheon City, South Korea



**Owner** Korea South East Power Co., Ltd. (KOSEP), Korea +++ **General Contractor** GS Engineering & Construction Co. Ltd, Korea +++  
**Subcontractor** Shinwoo Construction Co., Ltd., Korea +++ **Engineers** Hyundai Engineering Co., Ltd., Korea



**DSI Unit** DYWIDAG-Systems Korea Co. Ltd., Korea  
**DSI Services** Production and Supply  
**DSI Products supplied** 336, permanent double corrosion protected **GEWI®** Anchors

# 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.

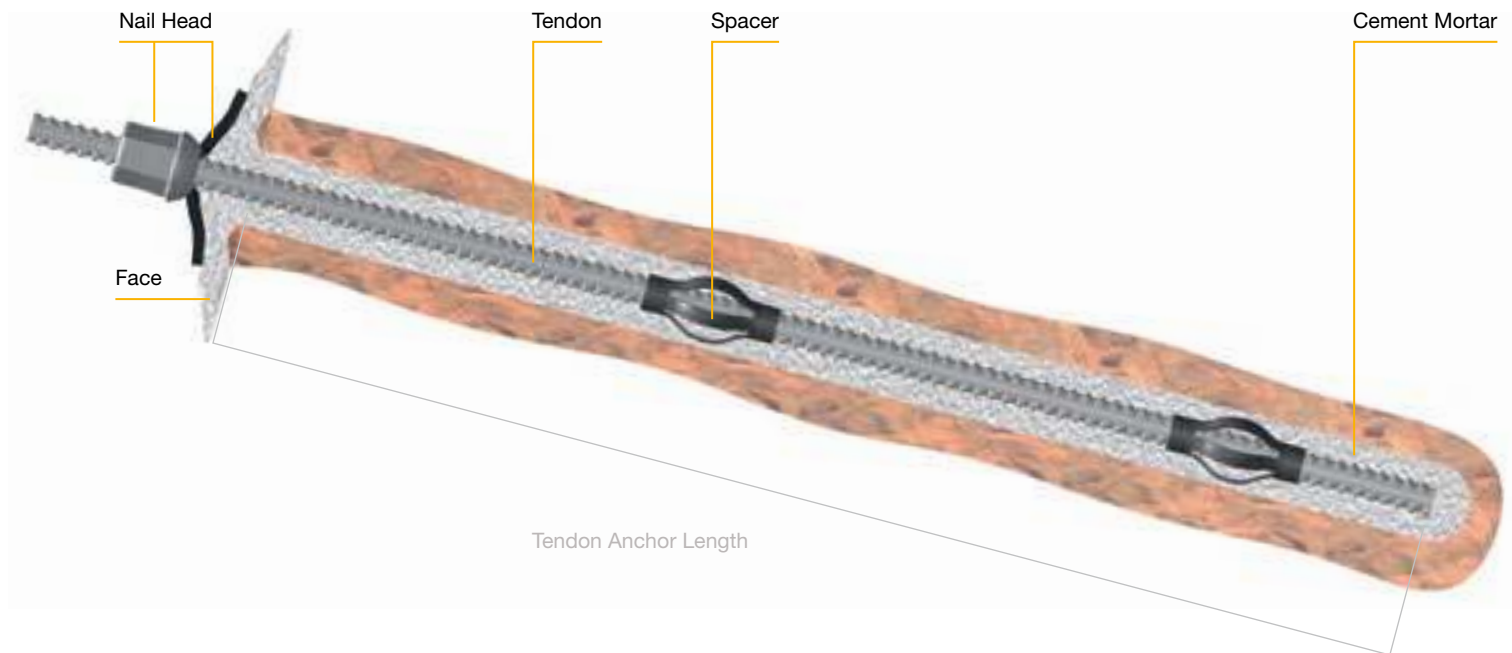
The load-bearing system significantly differs from ground anchors (actively tensioned) and tensile piles. In the case of soil nailing, the load-bearing capacity of the complete soil is increased because it is consolidated by the soil nails.

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 DIBt Z-20.1-106 / Approval Austria BMVIT-327.120/0022-II/ST2/2006

## DYWIDAG Soil Nails

### Technical Data

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

Nominal diameter $\varnothing$	Yield strength / tensile strength $f_{0,2k}/f_{tk}$	Cross- sectional area <b>A</b>	Load at yield <b>F<sub>yk</sub></b>	Ultimate load <b>F<sub>tk</sub></b>	Weight	Weight DCP	Approval
[mm]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
16	500/550	201	101	111	1.58	5.2	○
20	500/550	314	157	173	2.47	5.9	○
25	500/550	491	245	270	3.85	7.0	○
28	500/550	616	308	339	4.83	8.6	○
32	500/550	804	402	442	6.31	9.5	○
40	500/550	1,257	628	691	9.86	13.6	○
50	500/550	1,963	982	1,080	15.41	21.0	○
63.5	555/700	3,167	1,758	2,217	24.86	32.4	○

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

Nominal diameter $\varnothing$	Yield strength / tensile strength $f_{0,2k}/f_{tk}$	Cross- sectional area <b>A</b>	Load at yield <b>F<sub>yk</sub></b>	Ultimate load <b>F<sub>tk</sub></b>	Weight	Weight DCP	Approval
[mm]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
18	670/800	254	170	204	2.00	5.4	×
22	670/800	380	255	304	2.98	6.5	×
25	670/800	491	329	393	3.85	7.0	×
28	670/800	616	413	493	4.83	8.6	×
30	670/800	707	474	565	5.55	9.0	×
35	670/800	962	645	770	7.55	11.3	×
43	670/800	1,452	973	1,162	11.40	15.8	×
57.5	670/800	2,597	1,740	2,077	20.38	30.0	×
63.5	670/800	3,167	2,122	2,534	24.86	32.4	×
75	670/800	4,418	2,960	3,534	34.68	43.5	×

#### DYWIDAG Prestressing Steel Rock Bolts

Nominal diameter $\varnothing$	Yield strength / tensile strength $f_{0,1k}/f_{pk}$	Cross- sectional area <b>A</b>	Load at yield <b>F<sub>p0,1k</sub></b>	Ultimate load <b>F<sub>pk</sub></b>	Weight	Weight DCP	Approval
[mm]	[N/mm <sup>2</sup> ]	[mm <sup>2</sup> ]	[kN]	[kN]	[kg/m]	[kg/m]	
15	900/1.100	177	159	195	1.39	–	
26.5	950/1.050	552	525	580	4.48	7.4	△
32	950/1.050	804	760	845	6.53	9.8	△

- Germany: Z-20.1-106 DYWIDAG Soil Nailing System  
 × Austria: BMVIT-327.120/0022-II/ST 2/ GEWI® Plus Soil Nail  
 △ Germany: Z-20.1-17 Permanent DYWIDAG Bar Anchor

#### Additional Information

German Approval DIBt Z-20.1-106 / Austrian Approval BMVIT-327.120/0022-II/ST2/2006



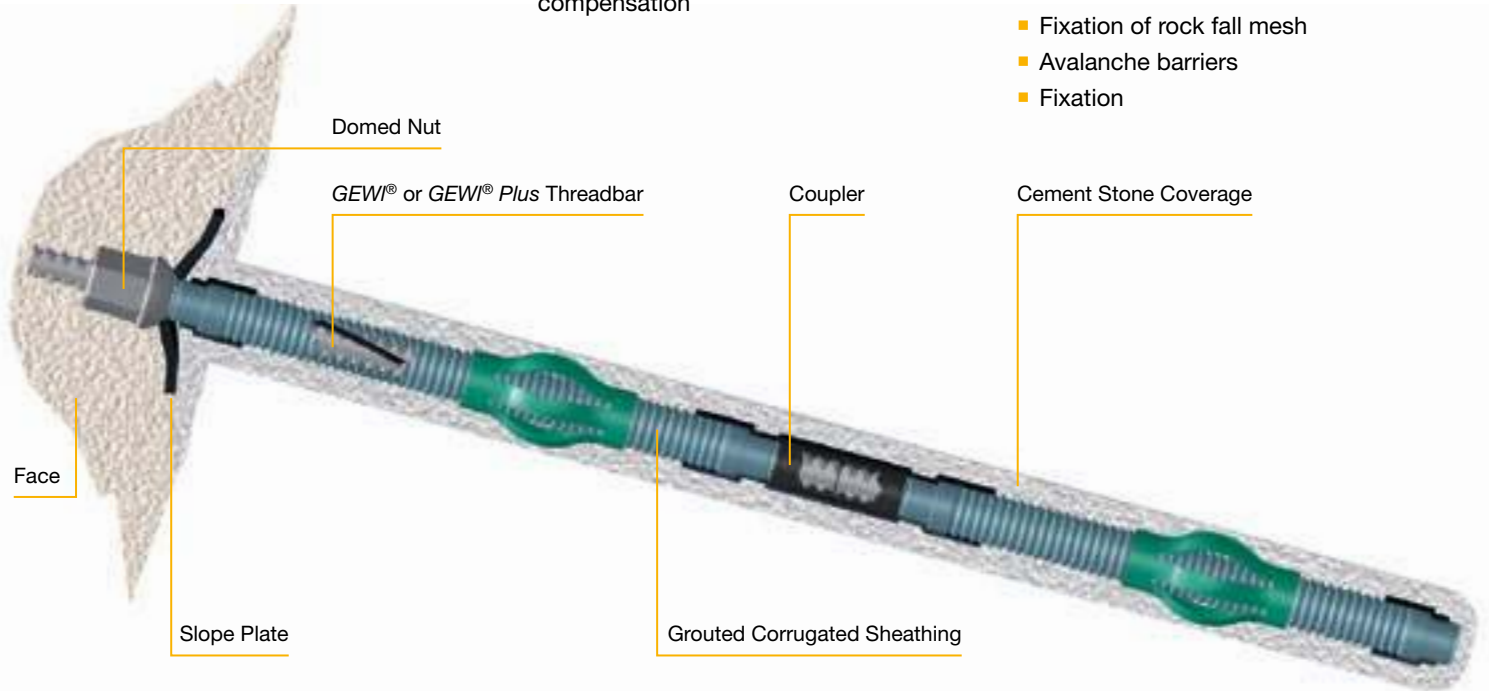
# DYWIDAG Soil Nails

## 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 shotcreting 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

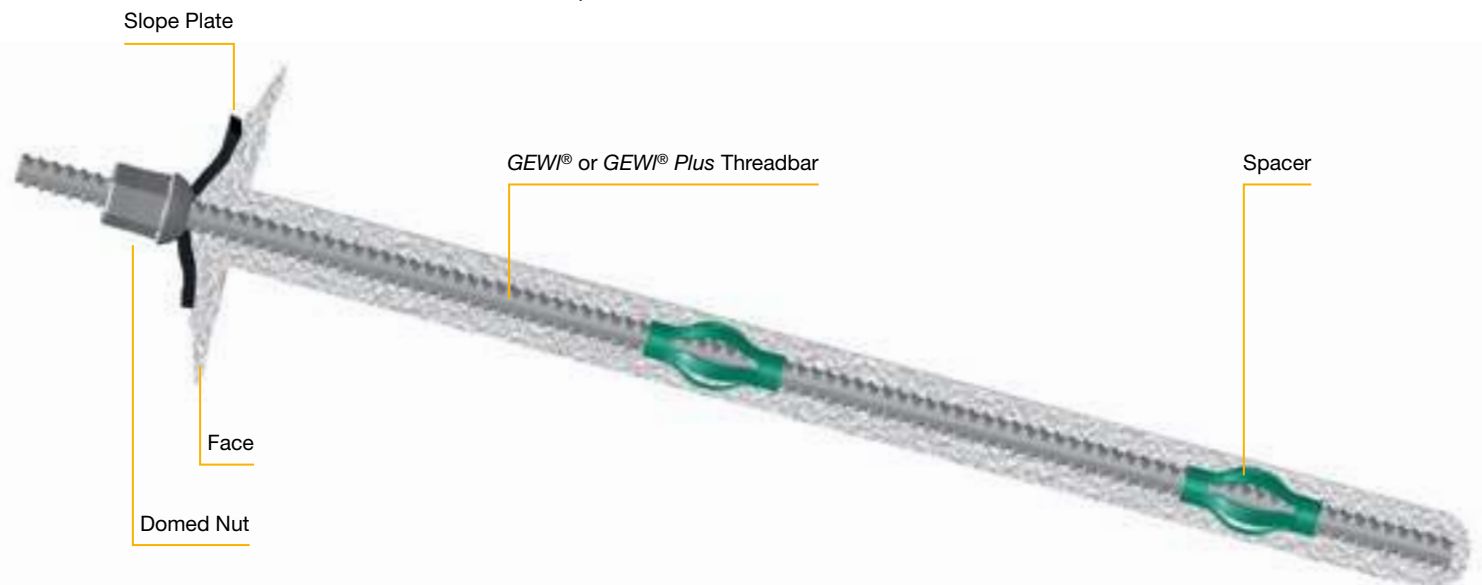


## Short Term Soil Nail / Temporary Soil Nail

- 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 shotcreting 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-20.1-106 / Austrian Approval BMVIT-327.120/0022-II/ST2/2006

## Summer Holidays without Traffic Jams: DYWIDAG Systems stabilize Autostrada Adriatica, Italy



**i** **Owner** Autostrade per l'Italia Spa, Italy +++ **Contractor** Pentapoli S.c.a.r.l. – Imola, Italy +++ **Consulting Engineer** SPEA Ingegneria Europe, Italy  
**DSI Unit** DYWIT S.P.A., Italy  
**DYWIT Services** Production, Supply and Technical Support  
**DYWIT Products** double corrosion protected  $\varnothing$  26.5mm DYWIDAG Soil Nails;  $\varnothing$  36 and 40mm DYWIDAG Bar Anchors; rental of equipment

## Brenner Expressway - Slope Protection using Double Corrosion Protected GEWI® Soil Nails, Austria



**i** **Owner** ASFINAG, Austria +++ **Main Contractor** Grund- Pfahl und Sonderbau GmbH, Austria  
**DSI Unit** DYWIDAG-Systems International GmbH, Austria  
**DSI Services** Production and Supply  
**DSI Products supplied** 12,000m, permanent GEWI® Soil Nails with double corrosion protection; 400 pcs. in lengths varying from 25 to 38m

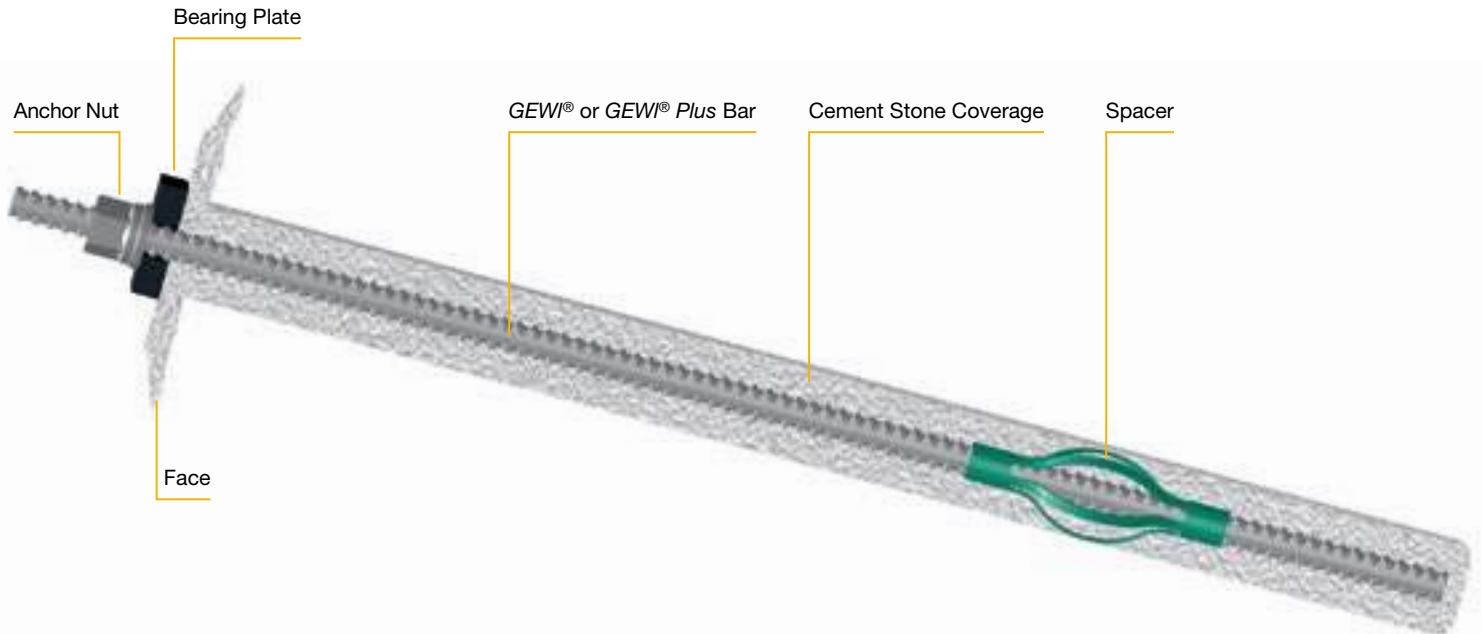
# DYWIDAG Rock Bolts

## SN Anchors / Fully Grouted Rock Bolt

- Steel tendon is grouted along its entire length
- Galvanized version available
- Excellent force / borehole ratio

## Fields of Application

- Ground support
- Rock stabilization
- Anchorages in rock
- Rock and soil

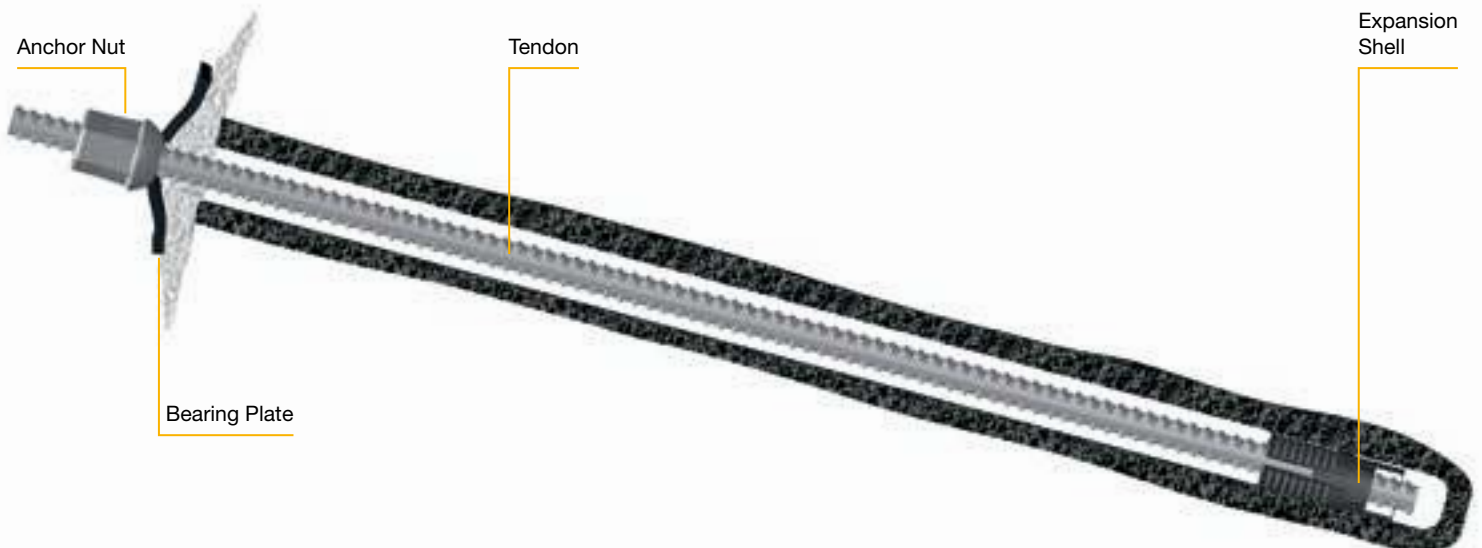


## Expansion Shell Anchors / Rock Bolts with Expansion Shell

- Extremely fast and easy installation
- Immediate load bearing capacity in the borehole
- Galvanized version available
- Retensionable
- Various angle compensation designs available
- Posterior grouting is possible – increased load bearing capacity and durability

## Fields of Application

- Face bolts
- Ground support
- Roof support
- Medium hard to hard rock
- Potash and salt



## Additional Information

German Approval DIBt Z-20.1-106 / Austrian Approval BMVIT-327.120/0022-II/ST2/2006



## Rock Face Stabilized using GEWI® Rock Bolts, France



**i** **Owner** City of Marseille, France +++ **General Contractor** SIMECO, Simiane Collongue, France

**DSI Unit** DSI-Artéon, France

**DSI Services** Supply

**DSI Products supplied** 455, GEWI® Rock Bolts incl. accessories; 1,600m<sup>2</sup>, of protective mesh; 1,000m, of strand

## New York Step-Street Stabilized Using GEWI® Rock Bolts, USA



**i** **Owner** City of New York, Department of Design and Construction, USA +++ **General Contractor** LAWS Construction, Pleasantville, USA +++ **Contractor** JANOD Construction Inc., USA +++ **Engineers** Langan Engineering & Environmental Services, USA

**DSI Unit** DYWIDAG-Systems International USA Inc., USA

**DSI Services** Supply

**DSI Products supplied** #8 grade 75: S 520/690N/mm<sup>2</sup> epoxy-coated GEWI® Rock Bolts incl. accessories: hex nuts, eyebolts and anchor plates

# DYWI® Drill Hollow Bar System

## Basic Concept

The DYWI® Drill Hollow Bar System combines the geotechnical load-bearing system with the creation of a borehole. Thanks to the self-drilling hollow bar system with simultaneous grout flushing, the installation procedure can be decisively eased and shortened.

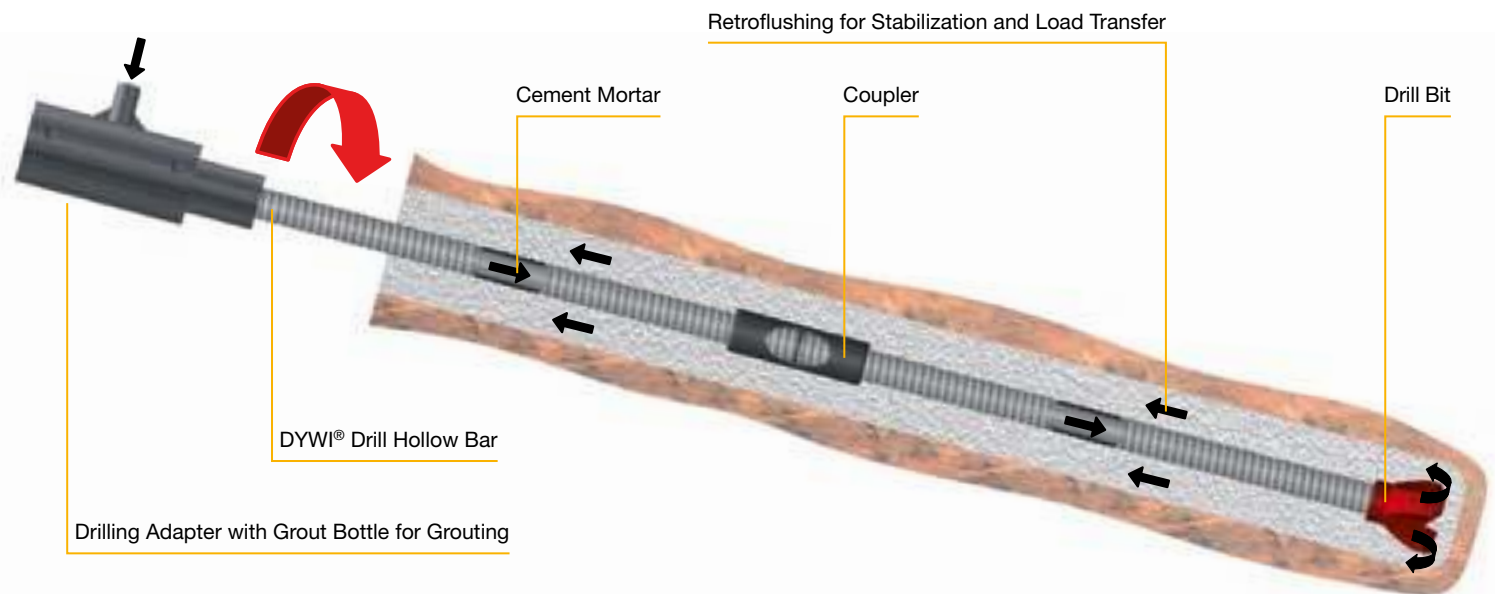
The DYWI® Drill Hollow Bar serves as a drill rod. It is fitted with a lost drill bit at the top that can be adapted to different soil conditions. After each single section of 1 to 6m, the subsequent bar is coupled to the previously installed segment.

At the final stage of drilling, cement mortar is injected into the hollow core of the bar using an injection adapter that is mounted at the drilling unit. The cement mortar exits at the bottom end through the flushing opening in the drill bit. The grout flushing simultaneously serves as slurry to stabilize the borehole and ensures the efficient retroflush of the borehole cuttings.

Once the required installation length has been reached, the grouting unit is switched to grouting mortar because it reaches higher compression strengths and thus ensures better load-bearing capacities. The hollow bar now serves as a steel tendon and can be used both as a soil nail or rock bolt and as a micropile.

DYWI® Drill Hollow Bars are produced in-house in our Center of Competence for Hollow Bars (Pasching, Austria).

The comprehensive DYWI® Drill Hollow Bar System product range offers tendons with ultimate loads from 210kN to 1,900kN including all system components such as drill bits for all soil conditions, couplers, spacers and anchor heads. Additional installation tools such as injection adapters or mortar mixers / pumps are constantly on stock or can be adapted and produced customized or adjusted to job site requirements on short notice.



## Fields of Application

- Slope, embankment and rock stabilization
- Excavations without special requirements
- Fixation of rock fall mesh
- Avalanche barriers
- Foundation
- Baseplates

## Key Features

- The tendon simultaneously serves as a drill rod
- Extremely fast installation because borehole drilling is made redundant by simultaneous drilling and grouting
- Compact equipment – space saving installation
- Drill bits are available for all varieties of soil and rock
- Can be used as a nail or a pile – many head varieties are available

## Additional Information

German Approval DIBt Z-14.4-674 and Z-34.13-208 / Austrian Approval BMVIT-327.120/0010-IV/ST2/2012 / European Approval ETA-12/0603

# DYWI® Drill Hollow Bar System

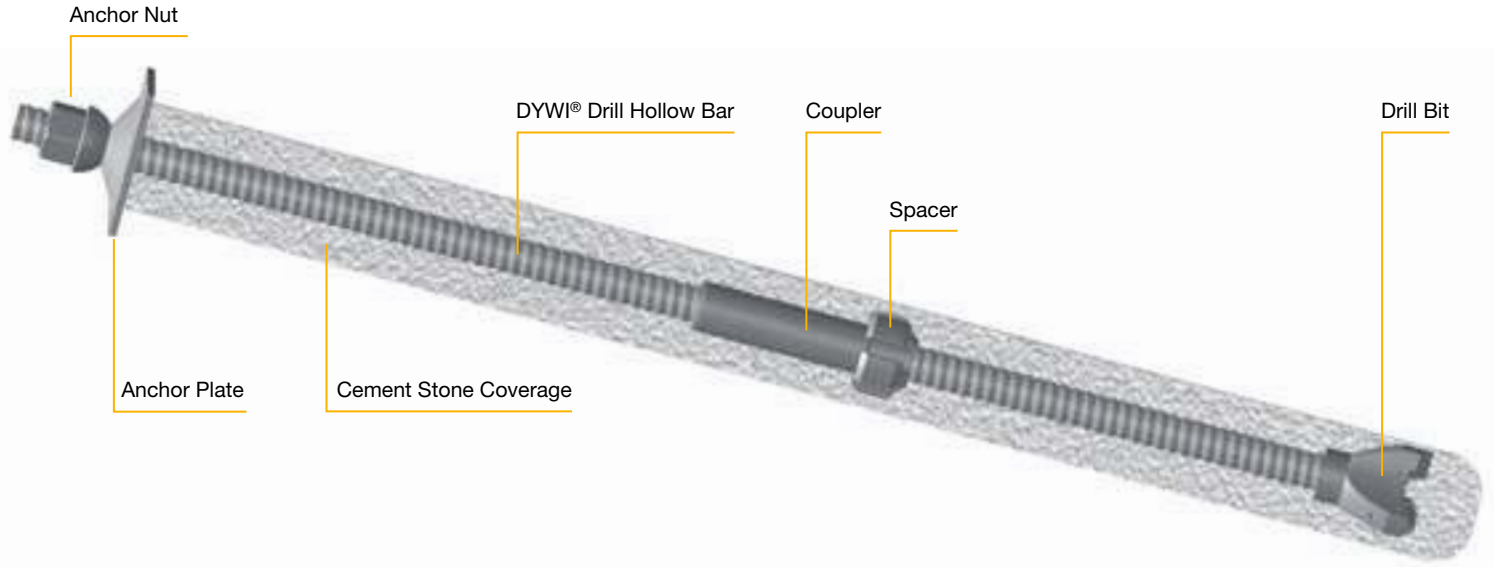
## Short Term Bolt / Temporary Bolt

### Short Term Bolt with Extended Service Life / Semi Permanent Bolt

- Temporary use of up to two years
- Extended use of up to 50 years after prior agreement of involved experts
- Galvanized design and Duplex Coating available
- Combination with different slope faces such as shotcreting construction, precast concrete elements, mesh or sheet pile walls
- Spacers center the nail inside the borehole and ensure sufficient coverage
- Several varieties are available for angle compensation

## Fields of Application

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



## Technical Data

Type	Cross-sectional area	Load at yield	Ultimate load	Weight	Approval
	A [mm <sup>2</sup> ]	F <sub>yk</sub> [kN]	F <sub>tk</sub> [kN]		
R32-210 (R32L)	340	160	210	2.65	○ × △
R32-250	370	190	250	2.90	○ × △
R32-280 (R32N)	410	220	280	3.20	○ × △
R32-320	470	250	320	3.70	○ × △
R32-360 (R32S)	510	280	360	4.00	○ × △
R32-400	560	330	400	4.40	○ × △
R38-420	660	350	420	5.15	○ × △
R38-500 (R38N)	750	400	500	5.85	○ × △
R38-550	800	450	550	6.25	○ × △
R51-550 (R51L)	890	450	550	6.95	○ × △
R51-660	970	540	660	7.65	○ × △
R51-800 (R51N)	1,150	640	800	9.00	○ × △
T76-1200 (T76L)	1,610	1,000	1,200	12.60	
T76-1600 (T76N)	1,990	1,200	1,600	15.60	
T76-1900 (T76S)	2,360	1,500	1,900	18.50	

Lengths of delivery L = 2/3/4/6m

- Germany: Z-14.4-674 & Z-34.13-208
- × Austria: BMVIT-327.120/0010-IV/ST2/2012
- △ Europe: ETA-12/0603

## Additional Information

German Approval DIBt Z-14.4-674 und Z-34.13-208 / Austrian Approval BMVIT-327.120/0010-IV/ST2/2012 / European Approval ETA-12/0603



## Hollow Bars stabilize motorway construction near Porth, South Wales, Great Britain



**Owner** Highways Agency, Great Britain +++ **General Contractor** Costain, Great Britain +++ **Engineers** Arup, Great Britain +++  
**Installation Subcontractor** Systems Geotechnique Ltd., Great Britain

**i** **DSI Unit** DYWIDAG-Systems International Ltd., Great Britain  
**DSI Scope** Supply  
**DSI Products supplied** 746 pcs., galvanized DYWI® Drill Soil Nails Type R25N, R32N and R32S in lengths varying from 4 to 7m

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## Widening of the M1: Largest Soil Nailing Project in Great Britain



**Owner** UK Highways Agency, Great Britain +++ **Engineers** URS Scot Wilson, Great Britain +++ **General Contractor** JV Costain Carillion, consisting of Costain Group, PLC and Carillion PLC, both Great Britain +++ **Drilling Contractor** Bachy Soletanche Carillion Piling JV, consisting of Bachy Soletanche Limited and Carillion PLC, both Great Britain

**i** **DSI Unit** DYWIDAG-Systems International Ltd., Great Britain  
**DSI Services** Production, Supply, Test Installation and Technical Support  
**DSI Products supplied** 17,000, Type R38 DYWI® Drill Hollow Bar Soil Nails, Ø 25mm GEWI® Soil Nails

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## Vienna's new Central Station: DSI Austria contributes to Increased Mobility, Austria



**i** **Owner** ÖBB (Federal Austrian Railway), Austria +++ **General Contractor** Grund- Pfahl- und Sonderbau GmbH and Porr GmbH, both Austria  
**DSI Unit** DYWIDAG-Systems International GmbH, Austria  
**DSI Services** Supply  
**DSI Products supplied** approx. 10,000, Type R32 DYWI® Drill Hollow Bar Anchors with accessories

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## DYWI® Drill Anchors Stabilize Spectacular Tunneling Project in Lima: Vía Parque Rímac, Peru



**i** **Owner** Municipalidad Metropolitana de Lima, Peru +++ **Client** Linea Amarilla S.A.C. (LAMSAC), Peru +++ **General Contractor** Constructora OAS Ltda., Peru +++ **Subcontractor** Geotechnics Mota-Engil Perú S.A., Peru  
**DSI Unit** DSI Peru S.A.C., Peru  
**DSI Services** Production and Supply  
**DSI Products supplied** 62,000m, Type R51 DYWI® Drill Anchors

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## DYWI® Drill Hollow Bars Secure the Future of Granary Island in Gdansk, Poland



**Owner** City of Gdansk, Poland +++ **General Contractor** Budimex S.A., Poland +++ **Contractor Drilling** AEnergopol Szczecin S.A., Poland +++  
**Installation Subcontractor** Systems Geotechnique Ltd., Great Britain



**DSI Unit** DYWIDAG-Systems International Sp. z o.o., Poland  
**DSI Scope** Production and Supply  
**DSI Products supplied** 1,036 pcs., Type T76-1200 DYWI® Drill Hollow Bar Anchors

## Replacement of Railway Bridges across the Waetern and Aller Rivers in Verden, Germany



**Owner** DB Netz AG Regionalbereich Nord, Germany +++ **General Contractor** Max Bögl Bauunternehmung GmbH & Co. KG, Germany +++  
**Contractor** Jähmig GmbH Felssicherung & Zaunbau, Germany



**DSI Unit** DYWIDAG-Systems International GmbH, BU Geotechnics, Germany  
**DSI Services** Production and Supply  
**DSI Products supplied** 210,200m, temporary Type R32-280 DYWI® Drill Soil Nails



## Chasing the World Record: New Ski Jump in Planica, Slovenia



**Owner** Zavod za šport RS Planica, Slovenia +++ **General Contractor** Gradbeni Holding – GH D.D., Sloveniaa +++ **Subcontractor** MINERVO D.D., Slovenia



**DSI Unit** DYWIDAG-Systems International GmbH, Austria  
**DSI Services** Production and Supply  
**DSI Products supplied** Type R32, 250kN DYWI® Drill Hollow Bar Anchors and system accessories

## DSI supplies DYWI® Drill Hollow Bars for new Transportation Corridor, Canada



**Owner** Government of British Columbia, Canada +++ **General Contractor** Fraser Transportation Group (FTG), Canada +++ **Subcontractor** Vancouver Shotcrete & Shoring Inc. / Belpacific Excavating & Shoring Limited Partnership, both Canada +++ **Consulting Engineers** Stantec Inc., Canada



**DSI Unit** DYWIDAG-Systems International Canada Ltd., Western Division, Canada  
**DSI Services** Supply  
**DSI Products supplied** 13,000m, Type T40N/16 DYWI® Drill Hollow Bars; 10,800m, Type R38N DYWI® Drill Hollow Bars with accessories

# DYWIDAG Tie Rods

## Basic Concept

DYWIDAG Bar Systems are perfectly suitable for transferring tensile forces and can therefore be used as tie rods.

### Applications:

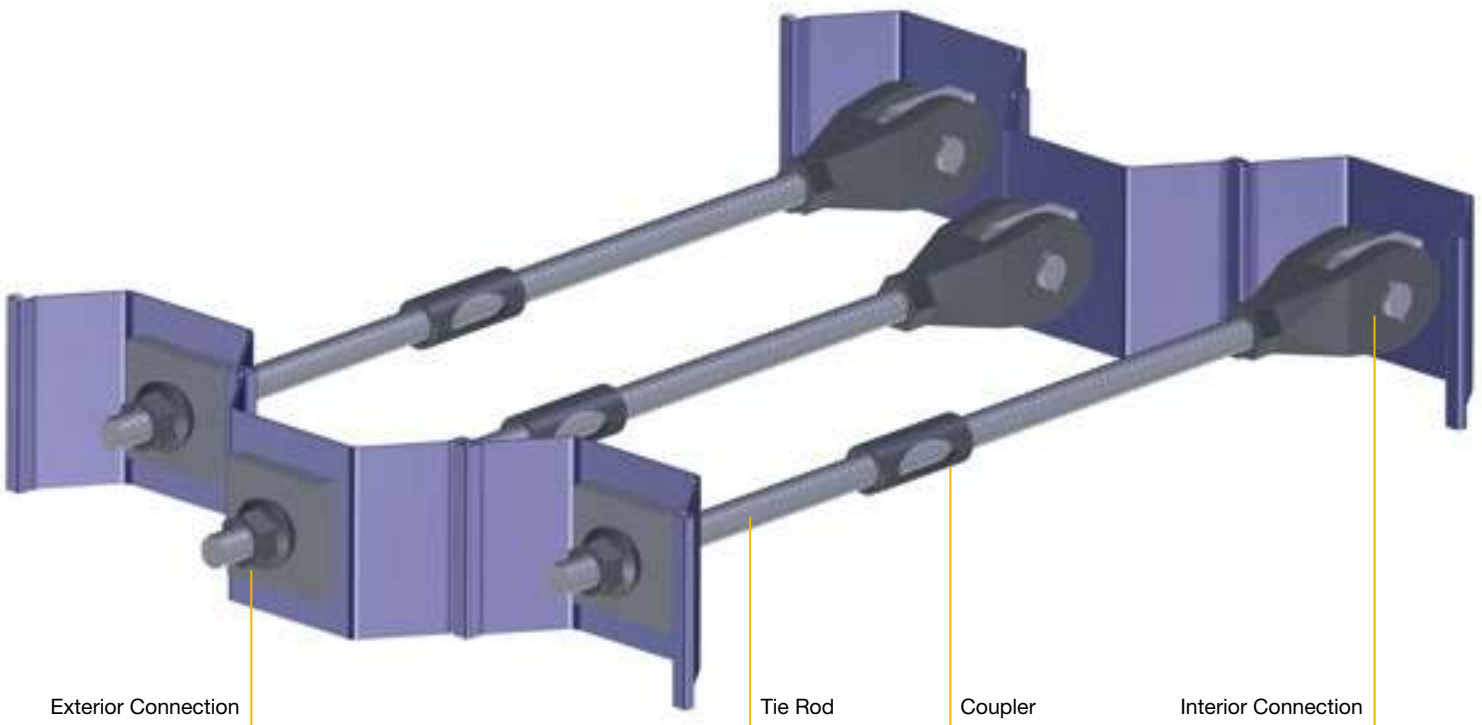
Sheet pile wall assembly in harbor and dam construction, cross-linkings, tying back walls in deadman structures, positional stability of joint connections, corner joints and foundations etc.

Due to the continuous *GEWI*® Thread, the bars can be cut, anchored, and coupled at any point and be adjusted to on-site requirements. This makes the system completely independent of installation conditions on site as well as of existing deviations or alterations.

Depending on requirements and steel grades, a variety of corrosion protection methods can be used. This includes loss of section (sacrificial corrosion), galvanizing and coating, wrapping as well as double corrosion protection for highest requirements.

The matching system is chosen in close cooperation with our system specialists and is prefabricated at our plants if necessary.

Special system solutions such as articulated connections, couplers or tensionable connections can be provided for anchoring and connecting DYWIDAG Bars to the structure that needs to be stabilized. Our Technical Service is able to provide prompt customized solutions for special installation situations such as limited working space.



## Fields of Application

- Harbor / quay construction
- Dam and ramp construction
- Bracings
- Tie rods
- Tie backs
- Positional stability

## Key Features

- The complete system features coarse *GEWI*® Thread that is suitable for on-site use
- *GEWI*® and *GEWI*® Plus steel grades are insensitive to embrittlement and stress corrosion cracking
- Various corrosion protection systems are applicable
- Comprehensive range of accessories for anchoring and coupling
- The system can be easily, quickly and safely adjusted to on-site conditions
- No limitation of installation tolerances
- Prestressing for deformation minimization
- Weldable bars and accessories
- Weight reduction of approx. 50% in comparison to S355 bars

## Additional Information

DYWIDAG Tie Rods Brochure

# DYWIDAG Tie Rods

## Corrosion Protection Systems

Our Sales and Technical Services teams will gladly support you in choosing a suitable corrosion protection system.

■ Double Corrosion Protection (DCP) in accordance with EN1537

- Shrinking with corrosion protection shrinking sleeves
- Wrapping with corrosion protection grease tape
- Epoxy-, PUR- or bitumen based coatings
- Hot-dip galvanizing
- Spray galvanizing
- Loss of section (sacrificial corrosion)

## Loss of Section in Accordance with EAU and DIN EN 14199 (Bar Diameter – Loss of Thickness in mm)

Aggressivity	Period of use		
	Short (up to 5 years)	Medium (50 years)	Long (100 years)
low	0.1	1	2
medium	0.2	2	–
high	1	–	–

## Technical Data

### GEWI® B500B & S555/700 Threadbar

Nominal diameter Ø [mm]	Yield strength / tensile strength f <sub>0,2k</sub> /f <sub>tk</sub> [N/mm <sup>2</sup> ]	Cross- sectional area A [mm <sup>2</sup> ]	Load at yield F <sub>yk</sub> [kN]	Ultimate load F <sub>tk</sub> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
16	500/550	201	101	111	1.58	5.2	○
20	500/550	314	157	173	2.47	5.9	○
25	500/550	491	245	270	3.85	7.0	○
28	500/550	616	308	339	4.83	8.6	○
32	500/550	804	402	442	6.31	9.5	○
40	500/550	1,257	628	691	9.86	13.6	○ X
50	500/550	1,963	982	1,080	15.41	21.0	○ X
63.5	555/700	3,167	1,758	2,217	24.86	32.4	○ X

### GEWI® Plus S670/800 Threadbar

Nominal diameter Ø [mm]	Yield strength / tensile strength f <sub>0,2k</sub> /f <sub>tk</sub> [N/mm <sup>2</sup> ]	Cross- sectional area A [mm <sup>2</sup> ]	Load at yield F <sub>yk</sub> [kN]	Ultimate load F <sub>tk</sub> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
18	670/800	254	170	204	2.00	5.4	△
22	670/800	380	255	304	2.98	6.5	△
25	670/800	491	329	393	3.85	7.0	△
28	670/800	616	413	493	4.83	8.6	△
30	670/800	707	474	565	5.55	9.0	△
35	670/800	962	645	770	7.55	11.3	△
43	670/800	1,452	973	1,162	11.40	15.8	△
57.5	670/800	2,597	1,740	2,077	20.38	30.0	△
63.5	670/800	3,167	2,122	2,534	24.86	32.4	△
75	670/800	4,418	2,960	3,534	34.68	43.5	△

## DYWIDAG Y1050H Prestressing Steel

Nominal diameter Ø [mm]	Yield strength / tensile strength f <sub>0,1k</sub> /f <sub>pk</sub> [N/mm <sup>2</sup> ]	Cross- sectional area A [mm <sup>2</sup> ]	Load at yield F <sub>p0,1k</sub> [kN]	Ultimate load F <sub>pk</sub> [kN]	Weight [kg/m]	Weight DCP [kg/m]	Approval
26.5	950/1,050	552	525	580	4.48	7.4	□ ◇
32	950/1,050	804	760	845	6.53	9.8	□ ◇
36	950/1,050	1,018	960	1,070	8.27	12.3	□ ◇
40	950/1,050	1,257	1,190	1,320	10.21	14.0	□ ◇
47	950/1,050	1,735	1,650	1,820	14.10	20.0	□ ◇

- Germany: DIBt Z-20.1-17
- × Germany: DIBt Z-34.11-225
- Germany: DIBt Z-1.5-76, Z-1.5-149, Z-1.5-2
- △ Austria: BMVIT-327.120/0034-II/ST2/2005
- ◇ Austria: BMVIT-327.120/0053-IV/ST2/2011

## Additional Information

DYWIDAG Tie Rods Brochure



# DYWIDAG Tie Rods

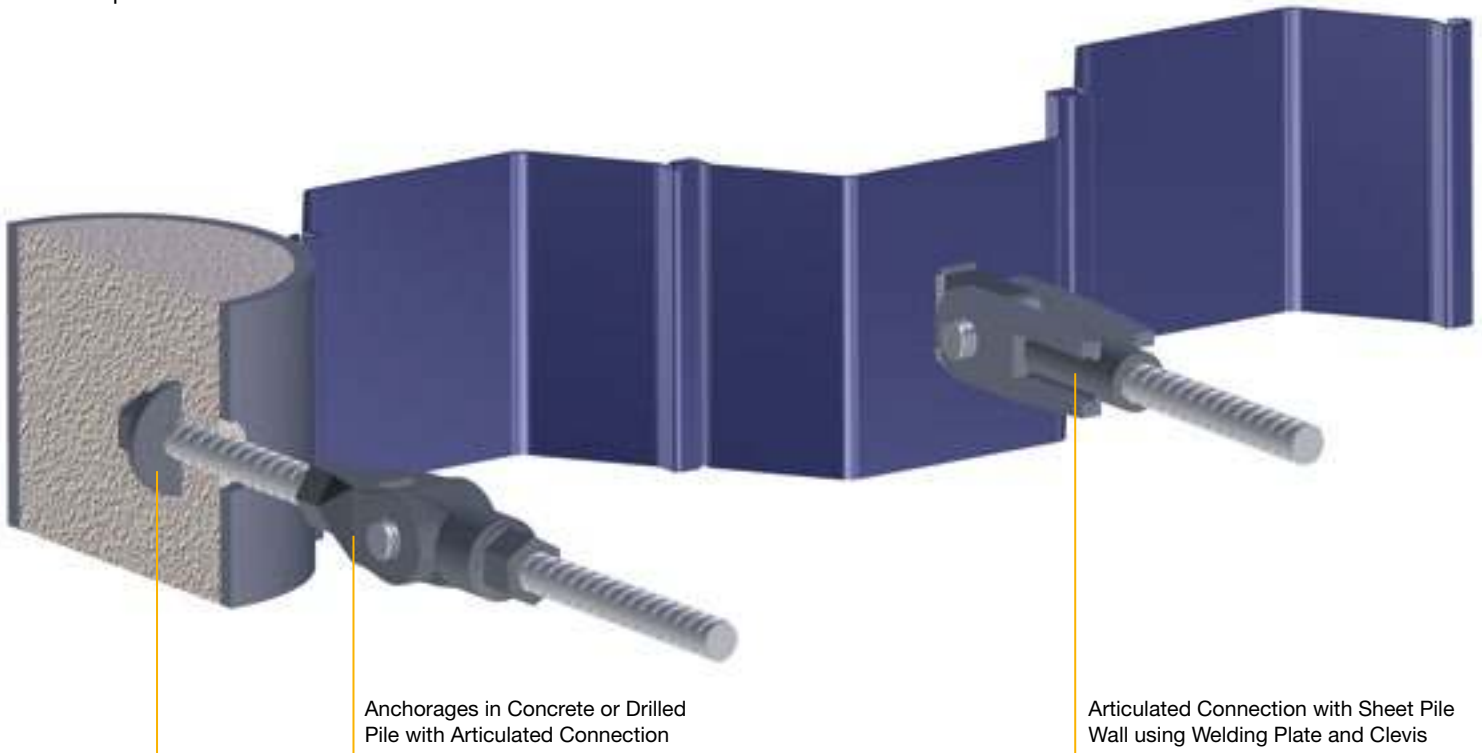
## Tie Rod Connections

Anchorage in different variations for steel and concrete structures

- Clevis connections
- Eye pieces
- Anchor pieces

- Articulated
- With angle compensation
- Self-aligning under load
- Tensionable
- Weldable

- Corrosion protected
- Counter-sunk
- Embedded in concrete



## Couplers and Connections

Many variations

- Coupler
- Turnbuckle
- Strap connector

- Articulated
- Double articulation
- With length compensation
- Fitting coupler

- Tensionable
- Weldable
- Corrosion protected



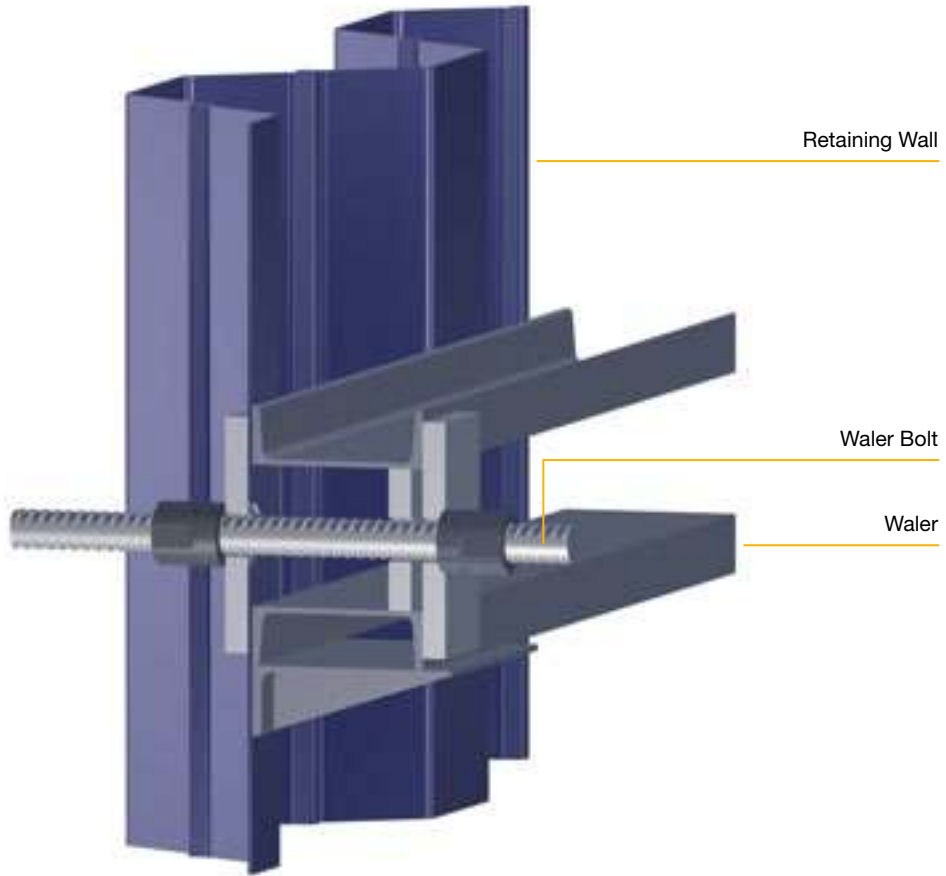
## Additional Information

DYWIDAG Tie Rods Brochure

# DYWIDAG Tie Rods

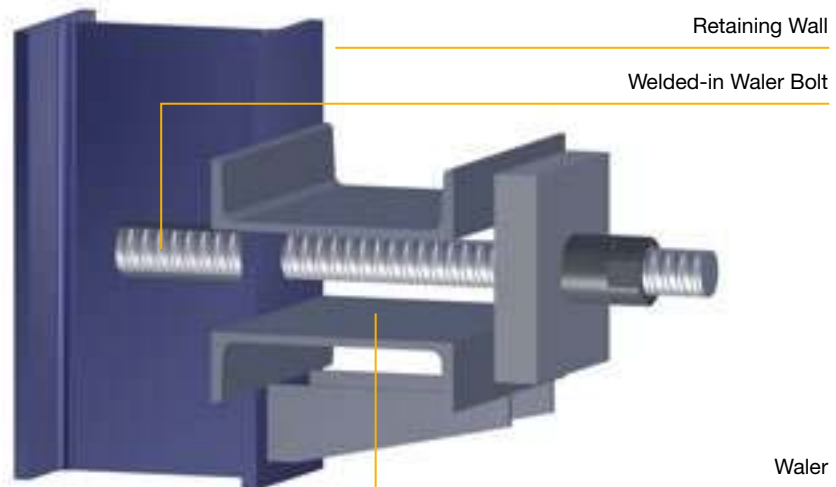
## Waler Bolt

- Replaceable
- Weldable
- Additional segments and systems can be connected using couplers
- With angle compensation
- Corrosion protected



## Welded-in Waler Bolt

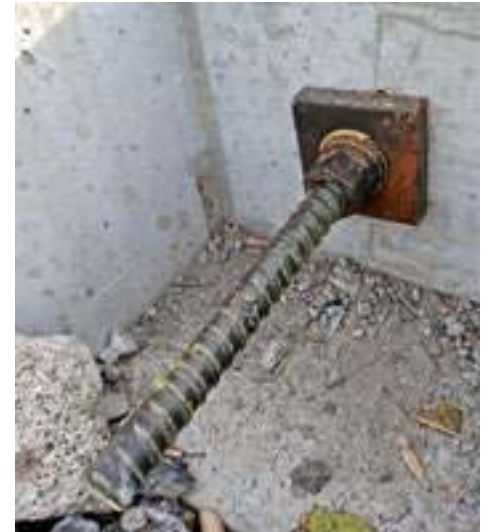
- Counter-sunk
- Inclined installation is possible
- Additional segments and systems can be connected using couplers
- Central load transfer on the center beam
- Easy and economical



## Additional Information

DYWIDAG Tie Rods Brochure

## Comfort and Design: The Marina d'Arechi, Italy



**i** Owner Gallozzi Group, Italy +++ General Contractor Impresa Pietro Cidonio S.p.A., Italy +++ Architect (Marina Buildings) Santiago Calatrava, Spain

**DSI Unit** DYWIT S.P.A., Italy

**DYWIT Services** Supply

**DYWIT Products** supplied 7,600m, double corrosion protected  $\varnothing$  50mm DYWIDAG Tie Rods made of GEWI® steel

## DYWIDAG Systems for US-American Base in Guam, Micronesia, USA



**i** Owner US Navy, Naval Base Guam, USA +++ General Contractor Black Construction Corporation, Guam, USA +++ Architect-Engineers Wilson Okamoto Corporation, Honolulu, Hawaii, USA

**DSI Unit** DYWIDAG-Systems International USA Inc., USA

**DSI Services** Supply

**DSI Products** supplied approx. 8,000m (26,000ft.), of Tie Rods with Polyken tape wrap



## GEWI® Tie Rods secure Sheet Piling for Quay Wall, Germany



**Owner** Hafententwicklungsgesellschaft Rostock mbH, Germany +++ **General Contractor** JV Erweiterung LP60 consisting of Bauer Spezialtiefbau GmbH, and Heinrich Hirdes GmbH, both Germany +++ **Engineers** INRS-LACKNER AG, Germany



**DSI Unit** DYWIDAG-Systems International GmbH, Germany

**DSI Services** Supply

**DSI Products supplied** 46. GEWI® Tie Rods, Ø63.5 mm in lengths varying from 20-40m including GEWI® couplers; 78 waler bolts made of Ø 63.5mm GEWI® Bars

## New Connecting Road in Sittingbourne enhances the Region's Economic Development, Great Britain



**Owner** Kent County Council, Great Britain +++ **Contractor** Jackson Civil Engineering Group Ltd., Great Britain +++ **Engineers** Jacobs Engineering Group Inc., Great Britain



**DSI Unit** DYWIDAG-Systems International Ltd., Great Britain

**DSI Services** Supply

**DSI Products supplied** Ø 63.5mm GEWI® Tie Bar; Clevis Connections

# The GEWI® System – Connecting Reinforcement

## Basic Concept

GEWI® reinforcing steel is B500B steel in accordance with DIN 488 with rolled-on thread on both sides forming a special left-hand thread along the entire bar length. The GEWI® System serves for coupling and anchoring these threadbars and has proven itself countless times during the last decades as an excellent connecting reinforcement on challenging jobsites.

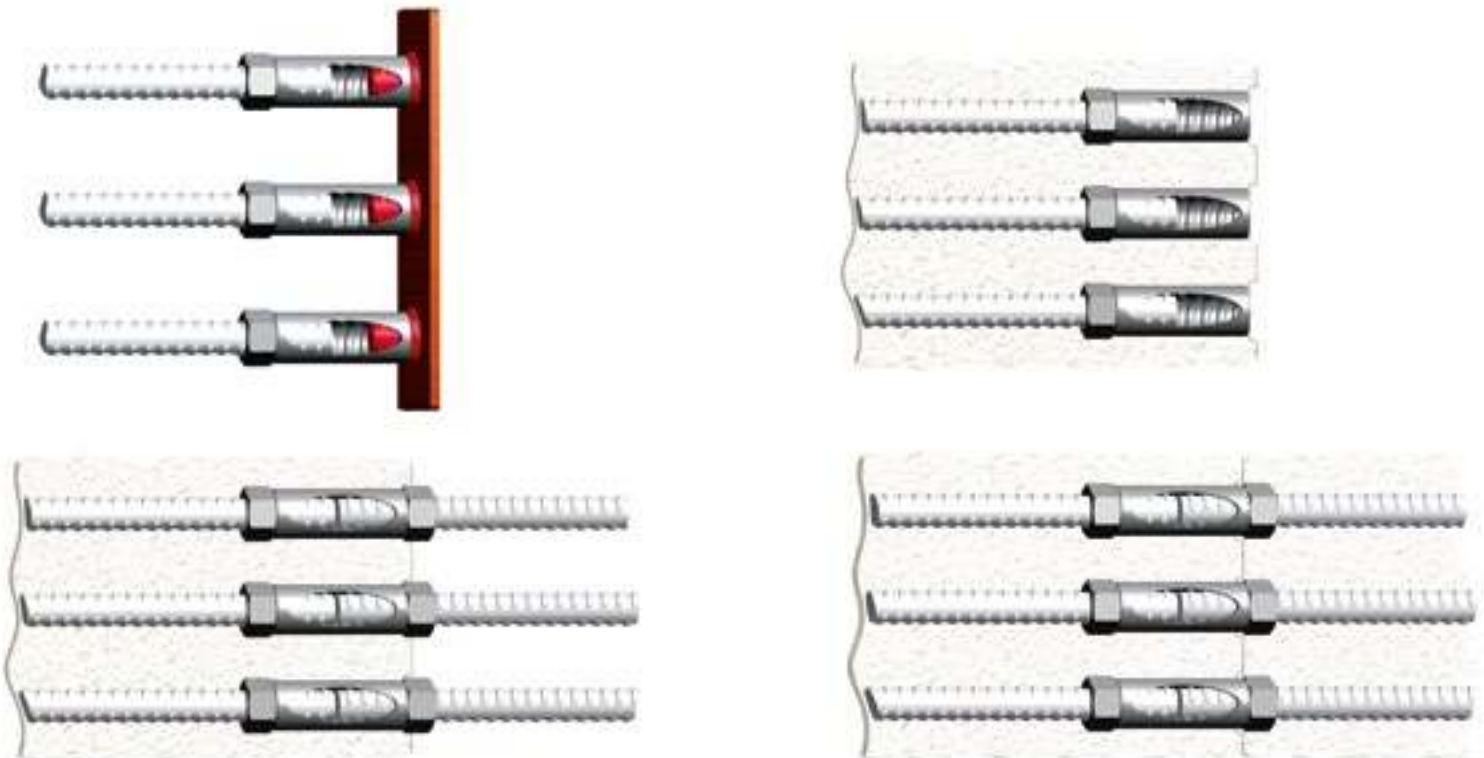
There is no need for using overlap connections and overlapping joints: GEWI® threaded reinforcing steel bars can be coupled directly and axially using couplers. The couplers are designed for transferring the calculational ultimate bar load with a safety factor of over 1.15 – all connections and design states can be realized as full joints independent of whether tensile, compression or alternating loads prevail.

Especially in heavily reinforced structural elements in which distances between individual reinforcing bars can be a problem, the GEWI® System offers major advantages. Areas with double bar levels are no longer necessary and larger passageways for inserting vibrators and pouring the concrete mix are created so that the concrete quality is enhanced.

The GEWI® System also achieves excellent results in the end anchorage area: The anchor lengths of the reinforcing bars can be reduced to a minimum using anchor pieces and plate anchorages, which significantly decreases the amount of steel and concrete that is needed.

Thanks to the coarse and extremely robust GEWI® Thread, GEWI® Threadbars are perfectly suitable for on-site use and can even be screwed when extremely dirty – the same applies to GEWI® nuts.

In the course of time, the GEWI® System has been continuously developed and optimized – a large range of products is available for almost any kind of application.



## Fields of Application

- Connecting reinforcement
- Challenging coupling solutions
- Civil engineering
- Construction of power plants

## Key Features

- Threadbars with proven coarse GEWI® Thread that is suitable for on-site use – screwable even under extreme conditions
- Thread along the entire length; lengths can be flexibly adjusted on site
- Easy application – thread does not have to be cut on site
- Sufficient coverage can be easily achieved
- Only little space is required during installation
- There is no increase in reinforcement ratio in the connection and anchorage zones
- Approved by the building authorities

## Additional Information

German Approvals DIBt Z-1.5-76 (Ø 12-32) and Z-1.5-149 (Ø 40-50)

# The GEWI® System – Connecting Reinforcement

## Technical Data

### GEWI® B500B Reinforcing Steel Threadbar

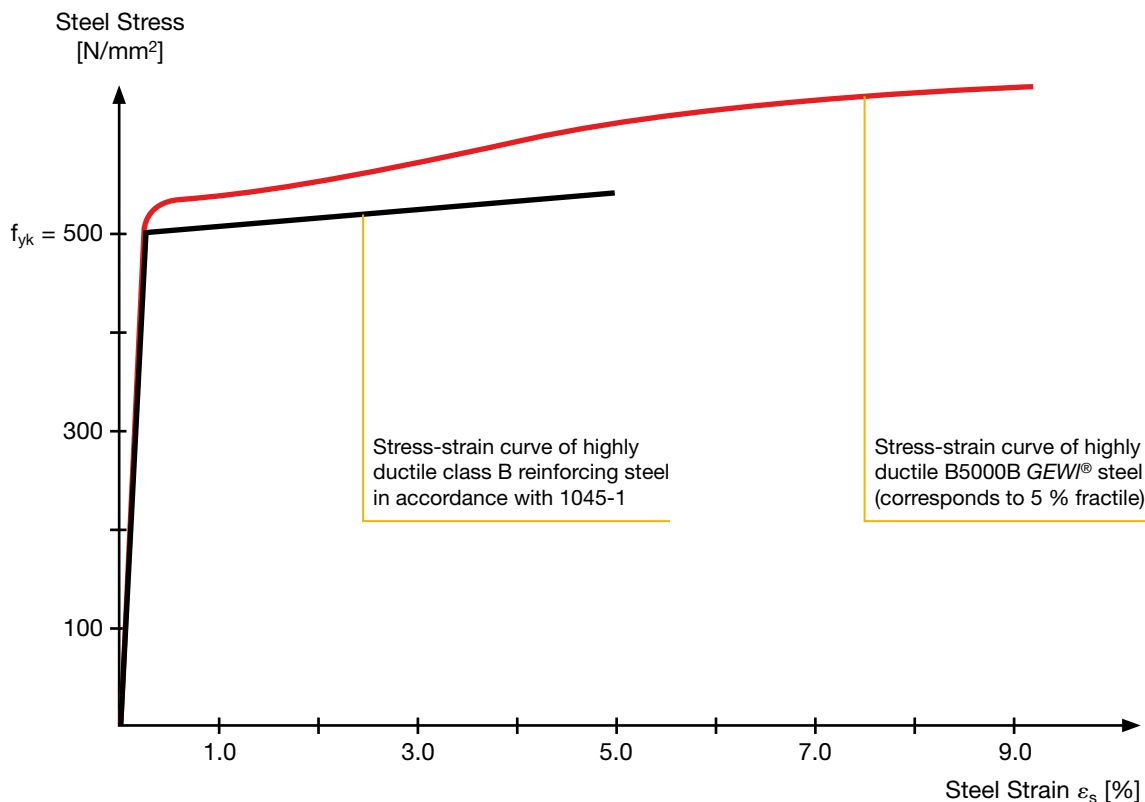
Nominal diameter $\varnothing$ [mm]	Yield strength / tensile strength $f_{0,2k}/f_{tk}$ [N/mm <sup>2</sup> ]	Cross- sectional area <b>A</b> [mm <sup>2</sup> ]	Load at yield <b>F<sub>yk</sub></b> [kN]	Ultimate load <b>F<sub>tk</sub></b> [kN]	Weight [kg/m]	Approval
12	500/550	113	57	62	0.89	○
16	500/550	201	101	111	1.58	○
20	500/550	314	157	173	2.47	○
25	500/550	491	245	270	3.85	○
28	500/550	616	308	339	4.83	○
32	500/550	804	402	442	6.31	○
40	500/550	1,257	628	691	9.86	×
50	500/550	1,963	982	1,080	15.41	×

○ Germany: DIBt Z-1.5-76  
 × Germany: DIBt Z-1.5-149

Thanks to excellent characteristics, the GEWI® Threadbar can be classified as a highly ductile bar (class B) in accordance with DIN 1045. It also fulfills all DIN EN 1992 (EC2) requirements.

The diagram shows that GEWI® Threadbars clearly exceed the requirements for standard reinforcing steel.

GEWI® accessories cover all common solid construction connections and anchorage systems. The required equipment such as equipment for countering coupler connections and end anchorages is detailed in the equipment section (see page 55).



## Additional Information

German Approvals DIBt Z-1.5-76 ( $\varnothing$  12-32) and Z-1.5-149 ( $\varnothing$  40-50)



# The FLIMU® System – Connecting Reinforcement

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## Basic Concept

The extruded coupler splice – respectively, the FLIMU® system – has been developed especially for realizing reinforcing connections in large numbers or very limited space conditions.

When realizing a FLIMU® coupler splice, two reinforcing bars are connected by extruding a coupler that has been placed onto both ends of the reinforcing bars. A reducing ring is pushed over the coupler using a high amount of pressure.

The reducing ring significantly reduces the exterior diameter of the coupler and creates a force fit connection between rebar and coupler (extrusion process).

Both B500 reinforcing steel with normal threads in accordance with DIN 488 and GEWI® reinforcing steel threadbar can be spliced using the FLIMU® system. This way, even reinforcing bars that have already been installed can be easily coupled to a GEWI® connecting bar.

The FLIMU® system is also suitable for many similar reinforcing steel bars such as Austrian ARI and ARI-G. Suitability tests can be performed for special applications.

The corresponding extruding equipment has been kept slim on purpose in order to ensure an economic realization of the connections in very limited space and in areas with tight reinforcement layers. Up to 30 connections per hour are possible if installation is done professionally by trained personnel.



## Fields of Application

- Connecting reinforcement
- Challenging coupling solutions
- Civil engineering

## Key Features

- Bars do not have to be screwed
- Preliminary work at the bars is not required
- High installation performance
- Both threadbars and GEWI® reinforcing bars can be coupled
- Space-saving installation – also for multilayer reinforcement
- The complete equipment and installation aids are on stock
- General building-authority approval for Ø 12 to 32mm

## Additional Information

German Approval DIBt Z-1.5-150

# The FLIMU® System – Connecting Reinforcement

## Technical Data

### FLIMU® System for B500 & GEWI® and ARI & ARI-G Reinforcing Steel

Nominal diameter $\varnothing$ [mm]	Yield strength / tensile strength $f_{0,2k}/f_{tk}$ [N/mm <sup>2</sup> ]	Cross- sectional area <b>A</b> [mm <sup>2</sup> ]	Load at yield <b>F<sub>yk</sub></b> [kN]	Ultimate load <b>F<sub>tk</sub></b> [kN]	Weight [kg/m]	Approval
16	500/550 (D) 550/620 (A)	201	101	111	1.58	○ ×
20		314	157	173	2.47	○ ×
25		491	245	270	3.85	○ ×
28		616	308	339	4.83	○ ×
32		804	402	442	6.31	○ ×
40		1,257	628	691	9.86	×
50		1,963	982	1,080	15.41	×

○ Germany: DIBt Z-1.5-150  
 × Austria: BMVIT 860.300/25-VI/7/92

## Overview Extruders

Extruder	Standard equipment for GEWI® Bars $\varnothing$ [mm]	Hydraulic power unit	Weight [kg]
Type 150	16 - 20	77-159	43
Type 250	16 - 28	77-159	75
Type 420	25 - 32	R13.3	206
Type 550	32 - 40	R13.3	225
Type 1000	50	R13.3	740



## Additional Information

German Approval DIBt Z-1.5-150



## FLIMU® System Convinces by Cost Effectiveness: Mittlerer Ring, Munich, Germany



Easy Application – simple Installation



Extruder in Use



High Installation Performance





On-site Service



Robust Equipment



Usable even in extremely tight Reinforcement Layers



Special Balancer in Use



Usable in rough Conditions

**Owner** Landeshauptstadt München, Baureferat, Germany +++ **General Contractor** Joint Venture Ingenieurbau LKP, Germany +++ **Contractor** W&F (Wayss & Freytag Ingenieurbau AG); Berger Bau, both Germany +++ **Architect** Baureferat München, HA Tiefbau und HA Ingenieurbau, Germany



**DSI Unit** DYWIDAG-Systems International GmbH, BU Geotechnics, Germany

**DSI Services** Production and Supply

**DSI Products supplied** approx. 35,000, Ø28mm FLIMU® couplers; approx. 20,000, Ø 32mm FLIMU® couplers; rental of equipment

## DYWIDAG Jacks

DYWIDAG Jacks are characterized by their robustness and multiple applications. Thanks to different interchangeable parts, the jacks can be adapted to different sizes of tendons. DYWIDAG Jacks are made of high-strength construction materials (steel and / or aluminum alloy).

The sealing and slide faces are precision finished, surface hardened and hard chrome plated. The exterior of the equipment is chromed or galvanized for protection against atmospheric influence. Consequently, all prerequisites for a long service life are fulfilled.

DYWIDAG Equipment is characterized by its robust design and has proven itself for decades in rough on-site use. In our internal workshop, the equipment is assembled, regularly maintained, checked and repaired quickly and economically if needed. Our high standards with regards to material, manufacturing quality and practicable application always ensure the availability of appropriate equipment at the right place.

Post-tensioning jacks are used for tensioning strands and bar anchors, tightening tie rods or carrying out test loads or proof tests on anchors, piles and nails. They are equipped with the matching mounting parts for each application.

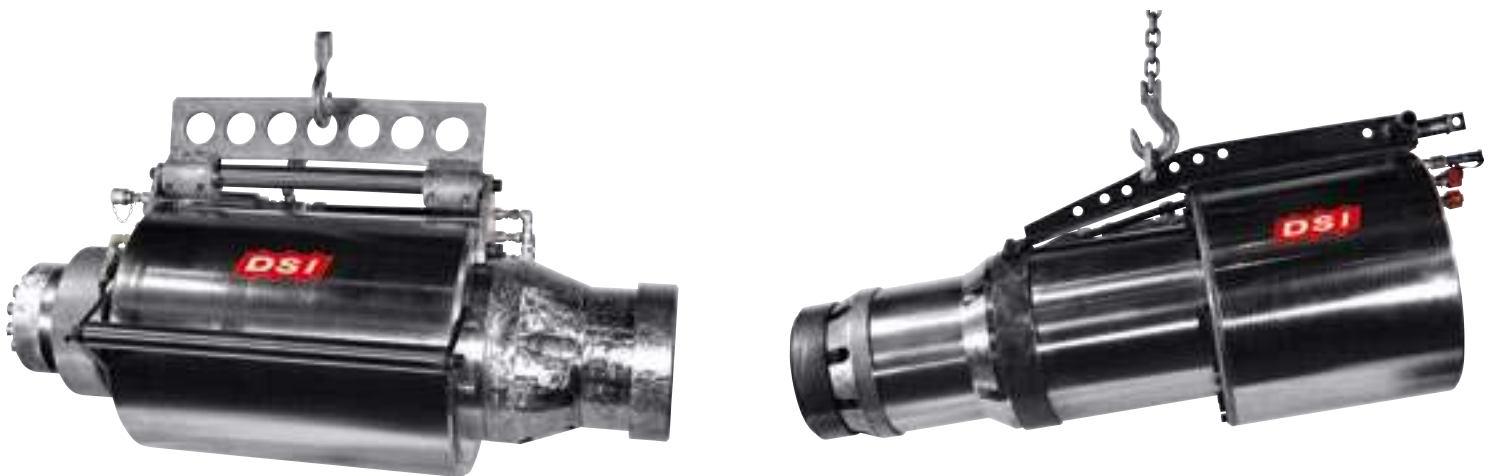
## Key Features

- Steel or aluminum design
- Low prices
- Extremely long-lasting in on-site use
- Maximum loads up to 15,000kN

## Technical Data

Jack	Nom. str. force	Length	Outer diameter	Stroke	Clear passage	Weight	Standard equipment for				Hydraulic power unit <sup>1)</sup>
							Strands	GEWI®	GEWI® Plus	Reinforcing steel	
Type	[kN]	[mm]	[mm]	[mm]	[mm]	[kg]	No.	Ø [mm]	Ø [mm]	Ø [mm]	
HOZ 250	250	580	125	50	33	13		16 - 28			①
25 Mp	250	550	125	100	48	25					②
60 Mp	600	600	190	50/100	60	45				26.5	②
110 Mp	1,100	750	267	50/150	86	55	3 - 5	16 - 50	18 - 43	26.5 - 40.0	②
1500 kN	1,500	870	310	250	100	125	3 - 7				②
HOZ 2000	2,000	880	325	150	140	210		63.5	57.5 - 63.5	47	② ③
HOZ 3000	3,000	1,200	385	250	162	400	8 - 12			57 - 65	③ ④
HOZ 5400	5,400	1,470	482	250	187	600	13 - 22			57 - 75	④
6800 kN	6,800	1,500	560	300	225	1,400	23 - 27				④
9750 kN	9,750	1,600	680	300	260	2,000	28 - 37				④
15000 kN	15,000	3,300	980	500	420	7,000	38 - 61				④

1) for details regarding the recommended hydraulic power units, please see table at the bottom of page 53



## Additional Information

Brochure / operating manuals



## Hollow-Piston CFRP Cylinders

Carbon Fiber Reinforced Hollow-Piston (CFRP) Cylinders are an optimum alternative to conventional hollow-piston cylinders made of aluminum and steel with weight savings of 60% and more. In most cases, tensioning work can be carried out by one to two workers without the need for lifting tools.

Despite their light weight design, Hollow-Piston CFRP Cylinders are robust and durable and are suitable for tensioning and testing anchors. Thanks to a large variety of different accessories, they can be universally used.

## Key Features

- Low weight
- Can be handled by a single person
- No need for lifting tools
- Fast application

## Technical Data

Jack Type	Height [mm]	Width [mm]	Stroke [mm]	Clear passage [mm]	Nominal stressing force [kN]	Weight [kg]	Standard equipment for				Hydraulic power unit <sup>1)</sup>
							Strands No.	GEWI® Ø [mm]	GEWI® Plus Ø [mm]	Reinforcing steel Ø [mm]	
L-HK-DZ 040-150-038	316	140	150	38	412	11.3	1	16 - 25	18 - 25		⑤ ⑥ ⑦
L-HK-DZ 080-200-080	382	190	200	80	832	20.7	3	16 - 40	18 - 35	26.5 - 32	⑤ ⑥ ⑦
L-HK-DZ 100-200-083	382	190	200	83	990	23.2	3 - 4	16 - 50	18 - 43	26.5 - 36	⑤ ⑥ ⑦
L-HK-DZ 120-180-090	362	215	180	90	1,175	25.3	3 - 7	16 - 50	18 - 43	26.5 - 40	⑤ ⑥ ⑦
L-HK-DZ 140-250-105	433	235	250	105	1,385	36.0	3 - 7				⑤ ⑥ ⑦
L-HK-DZ 170-250-110	447	260	250	110	1,781	52.1	5 - 9	63.5	57.5	47	⑤ ⑥ ⑦
L-HK-DZ 270-250-069	450	324	250	69	2,775	69.3	7 - 12		63.5 - 75	57 - 65	⑦
L-HK-DZ 400-250-100	481	354	250	100	4,089	93.0				75	⑦

1) for details of the recommended hydraulic power units, please see table below



## Recommended Hydraulic Power Units

Number	Hydraulic power unit Type	Max. operating pressure [mm]	Flow rate [l/min]	Oil filling [l]	Weight including oil filling [kg]	Dimensions L x W x H [mm]
①	Manual pump P39	700	–	1	6	600 x 150 x 140
②	77-193	600	3	13	60	420 x 380 x 480
③	R 6.4	600	6.4	100	315	1,400 x 700 x 1,100
④	R 11.2	550/600	22.4/11.2	125	630	2,000 x 800 x 1,300
⑤	P06-10	700	2.1	10	45	430 x 360 x 480
⑥	77-193/700	700	3.0	13	60	420 x 380 x 480
⑦	P06-25	700	2.1	25	60	430 x 360 x 480



## Additional Information

Brochure / operating manuals



## Tensioning Accessories

For the daily use of our jacks and equipment, we offer accessories that are robust, easy to use and perfectly suitable for on-site use. They are perfectly adapted to individual applications and the equipment used, thus facilitating work and ensuring a fast construction progress.

For clamping the strands easily and safely, our equipment either includes an in-built self-clamping device or a clamping bush that is mounted directly behind the jack. Additionally, the jack can be equipped with a wedging device for actively force-fitting the anchor wedges of strand anchors.

Special stressing chairs ensure an easy positioning of the jacks as well as permanent control of the wedge seating and allowance for tolerances during the tensioning and tying down of the anchors.

When used on bar systems, the anchor nuts can be tightened using a hand ratchet or screwed inside the stressing chair using a driver sleeve.



## Force / Displacement Measurement

For monitoring installation, tensioning for performance and proof tests and for the long-term controlling of forces, we offer a comprehensive range of measuring equipment such as analog and digital load

cells and length gauges of up to 750mm elongation.

Our special force measuring system DYNA Force® allows an extremely precise

readout of the anchor forces in strands and bars. The contact-free measuring is carried out inside the anchor so that no troublesome external devices have to be placed at the anchor head.



## Additional Information

Brochure / operating manuals

# DYWIDAG Equipment

## Torque Equipment

Anchorage elements and coupler connections can be countered for minimizing slippage in anchorages and threadbar connections and for increasing fatigue resistance. By defined tightening, the *GEWI®* and *GEWI® Plus* screw parts are tensioned against each other so that the spliced bars cannot be distinguished from non-spliced bars with regards to stress-strain behavior.

In addition, systems for alternating loads can be developed so deformation resistant by countering that a large number of load changes does not have any influence on the load-bearing behavior of the connections and anchorages.

DSI offers manual torque wrenches and hydraulic impact wrenches that cover the complete force range.

In conjunction with specially developed extension and adapter designs, these tools ensure trouble-free installation and efficient work flows. Regular inspections guarantee highest safety standards to eliminate possible risks for the operator and the environment. In our internal workshops, the equipment is regularly maintained, checked and repaired quickly and economically if needed.

## Technical Data

Torque Equipment	Type	Force range [kNm]	Standard equipment for	
			<i>GEWI®</i> Ø [mm]	<i>GEWI® Plus</i> Ø [mm]
DSG 4	manual	max. 0.4	12 - 20	
DSG 5	manual	0.4 - 1.2	20 - 28	18-25
DSG 7	manual	0.8 - 2.0	28 - 32	28 - 30
Type 60	hydraulic	0.3 - 3.0	40	35
Type 150	hydraulic	1.1 - 8.0	50	43
Type 200	hydraulic	2.0 - 16.0	63	57.5 - 63.5
Type 300	hydraulic	3.0 - 25.0		75

Hydraulic torque equipment is supplied as a complete set including matching hydraulic power unit

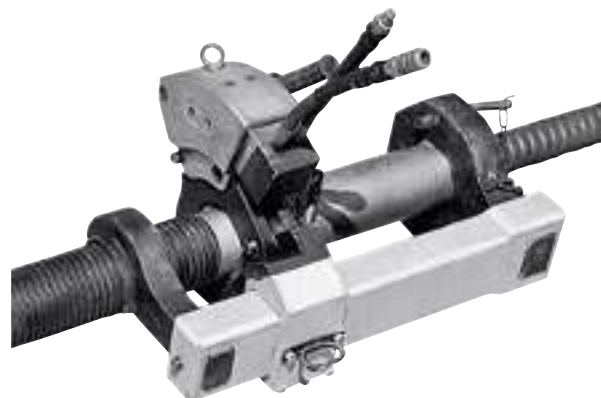
## Manual Type DSG Torque Wrench



## Hydraulic Torque Equipment, Type 200, complete



## High Power Wrench with Bridge, Type 200



## Additional Information

Brochure / operating manuals

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