Rock Bolts

Basic Concept

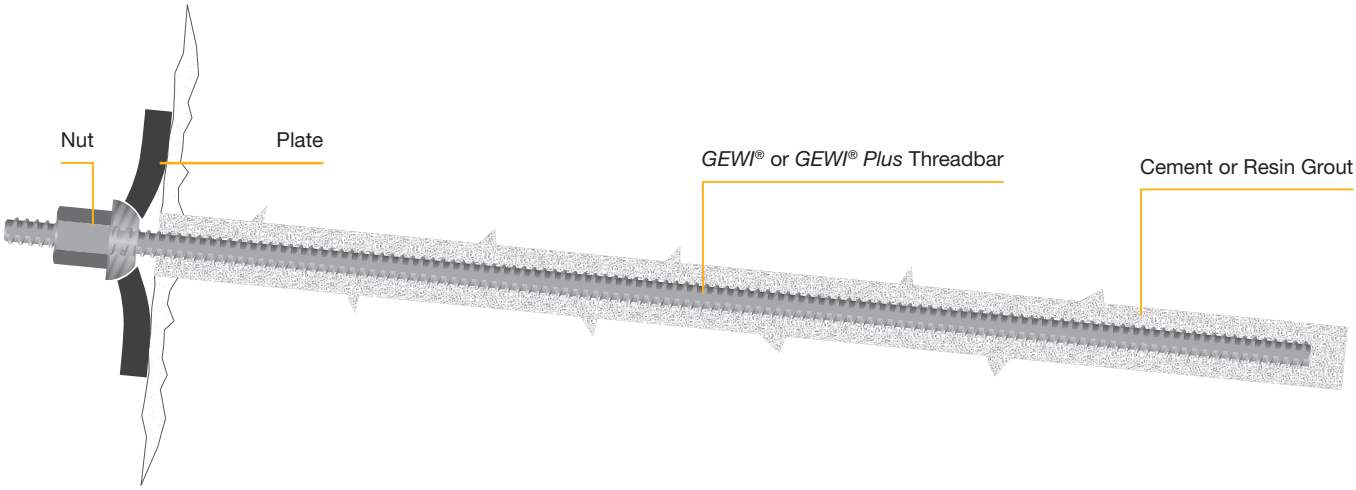
Rock Bolts are generally formed from solid threadbar systems, i.e. bar, nut, couplers and plates. The steel threadbar is used to bond unstable rock to stable sections, beyond the face, and requires both capacity for tensile and shear loads. Rock bolts are fully bonded and unlike ground anchors are passive installations.

Unless it has been severely weathered, rock will usually allow for an open hole to be drilled without any risk of collapse. Solid threadbars offer the most efficient means of transferring load and maintaining the smallest diameter borehole. Due to the higher bond strength offered by rock compared to soil, rock bolts can be installed into a much smaller hole than soil nails or ground anchors.

Smaller boreholes are desirable, as drilling through rock can be time consuming and expensive.

Fully threaded bar - can be cut and coupled at any point. They have a robust threadform that makes them ideal for construction site use:

- Coarse Pitch Threadform (d/2, except Ø 63.5mm which is d/3) with two flats – ensures thread is self cleaning
- Fully Galvanized Systems – galvanized threadbars and accessories also readily available



GEWI® Rock Bolts & DELTAX® – Installation at Heads of The Valley Road Improvement Scheme, A465 South Wales

Rock Bolts

GEWI®

GEWI® Steel High Yield Threadbars are formed from a high tensile alloy steel. The bars are manufactured with a coarse left-hand thread over their full length. *GEWI®* couplers can provide a 100% load transfer between lengths of bar. The bar is also manufactured with flats on either side; these allow the self removal of dirt or debris as the bar is threaded into any female accessory, preventing cross threading and making it ideal for geotechnical applications.

GEWI® bar is manufactured in accordance with the German Certificate of Approval (Deutsches Institut für Bautechnik), the system also offers general conformance with BS 4449 : 2005 (Steel Reinforcement of Concrete).

The minimum specified characteristic yield strengths are:

- 500 N/mm^2 for bar diameters 16 - 50mm
- 555 N/mm^2 for bar diameters 57.5 - 63.5mm

16 - 50mm bars can be welded using appropriate industry practices relative to the carbon content of the steel. Welding of the higher grade 63.5mm diameter bar is also acceptable with additional measures.

The most common sizes of *GEWI®* bar used in rock-bolting applications are 25 - 32mm. The *GEWI®* product comes with a full range of accessories including eye-nuts, domed nuts & hemispherical washers, wedge bosses to increase head plate articulation and full strength couplers. Modulus of Elasticity:

- E = 205,000 N/mm^2 +/- 5%
- Stock Lengths
  - All bar diameters 12.0m. Tolerances +/- 100mm. Special lengths up to 18.0m are available to order.

All bar diameters can be cut to length to suit customer requirements or supplied bent to BS 8666 : 2000.

GEWI® Plus

DYWIDAG-Systems International has developed the *GEWI® Plus* system to meet the challenges driven by a need for higher load capacities in smaller structural cross sections.

GEWI® Plus offers an increase in strength compared to traditional *GEWI®* Threadbars. *GEWI® Plus* has a yield strength of 670 N/mm^2 – an increase of 34% and an ultimate strength of 800N/mm^2 – an increase of 45%.

In instances where construction tolerances within a concrete column, pre-cast segment or borehole are tight, the increased strength offered by *GEWI® Plus* can allow for bar sizes to be reduced subsequently, allowing for concrete cover requirements to be met or borehole sizes to become smaller.

Compared to *GEWI®*, *GEWI® Plus* can reduce the cross sectional area of steel required in a rock bolt, pile or ground anchor by up to 25% due to the increased strength.

Despite the high strength, *GEWI® Plus* is not sensitive to stress crack corrosion and hydrogen induced embitterment.

The robust *GEWI® Plus* thread is specially designed for rough site conditions The right-hand thread over the full length offers the possibility to fix and couple the bars at any point.

GEWI® Plus is fully integrated in the ISO 9001 quality assurance system of DYWIDAG-Systems International.

GEWI® Rock Bolts & DELTAX® – Installation at Government House, Jersey

Rock Bolts

GEWI® Threadbar

Key Features

- Left Handed Thread
- Coarse Pitch Threadform (d/2), except 63.5mm
- Standard Load Range

Technical Data

Nominal Diameter [mm]	Steel Grade [N/mm²]	Ultimate Strength [kN]	Yield Strength [kN]	70 % Ultimate Strength [kN]	Cross-Sectional Area [mm²]	Diameter Over Threads [mm]	Thread Pitch [mm]	Weight [kg/m]
16	500 / 600	121	101	85	201	18	8	1.58
20		188	157	132	314	23	10	2.47
25		295	246	206	491	28	12.5	3.85
28		370	308	259	616	32	14	4.83
32		482	402	337	804	36	16	6.31
36		612	510	428	1,020	40	18	7.99
40		754	629	528	1,257	45	20	9.86
50		1,178	982	825	1,963	55	26	15.41
57.5		1,818	1,441	1,273	2,597	63	20	20.38
63.5	555 / 700	2,217	1,758	1,552	3,167	69	21	24.66
75	500 / 600	2,651	2,209	1,655	4,418	82	24	34.68

Accessories

Nominal Diameter	Static Coupler		Lock Nut		Hexagonal Nut		Domed Nut		Eye Nut SWL 2t	
										
	Dia.	Length	AF	Length	AF	Length	AF	Length	Width	Height
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
16	32	90	32	30	32	40	27	33	62	87
20	36	105	32	40	36	45	36	42	66	96
25	40	115	41	40	41	50	41	45	71	106
28	45	125	41	45	46	55	41	54	76	112
32	52	140	50	50	55	60	46	57	95	135
36	60	150	55	55	60	65	N/A	N/A	100	140
40	65	160	65	70	65	70	60	70	105	155
50	80	200	80	85	80	85	80	85	120	185
57.5	102	230	90	80	90	100	90	100	130	230
63.5	102	260	100	115	100	115	100	115	140	235
75	108	240	100	80	100	100	100	120	140	250

Rock Bolts

GEWI® Plus Threadbar

Key Features

- Right Handed Thread
- Reduced Pitch Threadform (d3)
- Increased Load Range Capacity

Technical Data

Nominal Diameter	Steel Grade	Ultimate Strength	Yield Strength	70 % Ultimate Strength	Cross-Sectional Area	Diameter Over Threads	Thread Pitch	Weight
[mm]	[N/mm²]	[kN]	[kN]	[kN]	[mm²]	[mm]	[mm]	[kg/m]
18	670 / 800	203	170	142	254	21	8	2.00
22		304	255	213	380	25	8	2.98
25		393	329	275	491	28	10	3.85
28		493	413	345	616	32	11	4.83
30		566	474	396	707	34	11	5.55
35		770	645	539	962	40	14	7.55
43		1,162	973	813	1,452	48	17	11.40
50		1,570	1,315	1,099	1,963	56	18	15.40
57.5		2,078	1,740	1,455	2,597	63	20	20.38
63.5		2,534	2,122	1,774	3,167	69	21	24.86
75		3,534	2,960	2,474	4,418	82	24	34.68

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	Dia.	Length	AF	Length	AF	Length	AF	Length	Width	Height
[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
18	36	100			36	45	32	35	66	96
22	40	110			41	50	36	45	71	106
25	45	120			46	55	41	50	76	116
28	50	140	46	53	50	60	46	55	80	125
30	55	150	50	60	55	65	50	60	85	140
35	65	120	55	65	65	70	60	70	105	155
43	80	200	70	80	80	90	70	85	120	190
50	90	210	80	90	80	100	80	100	130	200
57.5	102	250	90	100	90	120	90	115	130	230
63.5	114	300	100	105	100	145	100	125	140	230
75	108	250	100	120	100	130	120	150	140	250

Accessories

Bearing Plates

Bearing plates have a dual purpose: as well as acting as a reaction surface to material moving against the head of the plate, and it secures and transfers load from any facing system into the rock bolts.

Size and thickness of the head plate need to be determined during the design phase as each project requires a different plate and it should not be assumed that they are standardized parts. However, for rock bolting, plates tend to be smaller but thicker as bearing failure below the plate is rarely an issue.

In order to transfer load from the rock bolt to the face efficiently, the plate should be secured tight to the face using a domed or hexagonal load nut. If a specific torque value is stated in the design, all nuts should be correctly tightened. If no load is stated, then a nominal figure of 10kN/m should be adopted to ensure that all nuts are tightened to a consistent amount.

Rock bolt/head plate articulation needs to be provided to ensure that the plate can be secured flush with the rock face. Articulation is the movement between the plate and the rock bolt; different plates can increase or decrease the amount of articulation. Insufficient articulation will cause the outside surface of the bar to clash with the inside edge of the bearing plate before the plate has come into contact with the rock face.

DYWIDAG-Systems International provide different plate types to provide increasing amounts of articulation. This range ensures that every project can be catered for.

Flat Plate	**Formed Plate**	**Slotted Plate**
up to 15°	up to 20°	up to 55°
		

Resins

Fasloc® Resin Cartridges offer quick installation for rock bolts and dowels used for the stabilisation of rock faces, cuttings and tunnels. The resin has a fast cure time, enabling the bolt to be loaded following installation. Resin cartridges are used with *GEWI*® Steel and GRP rock bolts, where the bolt can be spun into the resin to achieve a full bond. The fast cure time of Fasloc® resin cartridges offers installation benefits for roped access work, as well as for rail possessions or night closures.

For installation, the resin cartridges are placed in to a 38mm borehole, followed by the rock bolt, which is spun in using an air-powered spinning tool. This process ensures the two-part resin is fully mixed, and extruded within the borehole to fill the annulus and achieve cure. Typical installed bolt lengths range from 0.6m - 2.3m, using one to four resin cartridges.

Fasloc® Resin Cartridges offer:

- Fast installation and cure for rock bolts – roped access installation, rail possessions.
- Efficient mixing of two-part cartridge, with slight expansion on final cure - increased bond
- Increased permeability of borehole wall - for greater friction in rock.
- Ease of handling and installation – for consistent performance.
- Greater load performance, due to superior load transfer between the resin and the rock.
- Increased film shredding (to prevent “gloving”), due to larger filler aggregate.
- Improved mixing between the two resin components, through low resin to catalyst ratio.

Borehole Depth [m]	**Borehole Diameter** [mm]	**Rock Bolt Type**	**Bolt Diameter (Nom. / Over Threads)** [mm]	**No. of Resin Cartridges**	**Mix Speed / Duration** [RPM / Sec]	**Ambient Temperature** [°C]
0.5	38	*GEWI*® or *GEWI*® *Plus*	25 / 28	1	150 / 20-30	15 - 20
1.0				2		
1.5				3		
2.0				4		

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