

## Self-drilling anchors and rock bolts in underground construction

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- Self-drilling anchors and rock bolts
  - General considerations
  - History and fields of application
  - Self-Drilling Hollow Bar System: DYWI® Drill
- Case studies
- Conclusions



## Self-drilling installation – general considerations

- Conventional anchors and rock bolts
  - Two-step installation procedure



- Self-drilling installation of ground control elements
  - Drilling of the borehole and installation in one operational step
  - Fast, safe, and reliable installation



## Conventional bolting practices

### Installation

- Multiple step procedure
- Additional sets of equipment
- Re-entry of personnel and machinery

### Operation

- Personnel present in critical areas
- Delays due to unstable borehole conditions
- Increased cycle times

### Performance

- Delay in load-bearing capacity
- Limitation of blasting works
- Quality control restraints

## Self-drilling anchors and rock bolts – main types

- Self-drilling hollow bar bolts



- Self-drilling resin grouted bolts



- Self-drilling mechanical anchors



- Self-drilling friction bolts



Sources:  
[www.hilti.co.uk](http://www.hilti.co.uk)  
[www.dywidag-systems.com](http://www.dywidag-systems.com)

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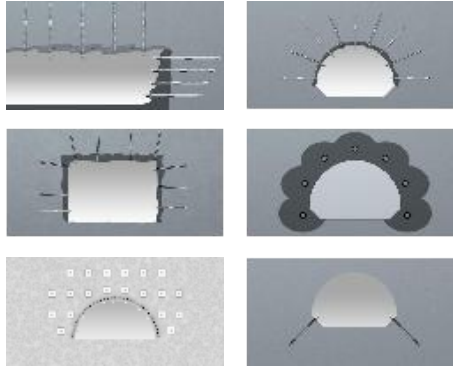


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## DYWI® Drill Hollow Bar System

### ■ Fields of application

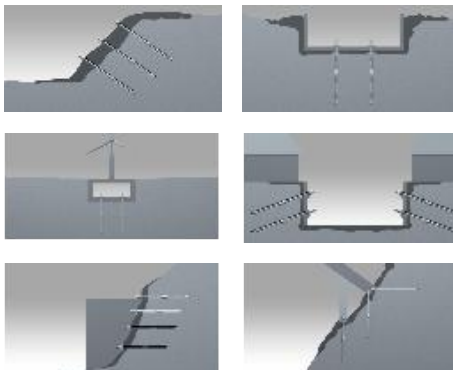
- Stabilization of tunnel portals, trenches, and cut-and-cover areas
- Forepoling
- Face stabilization
- Radial rock bolting
- Foot piles
- Roof and rib bolting
- Injection works



## DYWI® Drill Hollow Bar System

### ■ Fields of application

- Pile foundation
- Buoyancy control
- Slope stabilization
- Reinforcement of excavation pits and retaining walls
- Foundation of pylons
- Injection works



### System components

- Nut
- Plate
- Hollow Bar
- Coupling
- Single-use drill bit

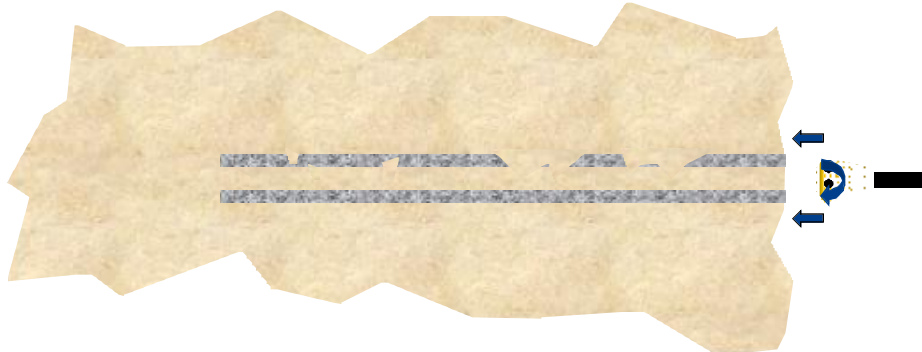


### Specifications

Characteristic Value / Type	Symbol	Unit	R32-210	R32-250	R32-280	R32-320	R32-360	R32-400
Nominal weight	m	[kg/m]	2.65	2.90	3.20	3.70	4.00	4.40
Yield load	$F_{p0.2.nom}$	[kN]	160	190	220	250	280	330
Ultimate load	$F_{m.nom}$	[kN]	<b>210</b>	<b>250</b>	<b>280</b>	<b>320</b>	<b>360</b>	<b>400</b>

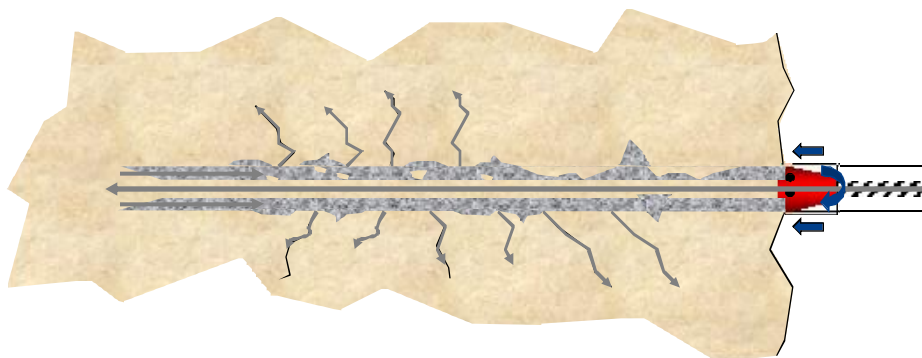
Characteristic Value / Type	Symbol	Unit	R38-420	R38-500	R38-550	R51-550	R51-660	R51-800
Nominal weight	m	[kg/m]	5.15	5.85	6.25	6.95	7.65	9.00
Yield load	$F_{p0.2.nom}$	[kN]	350	400	450	450	540	640
Ultimate load	$F_{m.nom}$	[kN]	<b>420</b>	<b>500</b>	<b>550</b>	<b>550</b>	<b>660</b>	<b>800</b>

### Installation of conventional rock bolts and soil nails



- |                     |                    |
|---------------------|--------------------|
| 1 Borehole drilling | 4/5 Bolt insertion |
| 2 Borehole cleaning | 5/4 Injection      |
| (3) Re-drilling     | (6) Fixation       |

### Installation DYWI® Drill Hollow Bar System



- |  |
|--|
| 1 Simultaneous drilling and installation |
| 2 Injection                              |
| (3) Tensioning                           |

## Corrosion Protection

- Design principle sacrificial corrosion protection
  - Consideration of loss in cross-section over the design life depending on the corrosion potential
- Improved corrosion protection of the DYWI® Drill Hollow Bar System: galvanized or duplex coated versions
  - Hollow bar galvanizing according to EN 1461
  - Hollow bar duplex coating according to EN 15773 & EN 13438



## Case study 1: Vía Parque Rímac, Peru

- False tunnel
  - 6 lanes
  - 2 [km] length
- Project challenges
  - Time-critical excavation
  - Excavation in a former river bed
  - Unstable ground (and boreholes)
  - Large-scale reinforcement – 15 [m] long self-drilling soil nails type R51



## Case study 2: Goetschka and Freistadt Tunnels, Austria, 2012

- Short-term mobilization
  - Portal areas
  - Use of underground drilling equipment
- DYWI® Drill – multiple-use
  - Slope stabilization
  - Protection of tunnel portals
  - Forepoling
  - Face stabilization
  - Radial rock bolting
  - Foot piles



## Case study 3: San Cristóbal Tunnel, Santiago de Chile

- Application of self-drilling rock bolts and soil nails
  - Changing ground conditions
  - Construction time constraints
- Different load-bearing capacity classes
  - Protection of tunnel portals
  - Face stabilization
  - Radial rock bolting





**Obrigado!**

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