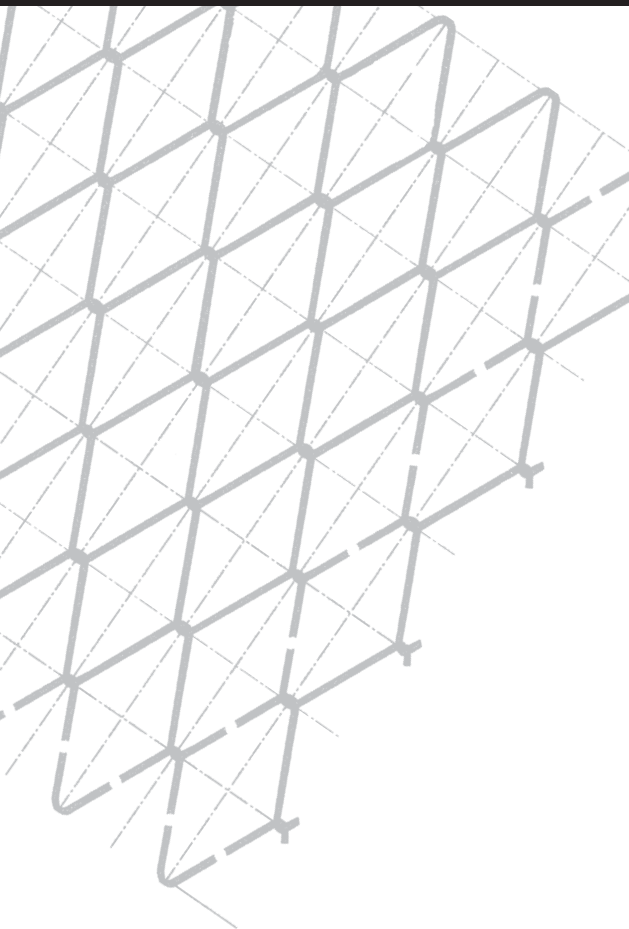




## **A new approach to ground support: Faster – safer – fully mechanised**



**TECCO® / DELTAX® high-tensile chain-link mesh system for surface support in underground mines:**

- Shorter ground support installation times
- Fully mechanised installation
- Mesh rolls fit drive size and advance length
- Mesh supplied in rolls e.g. 2.3 x 10 m
- Proven static and dynamic performance
- Higher labour safety



# High-tensile chain-link mesh for mechanised surface support: Strong, light and rockburst-resistant



Higher demands for resources require a faster extraction of ore. Increasing safety requirements and labour cost, call for a higher degree of mechanisation of the ground support process.

The continuously increasing depth in ore extraction leads to new challenges in hard rock underground mines. Conventional ground support systems often are not effective or economical enough in highly stressed or squeezing ground, and cannot withstand rockbursting ground caused by seismicity.



## Faster thanks to mesh rolls which cover the entire drive size and advance length

With the MESHA® installation handler the ground support with the TECCO®/DELTAX® high-tensile steel wire mesh is carried out fully mechanised by the operator of the underground Jumbo or bolter. The mesh, supplied in rolls, reaches over the entire drive size and advance length, is unrolled and bolted onto the wall by the jumbo operator in one working process.

## Substantial reduction in installation time

- Reduced installation times thanks to one-step unrolling of mesh with parallel bolting
- In situ site evaluations showed installation time reductions of 30% - 40%
- No curing time required as for shot- or fibrecrete
- Mesh is blast resistant. After firing the next cut no bending or damage was observed at the edge of the mesh at in situ site evaluations

## Reduction in overall installation cost

- Less labour cost. Only one operator and machine required
- Less mesh consumption. No overlap in cross section

- Potentially larger rock bolt spacing possible
- No mesh repairs after blasting

## Mechanised operation by the Jumbo or Bolter operator in one working process

- Pick-up cartridge with the mesh roll (normally 2.3 m x 10 m or adjusted to drive size and advance length)
- The unrolled mesh is kept tight at all time
- The drilling and rock bolting can be done in the same working process through the mesh
- No other machine is required



### Higher labour safety

- No operator or off-sider is working under unsupported ground until the mesh installation is completed
- No more hazard from falling welded mesh panels stored against the wall
- Safer handling of the rolls. E.g. 2.3 x 10 m TECCO® G80/4 weights only 60 kg and DELTAX® G80/3 weights only 33 kg

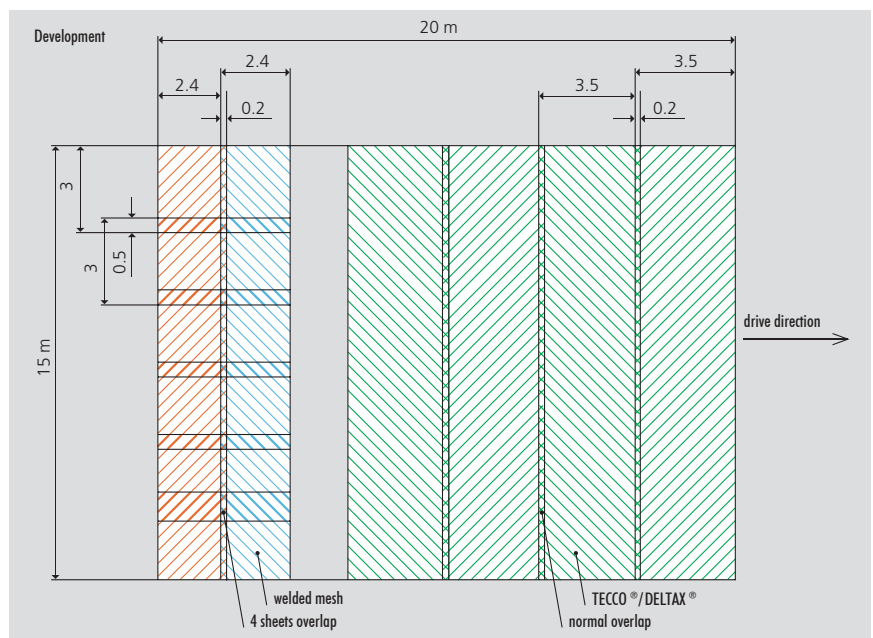
### Logistical benefits

- Instead of weld mesh sheets, TECCO® G80/4 and DELTAX® G80/3 are supplied in rolls of 2.3 x 10 m or as required
- The rolls of mesh can be delivered to the drive by a small truck with a small crane
- Good ratio of storage space to mesh area



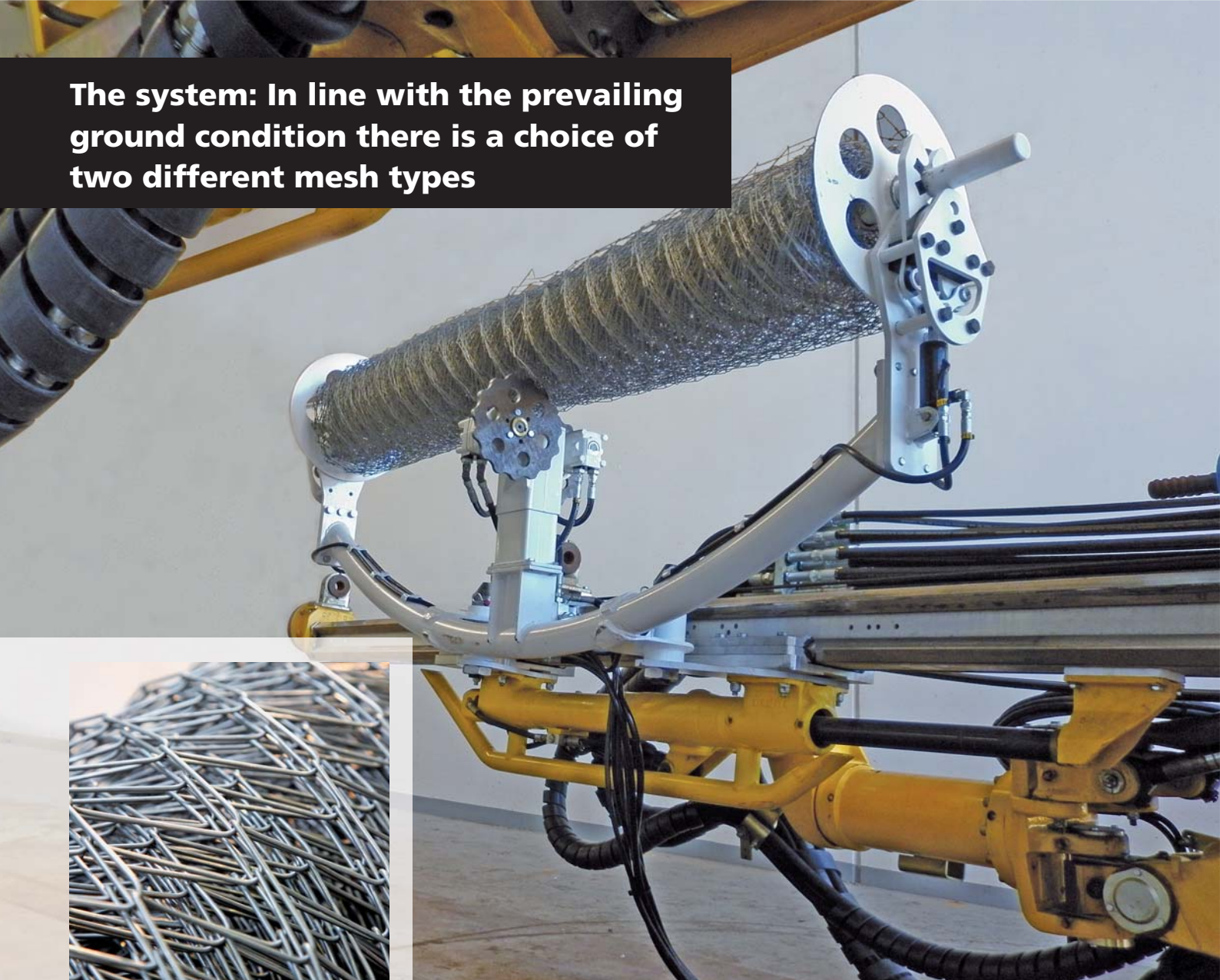
### The MESHA® installation handler can be retro fitted

- Fits to any multi-boom underground jumbo, cable bolting or roof bolting drill rig
- Fits on a jumbo boom by removing the drill or by installing parallel to the feed rail for drilling and meshing with the same boom
- With a quick release system, the jumbo can be transformed from a development drill to a full scale ground support rig in a few minutes





**The system: In line with the prevailing ground condition there is a choice of two different mesh types**



**For high stressed, rockbursting or squeezing ground: TECCO® G80/4 high-tensile steel wire mesh**

as a replacement or extension of shotcrete, fibrecrete or cable lacing.

The TECCO® mesh is made of high-tensile 4 mm wire. It was developed to withstand high loads and absorb dynamic impacts. It offers significantly higher static and dynamic capacity compared to mild steel weld mesh or brittle shotcrete.

**For general ground conditions: DELTAX® G80/3 high-tensile steel wire mesh**

as a light-weight replacement of weld mesh sheets or heavy chain-link mesh.

The DELTAX® mesh is made of high-tensile 3 mm wire. It offers higher strength than weld mesh commonly used with significant less weight and overlap loss.

**System spike plates**

For an optimal load transmission from the rock bolts to the TECCO® or DELTAX® mesh, a specially developed rigid spike plate made from a 5 mm thick galvanised steel is available. The three dimensional shaped system spike plate is very stiff and does not bend. It grabs the mesh in 6 positions and therefore increases the load capacity and load transfer.

**Rock bolts**

Standard rock bolt, selected in accordance with the ground conditions, ensure an optimal load transmission to the mesh.

**Important note: The total system will only be as effective as it weakest link. Therefore rock bolts have to be matched to the respective ground conditions.**

**MESHA® Installation handler for chain-link mesh**

With the chain-link mesh handler jumbo operators install and bolt the high-tensile chain-link mesh fully mechanised in the same working process. A mesh cartridge carries the TECCO® or DELTAX® mesh with width of up to 3.5 m and lengths of up to 40 m. Jumbo operators are never exposed to working on unsupported ground in front of the machine. The MESHA® fits/retrofits to any multiboom underground Jumbos.

The MESHA® was developed for the installation of high-tensile chain-link mesh by ROCK AUSTRALIA.



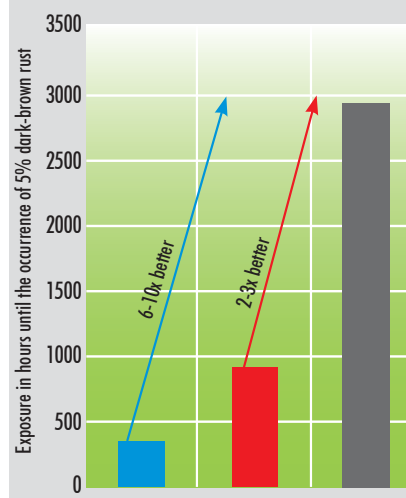


### The corrosion protection concept

The spike plates are supplied hot-dip galvanised, and the TECCO® and DELTAX® mesh with the zinc/aluminum coating GEOBRUGG SUPERCOATING® or GEOBRUGG ULTRACOATING®, the 3rd generation of our zinc/aluminium coating. Comparison tests with galvanised wires demonstrate in salt spray tests a working life of six to ten times longer for wires treated with ULTRACOATING®, and two to three times longer for those treated with SUPERCOATING®.

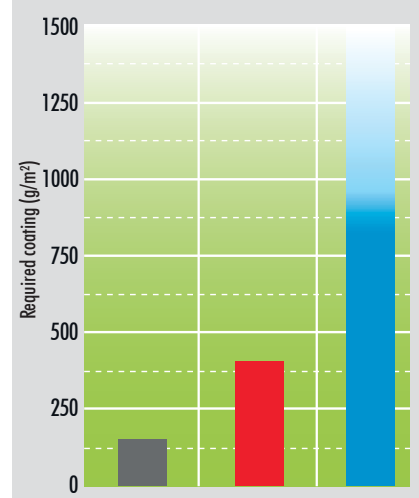
### Behaviour in the salt spray test

according DIN 50021-SS/ASTM B117/  
EN ISO 9227



### Required coating thicknesses

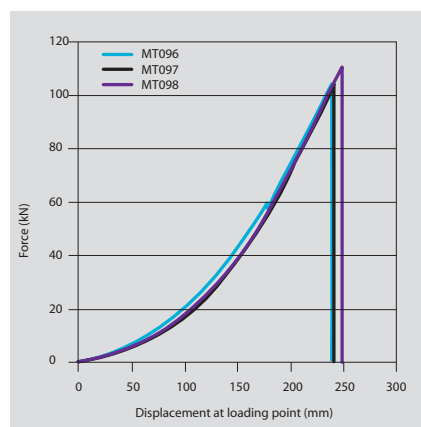
to achieve the same performance for 2'500 hours of salt spray test until the occurrence of 5% dark-brown rust



Hot-dip galvanised ■  
GEOBRUGG SUPERCOATING®, alu-zinc ■  
GEOBRUGG ULTRACOATING® ■



# Static and dynamic system capacity tested and validated to withstand high loads and rockbursts



Laboratory tests by the Western Australian School of Mines (WASM) have proven that TECCO® and DELTAX® with a tensile strength of 1770 N/mm<sup>2</sup> can carry much higher static and dynamic loads than traditional reinforcement nets and are also suitable to absorb significant rockburst energies:

## Static testing

A TECCO® G80/4 high-tensile mesh panel of 1.3 m x 1.3 m was loaded with 300 x 300 mm steel plate. The high-tensile mesh was able to bear a load of up to 100-110 kN before it failed at the edge of the loading

plate. In a 1:1 comparison the weld mesh failed with approximately 40 kN, and mild steel chain-link failed with less than 20 kN. — By purposely cutting one wire it has been proven that in the same set-up TECCO® and DELTAX® high-tensile mesh do not unravel. The DELTAX® G80/3 high-tensile mesh was able to bear a load of up to 50 kN before it failed at the edge of the loading plate.

## Dynamic testing

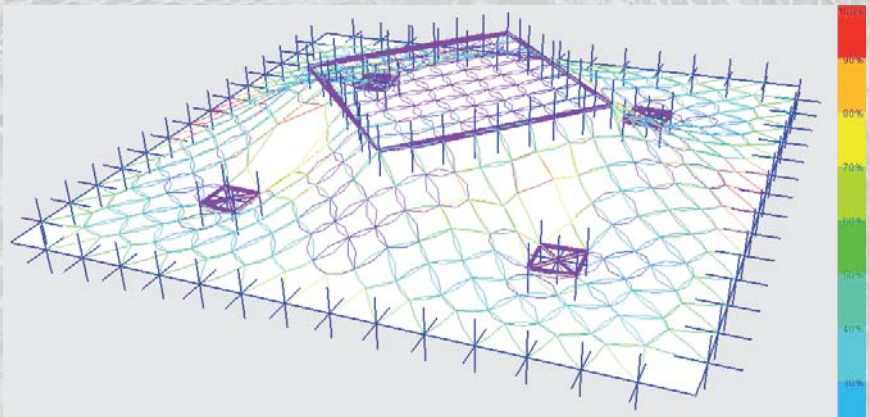
With the momentum transfer method a weight is dropped from different heights into the TECCO®







G80/4 high-tensile mesh panel mounted on a loading frame. High-speed video cameras, load cells and accelerometers record the impact. The TECCO® mesh is able to absorb energies of up to 10-12 kJ. This is equal to stopping a rock mass of 1000 kg accelerated to 4.5-5 m/s. This result represents the energy absorption of the mesh only, not considering any absorption by the rock mass or rock bolt. In a 1:1 comparison the welded wire mesh (wire diameter 5.6 mm and 100 mm wire spacing) showed energy absorption capacities in the range of 1-2 kJ only.



### Dimensioning concept with numerical model

Using a finite element program it is possible to simulate and vary the dynamic response of any project boundary condition for setup and loading. The finite element numerical model considers the entire system consisting of the TECCO®/ DELTAX® mesh, systems spike plates and selected rock bolts. The program allows to simulate the use of different rock bolt types and bolt patterns under different ground conditions.

### In situ site evaluations at different underground mines

Experiences by different mines after having completed several ground support cycles with the TECCO® G80/4 mm and DELTAX® G80/3 mm in combination with the MESHA® installation handler may be summarised as:

- Shorter ground support installation times
- Safer due to elimination of manual handling of weld mesh sheets
- No blast damage to the edge of the mesh
- Smaller aperture of 80 mm versus 100 mm of weld mesh.
- Higher corrosion resistance





# Geobrugg: A reliable partner with a worldwide presence



## Technical Data

	TECCO® G80/4	DELTA® G80/3
<b>Meshes</b>		
Mesh shape	rhomboid	rhomboid
Mesh width	80 mm	80 mm
Diagonal	102 x 177 mm (+/- 3%)	102 x 179 mm (+/- 3%)
No. of meshes transversal	9.8 pcs/m	9.7 pcs/m
No. of meshes longitudinal	5.6 pcs/m	5.6 pcs/m
<b>Steel wire</b>		
Wire diameter	4 mm	3 mm
Total height of mesh three-dimensional	15 mm (+/- 1 mm)	12.5 mm (+/- 1.5 mm)
Tensile strength	min. 1770 N/mm <sup>2</sup>	min. 1770 N/mm <sup>2</sup>
Material	high-tensile steel wire	high-tensile steel wire
Tensile strength of a wire	22 kN/m	12.5 kN/m
<b>Load capacity</b>		
Punching load 300 x 300 mm plate	100 kN	50 kN
Tensile strength of mesh longitudinal	190 kN/m	110 kN/m
<b>Mesh rolls</b>		
Mesh edges	mesh ends knotted	mesh ends knotted
Roll width	2.3 m (or acc. advance length)	2.3 m (or acc. advance length)
Roll length	10 m (or acc. drive size)	10 m (or acc. drive size)
Total surface per roll	23 m <sup>2</sup>	23 m <sup>2</sup>
Weight per m <sup>2</sup>	2.6 kg/m <sup>2</sup>	1.45 kg/m <sup>2</sup>
Weight per mesh roll	60 kg	33 kg
<b>Corrosion protection</b>		
Compound	GEOBRUGG ULTRACOATING® (94.5% Zn/5% Al/0.5% special add-on)	GEOBRUGG ULTRACOATING® (94.5% Zn/5% Al/0.5% special add-on)
Coating	150 g/m <sup>2</sup>	150 g/m <sup>2</sup>

Small deviations from the mesh geometry and other modifications are subject to change without notice.

## Consulting and supply concept

With production facilities on four continents, branch offices and representatives around the globe, Geobrugg is always close to its customers. Our services include:

- Assessment of requirements by our own engineers
- Manufacture in our own ISO certified factories
- Rental of MESHA®

## About «Product liability»

Rockfall, slides, mudflows and avalanches are natural events and therefore cannot be calculated. This is why it is impossible to determine or guarantee absolute safety for persons and property with scientific methods. This means that to provide the protection we strive for, it is imperative to maintain and service protective systems regularly and appropriately. Moreover, the degree of protection can be diminished by events that exceed the absorption capacity of the system as calculated to good engineering practice, failure to use original parts or corrosion (i.e., from environmental pollution or other outside influences).



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