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Safety is our nature

MINING SOLUTIONS

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Geobrugg North America, LLC
Geobrugg Group

BRUGG GROUP

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Diversified by 4 divisions

BRUGG GROUP Since 1896

- BRUGG CABLES Well connected
- BRUGG ROPES Safety first
- BRUGG PIPESYSTEMS Flexible solutions
- rittmeyer BRUGG

GEOBRUGG BRUGG Safety is our nature

FATZER BRUGG

BRUGG LIFTING Going up.

GLOBAL NETWORK

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350 employees worldwide

Head office in Romanshorn, Switzerland

6 production facilities on 4 continents

WHAT IS HIGH-TENSILE STEEL?

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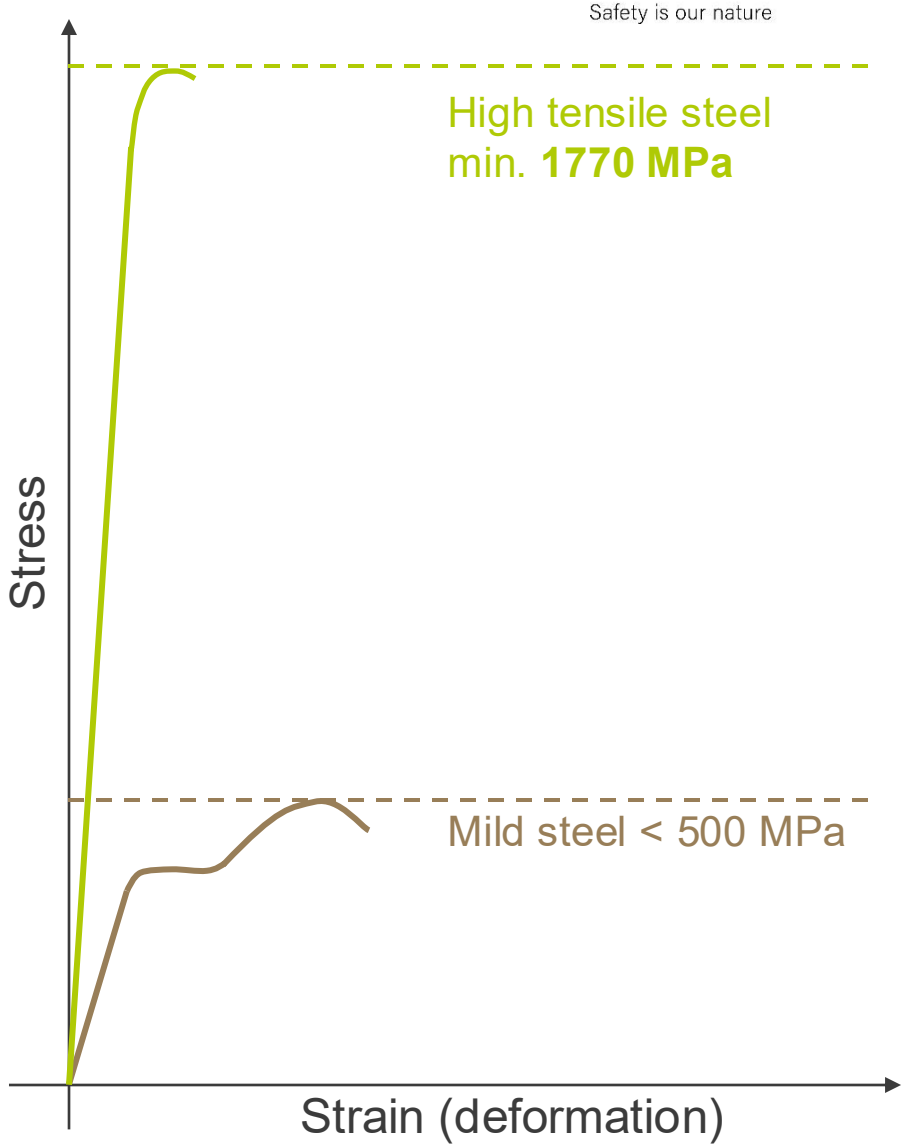
- Steel above 1000 MPa tensile strength
- Offers superior strength to weight ratio
- Can be pre-tensioned using high loads
- Transfers forces much faster



BREAKING STRENGTH

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Breaking Strength (lb) = D^2 x T x K

where:

D = Diameter of the rope in inches

T = Tensile strength of the wire in pounds per square inch (psi)

K = Constant calculated based on the number of wires in the rope

SIMILAR PRODUCTS?

It is possible to make a wire of mild steel which has similar strength

$$F = \frac{\pi \times 0.003^2}{4} \times 1770$$
$$= 1.25\ [t]$$

$$D = \sqrt{\frac{4 \times 1.25}{500 \times 3.14}} = 5.6\ [mm]$$

~4 times weight difference and still much higher elongation!

PRESENTATION AGENDA

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1. STABILITY ISSUES IN YOUR MINE
2. THE MINAX® MESH
3. INSTALLATION OPTIONS
4. THOROUGHLY TESTED PRODUCTS
5. OUTSTANDING PERFORMANCE UNDER TOUGH OPERATING CONDITIONS

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01

STABILITY ISSUES IN YOUR MINE OPNE PIT / UNDERGROUND

OPTIMIZATION OF OPEN PIT DESIGN

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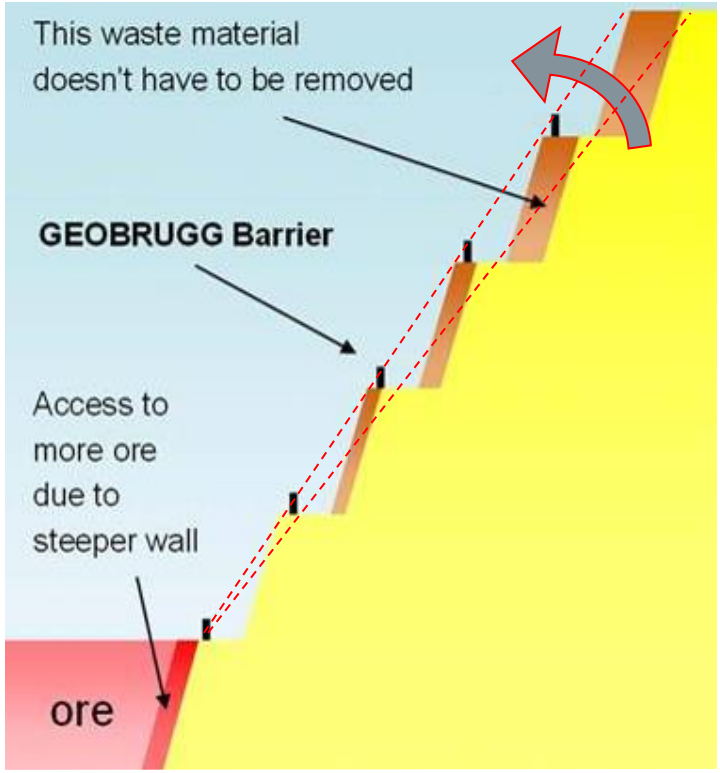
Option 1: reducing berm width

- Consequence: Increase of global pit inclination
- Basically, applicable for bench heights of 30…40 m
- More favorable **stripping ratio**
- Condition: **global stability**



OPTIMIZATION OF OPEN PIT DESIGN

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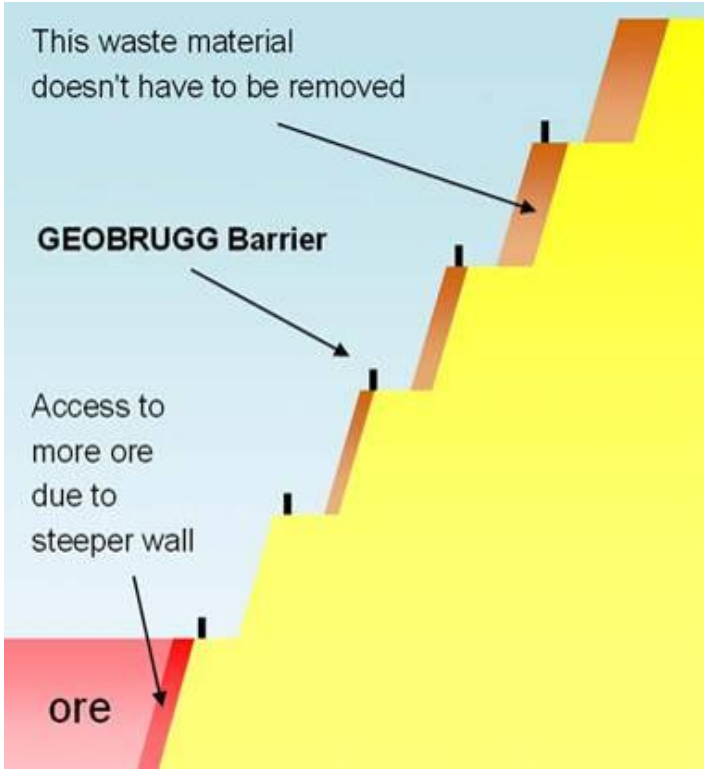
Option 2: reducing berm width



OPTIMIZATION OF OPEN PIT DESIGN

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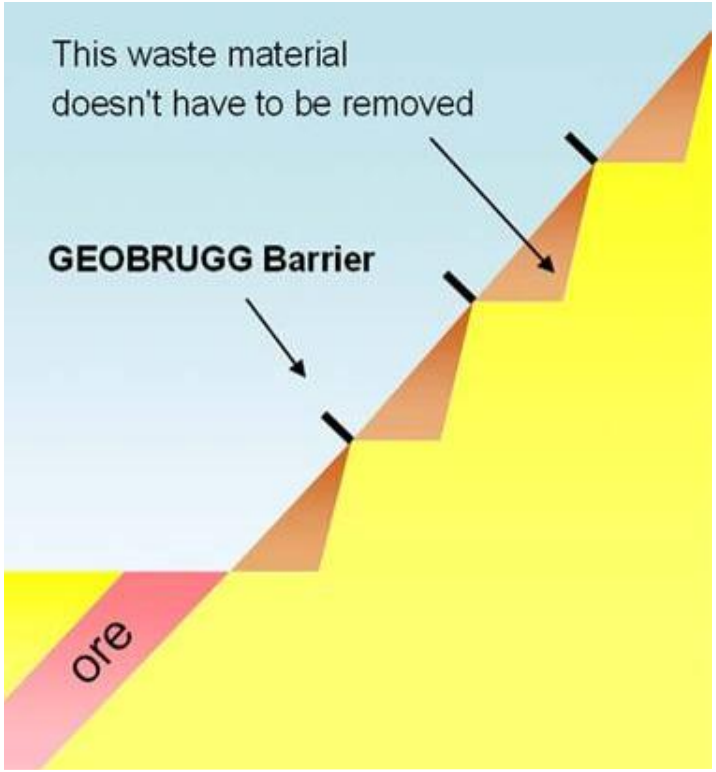
Option 3: no berms

- Design without berms in case of dipping angle of ore 40…50°
- Less waste material has to be processed
- More favorable **stripping ratio**
- Condition: **global stability**



OPTIMIZATION OF OPEN PIT DESIGN

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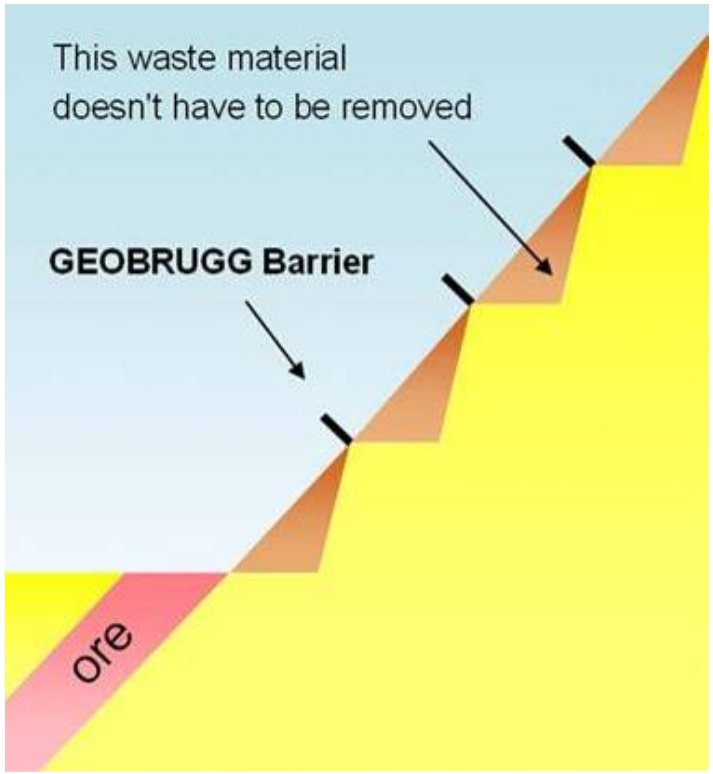
Option 4: no berms



EXPERIENCE IN CHILE

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Project: Minera Los Bronces

Year: 2001

Description:

Rockfall Barriers to protect the new stockyard during its construction

Systems: RXI-100 and RXI-150

Energy: 1000 kJ / 1500 kJ

Height of the Systems: 3 m and 4m

EXPERIENCE IN CHILE

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Project: Rajo Chuquicamata

Year: 2009

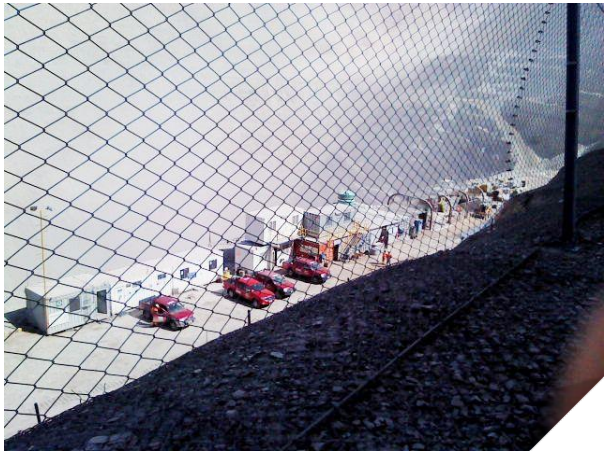
Description:

Rockfall Barrier to protect the ventilation tunnel on the west side of the pit

System: GBE 500A

Energy: 500 kJ

Height: 3 m



EXPERIENCE IN CHILE

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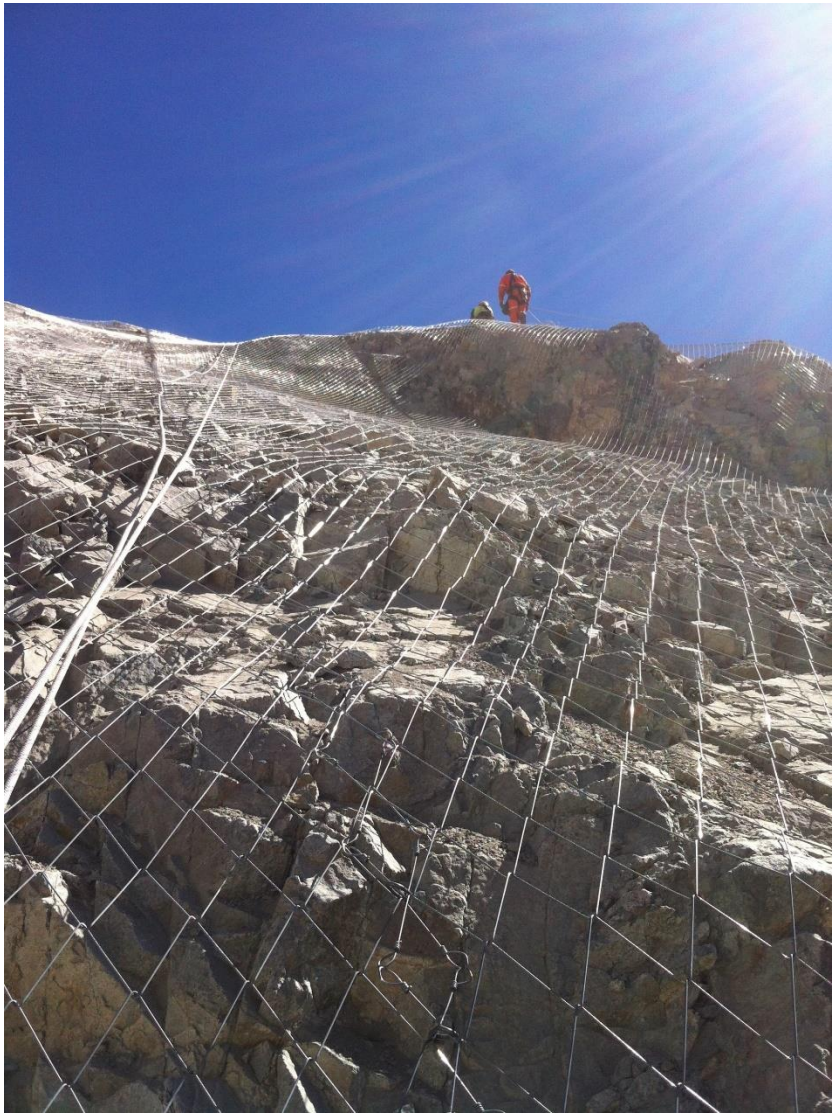
Project: Minera Los Pelambres

Year: 2016

Description:

"Passive" Drape mesh to allow controlled rockfall on the pit walls

System: DELTAX G80/2



EXPERIENCE IN BRAZIL

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Project: Mina de Águas Claras

Year: 2015

Description:

“Active” Slope Stabilization System to prevent erosion and collapse of the abandoned Open Pit Mine

System: MINAX 65/3, SPIDER S4-230, TECMAT

EXPERIENCE IN MEXICO

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Project: El Sauzal

Year: 20xx (Incident 2011)

Description:

pit

System: Rock Fall Barrier RXI 100

Energy: 1000 kJ

Height: 3 m

EXPERIENCE IN THE US

Project: Rajo Chuquicamata

Year: 2009

Description:

Rockfall Barrier to protect ongoing operations on the foot of the mine

System: Barrier RXI 050

Energy: 50 kJ

Height: 3 m

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02

THE MINAX® MESH FOR GROUND SUPPORT

SURFACE PROBLEMS

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Fall of Ground (FOG)

- Triggering effects:
- Gravity
- In situ stress level
- Seismic events
- Underground works

One of the most effective measures is rockbolting (reinforcement) in combination with surface support using high tensile wire mesh.

SURFACE PROBLEMS

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Rockburst

- Triggering effects:
- In situ stress level
- Seismic events
- Underground works

MINAX® 80/3 AND 80/4

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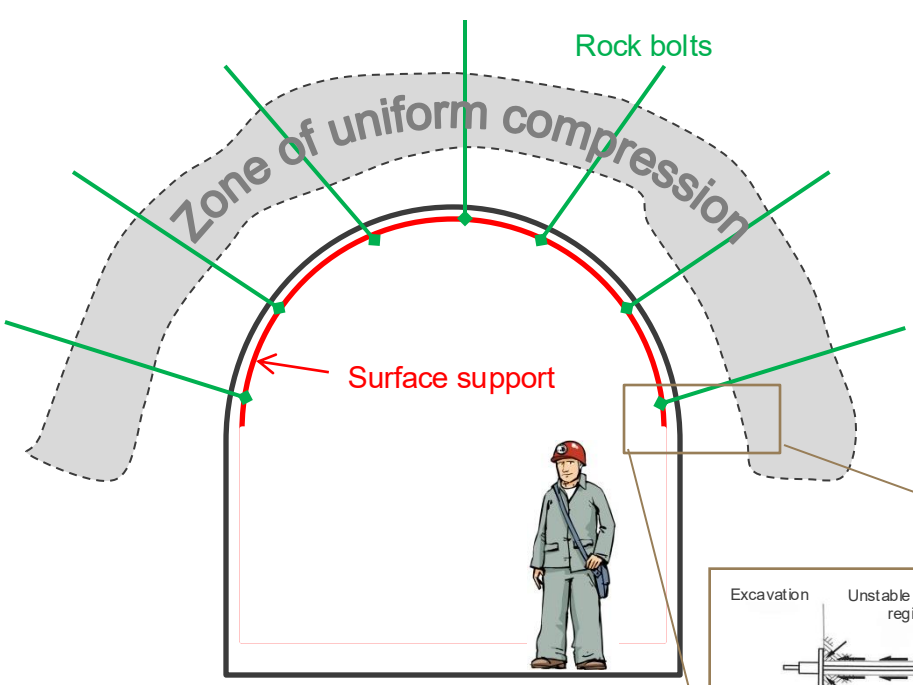
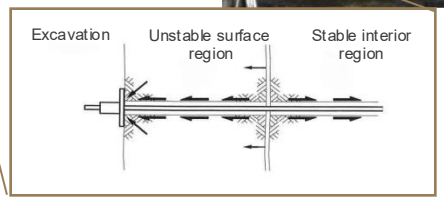
Ground support scheme





General idea of rock bolts reinforcement – arching effect.

SURFACE SUPPORT BY GEOBRUGG AG

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Different conditions, different products

Threat	Product	Static strength	Dynamic capacity
Fall of Ground	MINAX® 80/3	50 kN[1]	4 kJ[1]
Rockburst / FoG	MINAX® 80/4	110 kN[1]	12 kJ[2]
Rockburst / FoG	MINAX® 65/4	160 kN[1]	
Rockburst / FoG	MINAX® 80/4.6	200 kN[1]	
All threats	G-plate®	Capacities increased by better force transmission.	

[1] acc. to quasi static tests at WASM (Western Australian School of Mining)

[2] acc. to dynamic tests at WASM (momentum transfer methodology)

G-PLATE® - BLAST RESISTANCE IMPROVED

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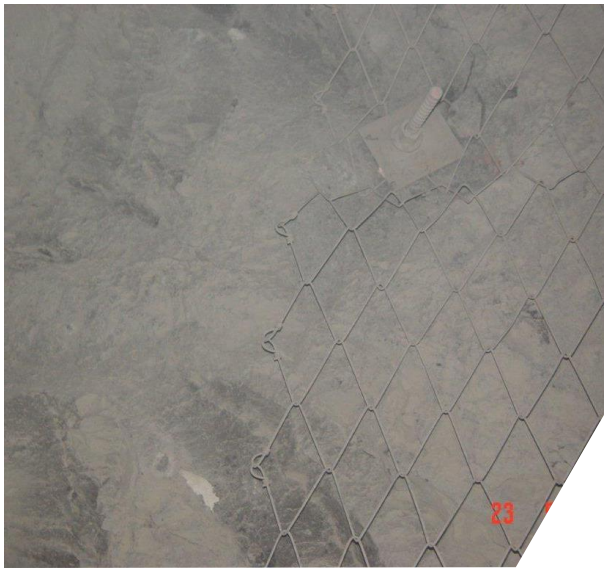
Use our meshes up to their highest limits!



Optimal force transmission between high tensile surface support and ground reinforcement bolts!

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03

INSTALLATION

MESHA® - MECHANIZED INSTALLATION

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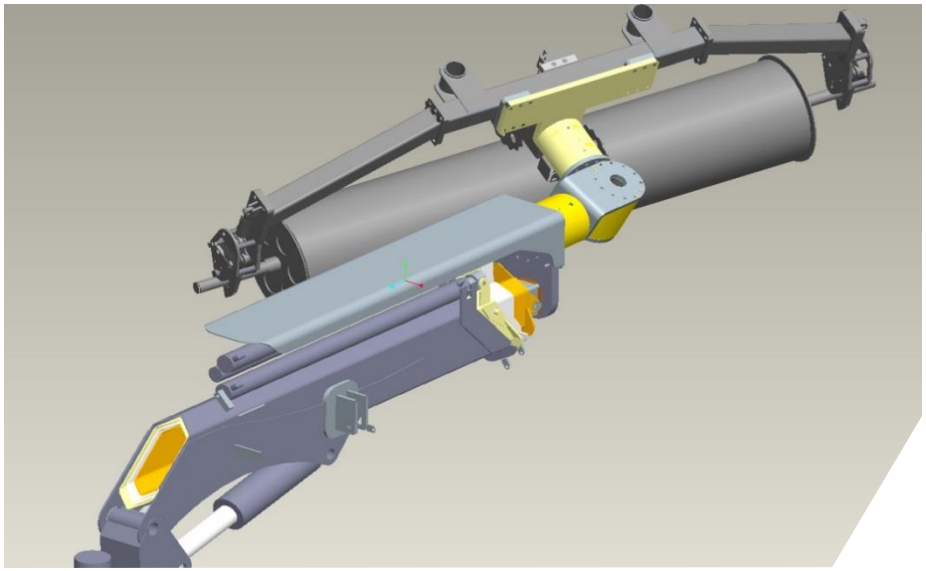
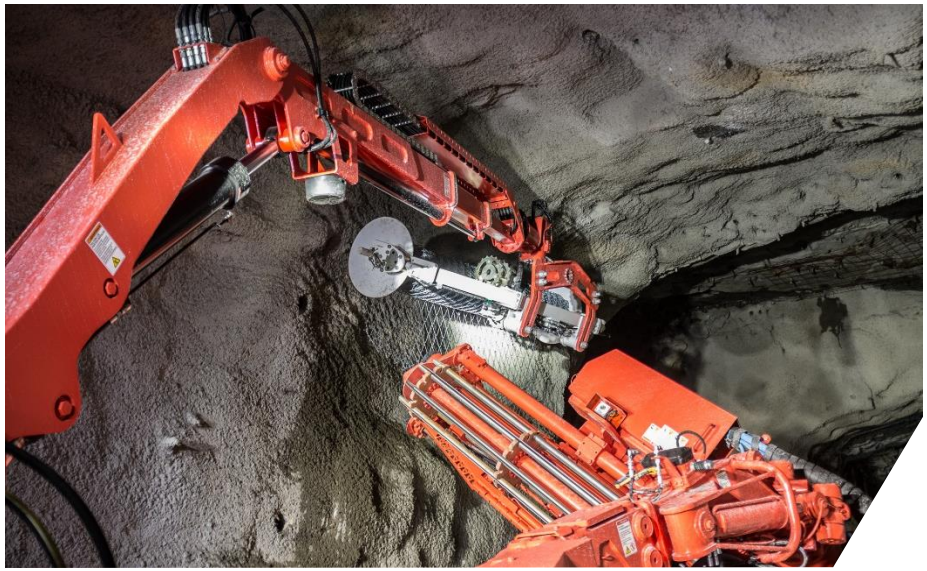
Highly improved safety without any compromises to efficiency!





MESHA® - mechanized installation tool - booming efficiency!

MESHA® - MECHANIZED INSTALLATION

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Ready to work with any machine

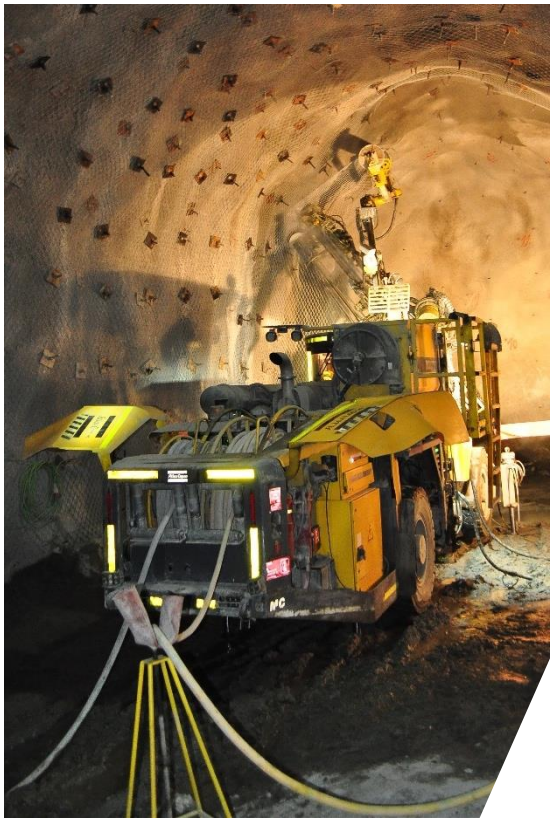
Can work parallel to already installed rock drill.

Installation on Jumbos: No need to dedicate one arm to MESHA® tool only.

MESHA® - MECHANIZED INSTALLATION

BRUGG Geobrugg
Safety is our nature

Ready to work with any machine



MESHA® - MECHANIZED INSTALLATION

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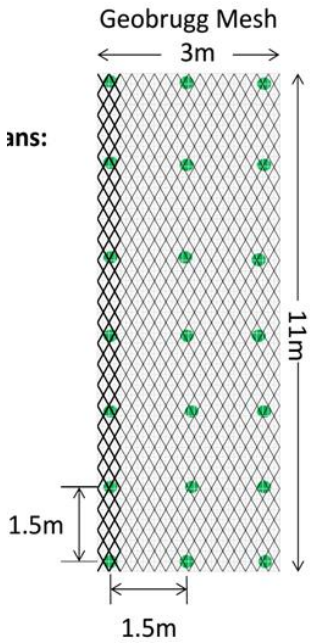
Bolting reduction



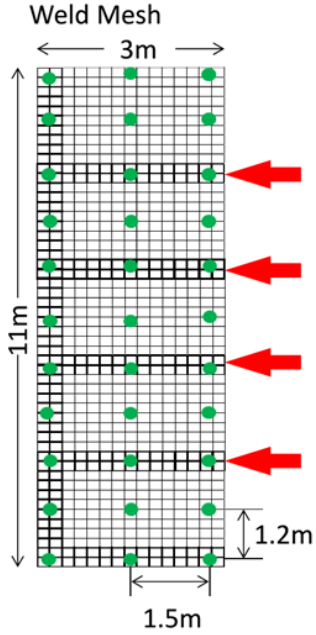
21 bolts

36 % bolts reduction

- ✓ Less drilling works
- ✓ Less weak points
- ✓ Less operations

≠

33 bolts



Example of bolting optimization: 12 bolts less per cut

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04

THOROUGHLY TESTED PRODUCTS

WHY IS HIGH TENSILE STEEL IMPORTANT?

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Max. dynamic deflection – **24 [cm] / 60 [kJ]**

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05

OUTSTANDING PERFORMANCE UNDER TOUGH OPERATING CONDITIONS

CODELCO, EL TENIENTE NML CHILE

Technical description	
Operations depth:	200÷1000 [m]
Tunnels sizes:	6m x 6m
Total tunnels length:	> 13 [km]
Surface support:	5÷7 [cm] shotcrete MINAX 80/4 2÷3 [cm] shotcrete MINAX 65/4 (special solution)
Bolts type:	Solid bars 25 [mm] – 4 [m] long Cable bolts – 6 [m] long
Bolting grid:	1 x 1 [m]

CODELCO, EL TENIENTE NML CHILE

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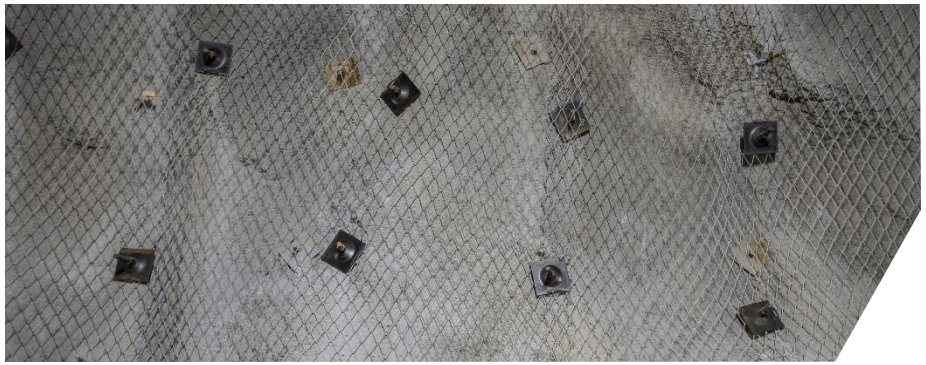
Execution: New Mine Level access tunnels



ALTO MAIPO
WATER POWER TUNNEL, CHILE

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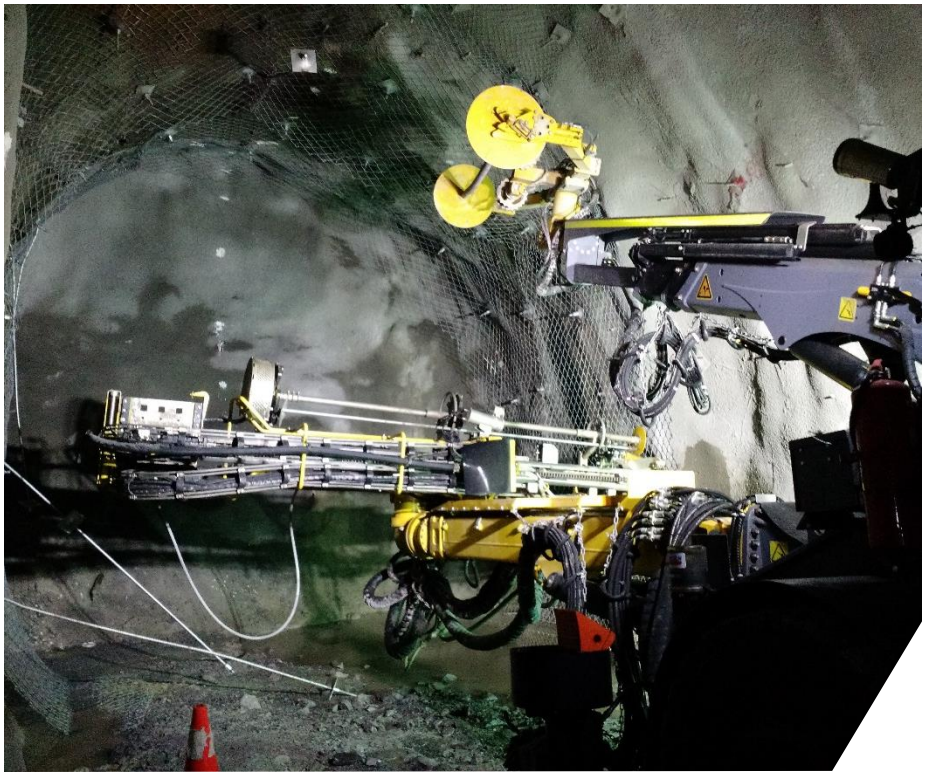

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ALTO MAIPO
WATER POWER TUNNEL, CHILE

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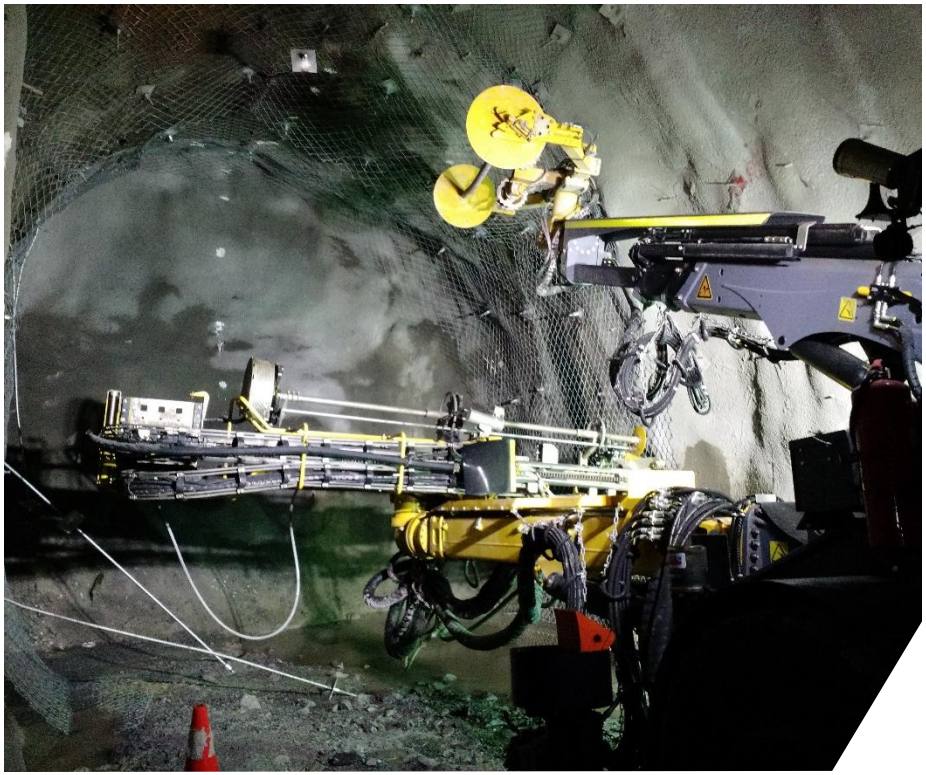

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THANK YOU !

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