

# Hard Rock Drilling 2011



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# 1. General history of Bauer

## Two centuries of experience



1790 · 1900 · 1902 · 1928 · 1948 · 1956 · 1958 · 1967 · 1969 · 1972 · 1975 · 1976 · 1984 · 1990 · 1992 · 1994 · 1998 · 2001 · 2008 -

**1790**

**1900-1970**

**1980-1990**

**2000-2009**



**After WW II (1950's):  
Start of construction  
business**

**End of 1970's:  
Start of  
international  
works**

**1958: Invention  
of the grouted  
tieback anchors**

**Early 1980's:  
Selling of  
equipment to third  
parties**



**4. Jul 2006:  
IPO  
Sept 2006:  
Admittance  
in SDAX**

**over 8000  
employees  
at present**

**Company founded  
as  
copper forge**



**Early 1970's:  
Start of equipment  
manufacturing**



**Early 1990's:  
Build up of  
specialist construction/  
environmental business**



Bau



Maschinen



Resources



# Segment Maschinen

## Produkt-range: BG-Systeme (BG 12 – BG 50)



small rigs (BG 12 – BG 18)

medium size rigs (BG 20 – BG 28)

big rigs (BG 36 – BG 50)



**BG 12**

**BG 15**

**BG 18**

**BG 22**

**BG 24**

**BG 28**

**BG 36**

**BG 40**

**BG 50**

125 kNm\*

151 kNm\*

177 kNm\*

222 kNm\*

222 kNm\*

269 kNm\*

367 kNm\*

390 kNm\*

468 kNm\*

\* Drehmoment

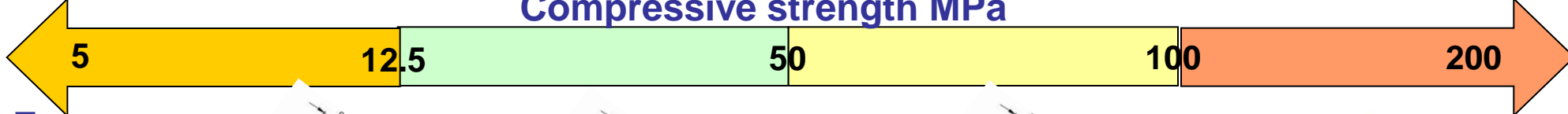
# Hard rock drilling with BG's



# Rock Drilling - Kelly Mode Suitability of Tools



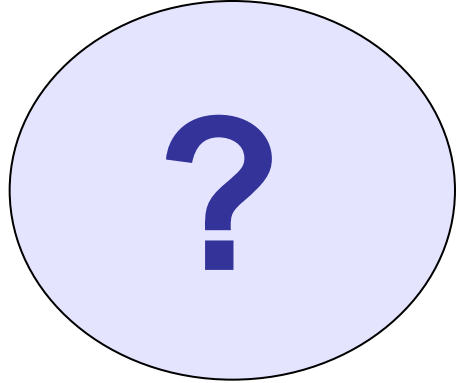
Compressive strength MPa



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# Rock Drilling over 100 MPa ?



## Possibilities:

1. roller bit core barrel
2. full face cutter
3. DTH – Drilling
4. MHD – Drill

# Rock drilling above 100 MPa

## 1. roller bit core barrel and flushing head



material transport via air lift

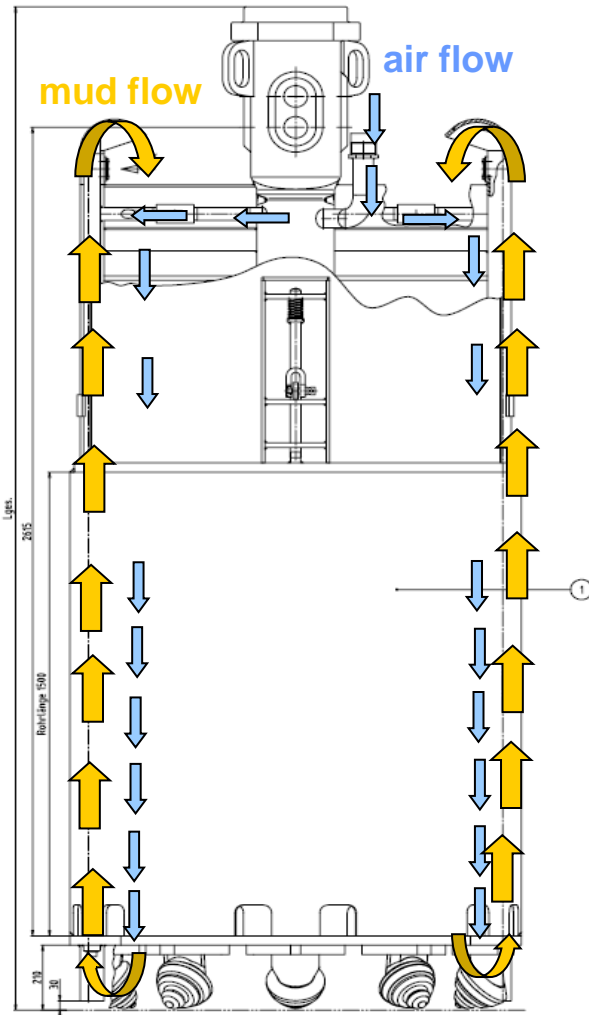


- air must get through the flushing head
- no rotating of the air hose



# 1. roller bit core barrel

## material transport inside roller bit core barrel



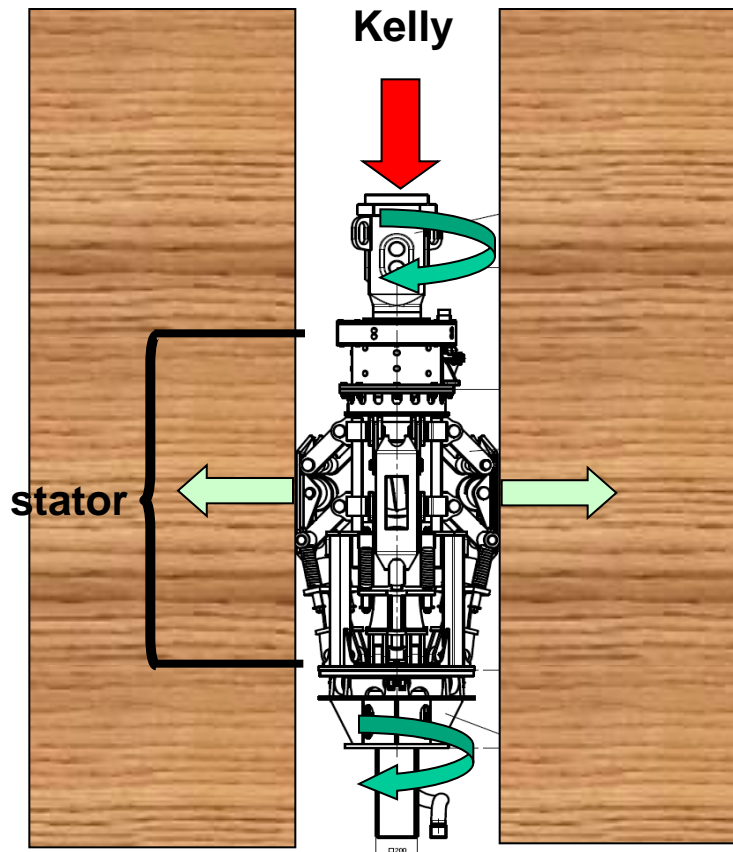
material transport using air lift



material is collected between cutting tool and flushing head

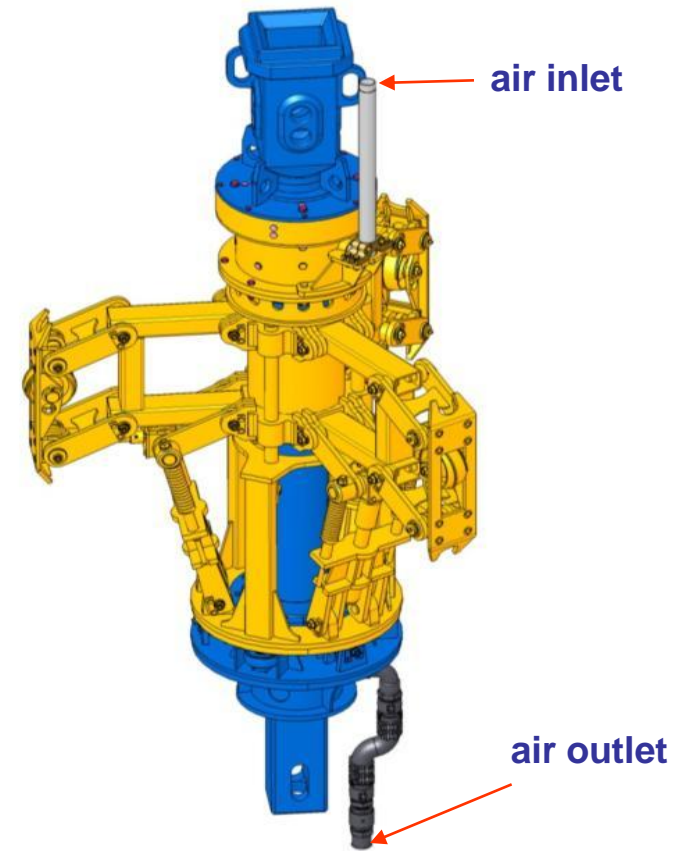
# Rock drilling above 100 MPa

## Flushing head



when crowd force is applied via kelly bar:

- stabilizer move out via lever system
- stabilizer are pressed against casing
- stabilizer act as torque support



- non rotating parts yellos = stator
- rotating parts blue = rotor

# 1. rock drilling with roller bit core barrel

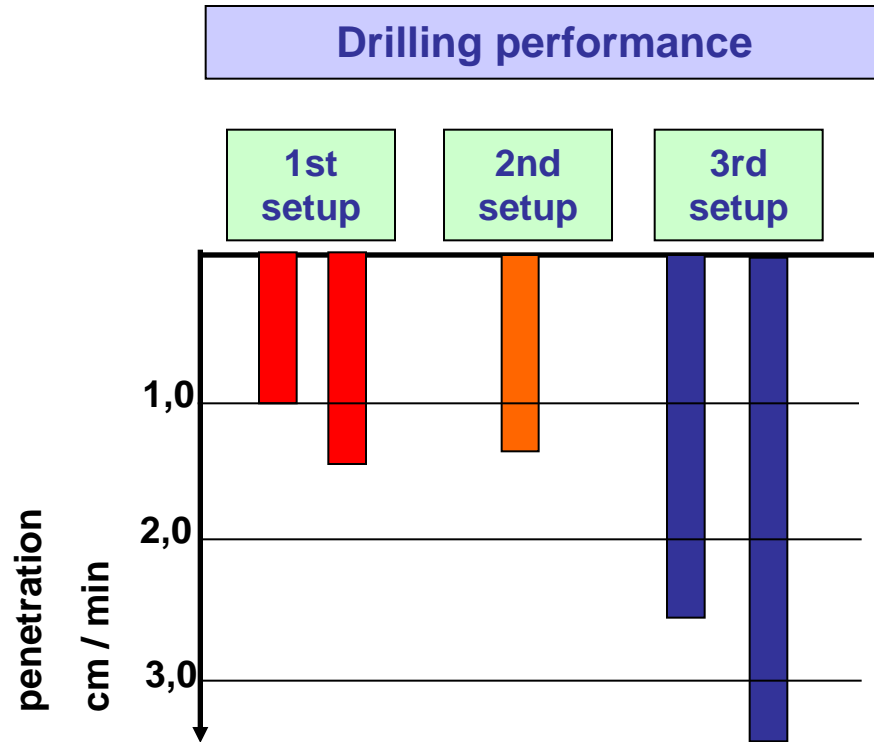
## reference project Wladiwostock- Russia



### BG 36 # 1720 - Wladiwostock

<b>Drilling Rig:</b>	<b>BG 36</b>
<b>Drilling depth:</b>	<b>37 m</b>
<b>Casing Diameter:</b>	<b>2000 mm</b>
<b>Drilling system:</b>	<b>Kelly, cased</b>
<b>Rock strength:</b>	<b>160 MPa</b>
<b>Rock socketing:</b>	<b>3 - 5 m</b>

# References - Russia Results



# Rockdrilling >100 MPa

## 1. roller bit core barrel

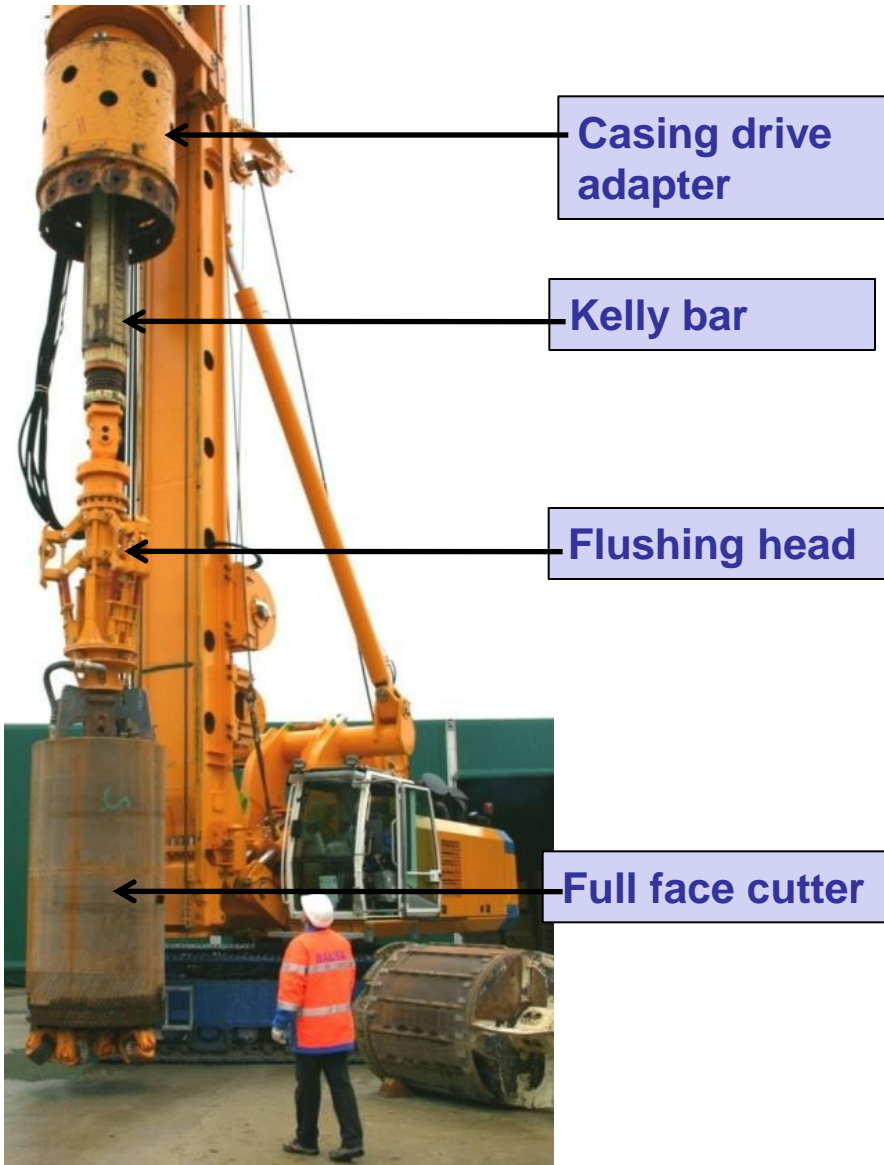


Core barrel diameter [mm]	Casing diameter [mm]	Air volume [m <sup>3</sup> /min]	Rig size
780	880	12	From BG 24
1060	1180	16	From BG 28
1350	1500	20	From BG 36
1830	2000	20	From BG 36

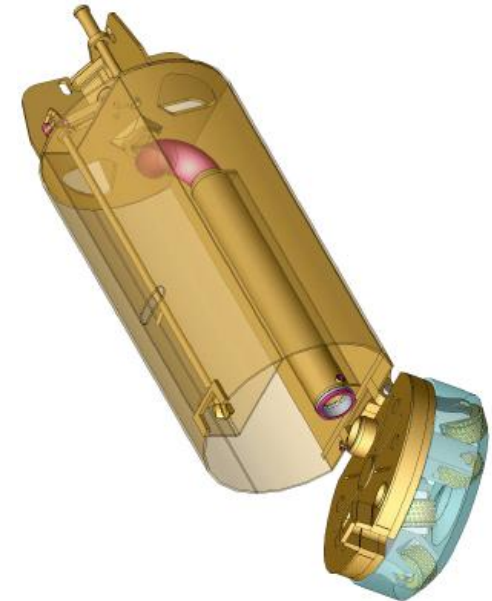
assuming a constant rotation speed

# rock drilling over 100 MPa

## 2. full face cutter



Advantage	Disadvantage
<ul style="list-style-type: none"><li>• easy adaption</li><li>• rock strength up to 250 Mpa</li><li>• quick discharge</li></ul>	<ul style="list-style-type: none"><li>• solid rock required</li></ul>



## 2. full face cutter

reference project in Lövö, Finland



**BG 30 # 74**

<b>Drilling Rig:</b>	<b>BG 30</b>
<b>Drilling depth:</b>	<b>6 – 25 m</b>
<b>Casing Diameter:</b>	<b>1500 mm</b>
<b>Pile inclination:</b>	<b>6 °</b>
<b>Drilling system:</b>	<b>Kelly, cased</b>
<b>Rock strength:</b>	<b>&gt; 150 Mpa</b>
<b>Sloping rock surface (11°)</b>	
<b>Rock socketing:</b>	<b>up to 1m</b>

## 2. full face cutter



sand, gravel, chippings

Full face cutter with flushing head

Performance in rock: 20 – 100 cm/h



# Rockdrilling >100 Mpa

## 2. full face cutter



Full face cutter diameter [mm]	Casing Diameter [mm]	Air flow [m³]	Rig size
780	880	16	From BG 28
1060	1180	18	From BG 36
1350	1500	20	From BG 40

assuming a constant rotation speed

# Rock drilling over 100 MPa

## 3. DTH-Drilling



- 300mm to 800mm diameter in combination with BG
- with the diameter the air consumption increases significant
- connection of the DTH via hexagonal-connections or API – thread, not normal connection to Kelly box possible
- established system for drilling into hard rock

### 3. DTH – Hammer drilling reference project St. Petersburg, Russia



**BG 25**

**Drilling Rig: BG 25**

**Drilling depth: 14 m**

**Casing Diameter: 620 mm**

**Bit Diameter: 485 mm**

**Drilling system: DTH, cased**

**Rock strength: up to 300 Mpa**

**Presence of boulders after 4m**

**Rock socketing: 1,5 m**

# Rock drilling over 100 MPa

## 4. Multi Hammer Drill (MHD)



- MHD attached to standard Kelly box
- uniform hammers and bits
- drilling diameter in full face: 560 mm up to 2134 mm
- hole opener: 1600 mm up to 3048 mm

### Application

- rock strength: 100 MPa to 300 MPa
- Ø1500mm, progress of 0,6 – 1 m/h at 300 MPa
- boulders (any size)
- in dry and wet boreholes

## 4. Multi Hammer Drill (MHD) reference project in Sochi, Russia



<b>Drilling Rig:</b>	<b>BG 28</b>
<b>Drilling depth:</b>	<b>approx. 25 m</b>
<b>Casing Diameter:</b>	<b>1500 mm</b>
<b>Drilling system:</b>	<b>MHD, cased</b>
<b>Rock strength:</b>	<b>300 MPa</b>
<b>Boulder layers in a river bed</b>	

# application recommendations for rock > 100 MPa



method	Casing Diameter	Rock strength	Recommendations	BG attachment
roller bit core barrel	880 mm - 2000 mm	100 MPa till 250 MPa	Big diameter on smaller rigs possible	attachable on Kelly box
full face cutter	880mm – 1500 mm	100 MPa till 250 MPa	Solid rock for small to medium diameters	attachable on Kelly box
DTH - Drilling	300 mm– 800 mm	various	For small diameter with limited drilling depth	attachable to special flushing Kelly
MHD– Drill	500 mm – 2100 mm	various	For big diameter and boulders	attachable on Kelly box

Thank you for your attention!

