



BAUER Maschinen GmbH

## Electrification of drilling rigs

Discover energetic improvement potential and invest in modern technology

Business unit BG and TG

2021-12-16



# Agenda



<b>Nr.</b>	<b>Topic</b>
1	Global challenges and EU Green Deal
2	Energetic improvement potential of drilling rigs
3	BMA experience in electrical systems
4	Electrification of high performance applications
5	eBG 33 Modern drilling rig and its benefits

# 1

## Global challenges and EU Green Deal



# Global challenges



Everyone has to contribute to change the existing way



# EU Green Deal



## Political framework

**1997 Kyoto Protocol**  
Framework Convention on  
Climate Change



**2015 UN – Climate Conference**  
in Paris,  
agreement on 2°C goal



**2020 EU Green Deal**  
EU wants to be the first climate-neutral  
continent by 2050. Investment sum:  
1 trillion Euro



**2001 Clean Development Mechanism CDM**  
for environmentally friendly development



**2018**  
174 states have ratified the Paris  
Agreement



## Contribution on equipment side



**CO2 reduction**



**Noise reduction**



# 2

## Energetic improvement potential of drilling rigs

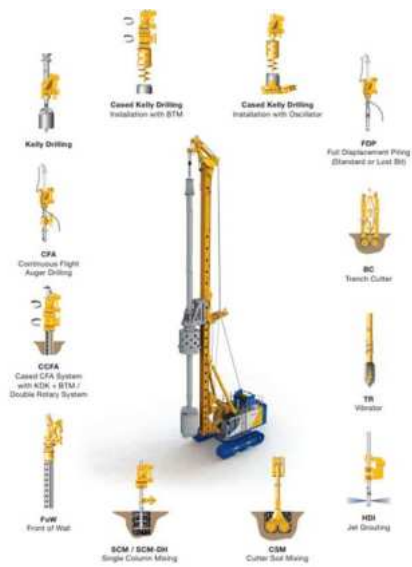


# What can be done to save energy?



## Basic measurements for drilling rigs

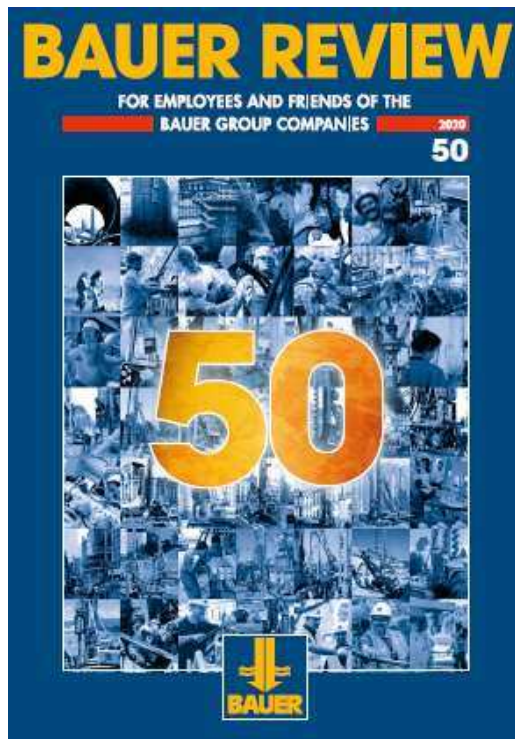
### Apply the proper method!



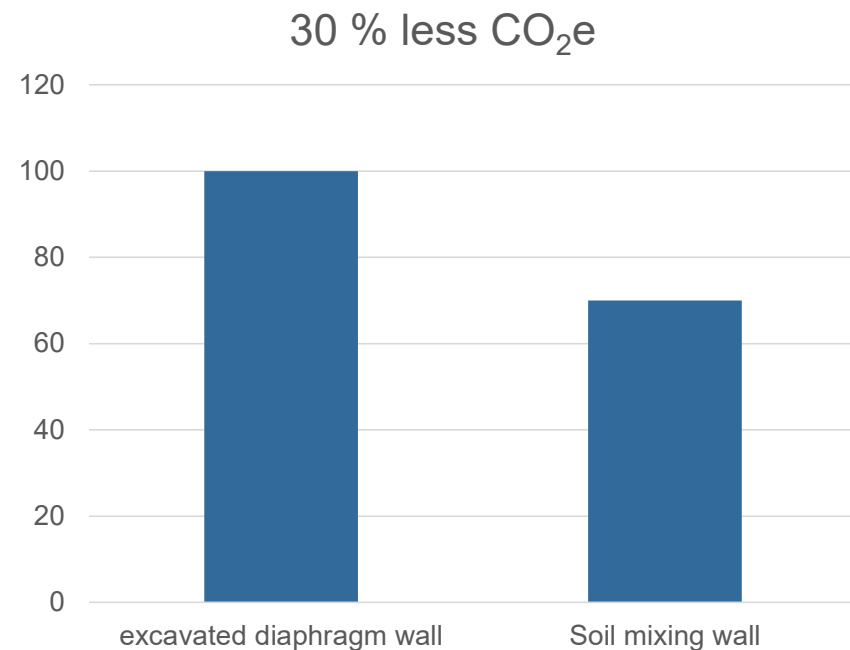


# Product carbon footprint reduction

## Additional carbon footprint by using resource-efficient methods: Example soil mixing



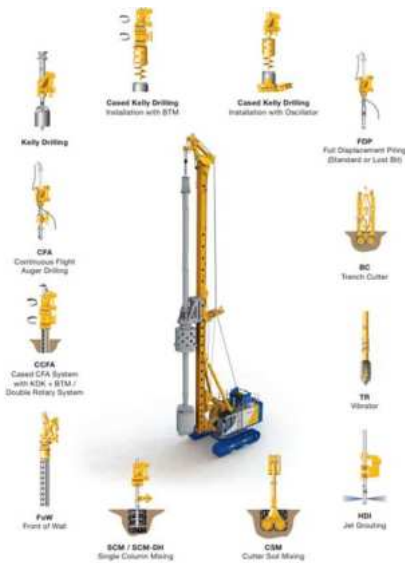
a reference. The result: The MIP method was able to save 330 t of CO<sub>2</sub>e in comparison, which corresponds to a value of 30%. "The method offers various advantages," explains Andre Seidel, Head of MIP Core Technology at Bauer Spezialtiefbau. "Apart from resource efficiency and low-vibration production, the Mixed-in-Place method is extremely flexible and productive, and it also involves lower noise and exhaust emissions. Last but not least, it is cheaper than conventional specialist foundation engineering methods."



# What can be done to save energy?

## Basic measurements for drilling rigs

### Apply the proper method!



### Ensure smart realisation!

- Use assistance systems!
- Train your staff!
- Gain experience!

### Use efficient machines!

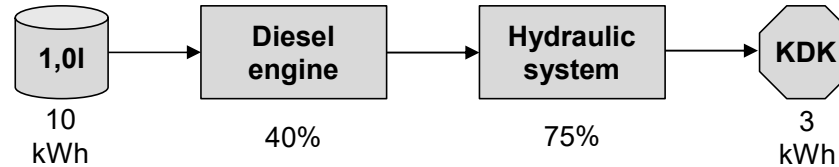
- Optimize efficiency factor of drive train.
- Optimize efficiency factor of hydraulic system.
- Reduce friction and pressure losses, where possible

# How to improve the efficiency of the machine?

## Tank to motor (KDK) analysis

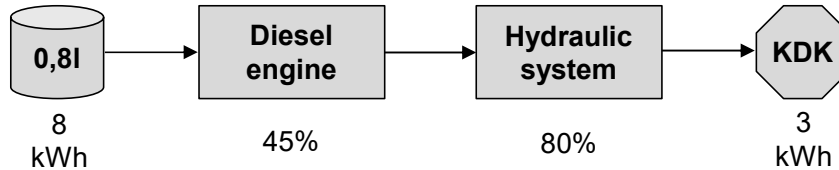
- Diesel-hydraulic

1 Liter Diesel eq.  
1 Liter Diesel



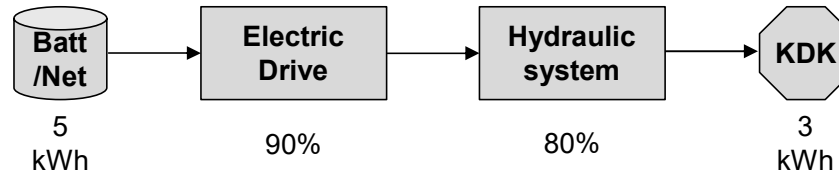
- Diesel-hydraulic with *EEP*

1 Liter Diesel eq.  
1 Liter Diesel



- Electric-hydraulic with *EEP*

5 kWh eq.  
1 Liter Diesel



Disclaimer: rounded indicative values

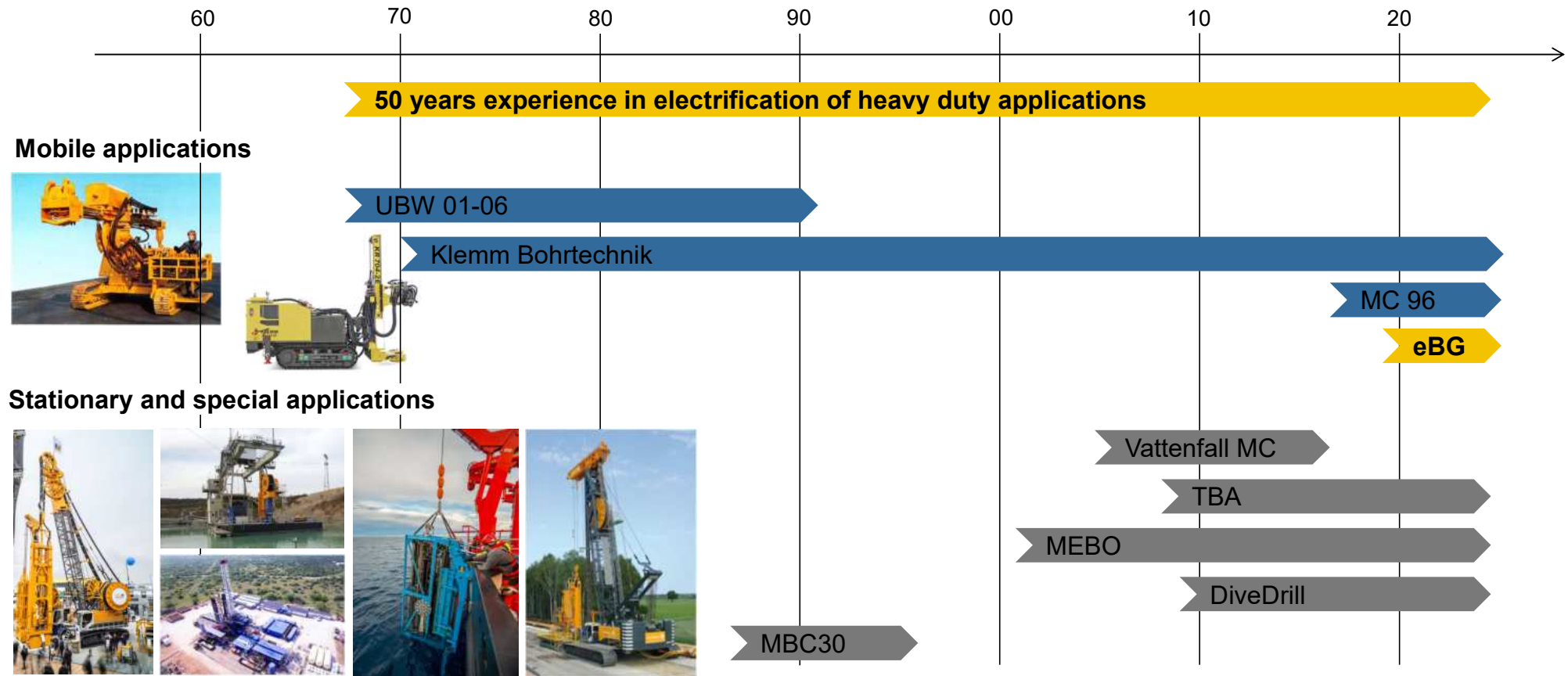
# 3

## BMA experience in electrical systems

- Overview
- Mobile applications



# Electrical systems by BMA

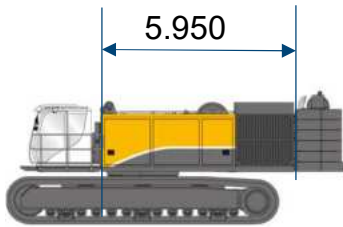


# Electrification of mobile applications

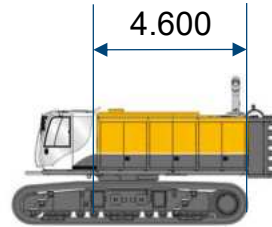
**UBW 06 / KB II**  
~ 50kW



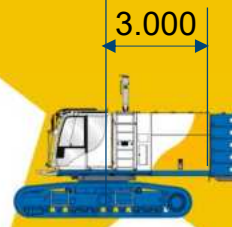
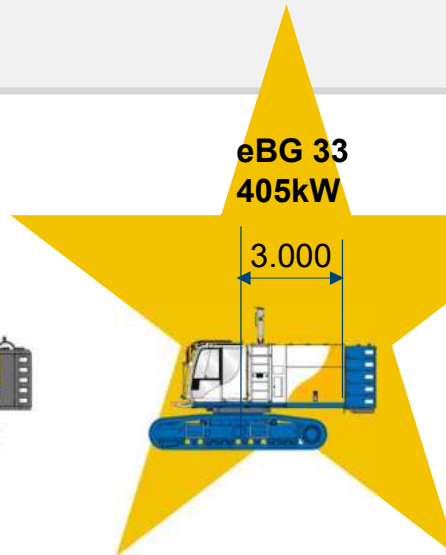
**eMC 128**  
400kW



**eMC 96**  
550kW



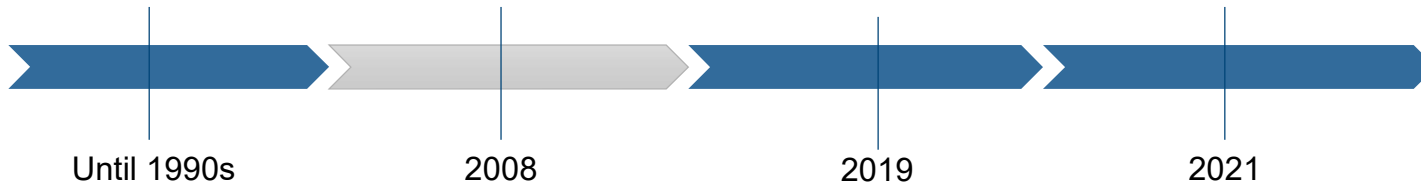
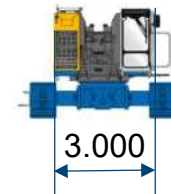
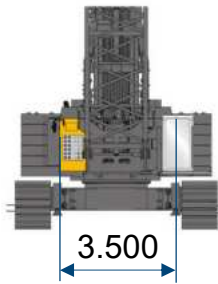
**eBG 33**  
405kW



## Increase of Power Density

- Electric motor with 405 kW implemented in serial middle class BT carrier
- Significant increase in performance density

Width 2.500





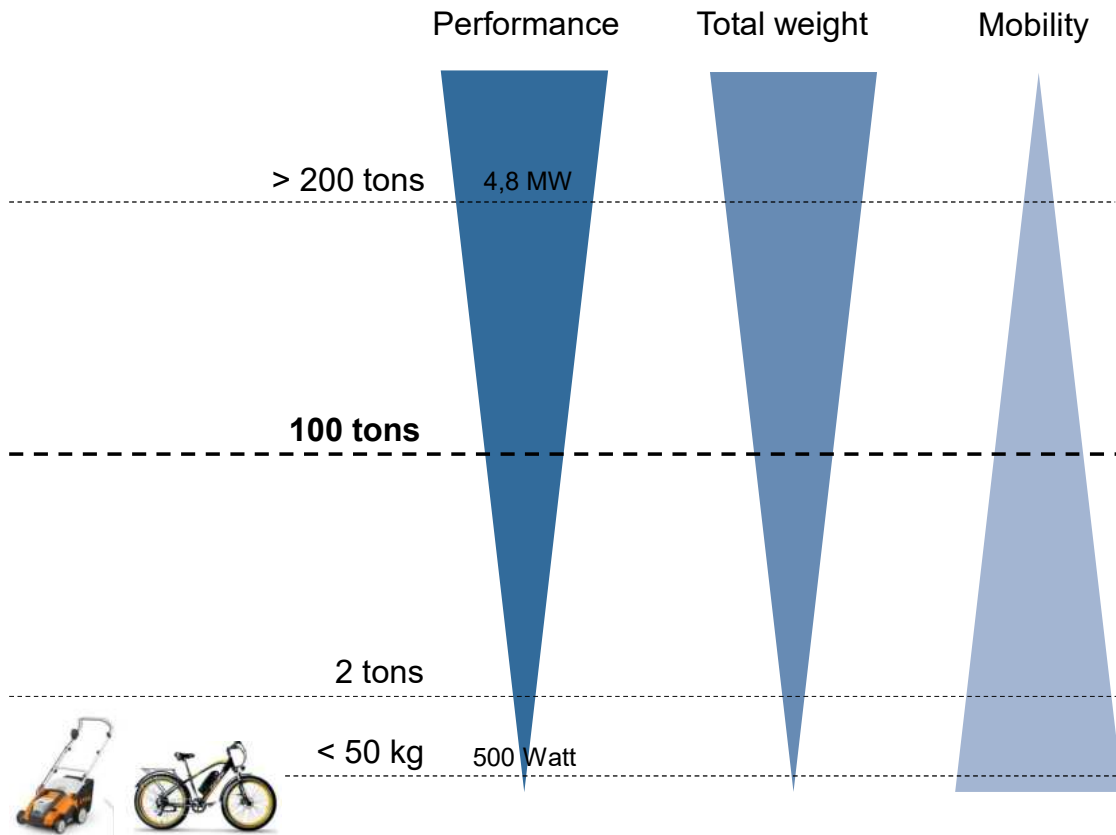
# 4

## Electrification of high performance applications

# What does electrification look like?

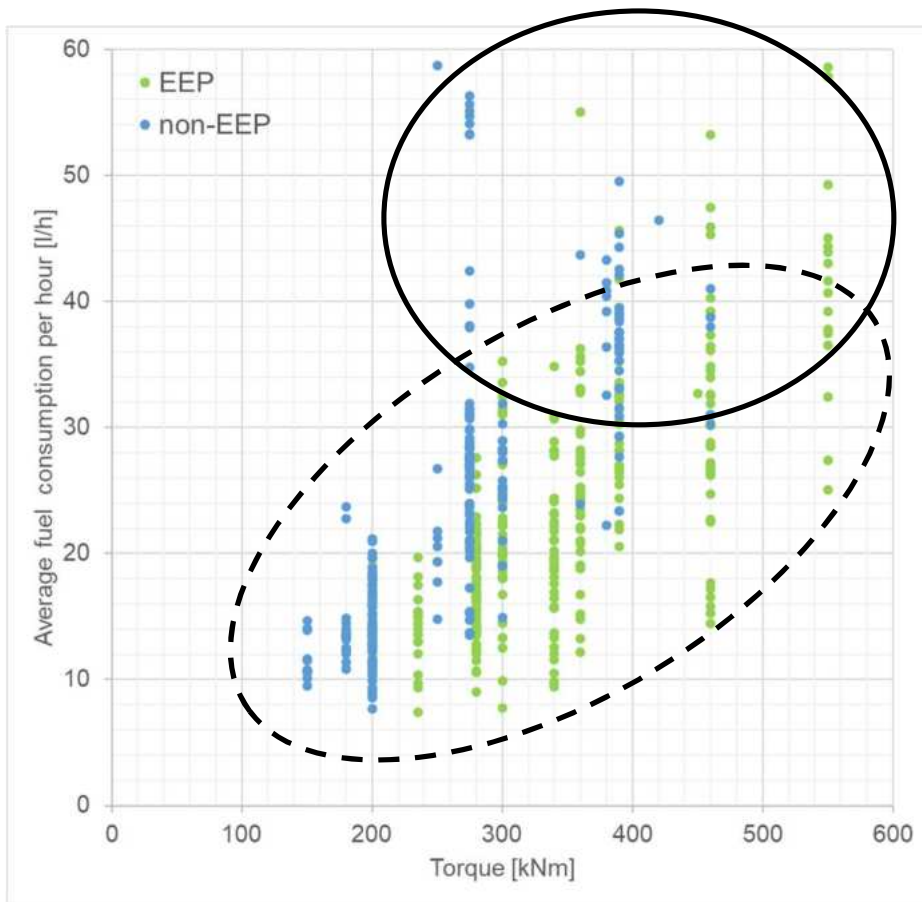


## Challenges in special foundation





# Wide range of fuel consumption for drilling rigs

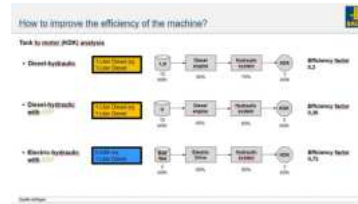


Fuel consumption with diesel engine /8h

Energy amount with electrified machine /8h

**High performance**  
 240 – 480l      1200 – 2400kWh  
**Multi purpose**

**Low performance**  
 60 – 240l      300 – 1200kWh  
**Mainly Kelly**



From efficiency factor analysis

5 kWh eq.  
1 Liter Diesel

# Impacts on carrier architecture

## Comparison of energy storage volume, per average 8h shift

**High performance**  
**Multi purpose**

400l

2000kWh in 10m<sup>3</sup>

10 ft container

Not possible with current technology

Plugged

**Low performance**  
**Mainly Kelly**

140l

700kWh in 3.5m<sup>3</sup>

5 kWh eq. 1 Liter Diesel

Unplugged

### Example from automotive technology

Audi Q4 e-tron

80kWh

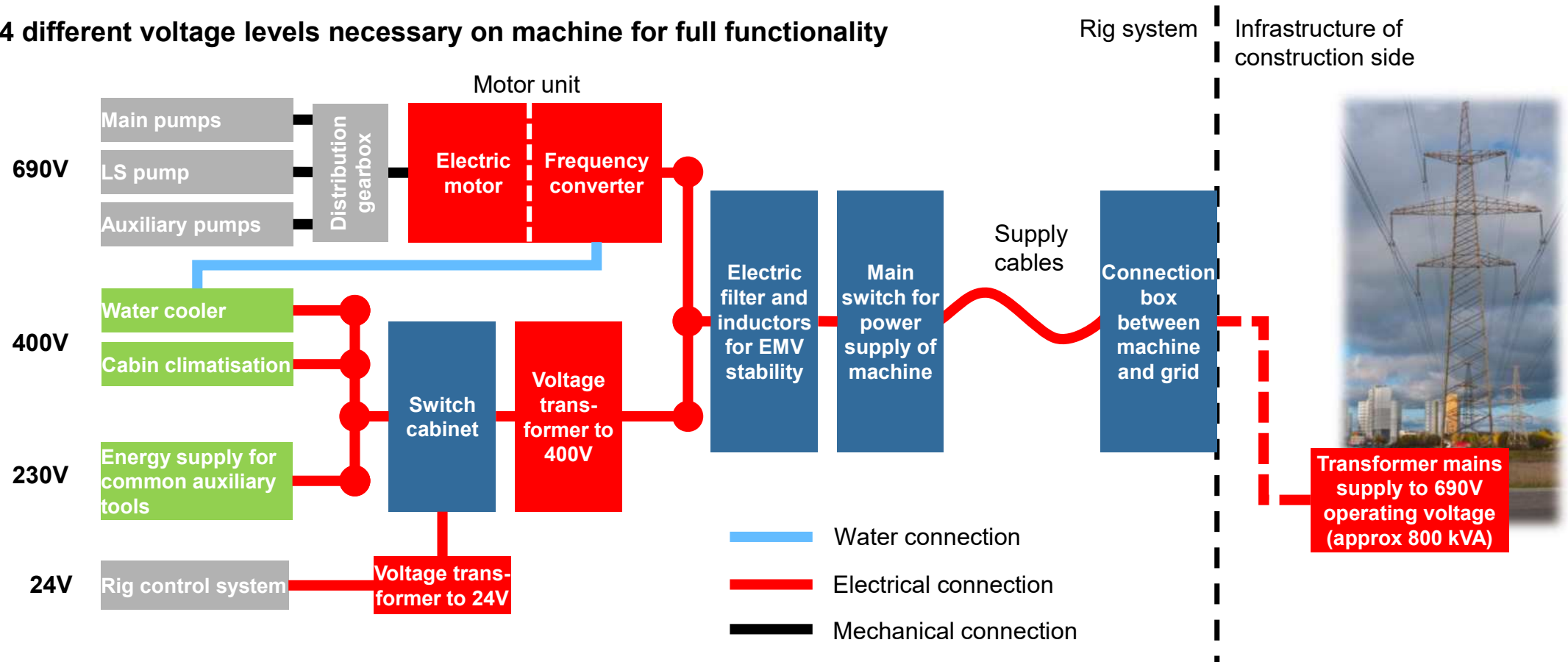


Completely different load profile:

- Power peaks instead of continuously high power demand
- Low average power

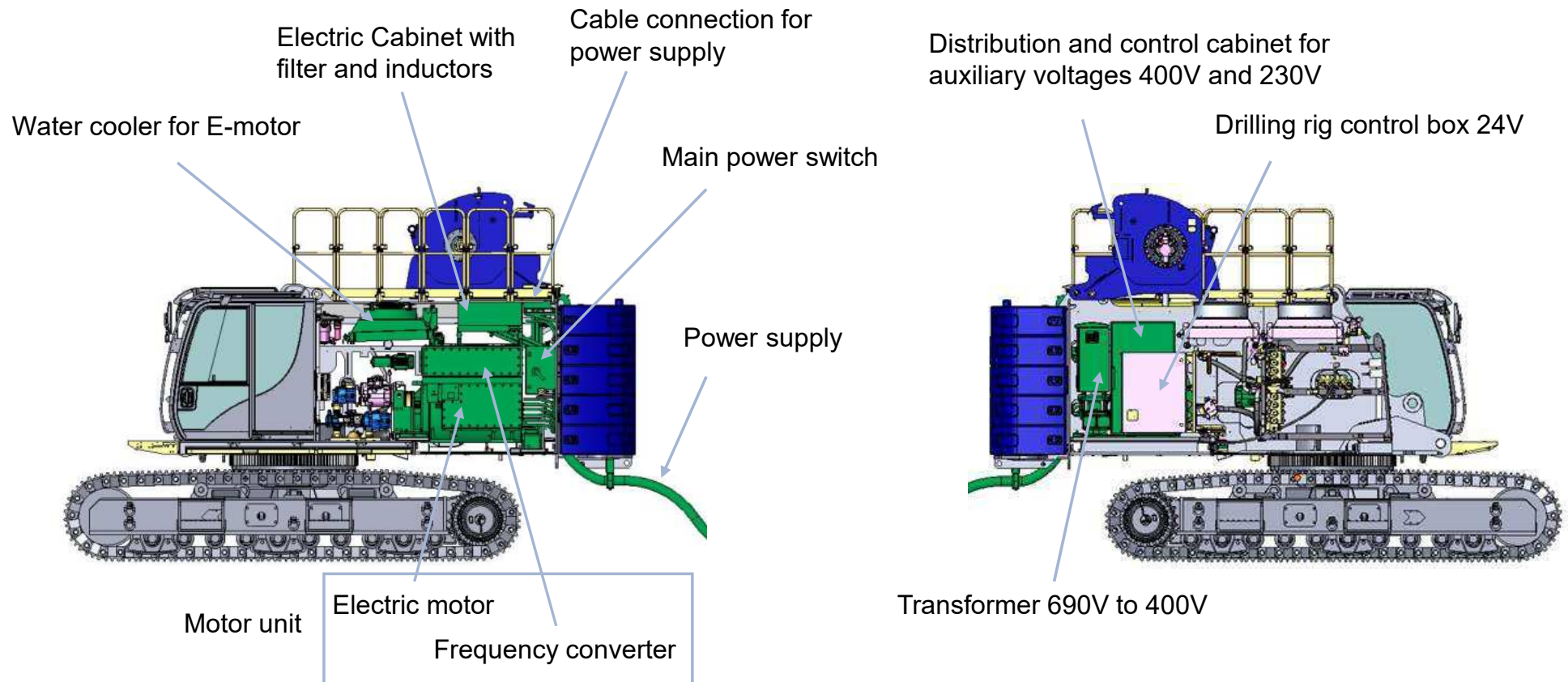
# Architecture of a plugged system

## 4 different voltage levels necessary on machine for full functionality



# Packaging of electrical system in BT 85

## Physical components



# BT 85 carrier with electrified drive unit

## Real life impressions



Serial carrier of BT 85



405kW electric motor unit



Additional electric cabinets

# 5

## eBG 33 Modern drilling rig and its benefits

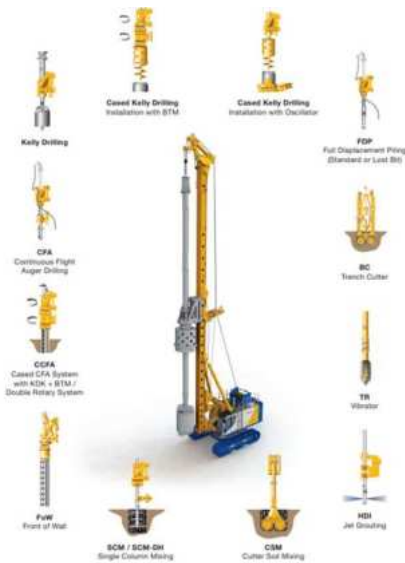


# What can be done to save energy?

Have a real close look at our **eBG 33 !**



## Apply the proper method!



## Ensure smart realisation!

- Use assistance systems!
- Train your staff!
- Gain experience!



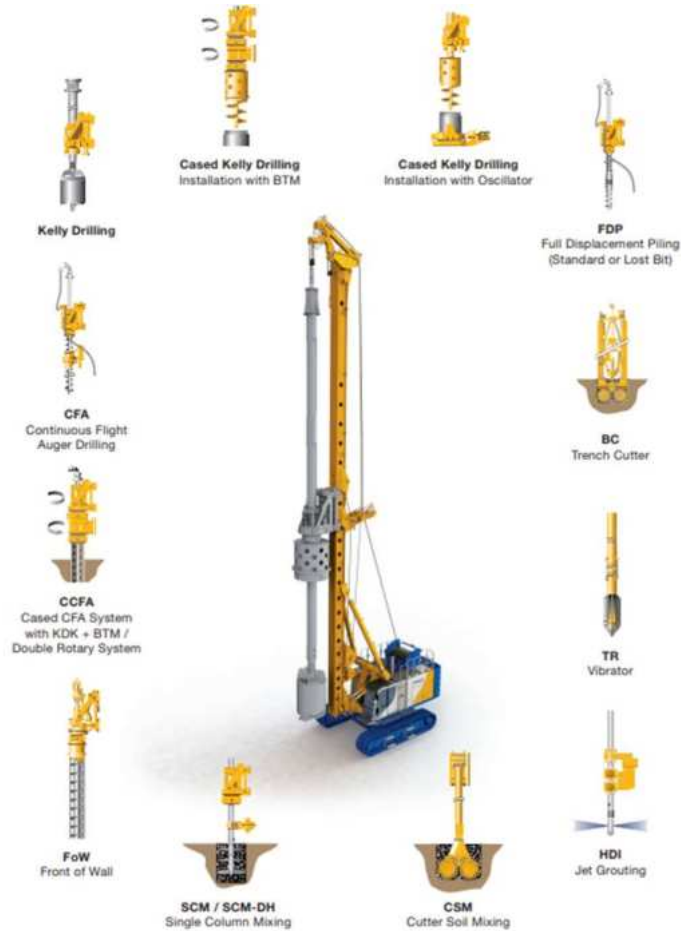
## Use efficient machines!

- Optimize efficiency factor of drive train.
- Optimize efficiency factor of hydraulic system.
- Reduce friction and pressure losses, where possible

# eBG 33 Multiple applications



## Multi application rig



- Urban, complex jobsites
- Jobs in enclosed spaces (tunnels, halls, buildings,...)
- New options for ex-protection demands and mining
- Linear construction sides, like dam renovation,
- Work in environmental sensitive areas
- And many more...
- We are curious to hear your ideas!



# eBG 33 offers full range of applications

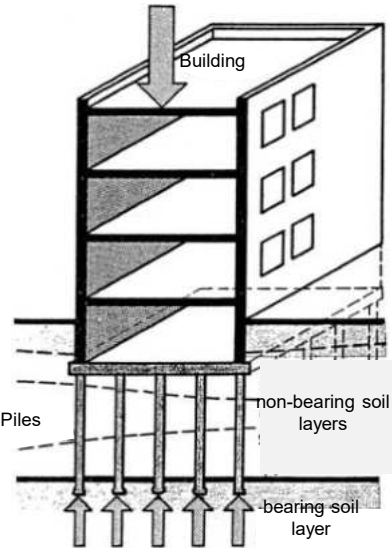


## Foundation on urban jobsite



Retaining walls

Kelly  
CFA  
CCFA  
FOW  
CSM  
Cutter



Piles

Kelly  
CFA  
CCFA  
FDP



Sealing slabs

HDI  
High pressure injection

# Contribution to sustainability goals

## Comparison eBG – Standard, high performance application, 8h shift (50l Diesel/h)

### eBG 33

#### CO<sub>2</sub> emission

- During consumption 0 gCO<sub>2</sub>/kWh
- → **local ZERO emission**



If we consider electricity production:

- 4.4 g CO<sub>2</sub>/kWh (green electricity: Offshore wind) during electricity production
- Average 250kW/h for 8 h shift = 2000 kWh
- → **8.8 kg CO<sub>2</sub>/shift**
- → **8.8 kg CO<sub>2</sub> total global emission per shift**

5 kWh eq.  
1 Liter Diesel

#### Noise emission

- Sound power level 107 dB(A)
- → 50% sound power of conventional machine
- → Significantly reduced noise perception

### Diesel powered equipment

#### CO<sub>2</sub> emission

- Only consumption 2,65 kgCO<sub>2</sub>/l
- → **1 t CO<sub>2</sub>/shift local emission at site**



If we consider diesel production:

- Additional 640 g CO<sub>2</sub>/l
- Average 8h \* 50 l/h = 400 l
- → **256 kg CO<sub>2</sub>/shift emission in production**
- → **1,3 t CO<sub>2</sub> total global emission per shift**

#### Noise emission

- Sound power level 110 dB(A)



# eBG 33 at inhouse exhibition 2021





*PASSION for  
PROGRESS*



BAUER Maschinen GmbH

# BAUER Cube System

... to enable the construction of D-walls, where you never thought before

2021-12-16



# Agenda



No.	Agenda topic
1	Motivation
2	Our Background
3	The Cube System
4	How it works
5	BAUER Cube System Test

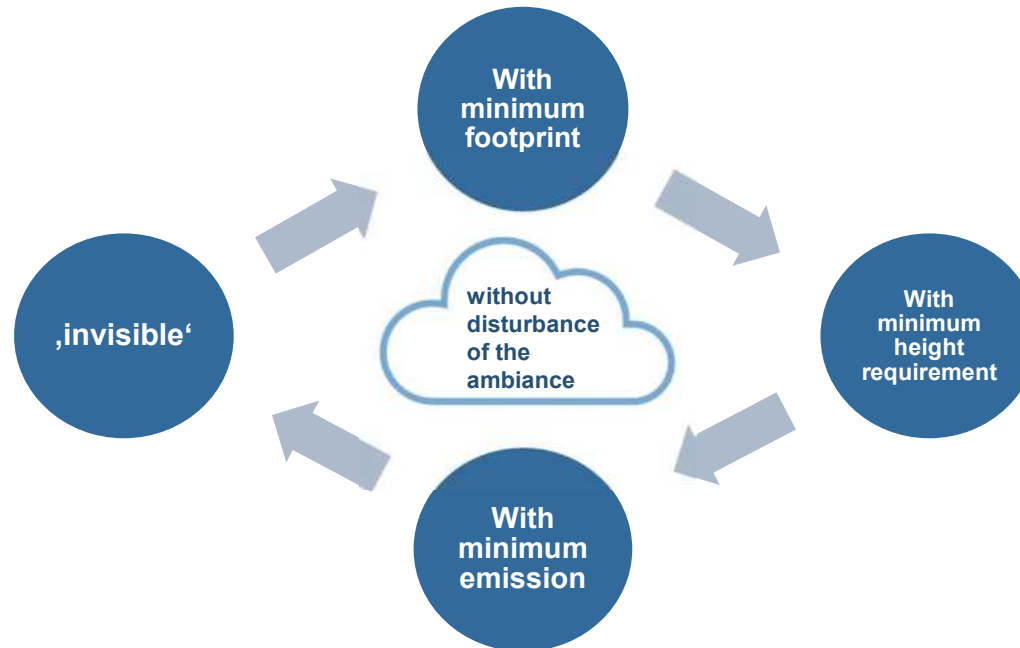
# 1

## Motivation





➔ Demand for new equipment, which can operate





# 2

## Our Background



A cooperation ...



between the construction specialist

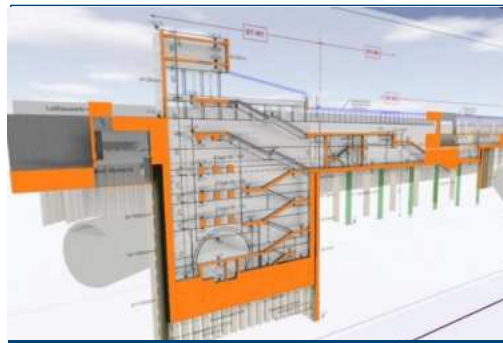


and the equipment specialist **BAUER Maschinen GmbH**

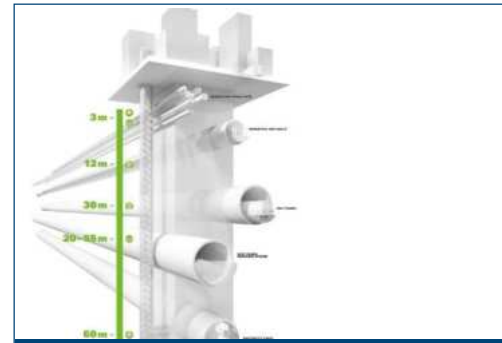
... to enable the construction of D-walls, where you never thought before



Underground parking space



Addition of underground space to existing metros/building



Working under the city in confined spaces



Logistic space under airport/runway



Construction of dams



Water storage / underground building



Extending / renovation of utility tunnels



Creating space for energy storage underground

# Combined experience



1984: first BAUER Trench cutter

**37 years experience** in trench cutter units

More than **350 units** operating worldwide

Many successful **challenging projects**

Up to 2.5 m  
wall thickness

Down to 250 m

Rock strength  
up to 200 MPa



2019: FalCon project – 250 m record



- More than **60 years** of experience in tunneling and foundations works



## Working in confined space

### Schuhman – Josaphat (Brussels, 2008 – 2012)

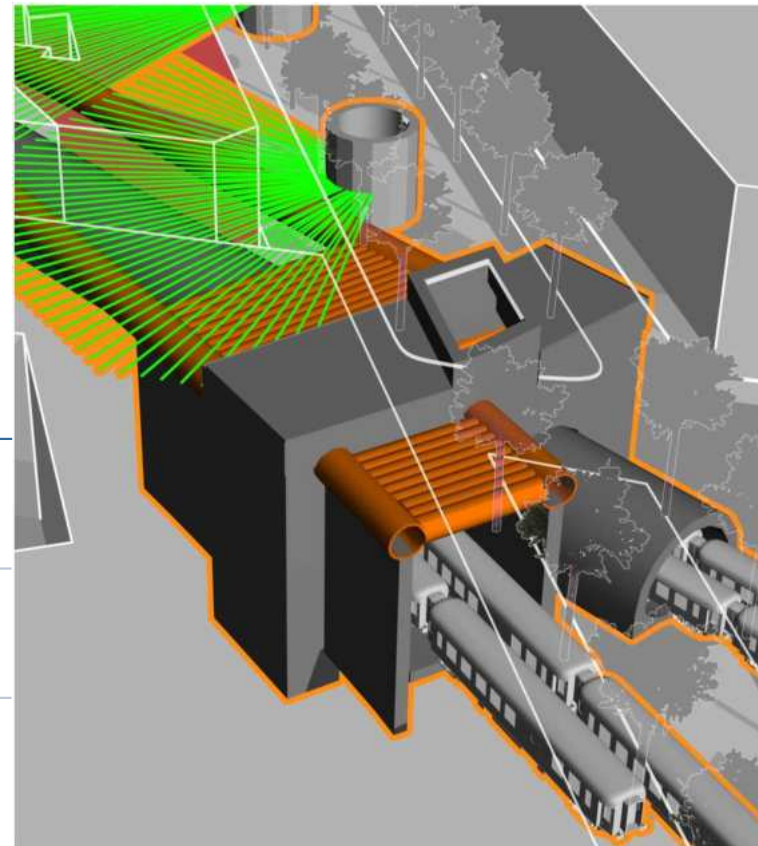
Underground railroad connection

by **DENYS**

**Minimal  
socio-  
economic  
impact**

Installation from a 6 m by 8 m vertical shaft at the surface

Partly underneath historic buildings



# Working in confined space

Schuhman – Josaphat (Brussels, 2008 – 2012)

Underground railroad connection

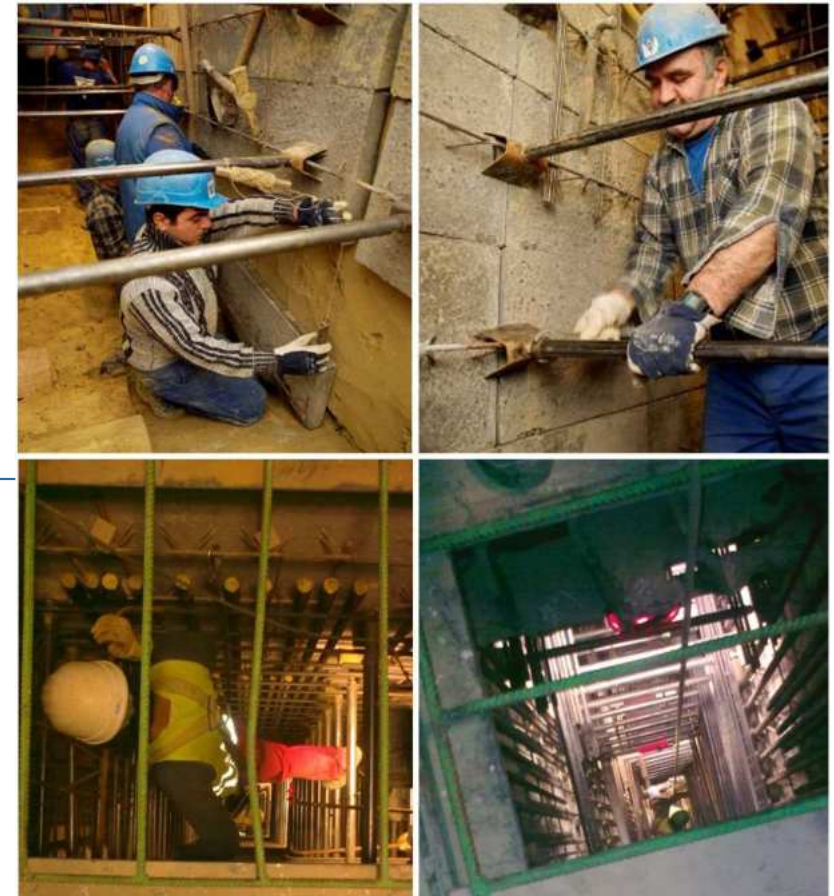
by **DENYS**

## Deep braced excavations

*State of the art*

Risk analysis	Danger of falling persons and objects
	Presence of harmful gases
	Hazard of collapse of the trench
	Long term health issues due to non-ergonomic work conditions

**Deep braced excavations are applied by lack of alternative methods.  
Only possible above groundwater.**



## Working in confined space

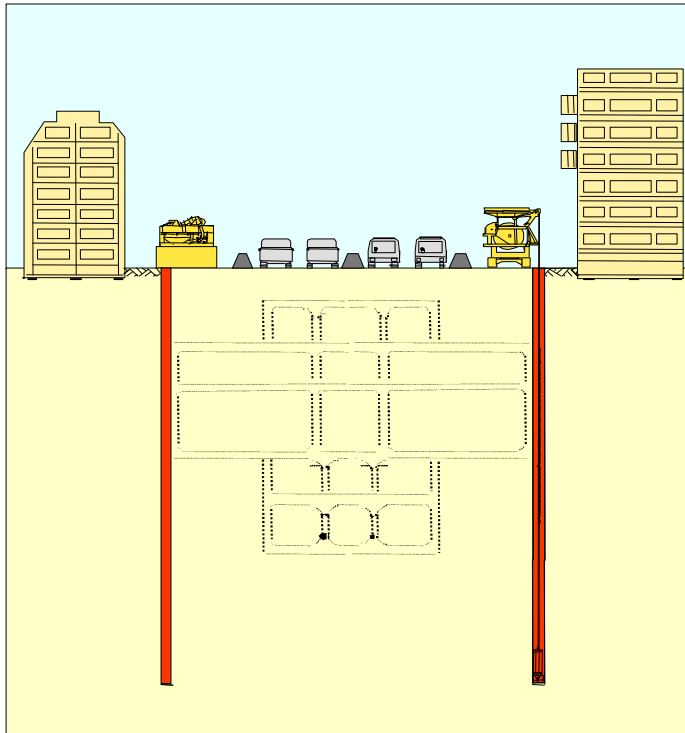
### Tokio Subway Station - Lowhead Cutter in 1991



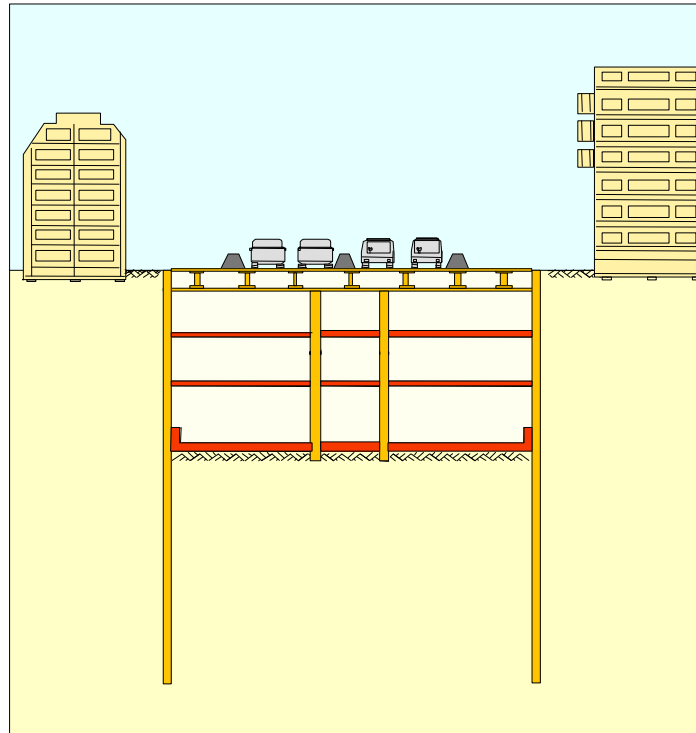
# Working in confined space



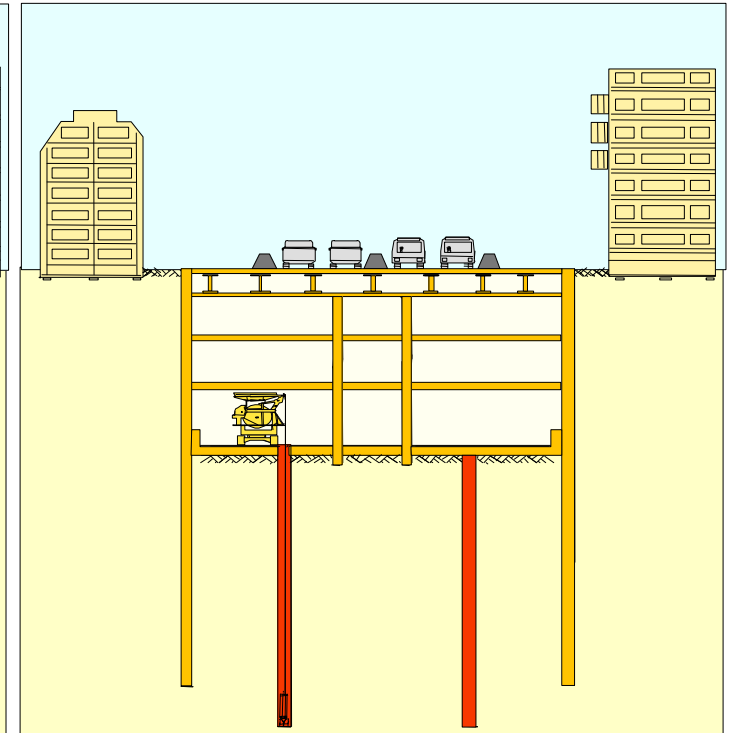
## Tokio Subway Station



Construction of **outer walls**



Construction of the **upper floors**

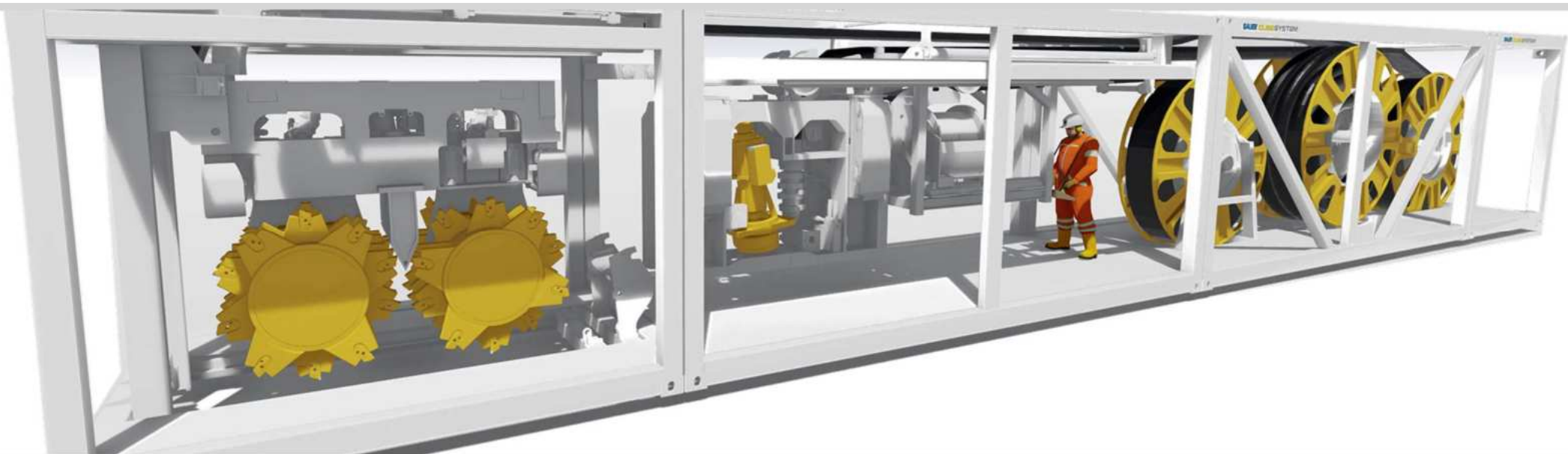


Construction of **inner walls**  
from the lowest level

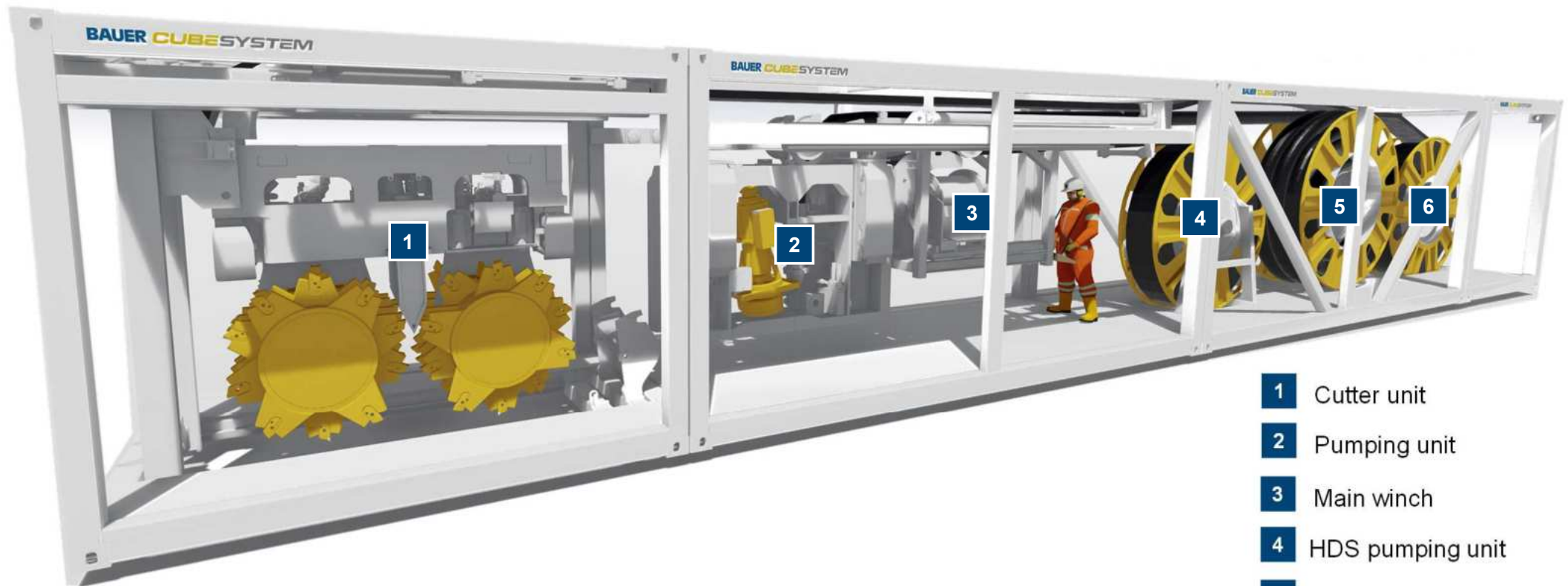


# 3

## The Cube System

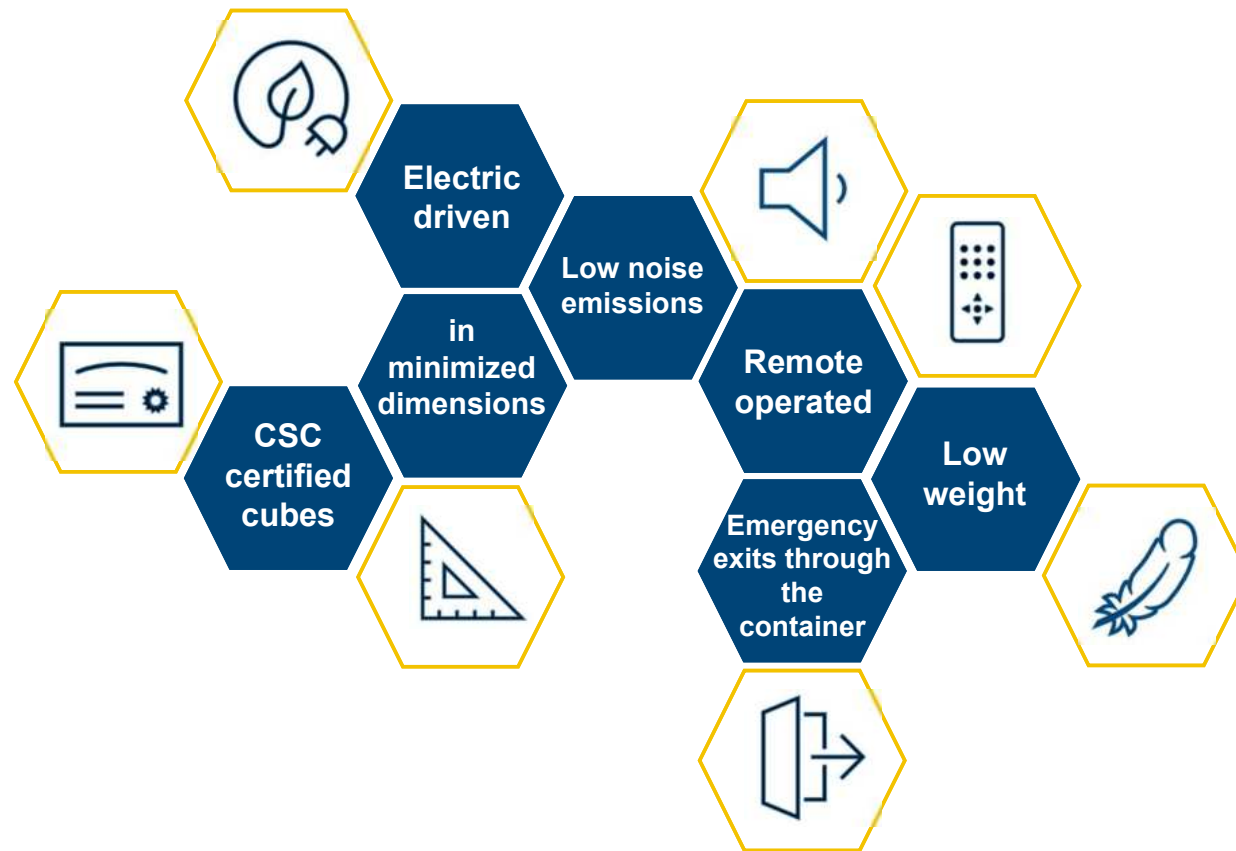


# The Cube System



- 1 Cutter unit
- 2 Pumping unit
- 3 Main winch
- 4 HDS pumping unit
- 5 HDS mud hose
- 6 HDS cutting unit

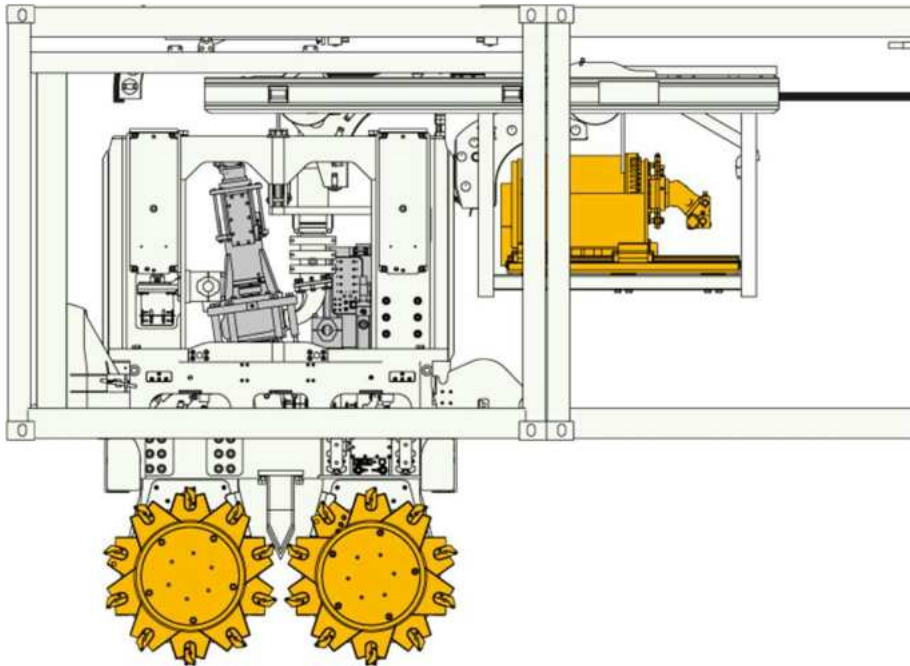
## → We offer the complete Cube System



# Cutter



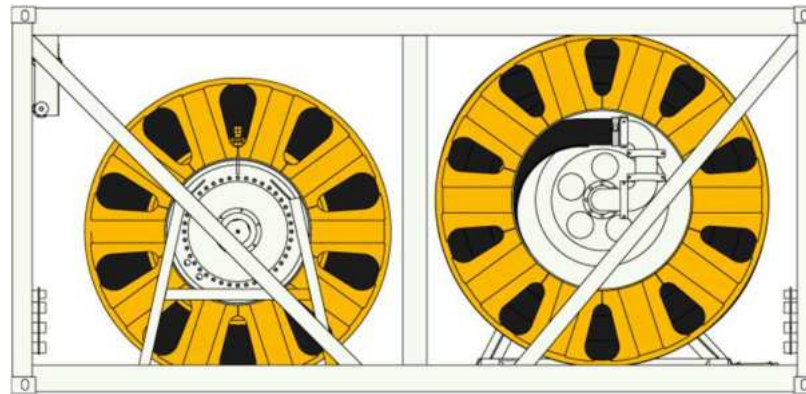
## Cutter assembled



### Technical Specifications

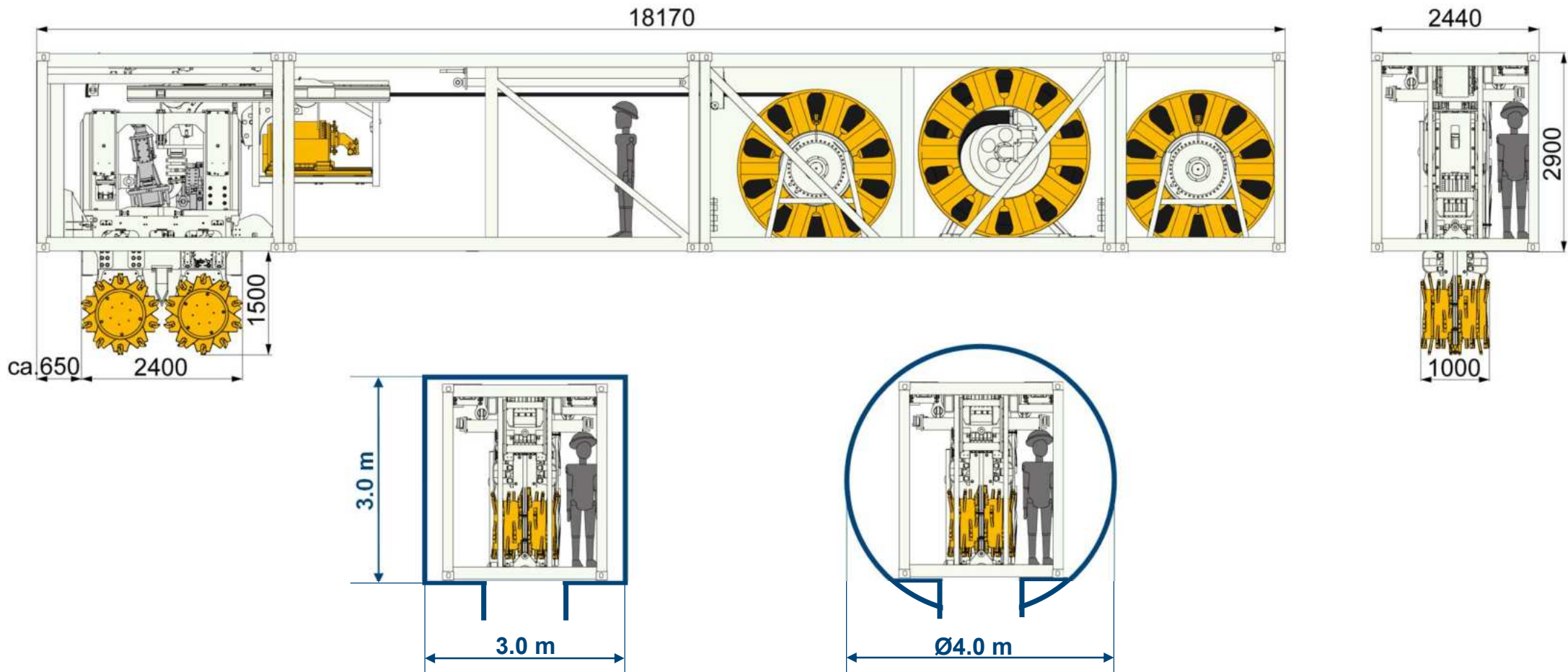
<b>Cutter height</b>	3,600 mm
<b>Trench length</b>	2,400 mm
<b>Trench width</b>	640 mm – 1,000 mm
<b>Steering flaps</b>	8 pc
<b>Hook load</b>	20 t
<b>Min. weight</b>	12.8 t
<b>Max. weight</b>	14.3 t
<b>Mud pump</b>	127 mm (5")
<b>Gearbox</b>	BCF 5 (2 x 46 kNm)

# Hose Drum System (HDS)



<b>Hydraulic hose bundle</b>	NW 32
<b>Hose Drum System</b>	HDS 40
<b>Mud Hose</b>	127 mm (5")

# Cutter Cube

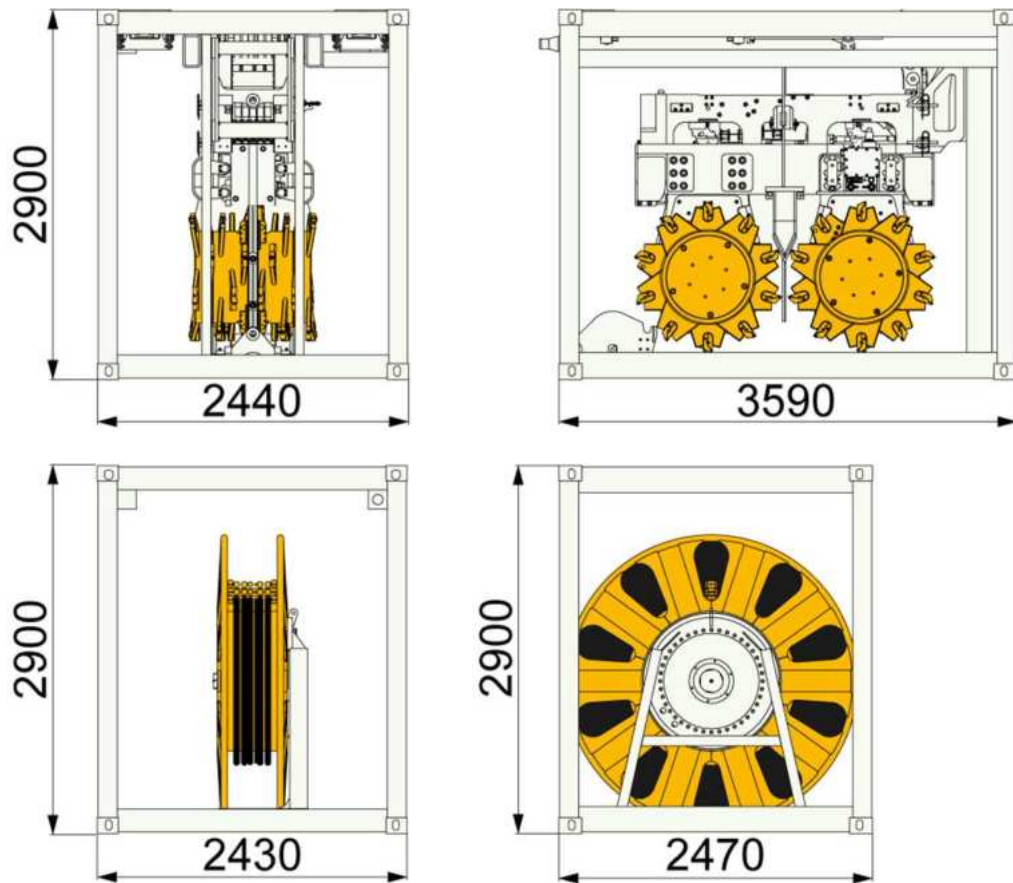


# Cutter Cube

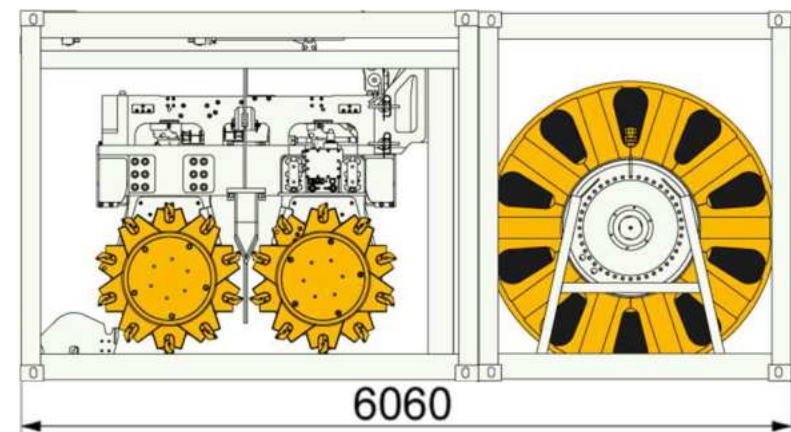


## Technical Specifications

single

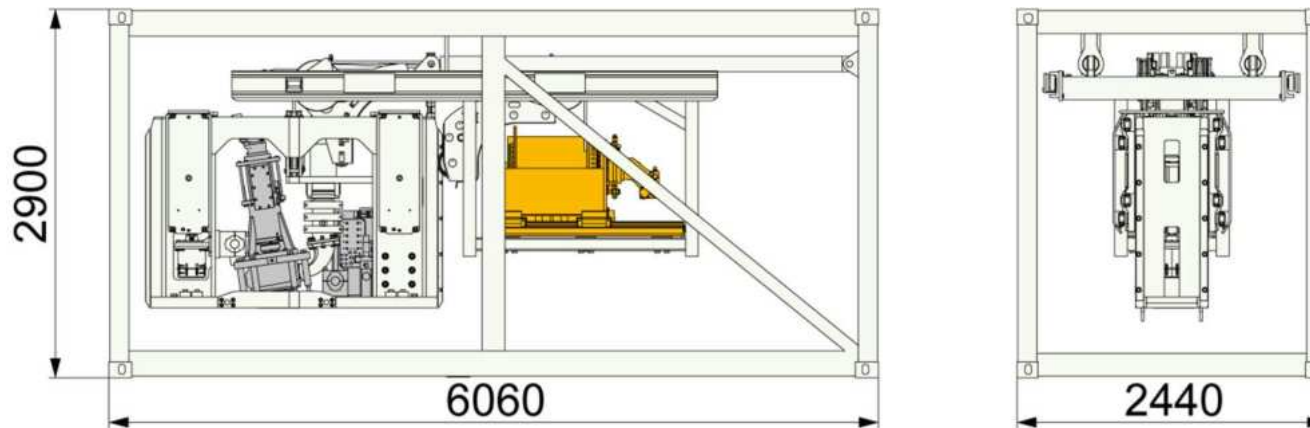


for transportation



Weight of cutter cube	13 t
Weight of cutter HHS cube	6 t
CSC (Convention for Save Containers)	Certified
CE	Certified

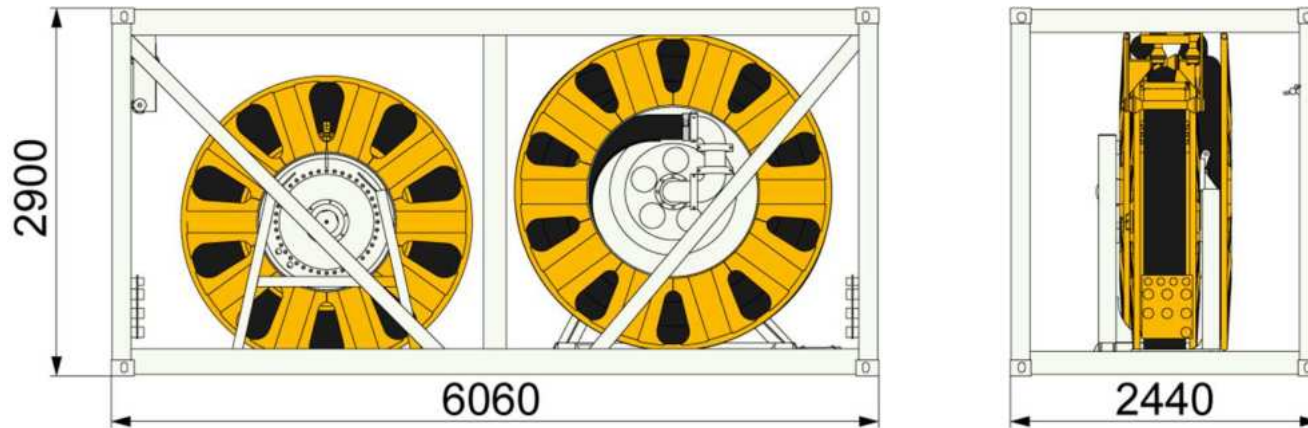
# Pumping Cube



<b>Weight of pump cube</b>	19.5 t
<b>CSC</b>	Certified
<b>CE</b>	Certified



# HDS Cube

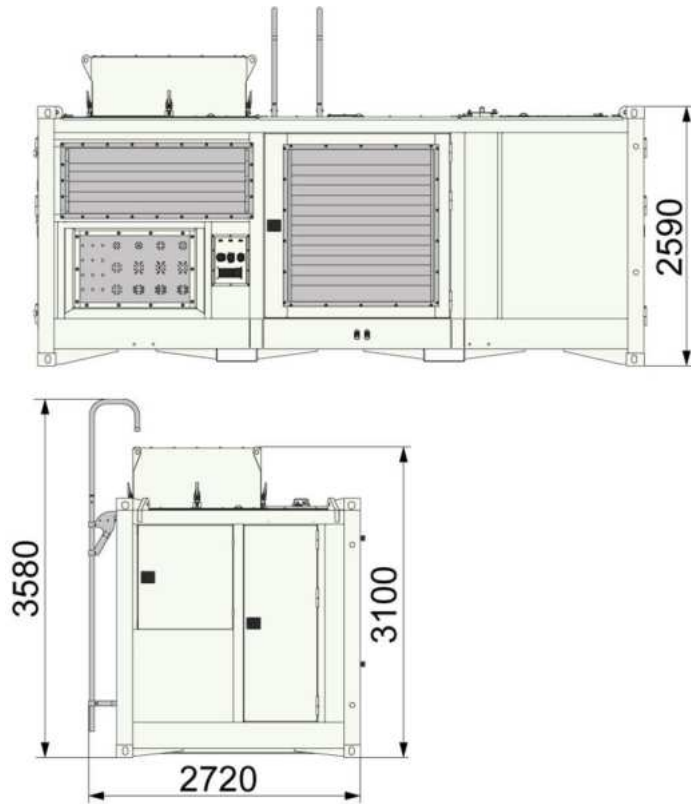


<b>Weight of pump cube</b>	10.5 t
<b>CSC</b>	Certified
<b>CE</b>	Certified

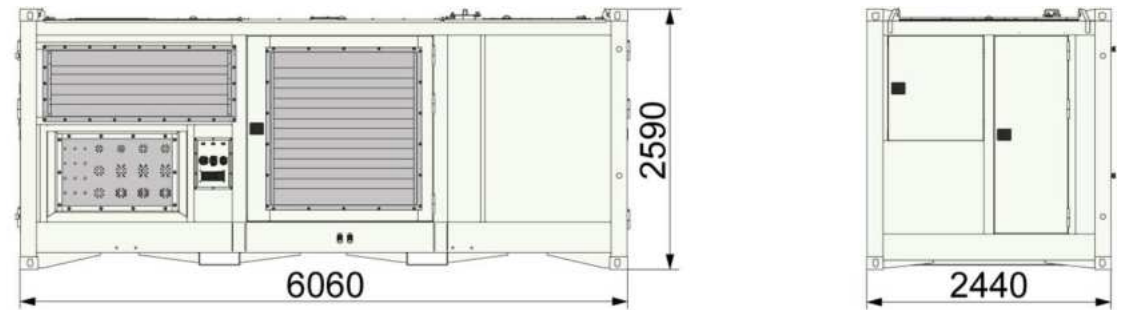
# Power cube - HE 1400 C



in operation

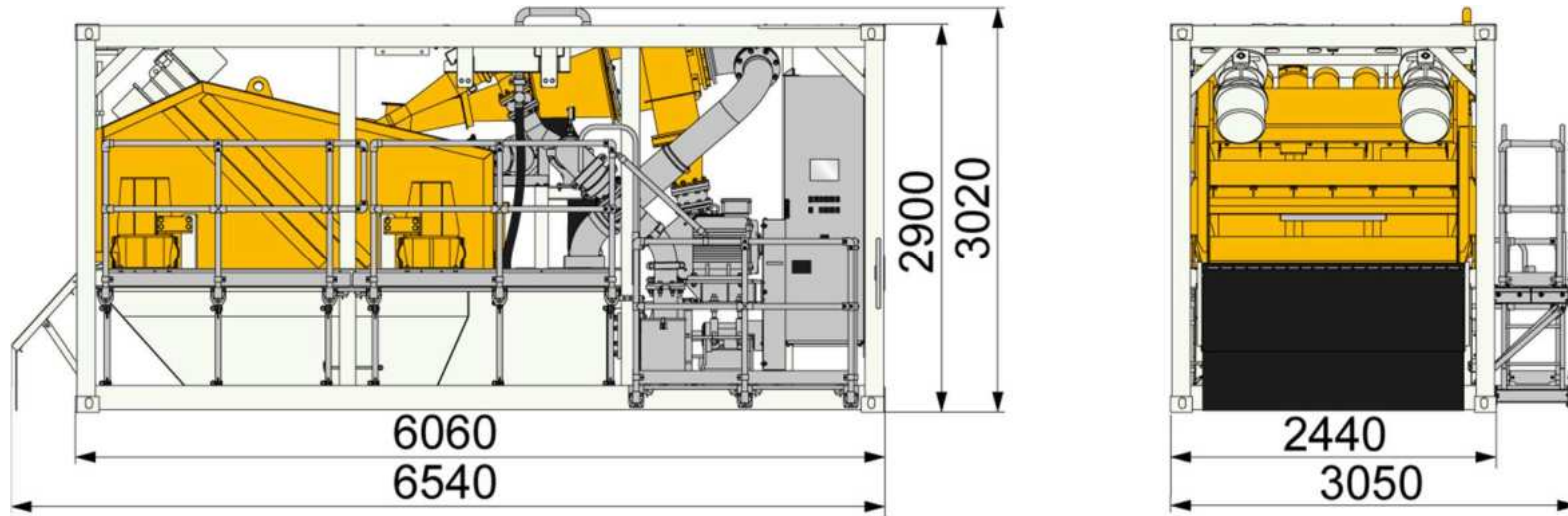


for transportation



<b>Power Output</b>	550 kW @ 1,500 rpm
<b>Weight</b>	16.5 t
<b>Sound power level</b>	105 (102 + 3) dB(A)
<b>Hydraulic flow rate</b>	3 x 345 l/min + 1 x 325 l/min + 2 x 125 l/min
<b>CE</b>	Certified

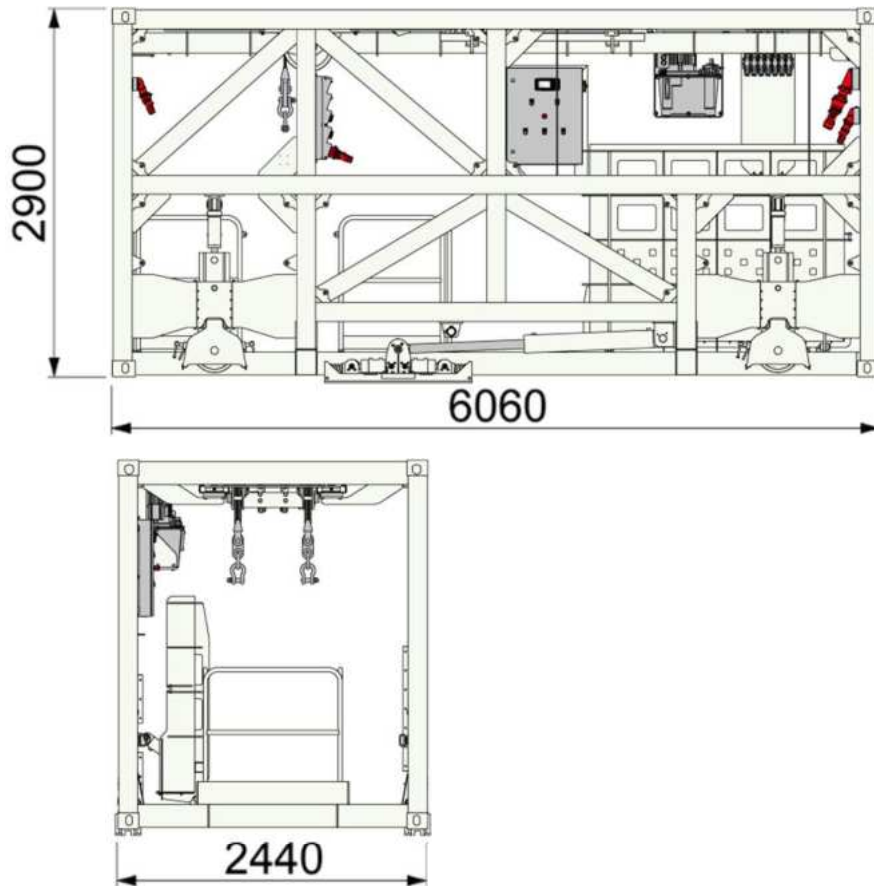
# Separator cube - BE 300 C



<b>Capacity max.</b>	300 m <sup>3</sup> /h
<b>Cut point d50</b>	30 µm
<b>Weight</b>	12.0 t
<b>CSC</b>	optional
<b>CE</b>	Certified

Further information: BAUER MAT BE 300-C [Trennen \(bauer-mat.de\)](http://bauer-mat.de)

# Reinforcement- and Concreting Cube



## Technical specifications

**Main lifting capacity** 15 t

**Auxiliary lifting capacity** 1 t

**Tremie pipe rack** 19 x 1.5 m

**Max. height reinforcement cage** 1.86 m

**Weight** 8.5 t

**CSC** optional

**CE** Certified

# Reinforcement- and Concreting Cube

## Procedure



Cutting the excavation

Positioning reinforcement cages

Setting up the tremie pipes

Concreting the excavation step by step

Dismantling the pipes piece by piece

Finished D-Wall



# 4

## How it works





# 5

## BAUER Cube System Test





# BAUER Cube System Test



## Setup

- Cube System
- Concreting Container
- Hydraulic unit HE1400
  - Sound power level: 105 dB(A)
- Desanding unit BE300
  - Sound power level (operating position): 79 dB(A)
- Reinforcement
  - Pre-fabricated cages with Lenton coupler
  - Length: 1,85 m
- Discharge pipes
  - Inner diameter: 150 mm
  - Length: 1,5 m

# BAUER Cube System Test



## Scope of work

- 7 Trench locations
  - 5 Primaries
  - 2 Secondaries (both reinforced)
  - Cutter dimensions 2400 x 1000 mm
- Depth
  - 6 trenches to a depth of 15 m
  - 1 trench to maximum depth of 42 m
- Simulation of rock embedment
  - Cut 1 secondary twice
  - Concrete (“rock”) strength around 45 MPa

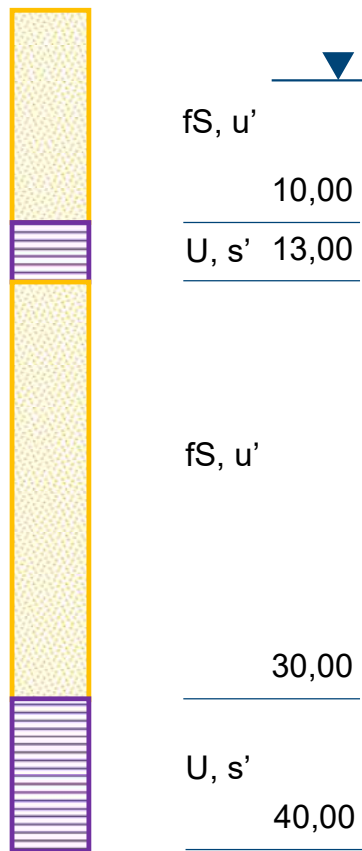
# BAUER Cube System Test



## Test site in Aresing

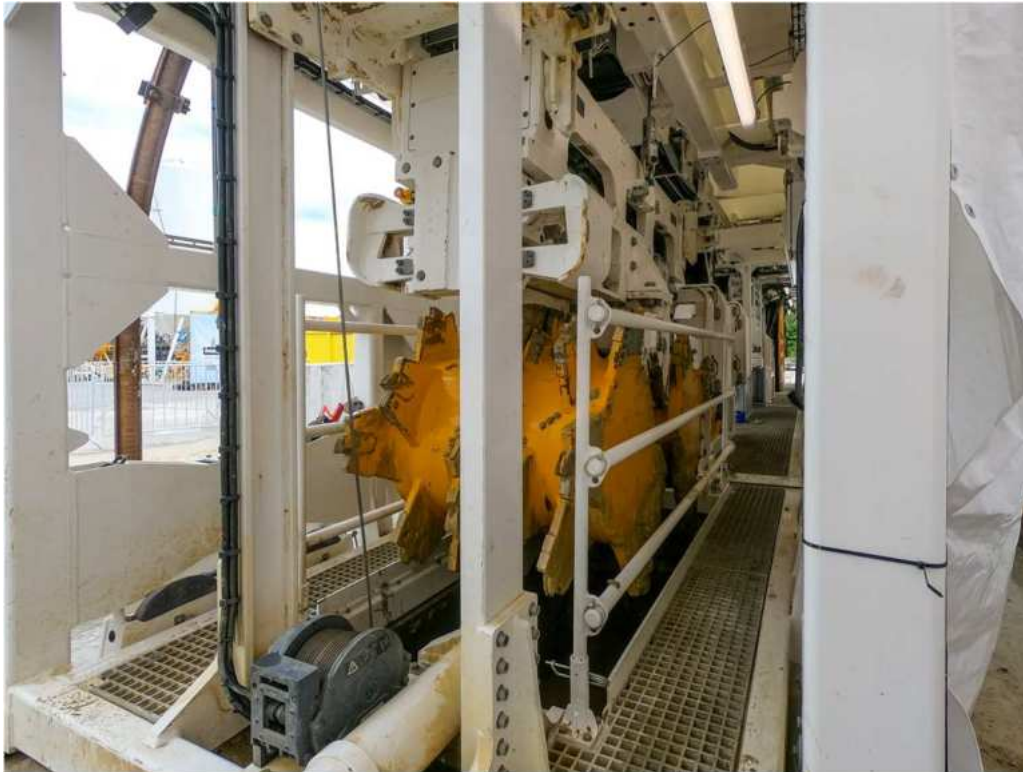


# BAUER Cube System Test



## Soil profile

- Alternating
  - Sand
  - Clay
- Use of Decanter for longer utilization of slurry



## Results

- Progress rates
  - 15-25 cm/min primaries
  - 1-5 cm/min for “rock embedment”
  - 42 m trench depth is the limit for HDS drums and winch
  - Time to connect cutter unit and pumping unit is about 15 min
  - Min. pre-excavation of 1,5 m
- Installation of reinforcement
  - Around 15 min per connection of segments
  - Connection height close to bottom of container
- Concreting
  - Around 3 hours (for 40 m<sup>3</sup>) using concrete pump
  - Installation of pipes by small lifting device around 1 h to 40 m

# BAUER Cube System Test



Cube System



Desanding unit



Concreting



*PASSION for  
PROGRESS*

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