



Introduction of world construction methods and trends



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Tokyo, 2017-11-29

Introduction of world construction methods and trends

Outline



- **Single Pass Piling** - Looking for faster pile installation
- **Cutter Soil Mixing** - Aiming for increasing depth achievements
- **Ground Improvement** - Known techniques, further improvements
- **Automatization** – Relieving the operator, achieving constant quality



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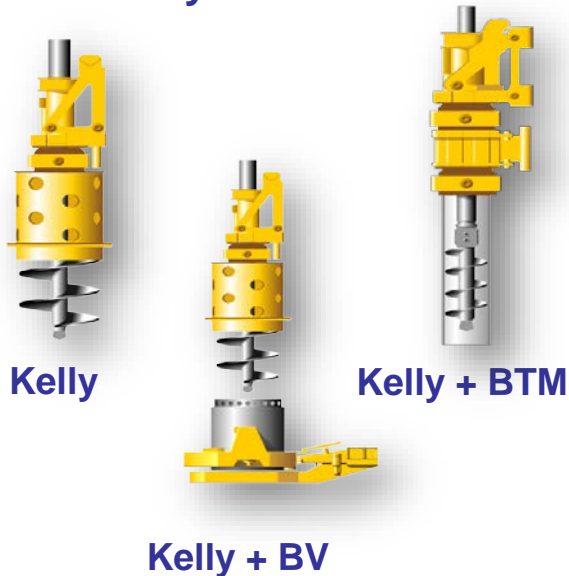
Classification

Production



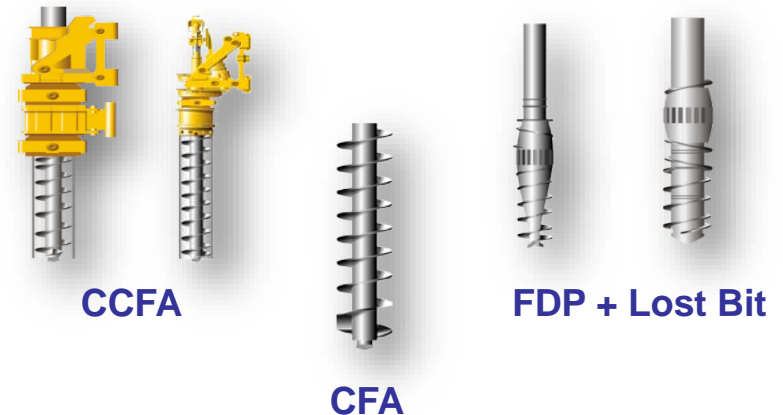
Multi Pass

- Bigger Depth
- Bigger Diameter
- Big Variety of Tools
- Very flexible
- Higher Operator Qualification necessary



Single Pass

- Higher Performance
- Higher Automation Level possible
- High Level necessary:
 - Jobsite Logistics
 - Concrete Quality
 - Reinforcement Design
- Additional Equipment (Pump, Auger Cleaner, Vibrator ...)



Drilling Method

CFA



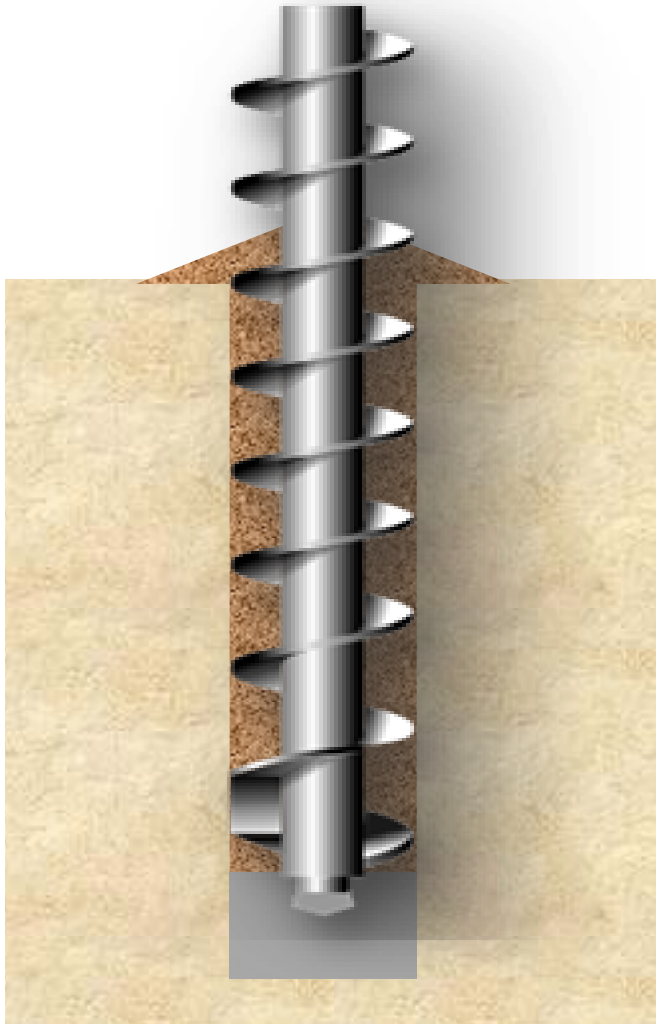
In CFA, a continuous flight auger with hollow stem is screwed into the soil with controlled penetration rate.

After reaching the final depth, concrete is pumped through the hollow stem with constant pressure during pulling.

Finally the reinforcement cage is installed to desired depth into the fresh concrete.

Drilling Method

CFA



Sidewall support is done by the cuttings on the flights as well as by the pumped concrete.

The RPM to penetration rate is essential, to avoid side wall erosion or cork screw effect.

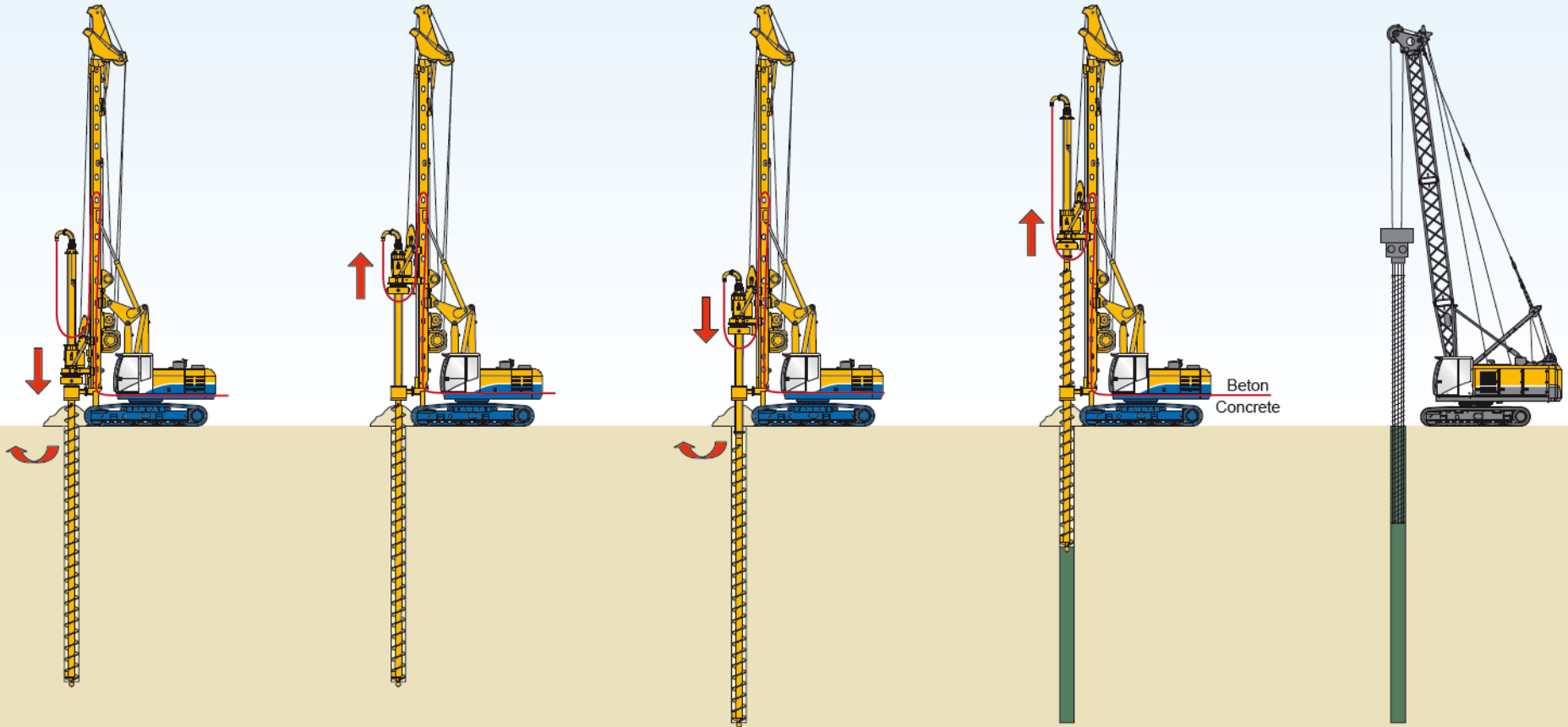
Geology:

- Shear resistance: $c_u > 15 \text{ kN/m}^2$
- No boulders
- cohesive, non-granular soils

Usage:

- Foundation
- Pile walls (restricted)

Drilling Method CFA



Drilling
down

Extending

Drilling to
final depth

Concreting

Reinforcing
w/ vibrator

Drilling Method CCFA (FoW, CCFA-BTM)



Drilling Method

CCFA (FoW, CCFA-BTM)



Two counter-rotating rotary's drive auger and casing.
The auger can be moved relatively to the casing.

Sidewall support by the casing as well as by the pumped concrete.

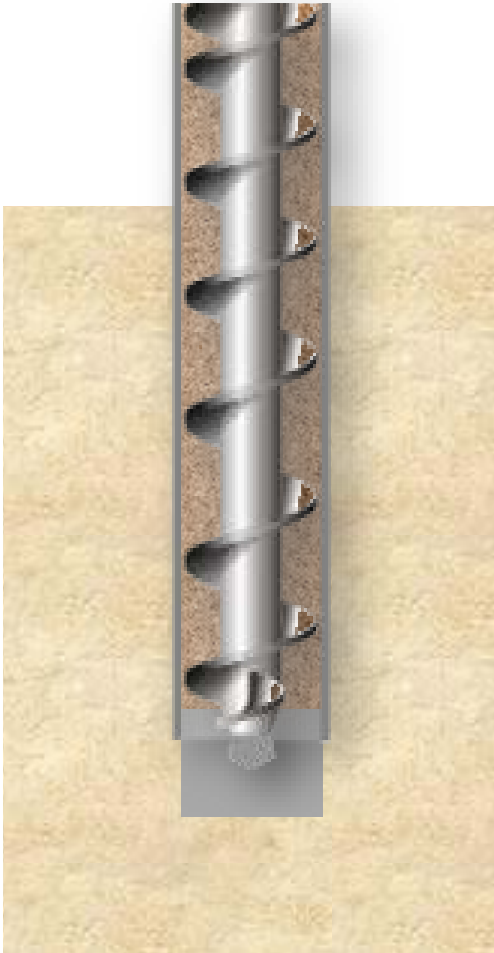
The vertical accuracy is enhanced due to the stiffness of the drill string.

Geology:

- UCS < 20 MPa
- No boulders
- Cohesive, non-granular soils
 - Conveying can be improved with pressurized air

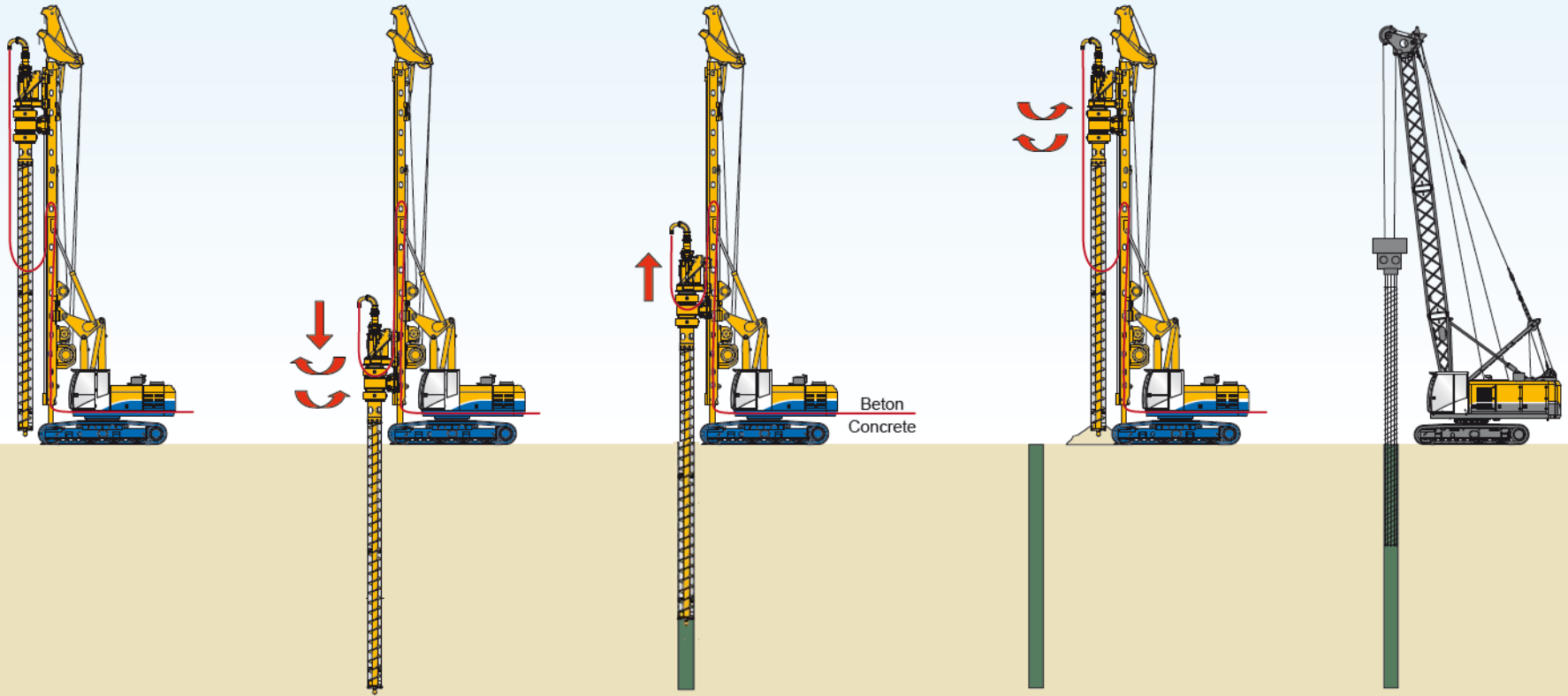
Usage:

- Foundation
- Pile wall, secant/tangent



Drilling Method

CCFA (FoW, CCFA-BTM)



Setup

Drilling to final depth

Concreting

Emptying of drill string

Reinforcing w/ vibrator

Drilling Method FDP



Drilling Method

FDP - General

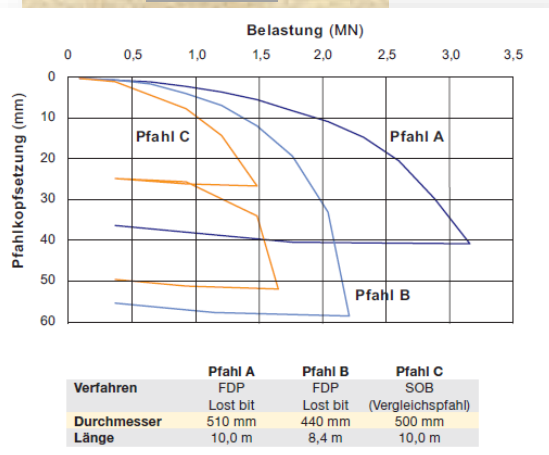


The loosened material is pushed into the side walls and densified by the displacement body.

This effect leads to an increase in shaft friction and resulting bearing capacity.

Additional advantages:

- Minimized spoil
- Reduced concrete overconsumption
- Vibration free



Geology:

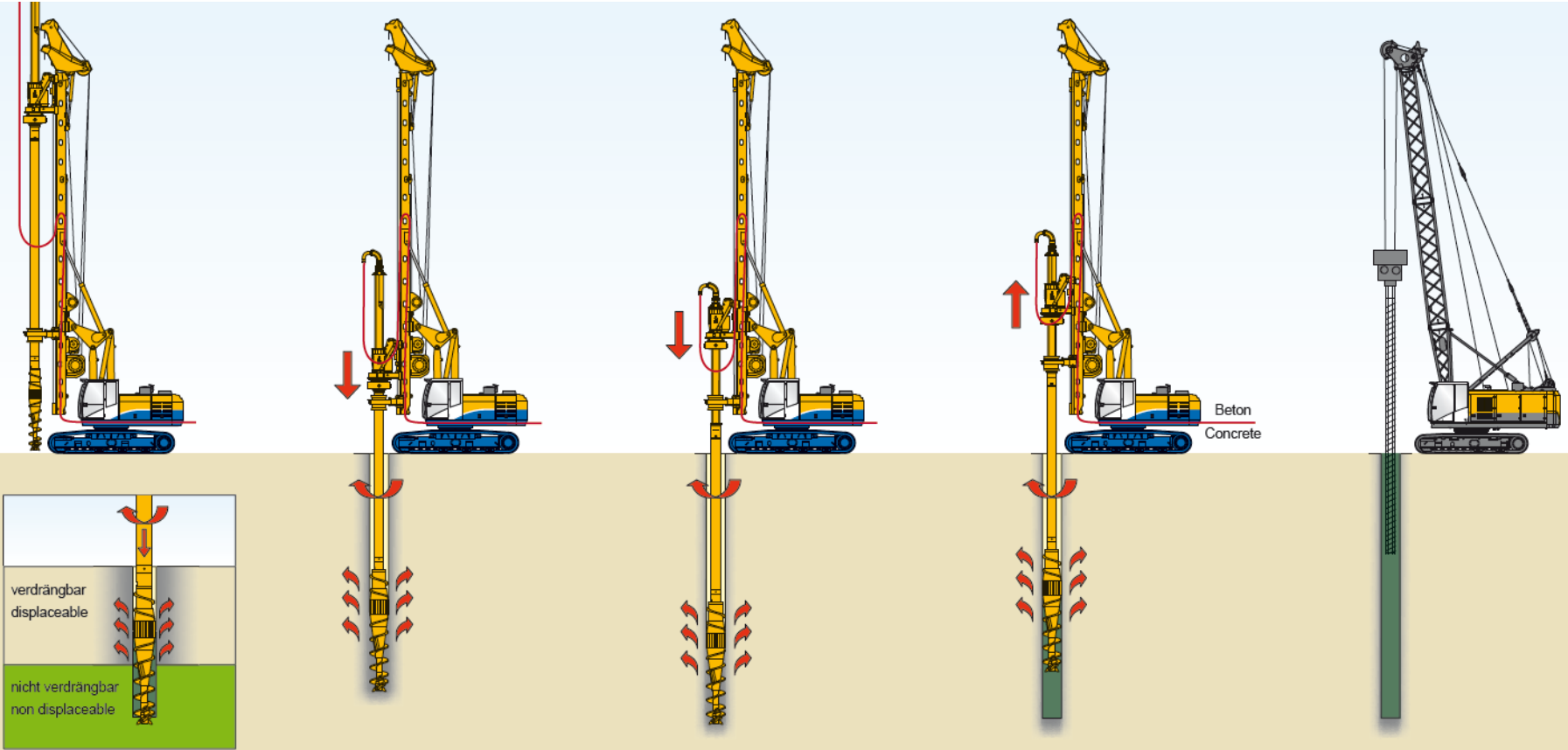
- Displaceable soils
- SPT $N_{30} < 30$ or CPT < 10 MPa
- Non displaceable layers < 1.5 m
 - Socketing depth can be increased w/ auger extensions

Usage:

- Foundation

Drilling Method

FDP - Standard



**Drilling
down**

Extending

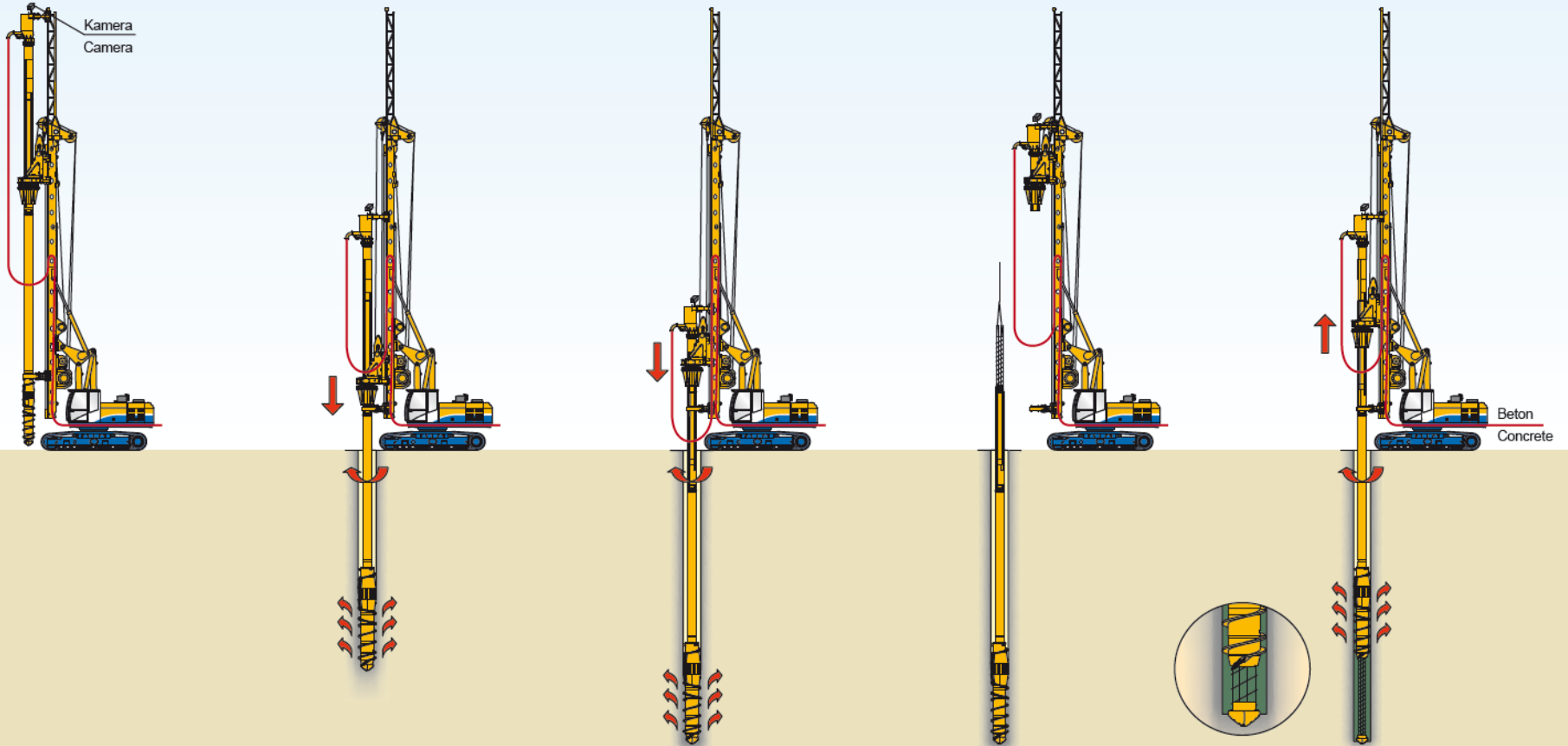
**Drilling to
final depth**

Concreting

**Reinforcing
w/ vibrator**

Drilling Method

FDP - LostBit



Setup

Drilling

Drilling to final depth

Reinforcing

Concreting

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Outline



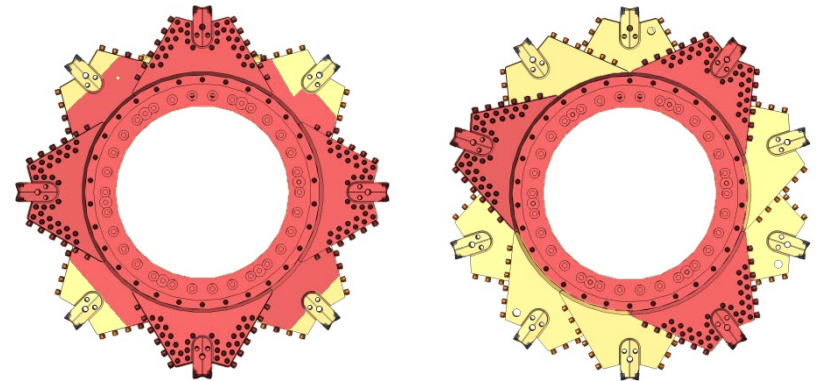
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Cutter Soil Mixing

Improvement in Depth Achievement - World Record Mixing Depth



Symmetric mixing wheels



Double cutter teeth



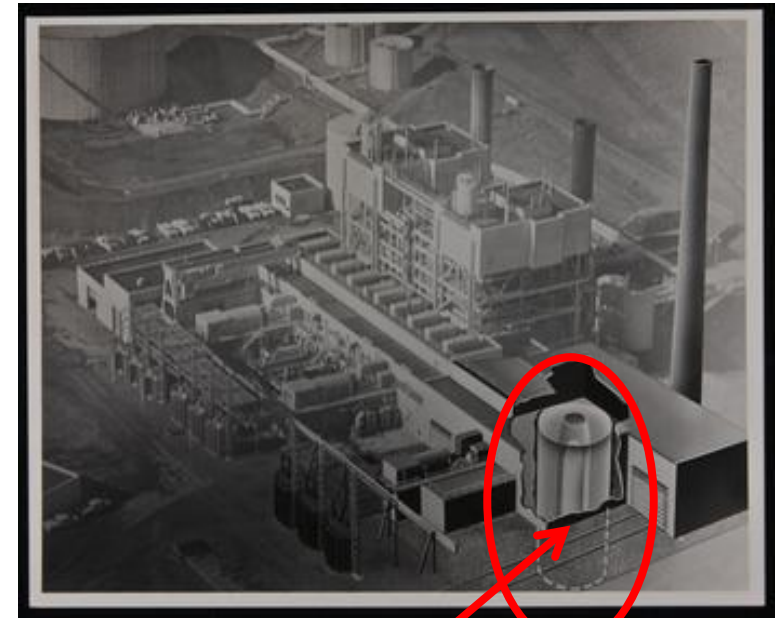
Cutter Soil Mixing

Improvement in Depth Achievement - World Record Mixing Depth



project: Eureka, California, USA; round retaining / cut-off wall for dismantling of the Humboldt Bay Nuclear Power Plant

machine: BG 50 + BCM 10, BG 40 + BCM 10



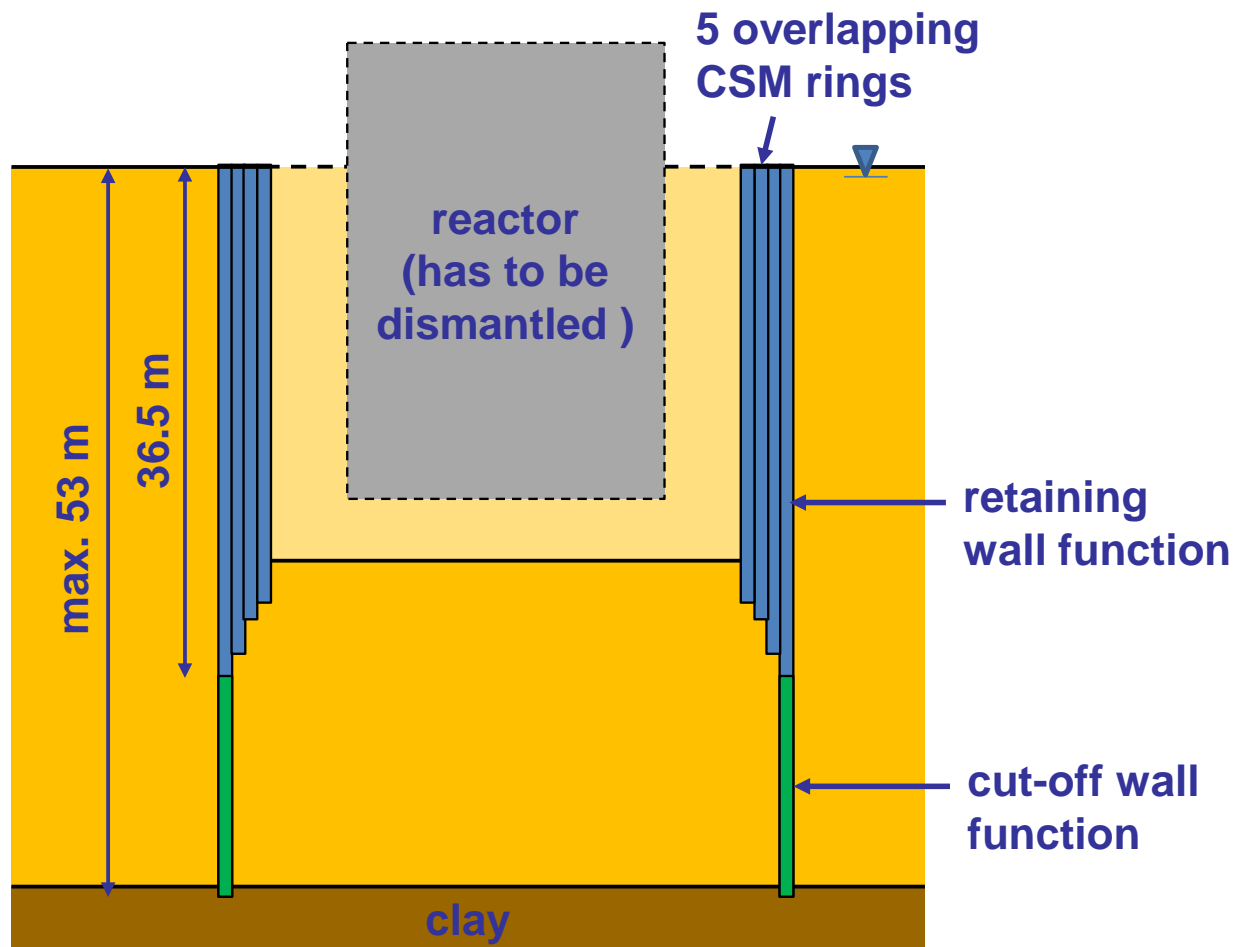
reactor

Cutter Soil Mixing

Improvement in Depth Achievement - World Record Mixing Depth



mixing width: 1000 mm
mixing depth: max. 53 m
method: 2-Phase



Cutter Soil Mixing

Improvement in Depth Achievement - World Record Mixing Depth



Cutter Soil Mixing Improvement in Depth Achievement - World Record Mixing Depth



project: Shanghai, China; installation of 3 test panels with 80 m depth

machine:

MC 64 +
TandemCuter
(BCM 10)



Cutter Soil Mixing

Improvement in Depth Achievement - World Record Mixing Depth



mixing width: 1200 mm

mixing depth: 80.11 m

procedure: 2-Phase; fresh-in-hard with 30 cm overcut



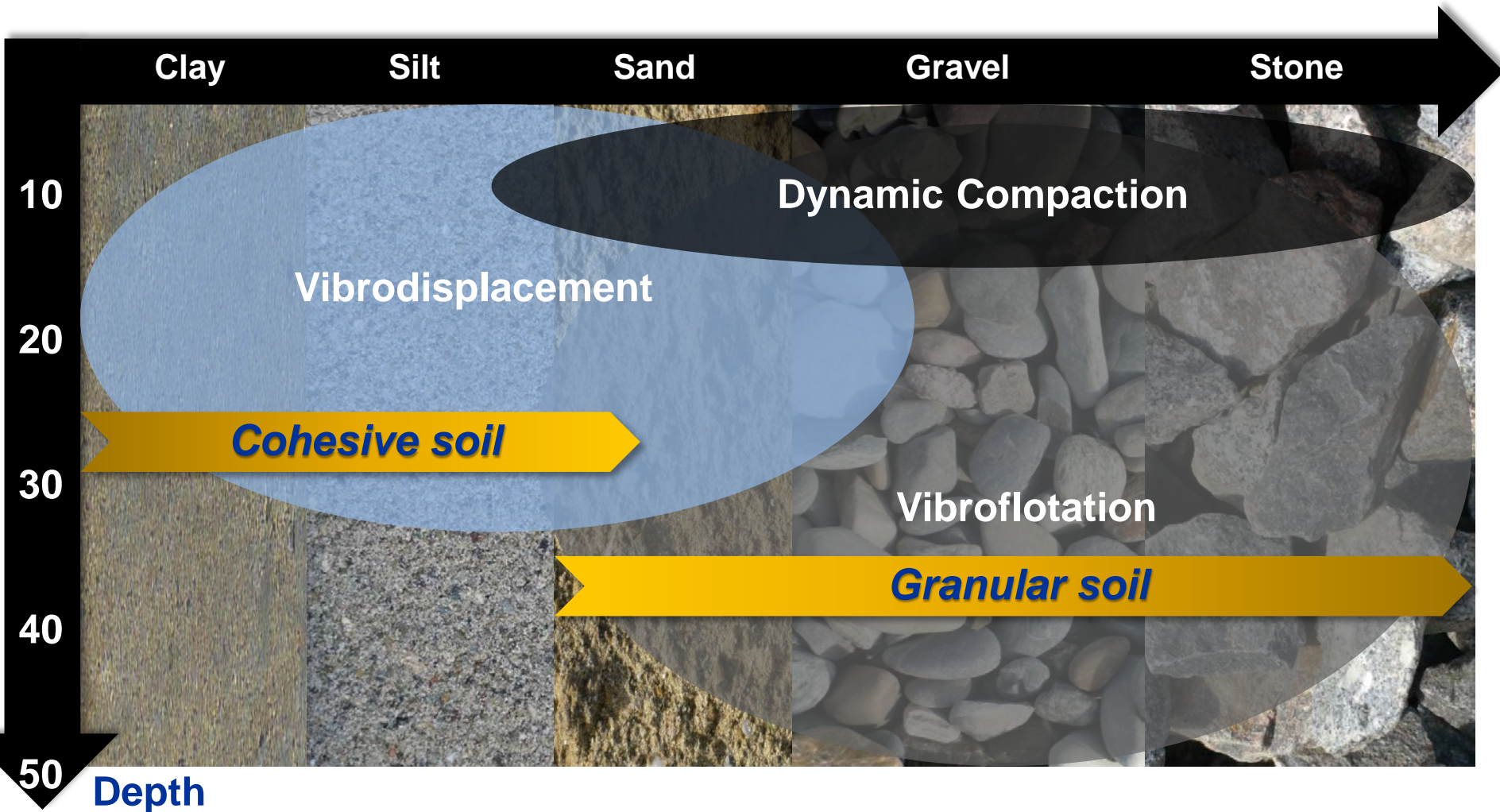
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Ground Improvement Soil Conditions



Ground Improvement Bauer Dynamic Compaction



- By drop weight in granular, non-cohesive soil
- Improvement depth up to 12 meter



Treatment depth

It can be estimated using the following formula

$$\text{Depth [m]} = a \times \sqrt{W \times H}$$

a = correction factor 0.3 ... 0.6

W = drop weight [to]

H = drop height [m]

Ground Improvement

Bauer Dynamic Compaction

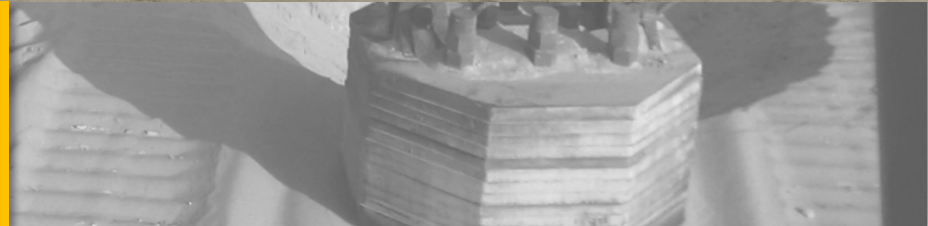


Applicable in:

- Loose, non-cohesive soils
- Landfill deposits
- Special wastes



- Pounder weights range from 6 - 40 tons
- Drop heights range from 10 - 30 meter
- Backfill material 2 - 200 mm
- Automatic quality control (drops, energy)



Ground Improvement

Vibrodisplacement - Bauer Flying Vibro



Ground Improvement

Vibrodisplacement - Bauer Flying Vibro



- Penetration depth up to 35 m (MC 96)
- Column diameter 900 mm - 1200 mm
- Dual material tube
- Hydraulically powered by base unit
- Quality control by B-Tronic
- Additional winch for material hopper



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Automatization

Relieving the operator, achieving constant quality

Assistance systems at BAUER

Advantages of assistance systems

- Eases work for operator
- Helps prevent operating errors
- **Increases drilling performance** through quick control processes
- **Reduces the wear** (of the machine and the drilling tool) and **protects the machine**
- Reduces dependence of the drilling performance and production quality on qualification and condition of the operator on that day

Automatization

Relieving the operator, achieving constant quality



Available assistance systems

Over 20 different assistance systems are used in BAUER machines

Overview of Assistance systems (Selection)



- Adaptive Kelly Speed Assistant
- Kelly drilling assistant
- Automatic crowd control
- One-directional spoil discharge assistant
- Bi-directional spoil discharge assistant
- Casing extraction assistant
- Automatic swivel alignment
- Hold-back control
- Slack rope prevention
- Crowd stroke monitoring
- Automatic compaction control
- Automatic drilling and extraction control - single pass
- Soil mixing assistant SCM
- Surcharge control - cutter
- HDS (Hose Drum System) control
- Grab assistant
- Automated chisel control
- BDC (BAUER Dynamic Compaction)
- Automatic mast alignment
- Power metering regulator

Automatization

Relieving the operator, achieving constant quality

Adaptive Kelly Speed Assistant

Initial situation – kelly drilling:

- Reduction of the winch speed at the transitions during extension and retraction of single kelly sections, in order to protect the material
- Reduction of the winch speed before ground contact, so that the drilling tool is not damaged
- Monitoring during retraction, that the kelly bar does not get locked accidentally
- Direct stop in case of a fault
- The deeper the borehole, the more active control and monitoring is needed

The adaptive Kelly Speed Assistant automates the controlled extension and retraction of the kelly sections



Automatization

Relieving the operator, achieving constant quality

Adaptive Kelly Speed Assistant

Customer benefits:

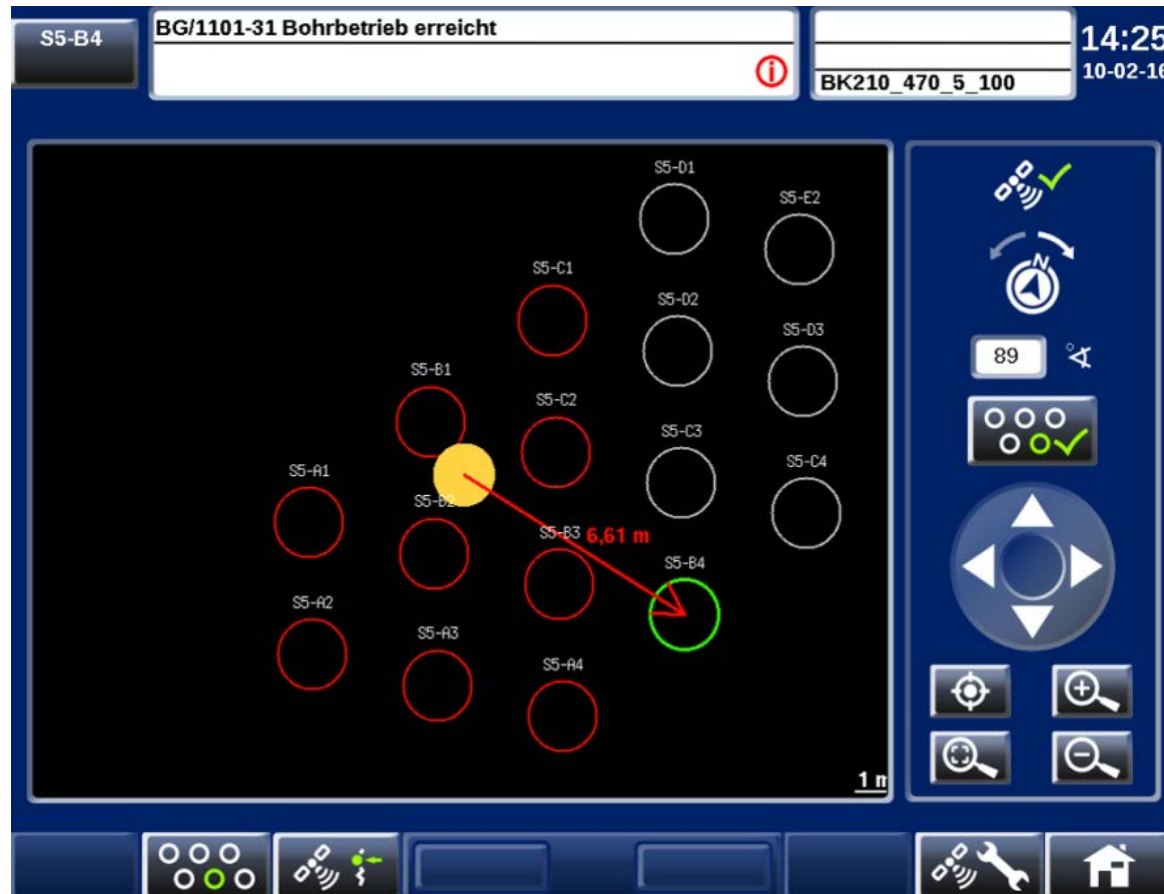
- **Reduction of wear and damage prevention,**
 - since operation is always with material-friendly, optimum, controlled winch speeds
 - since the last depth is reached at a reduced speed
- **Increase in drilling performance,**
 - since work is carried out at a constant, optimum speed the entire day
 - since speed control during the lowering process (in slurry-supported boreholes) prevents slack rope.
- **Damage prevention**
 - since pulling up of a locked kelly bar is prevented.
 - since the risk of the kelly bar falling is eliminated

Automatization

Relieving the operator, achieving constant quality



Operating screen for satellite based positioning

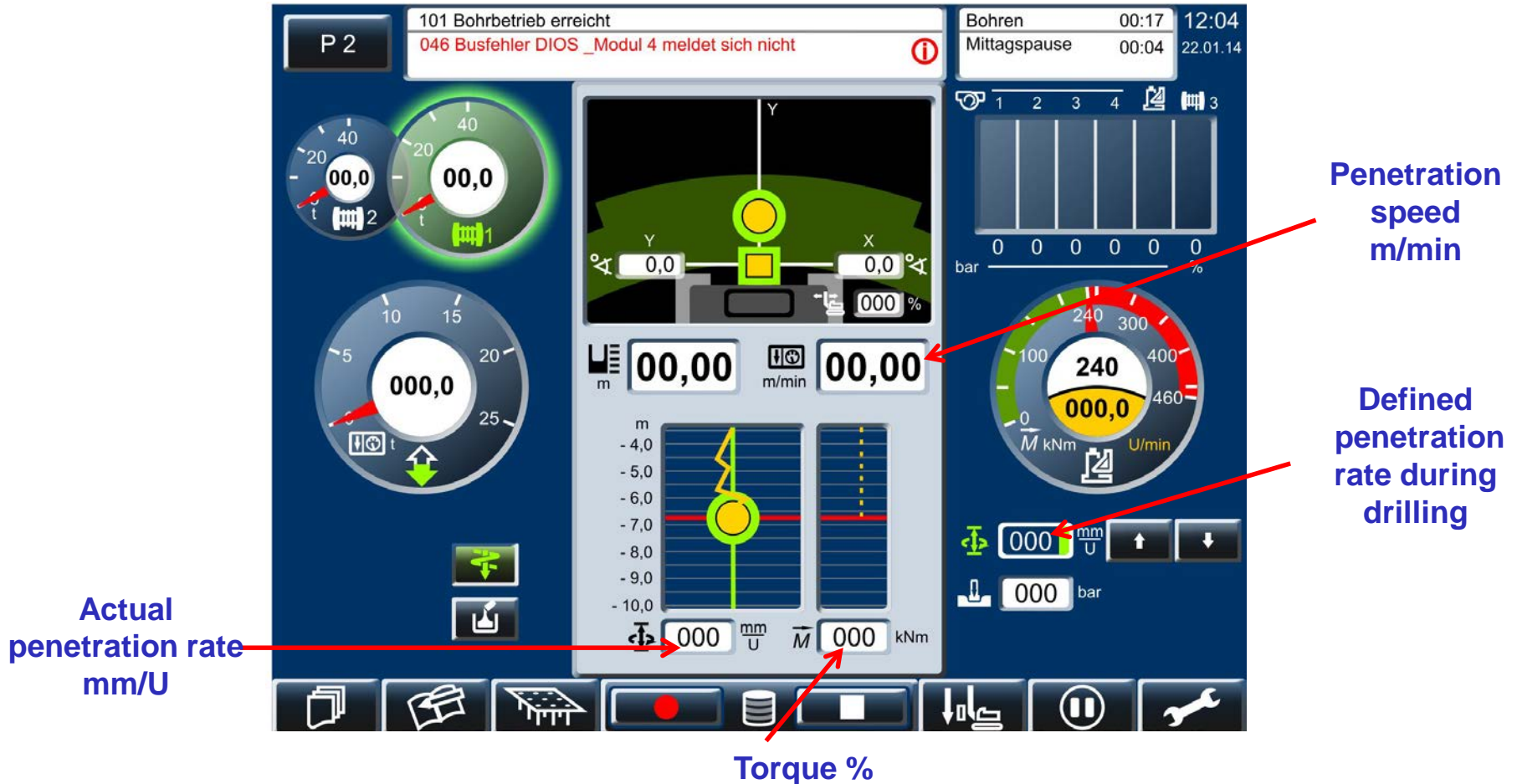


Automatization

Relieving the operator, achieving constant quality



Exemplary B-Tronic display - drilling assistance for single pass method



Automatization

Relieving the operator, achieving constant quality



Exemplary B-Tronic display during the concreting process in automatic extraction mode





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