

Overburden Tooling

JF Nutbroek, Business Development



Definition of overburden



A mantle of soil, rock, gravel, or other earth material covering a given rock layer or bearing stratum



What are Overburden Tools?



Systems for *ground stabilization* drilling

- Anchoring
- Jet grouting
- Ground freezing
- Micro piling
- Vibro Drilling
- (Geothermal drilling)

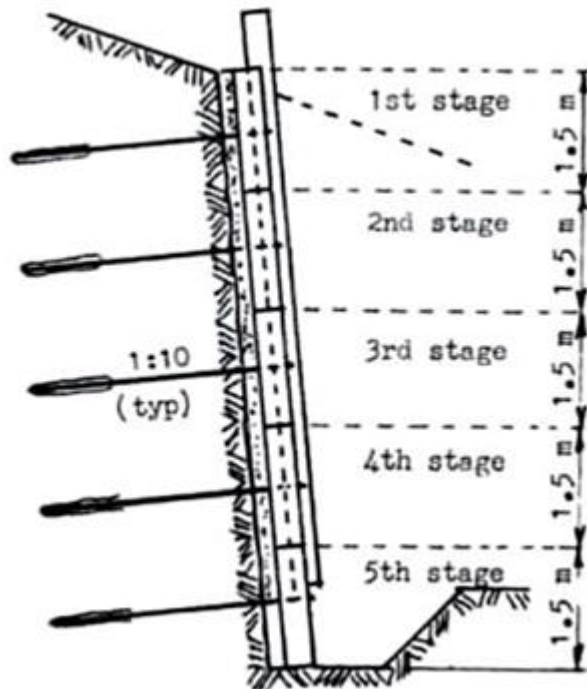


Drilling Applications



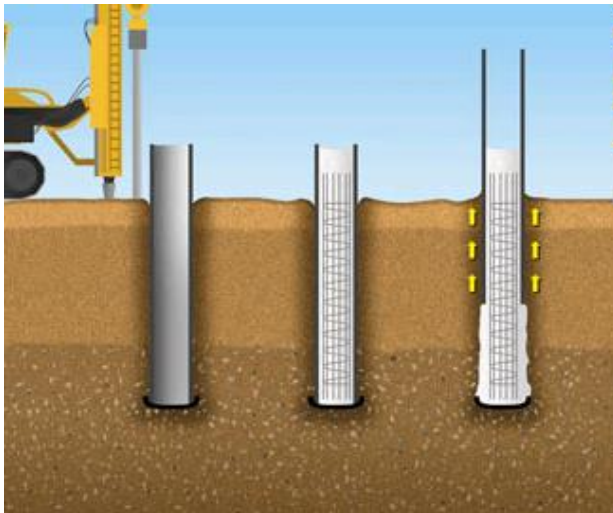


- A borehole is required to install an ‘anchor’ or ‘soil nail’
 - To stabilize a wall, dam, landslide, embankment, excavation, ...
- Typical bore hole is 6 to 30m length, and on an angle °
- Typical diameter varies between Ø 95 mm to Ø 185 mm





- A borehole is filled with cement and rebar steel
 - To create a pile for the foundation of a building, road, etc.
 - In some projects the casing is left in the hole
- Typical bore hole is 10 to 30m depth, and mainly vertical
- Typical diameters are 100mm up to 300mm Ø or more





- A borehole is drilled to create a pile by injecting grout
 - To create or stabilize a foundation, subsurface barrier or floor, ...
- Typical bore hole is 10 to 30m depth, and mainly vertical
- Typical borehole diameter of \varnothing 127 and \varnothing 140mm
 - The created pile is larger up to 2200mm or more



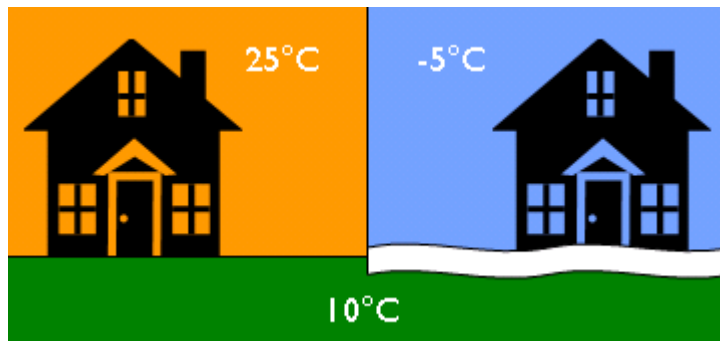


- A borehole is drilled to install permanent casing
 - Very cold brine is circulated inside the casing to freeze the ground
- Typical bore hole is 10 to 30m depth, and mainly vertical
- Typical borehole diameter of \varnothing 127mm
 - The frozen area around the casing is larger





- A borehole is required for a heat exchange system
 - To heat or cool houses, buildings, green houses, industry, ...
- Typical bore hole is 30 to 400m depth (oil & gas is deeper)
- Typical diameters vary between 100 to 250mm Ø



Drilling Applications



... for inner city construction



Drilling Applications



... for slope reinforcement



Drilling Applications



... for dam or bridge construction



Drilling Applications



... for underground / subway construction



Drilling Applications

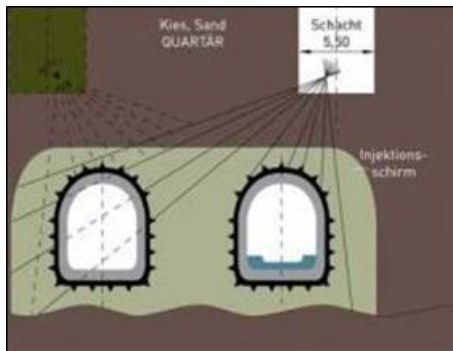
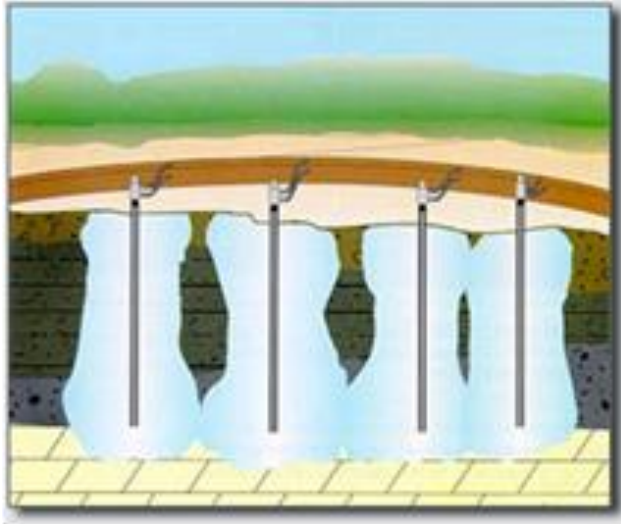


... for river bypass / underpass construction





... for tunneling in water saturated formations (ground freezing)



Drilling Applications



... for mining applications (Freeport / Voorspoed) anchored & piled walls



Drilling Applications



... and countless other projects that require ground stabilization



Overburden Drill Rigs





1. Drive Drilling
2. Auger Drilling
3. Duplex Drilling
4. Rotary Drilling
5. Double Head: Drifter
6. Double Head: Rotary
7. Vibro Drilling
8. Jet Grouting

Selection of Tooling System



1. Site specific conditions

1. Geology and ground expertise
2. Construction plan from the engineers
3. Construction permit

2. Contractor specific conditions

1. Type of ground stabilization work
2. Available rig fleet
3. Preference regarding drilling method



Tooling requirements are mostly well defined



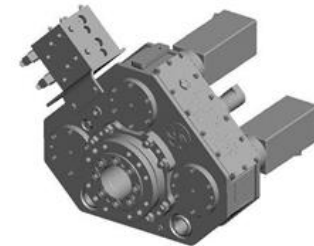
Single Drifter (most common)

- Percussive force + rotation
- Drive drilling
- Duplex Drilling



Single Rotary Head

- Rotary only
- Rotary / DTH Drilling
- Auger Drilling



Vibro Head

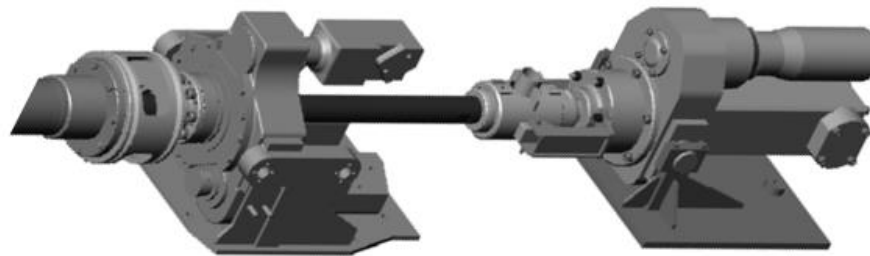
- Rotary + Vibration





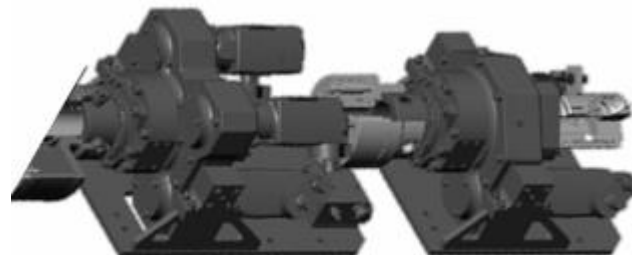
Drifter + Rotary head

- Rotation of casing (RH)
- Percussion + rotation for inner drill string (LH)



Rotary head + Rotary head

- Rotation of casing and inner drill string (LH/RH)



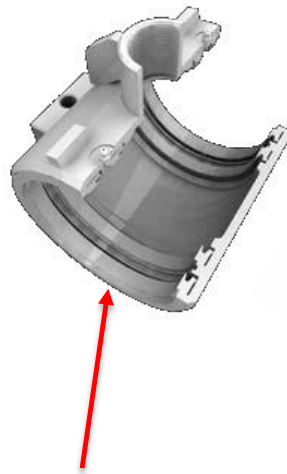


Systems are top-drive

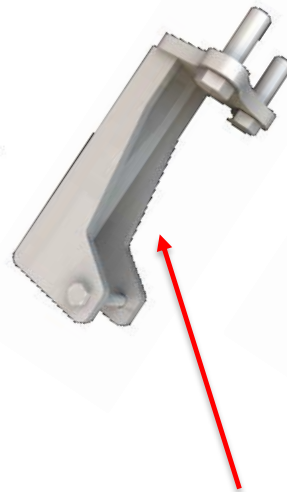
- Flushing head is installed under the drifter/rotary head
- All systems/diameters have the same design principle



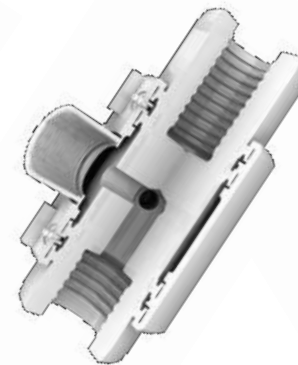
Flushing Body
Rotating
Threaded connections



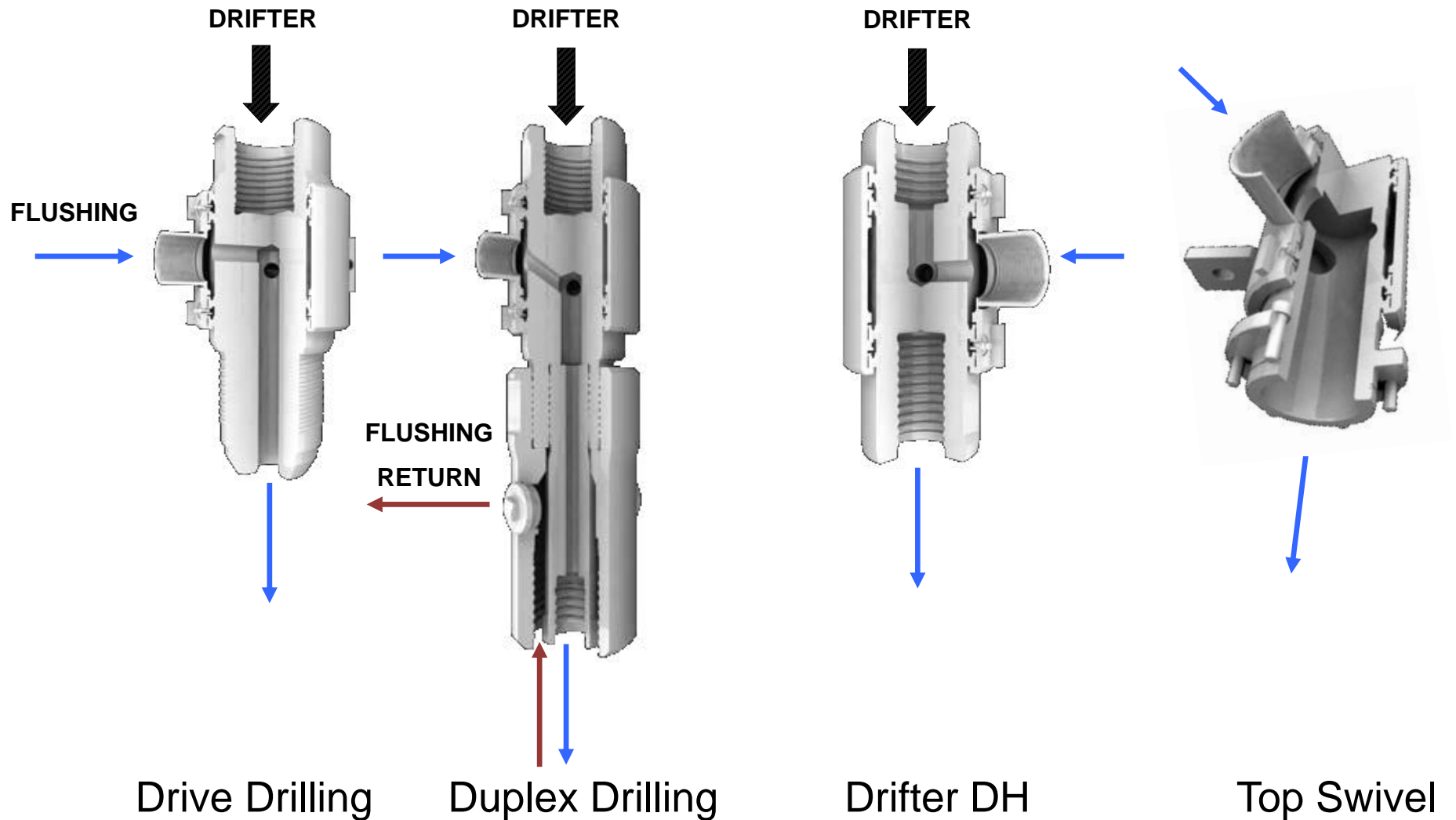
Flushing Ring
Stationary
Mounted with bracket



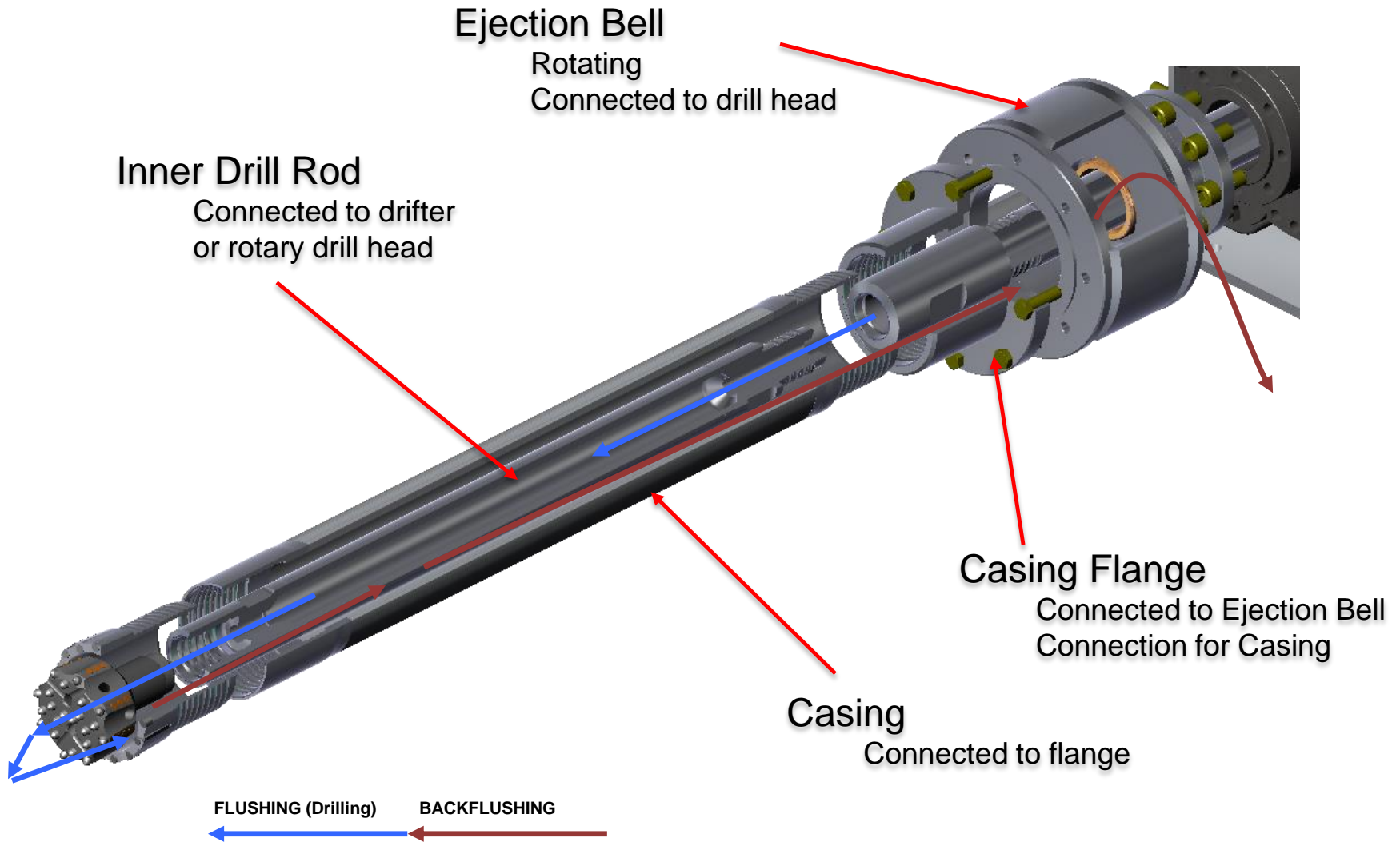
Mounting Bracket
Stationary
Fixed on drill head



Drilling Systems – Flushing Head



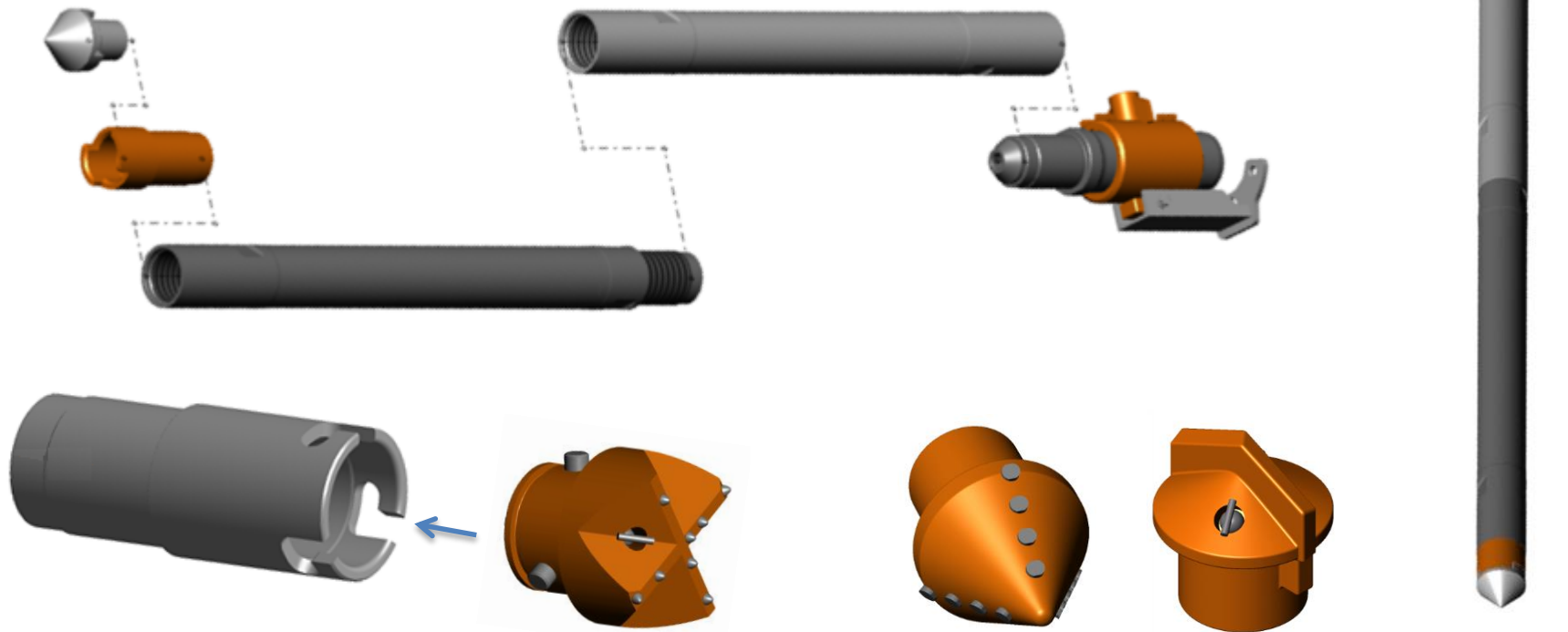
Drilling Systems – Return Flushing



1. Single Head: Drive Drilling Method



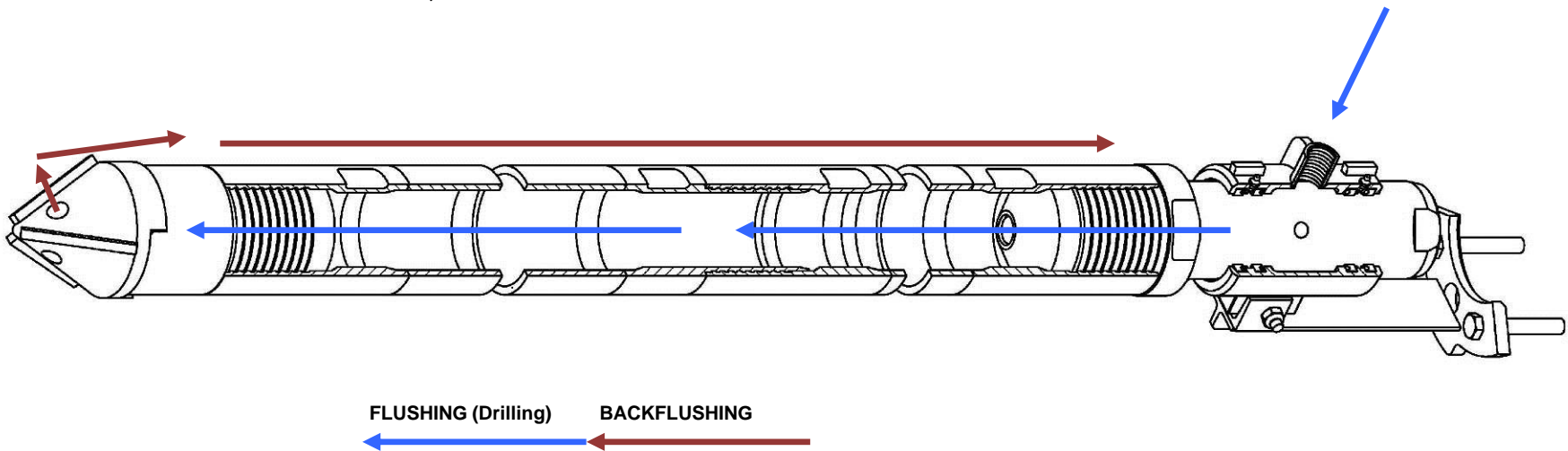
- For soft soils using a drifter and limited rotation
- Casing is driven (hammered) into the ground
- This method uses a lost bit, flushing is possible



1. Single Head: Drive Drilling Method



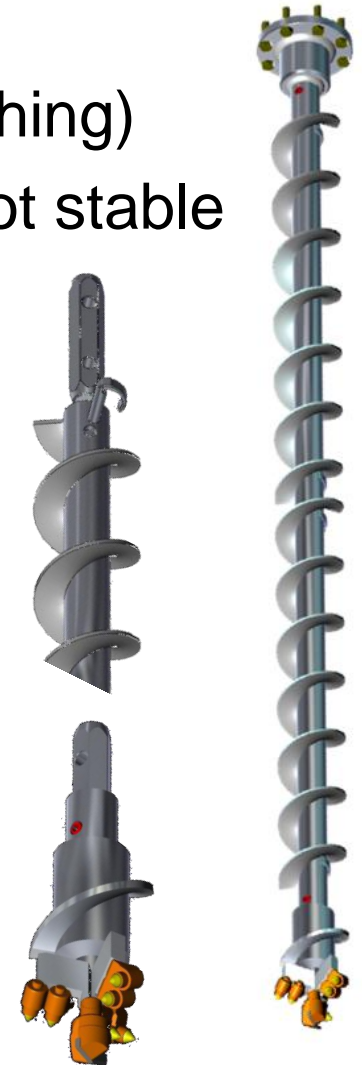
- Single drill string: Only casing is used
- All flushing returns come back via the annulus
- At target depth drill bit remains in the hole (lost)
- When anchor is installed casing is retrieved
- Diameters 88,9 / 101.6 / 114.3 / 133 / 152.4 mm



2. Single Head: Auger Drilling Method



- For soft stable soils using rotation only
- Solid hex or hollow stem augers (to allow flushing)
- Can be combined with casing if borehole is not stable



3. Single Head: Duplex Drilling Method



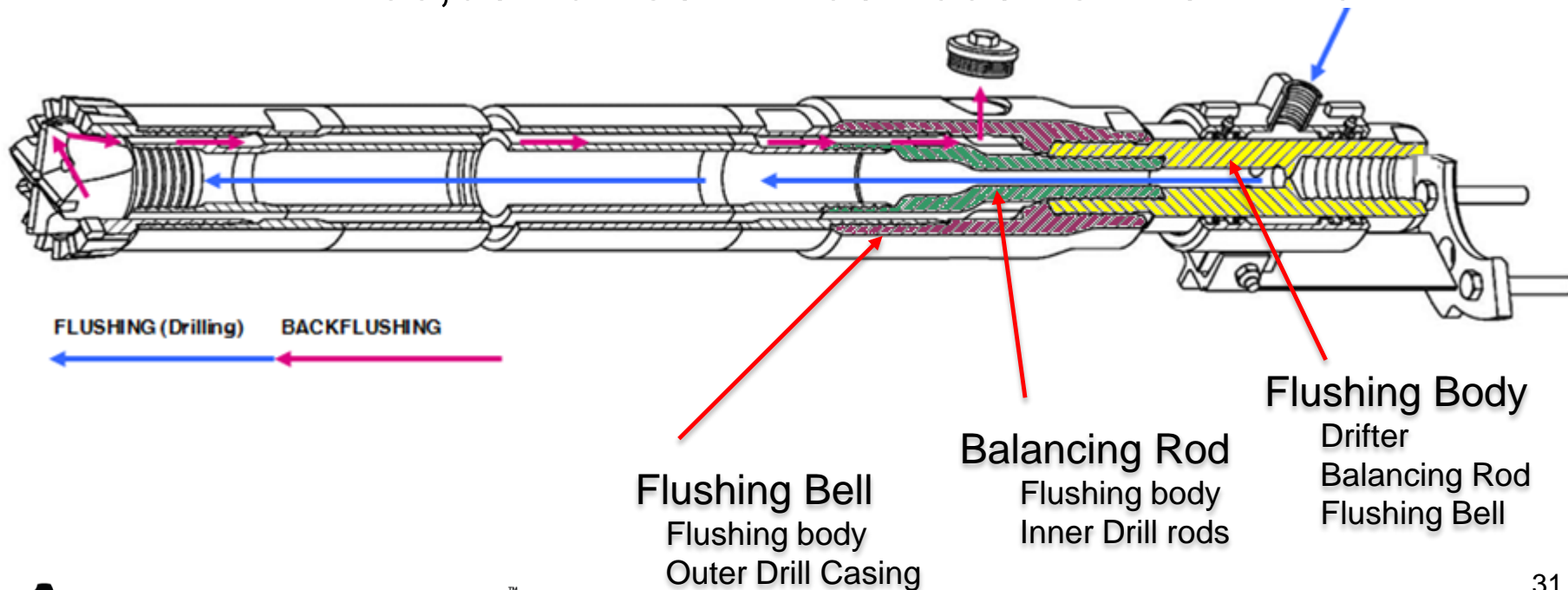
- For all soils using a drifter – *most popular method*
- Inner rods + outer casing are rotated simultaneously
- Percussive energy is transmitted to both strings
- Flushing medium contained inside the casing
- Inner drill string can be equipped with DTH hammer
 - For deeper holes (diminishing percussive power)



3. Single Head: Duplex Drilling Method



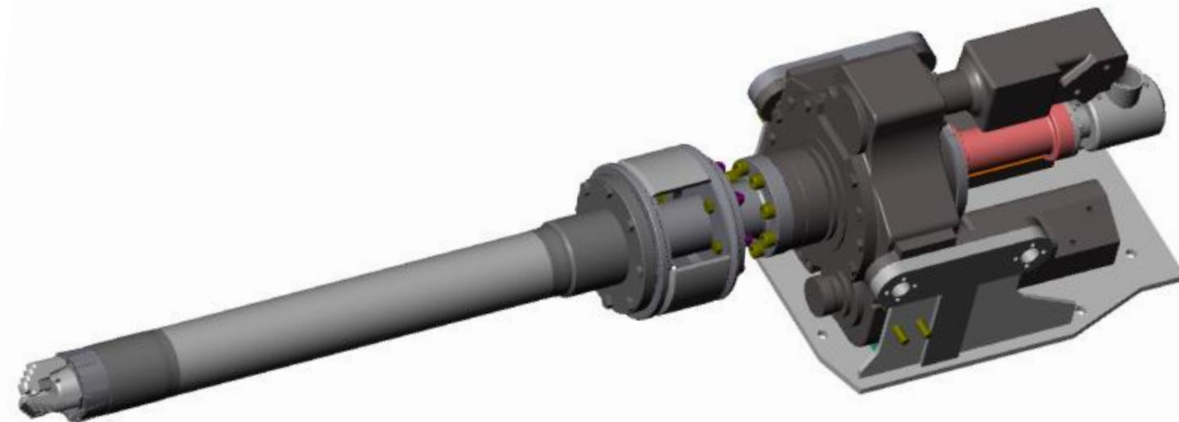
- Double drill string: Casing + inner drill rods
- Flushing return contained or via outside annulus
- At target depth inner drill rods & drill bit are retrieved
- When anchor is installed casing is retrieved
- Diameters 88,9 / 101.6 / 114.3 / 133 / 152.4 / 177.8 mm



4. Single Head: Rotary Drilling Method



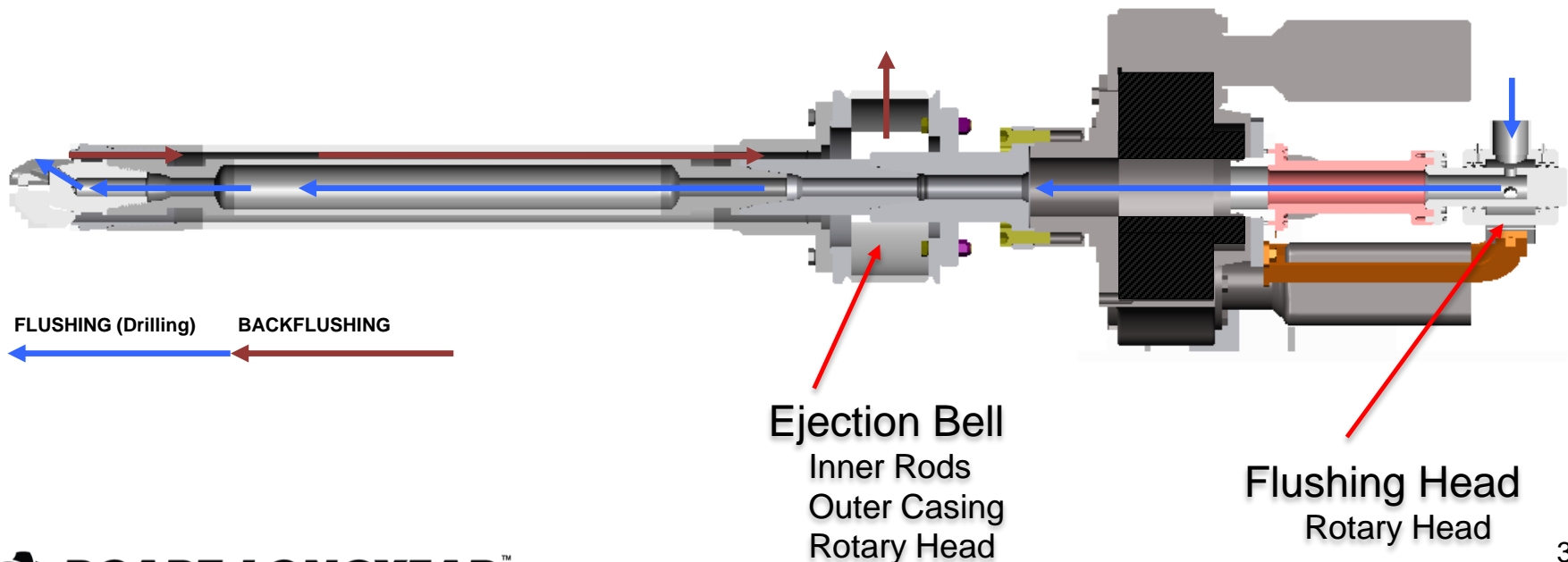
- For all soils using rotary
- Inner rods + outer casing are rotated simultaneously
- Flushing medium contained inside the casing
- Inner drill string can be equipped with DTH hammer
 - For deeper holes (diminishing percussive power)



4. Single Head: Rotary Drilling Method



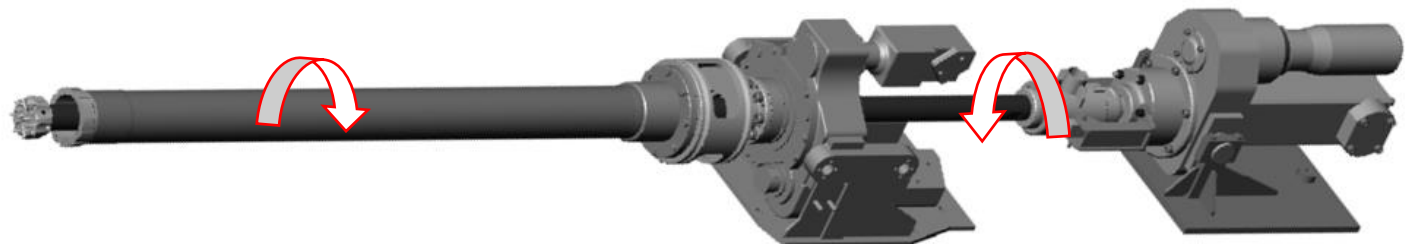
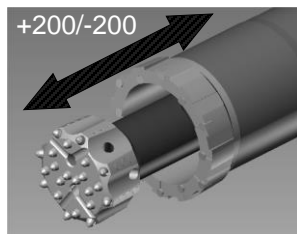
- Double drill string: Casing + inner drill rods
- Flushing return through annulus rods & casing
- At target depth inner drill rods & drill bit are retrieved
- When anchor is installed casing is retrieved
- Diameters 114.3 / 133 / 152.4 / 177.8 mm



5. Double Head: Drifter + Rotary



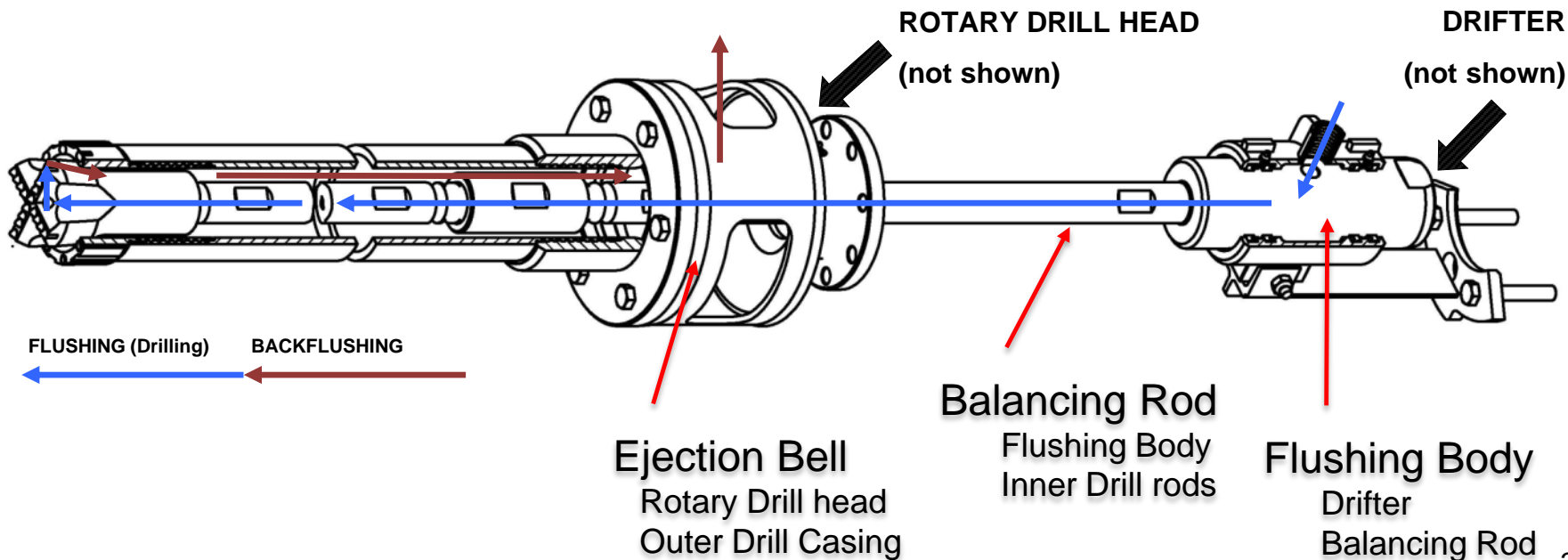
- For all soils using a drifter (LH) + rotary head (RH)
- Recommended for drilling shallow straight holes
- Drifter rotates + hammers on inner rods
- Rotary head rotates outer casing
- Casing and inner rods rotate in opposite directions
- Double head slide can advance or retract the inner drill string



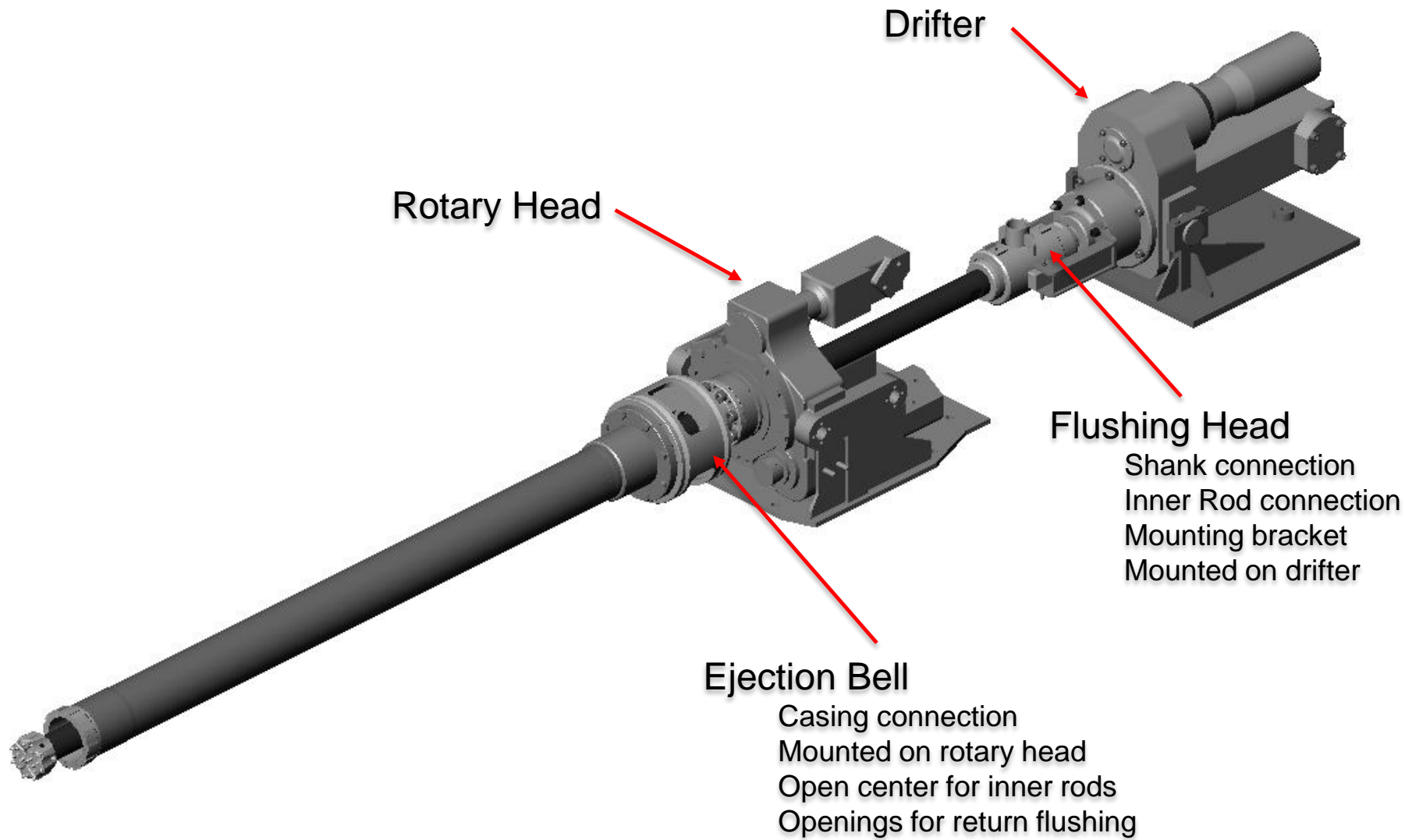
5. Double Head: Drifter + Rotary



- Double drill string: Casing + inner drill rods
- Flushing return contained or via outside annulus
- At target depth inner drill rods & drill bit are retrieved
- When anchor is installed casing is retrieved
- Diameters 114.3 / 133 / 152.4 / 177.8 mm



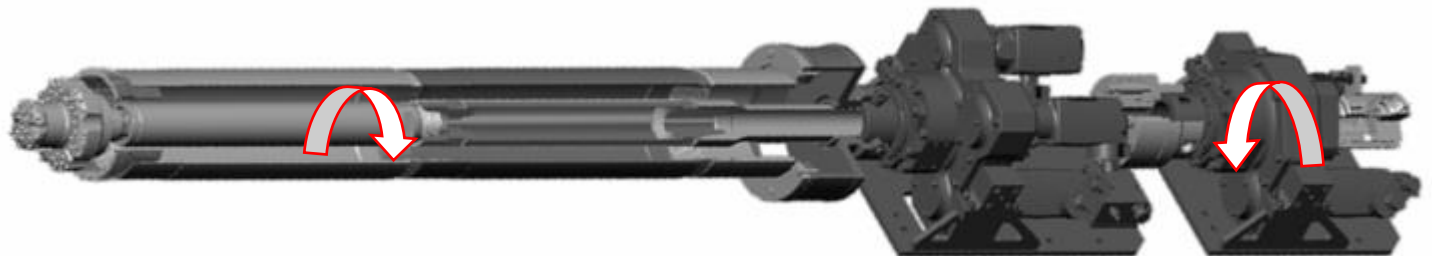
5. Double Head: Drifter + Rotary



6. Double Head: Rotary + Rotary



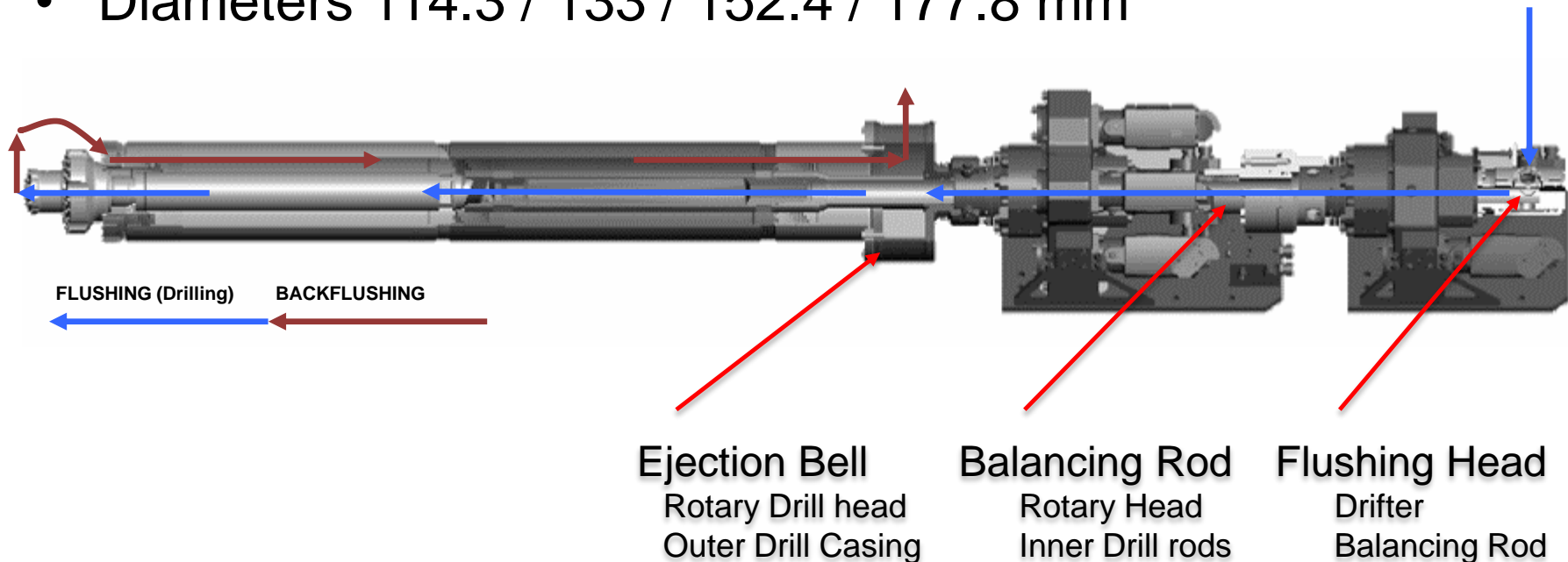
- For all soils using 2 rotary heads
- Recommended for drilling deep straight holes
- Inner rods and casing rotate in opposite directions
- Inner string uses rotary bit, drag bit or DTH hammer
- Flushing medium is contained inside the casing
- Double head slide can advance or retract the inner drill string



6. Double Head: Rotary + Rotary



- Double drill string: Casing + inner drill rods
- Flushing return contained or via outside annulus
- At target depth inner drill rods & drill bit are retrieved
- When anchor is installed casing is retrieved
- Diameters 114.3 / 133 / 152.4 / 177.8 mm



7. Single Head: Vibro Drilling



- New technology for the overburden industry
- Higher drilling speeds v.s. drifter
- Vibration on casing only is possible
- Low Hz (60Hz / 160kN) – High Torque
- Less risk of damaging anchor
- Reduced noise & fuel consumption v.s. drifter

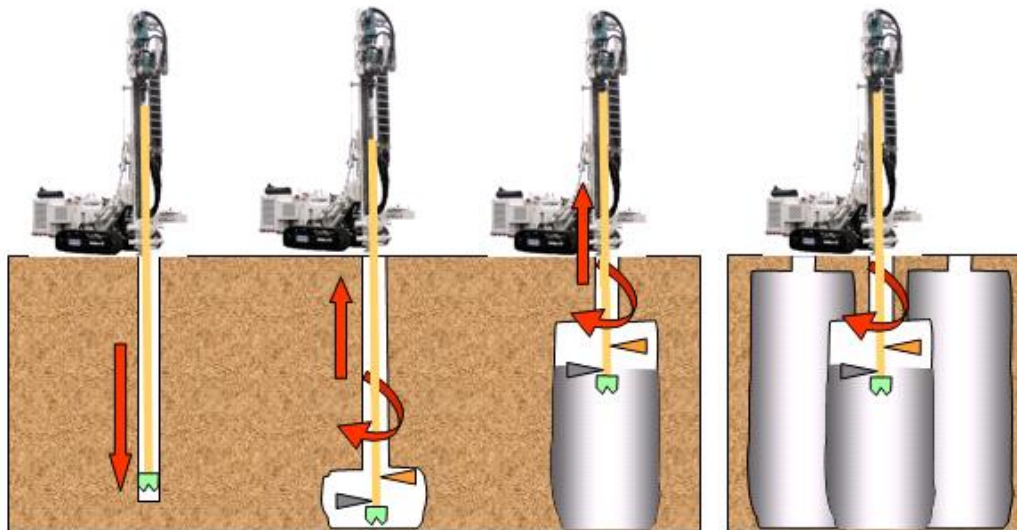
Boart Longyear manufactures an exclusive line of Vibro Twin Drive™ tooling. The combination of 30 years of experience in developing sonic threads and overburden threads.



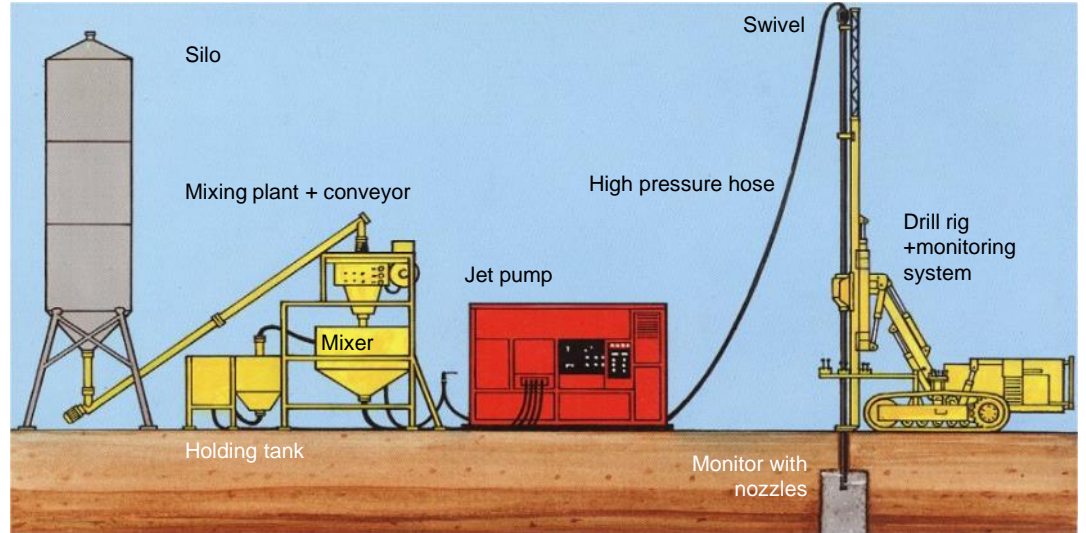
8. Single Head: Jet Grouting



- For soft soil using a hollow spindle rotary head
- High pressure cement or air/cement is injected in the single or dual pipe drill string while pulling up in a single pass to create a pillar
- Single or dual wall jet grouting rods 88.9 / 114.3mm



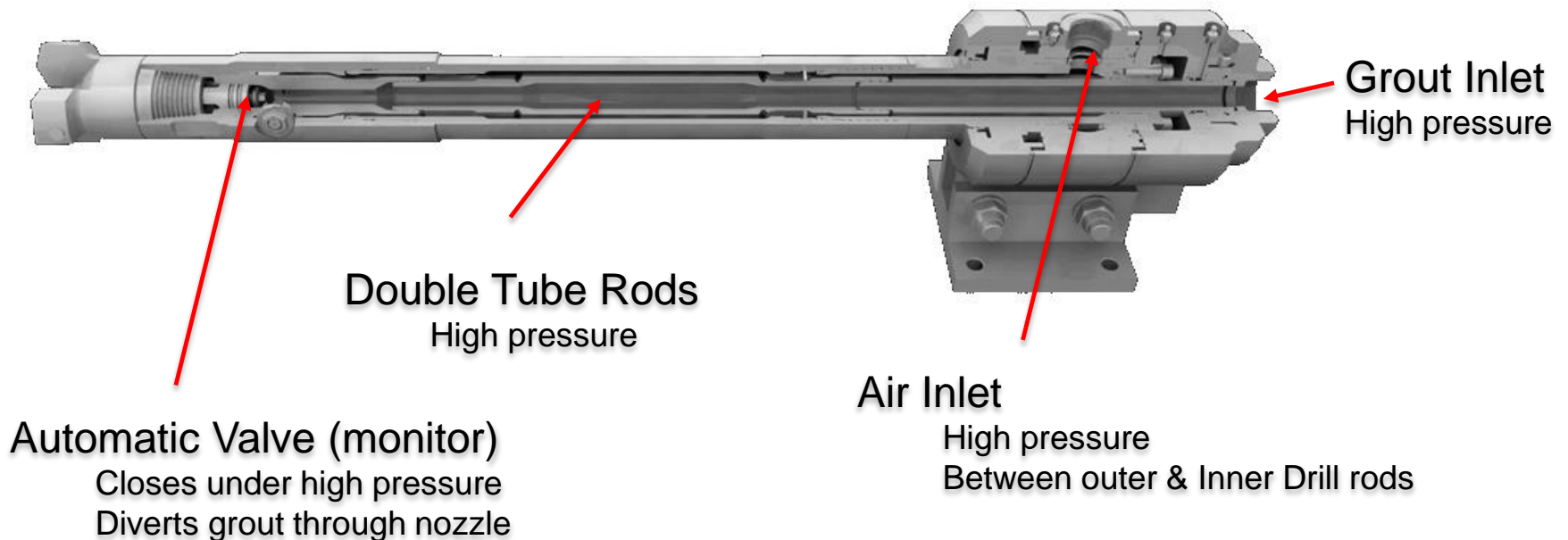
8. Jet Grouting



8. Jet Grouting



- Standard rotary drilling & flushing until target depth
- High pressure grouting by manual or automatic valve
- The air in the dual tube system creates a jacket around the grout to cut deeper in the soil for larger piles



8. Jet Grouting



NEW HEAD

- Compact lightweight modular construction
- Easy maintenance and improved lubrication
- Switch easily between 89mm and 114mm grouting rods
- Reduced spare parts requirements



- **Tooljoint (Male-Female / Pin-Box)**

- The threaded connection at the end
- Increased wall thickness, high quality steel
- Heat treated to provide longer life



- **Midbody**

- The tube connecting the tool joints together
- Smaller wall thickness, lower steel grade



- **Construction techniques**

- **Friction welding** - preferred method due to high quality welds
- **Hand Welding** - required for larger diameter tubes / specials
- **Threaded** – used with nipple connections (couplings)
- **Forged** – mechanically created upset ends – once piece design



Rotary Percussive, Rotary and Vibro casing.

- **Rotary Percussive casing** uses couplings with increased wall thickness and mid-body material of higher tensile strength to cope with drifter percussive forces
- **Rotary casing** uses larger ID couplings and mid-body material with lower tensile strength, a more economical choice for rotary only applications
- **Vibro casing** uses sonic Twin Drive™ threads with increased wall thickness and precision mid-body material of higher tensile strength to cope with vibro forces

Rotary Percussive Casing



- Friction welded tool-joints or nipple connections
- Annealed mid-grade mid-body material
- Quench and tempered threads (increased thread life)
- Increased wall thickness on the couplings
- Available from Ø 51mm up to Ø 152.4mm
- Available in Left Hand and Right Hand threads





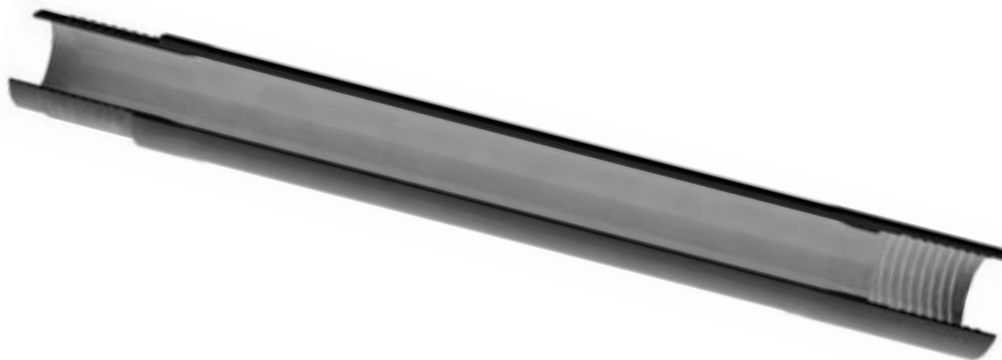
- Friction welded tool-joints (up to 152.4mm)
- Economical mid-grade mid-body material
- Quench and tempered threads (increased thread life)
- Available from Ø114mm up to Ø 406mm
- Available in Left Hand and Right Hand threads

Option: Direct thread casing – no friction welding





- Friction welded tool-joints
- High grade mid-body precision material
- Quench and tempered threads (increased thread life)
- Increased wall thickness on the couplings
- Vibro TwinDrive™ threads



Rod Offering



- API Rod: Rotary only
- CBXP Rod: Rotary & limited percussion
- TDN Rod: Rotary & percussion for hard ground
- T Rod: Percussion for very hard ground
- Sonic Rod: Sonic / Vibro Sonic applications





API rods for rotary drilling applications no percussion

- Friction welded tool-joints
- Economical mid-grade mid-body material
- Quench and tempered threads (increased thread life)
- Standardized thread “American Petroleum Institute”
- Various sizes of connections (RH/LH) and diameters
- Possibility for spanner flats on the tool-joints



MIN Percussive force MAX



CBXP rods for rotary drilling with limited percussion

- Friction welded tool-joints
- Economical mid-grade mid-body material
- Quench and tempered threads (increased life)
- **CBXP thread** (LH or RH), increased wall thickness
- Large ID to optimize flushing compared to API / TDN
- Large OD to create a smaller annular volume
- Easier coupling/uncoupling compared to API



MIN

Percussive force

MAX

TDN Rod – Rotary Percussive Applications



TDN rods for percussive drilling in hard rock

- Friction welded tool-joints
- Annealed mid-grade mid-body material
- Quench and tempered threads (increased thread life)
- **TDN thread** (LH or RH), increased wall thickness
- Larger ID and larger OD compared to T (HM) rods
- Larger OD to create a smaller annular volume
- Improved flushing, higher torque compared to CBXP



MIN

Percussive force

MAX

HM/T Percussive Rod (T38, T45, T51 etc.)



HM/T rods for percussive drilling in very hard rock

- Solid piece M/M or friction welded female end
- High grade specialty carburized steel
- Quench and tempered threads (increased thread life)
- Mining Industry standard rope thread (**LH only**)
- Small ID (15 – 22mm), Small OD (38 – 68mm **EL68**)
- Poor flushing/coupling characteristics compared to TDN

HM/T rods offer optimum resistance to percussive force



MIN

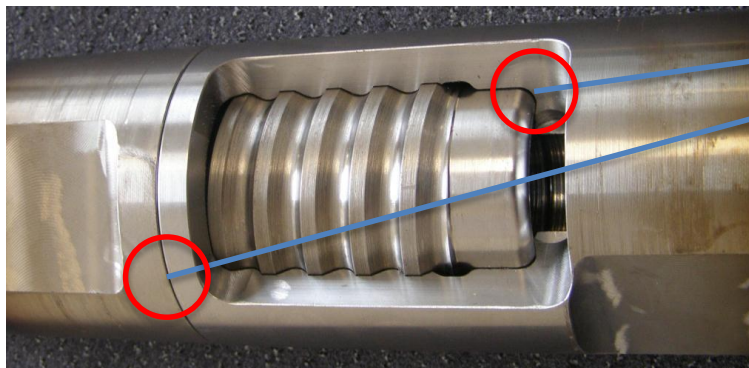
Percussive force

MAX



Patented Boart Longyear rod thread for heavy duty rotary percussive applications:

- Easier and faster coupling / uncoupling
- Less susceptible to dirt, flowing liquids, less delicate
- Less wear – up to 40% increase of life is possible
- Preferred thread for difficult and hard formations
- Optimum flushing characteristics, large OD/ID

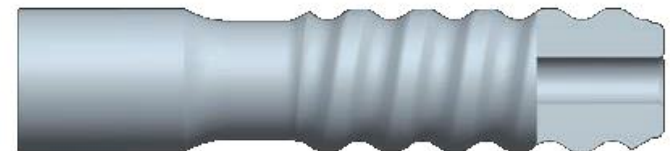
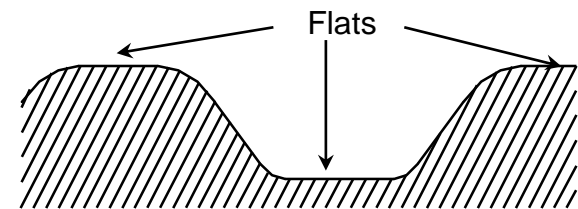


TDN
Two points of contact

EL Percussive Thread



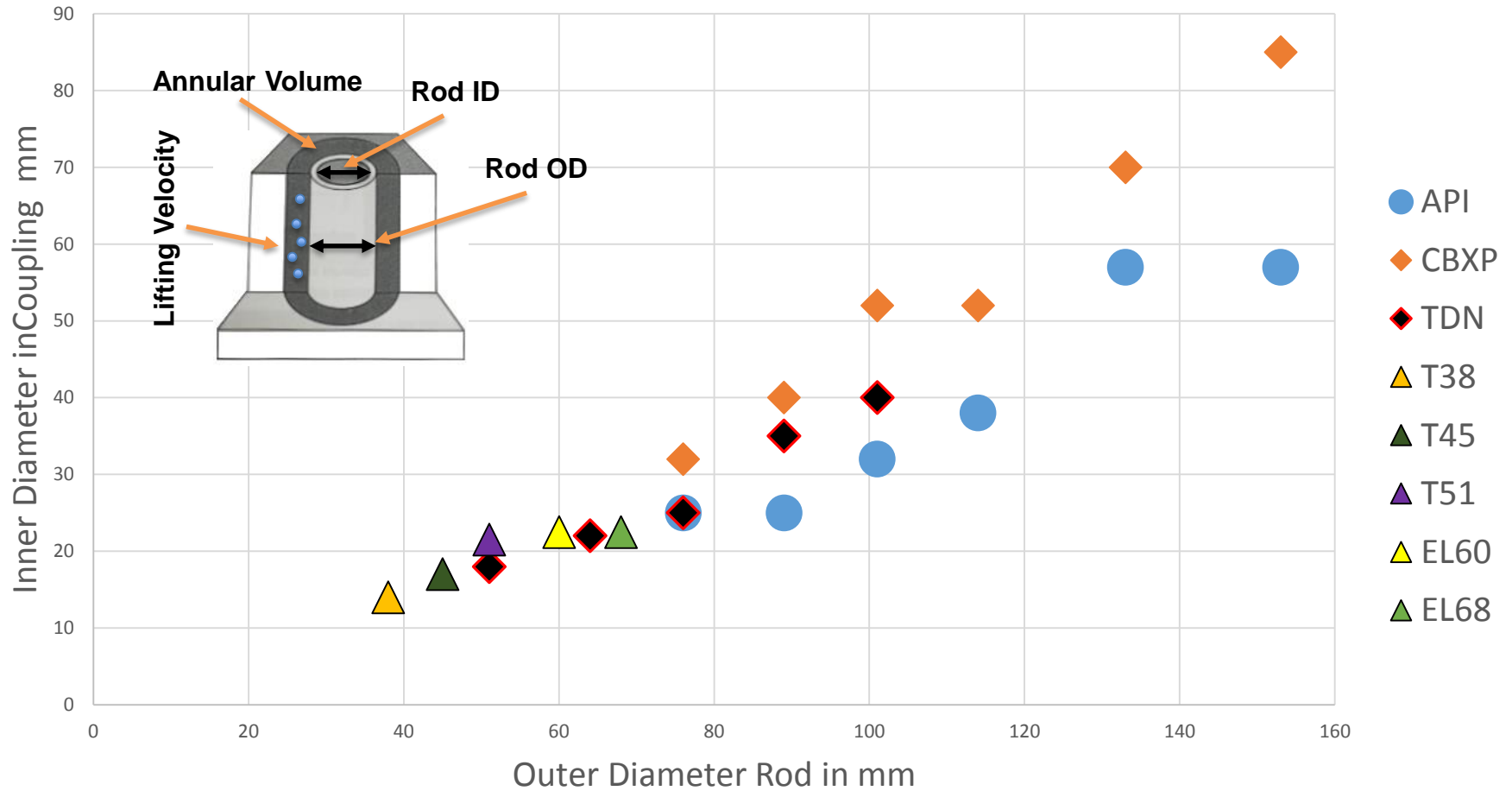
- Specifically developed for straight large diameter drilling
- Better coupling/uncoupling characteristics vs T51
- Excellent load bearing, excellent thread wear properties
- Suited for high torque rotary percussive applications
- Superior performance and high penetration rates
- Available in 60mm and 68mm rod diameter
- Bits from Ø92mm to Ø165mm



Inner x Outer Diameter of Rods



Inner Flushing Capacity Drill Rod





Sonic rods are used for rotary sonic & vibro applications

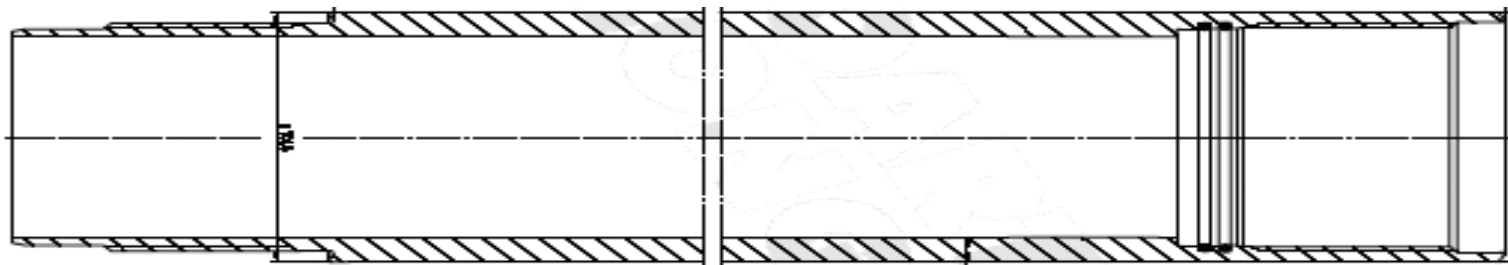
- Friction welded or forged tool-joints (one piece rod)
- High grade mid-body precision material
- Quench and tempered threads (increased thread life)
- **Sonic threads** (LH or RH), increased wall thickness
- Larger ID compared to API / TDN rods
- Rotary Sonic or Twin Drive Vibro threads



Specialty: Ground Freezing Rods / Casing



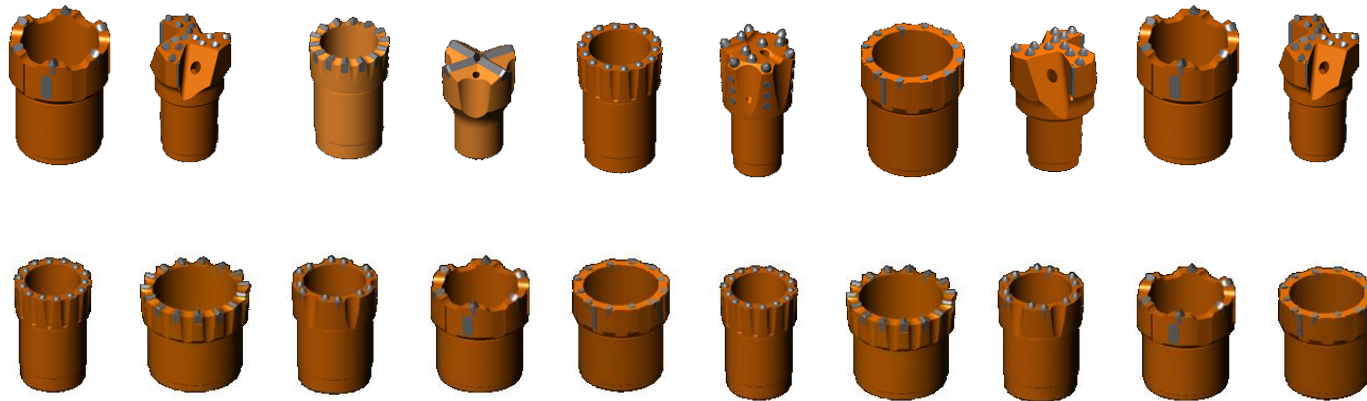
- Stabilize the soil and control groundwater before the excavation by freezing the surrounding soil
- Requires specialty steel rods and threads to remain waterproof under extreme cold temperatures
- Boart Longyear is the #1 supplier for this application





Carbide insert bits for percussive/rotary/sonic applications

- Different carbide insert configurations (ground type)
- Wear protection, shrink fitted inserts, brazed inserts
- Wide range of casing & inner drill string bits
- Custom design: Possible for larger quantities



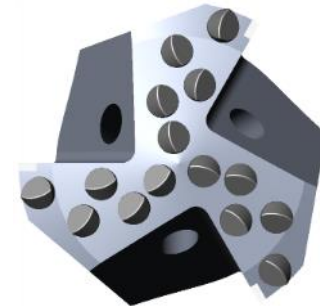
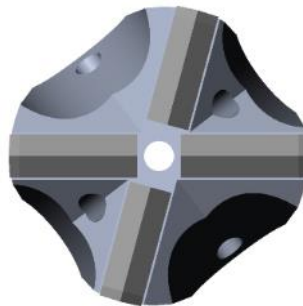
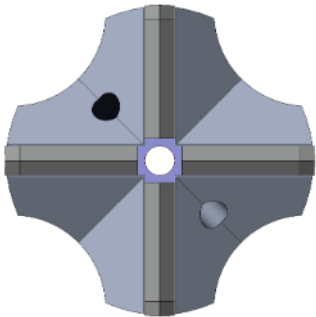
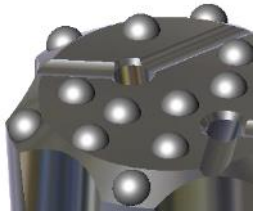
Bit Insert Types



- Hemispherical
 - Hard rock rotary/percussive
- Ballistic
 - Medium hard rock rotary/percussive
- Two step button
 - Medium hard loose rock rotary/percussive
- Scraping
 - Soft loose rock rotary with limited percussion
- Scalping
 - Soft loose rock, concrete, rotary only



Insert examples



Inner Bit examples



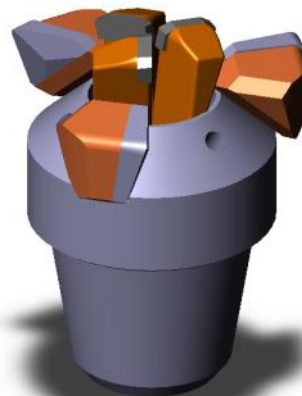
Inner Bit examples



Casing Bit examples



Rotary Bit examples





Industry 'non-standardized' threads for casing & rods:

- LEFT or RIGHT hand (LH or RH)
- CYLINDRICAL or CONICAL
- 1 start, 2 start or 3 start

Standardized threads:

- Boart Longyear patented TwinDrive™ thread (LH or RH)
- API Threads on rotary rods (LH or RH)
- CBPX Threads on CPBX rods (LH or RH)
- HM/T38, HM/T45, HM/T51 and EL60/68 rods (LH)



Patented Boart Longyear thread for rotary percussive:

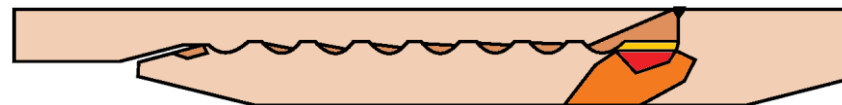
- Easier and faster coupling / uncoupling
- Less susceptible to dirt, flowing liquids, less delicate
- Less wear – up to 40% increase of life is possible
- Preferred thread for difficult and hard formations
- Standardized multi starts (depends on diameter)



Shockwave stress distribution

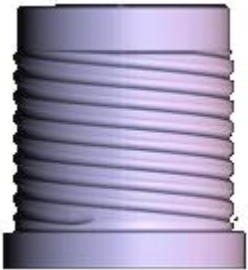


Standard Thread



TwinDrive™ Thread

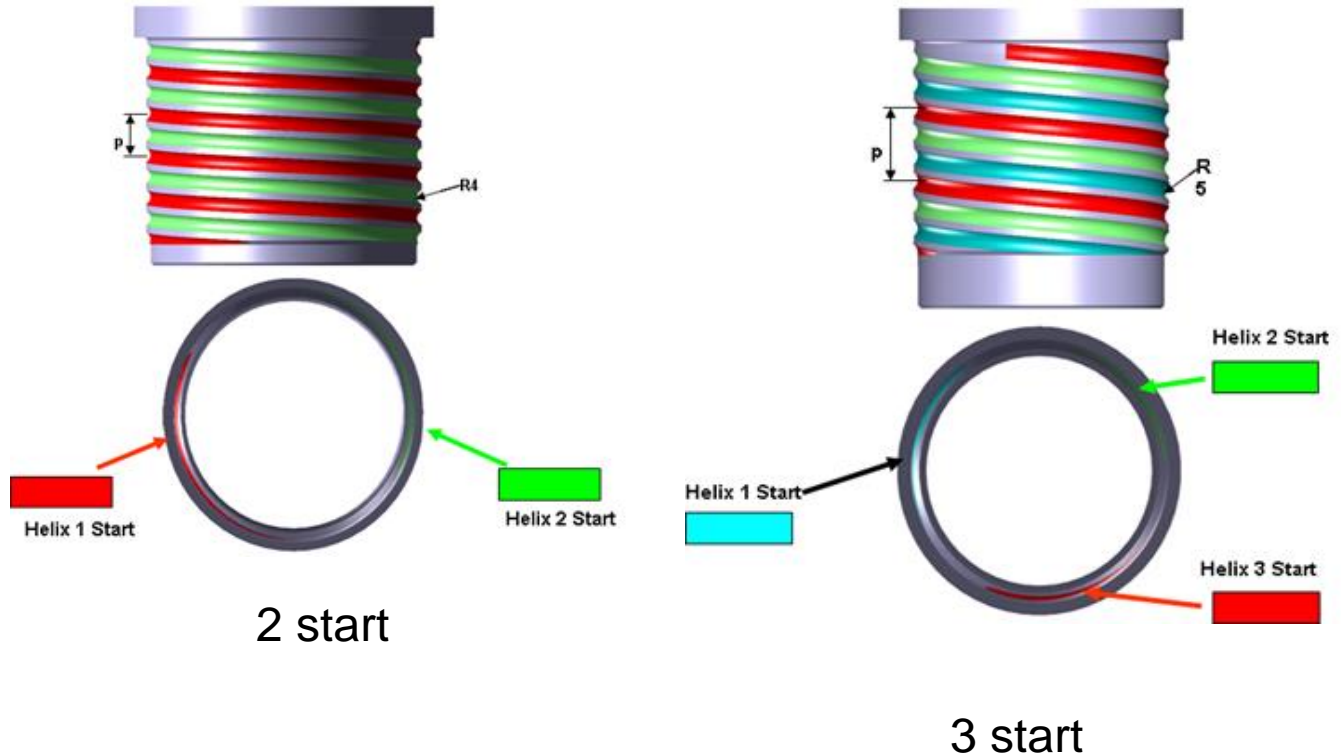
Thread Configurations



Cylindrical



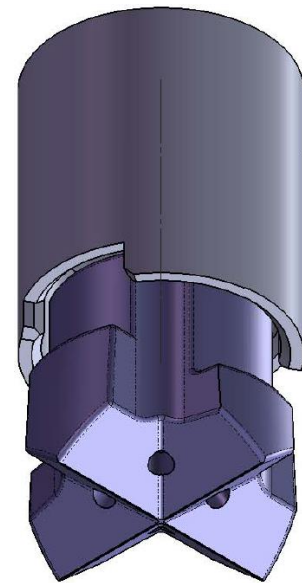
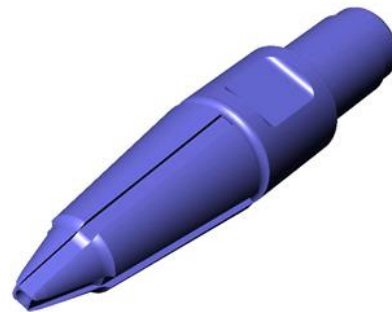
Conical



Multiple configuration possible
It is important to know what thread is in use
Samples might be required



- Flushing heads & spares (seals, plugs, grease nipples)
- Thread adapters, spacer rods, grout injection adapters
- Flange adapters, Injection adapters
- Fishing tools, taps & bells
- Lost bits & drivers
- Rod & casing wrenches
- Balancing rod wrenches
- ...



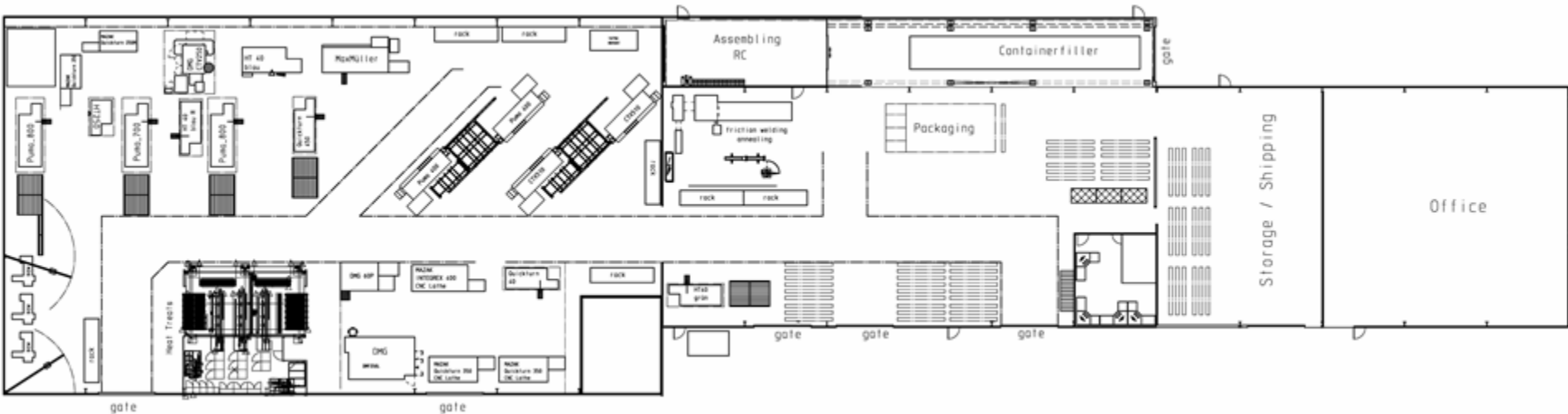


- DeltaTools Drilling Systems are made to order
 - Large variety in thread designs, lengths, diameters
- Manufacturing plant & engineering located in Germany
 - Flexible and lean set-up results in short lead times
- In-house friction welding up to Ø 152.4mm
 - Guarantees high quality welds for rods and casing
- Team of professionals
 - Many years of industry & design experience together

Plant Parameters



- 4500 m² production area
- 550 m² office space
- Size of plot = 14000 m²





ISO Management Systems

- Quality Management:
ISO 9001 certified since 1993
- EH&S:
ISO 14001 certified since 1999
OHSAS18001 certified since 2006





Thank you for your attention

