UCT
THE UNDERGROUND UTILITIES EVENT
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Evolution of Dual Pipe Makes Mid-Sized Rock Drilling Practical

Cory Maker

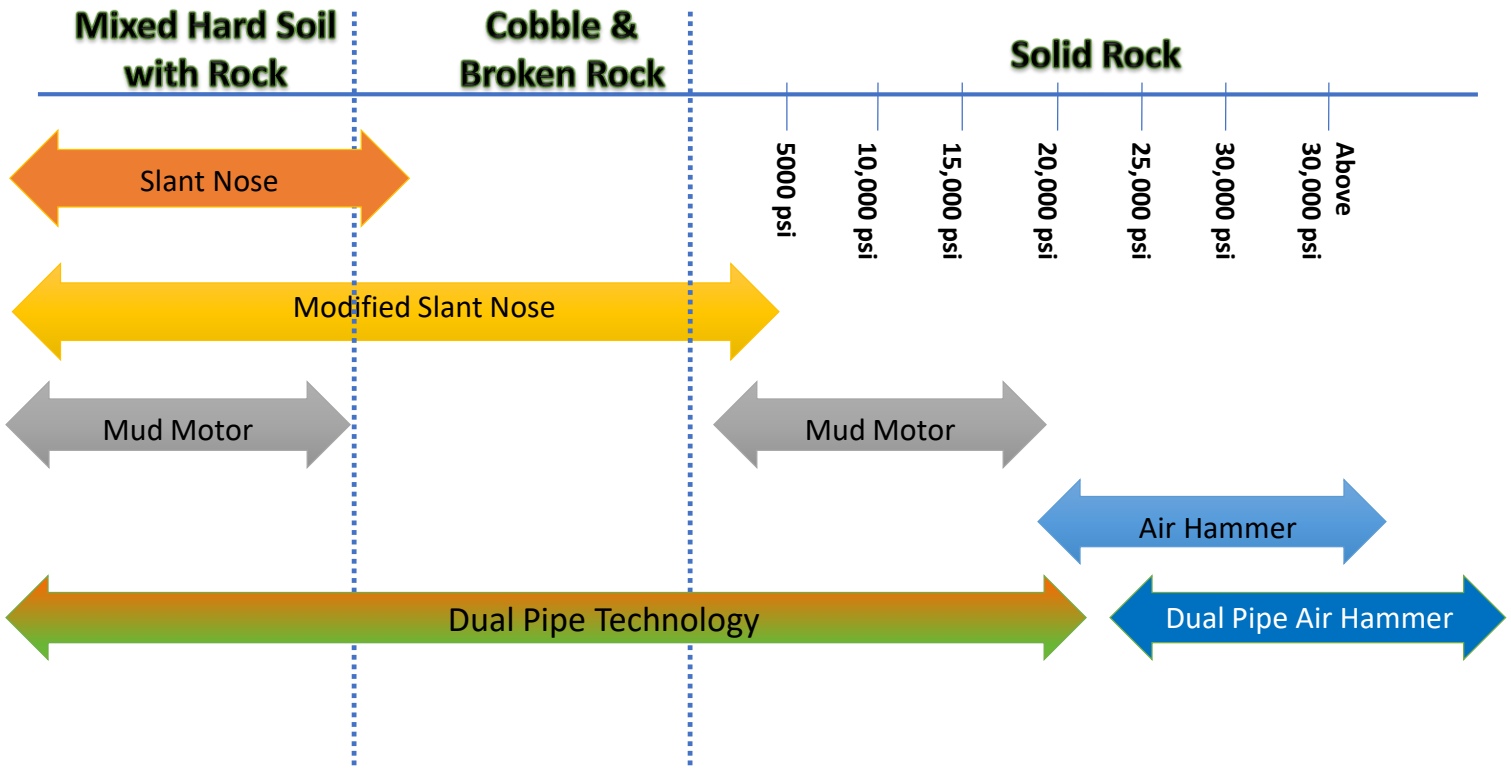
Agenda

- Pre-planning for drilling
- Potential pitfalls to avoid
- Downhole tools for diverse ground conditions
  - Single-pipe downhole tools
  - Dual-pipe downhole tools
- Summary/Conclusion
- Questions

Pre-planning

- Preparing for HDD jobsites, step one: test ground conditions
  - Common pitfalls when meeting unfamiliar terrain
    - Project delays
    - Increased costs
    - Decreased profits
    - Incorrect drilling method selection and improper bit selection for formation
    - Lack of preparation and operator frustration
- Testing will help operators correctly match tooling to ground conditions, leading to:
  - Increased productivity
  - Reduced premature wear, increased tool longevity

Drilling Technology Effectiveness



Downhole Tools for Diverse Ground Conditions

- **Single pipe DHT**
  - Conventional carbide-tipped spade bits
    - Corse soils dirt and gravel
  - Replaceable insert carbide tooth bits
    - Rocky cobble soils
  - Single roller cone TCI rock bits
    - Layered rock
    - Solid rock
  - Air hammer with TCI bits
    - Layered rock
    - Solid rock
  - Mud motors with rotary bits and drag bits
    - Layered
    - Solid rock
- **Dual pipe DHT**
  - Mechanical motors with TCI bits
    - Cobble rock
    - Solid rock
  - Mechanical motors with air hammers systems
    - Mixed soils, sandy loam
    - Solid rock

Downhole Tools for Diverse Ground Conditions

Single Pipe Downhole tools

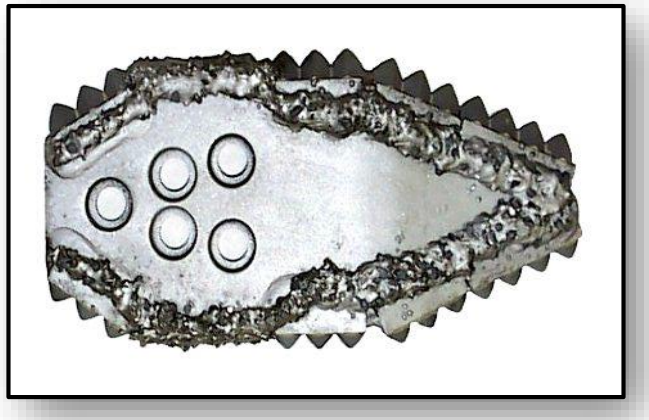
Dual Pipe Downhole tools

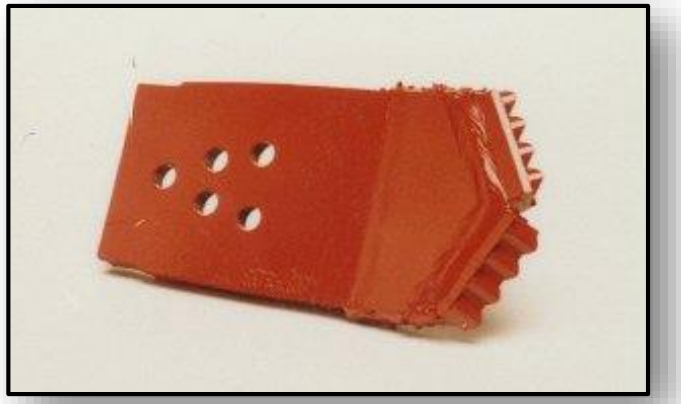
Potential Pitfalls

- Three important factors in rock drilling:
  - RPM (rotation per minute)
    - The key factor for RPM in rotary bits is life of seals, bearings and carbide cutting structure
  - WOB (weight on bit)
    - Very important when drilling in rock; life factors of tooling
  - Drilling fluids
    - One of the most important factors in rock drilling - mud is your friend
    - You must be able to move cutting out of the borehole to complete your job!

Single Pipe Downhole Tooling

- Conventional carbide-tipped bits
  - Effective in most soil conditions but primarily recommended for use in soft rock (sandstone, shale) and light cobble stone

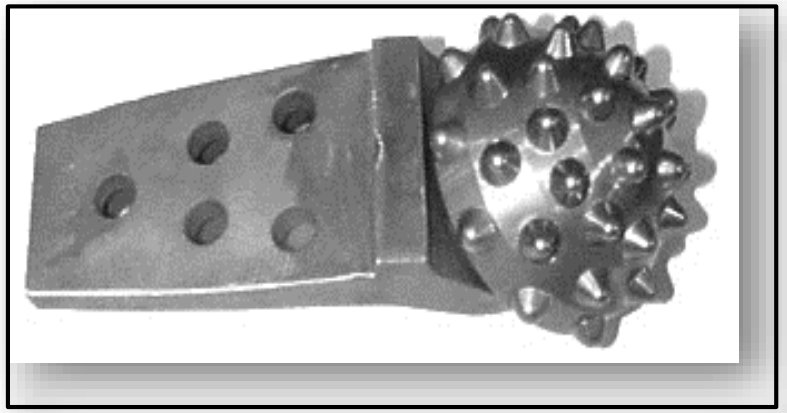




Single Pipe Rock Tooling

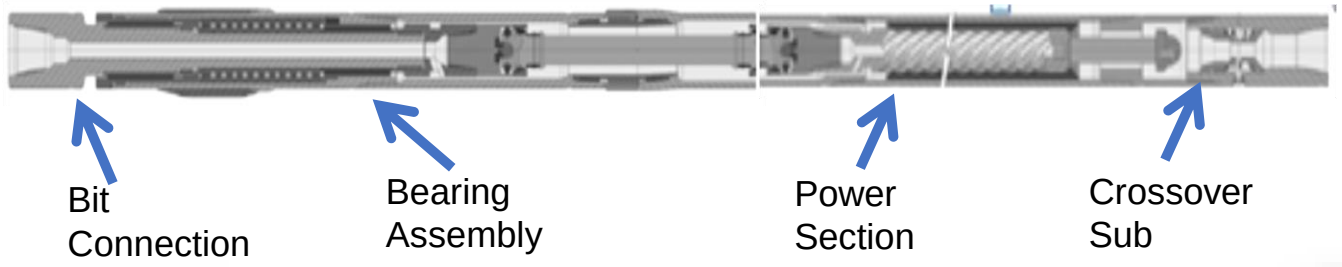
Single roller cone rock bits

Effective for use in layered rock and solid rock



Single Pipe Rock Tooling

- Mud motors with rotary bits and drag bits
  - Effective for use in cobble, layered and solid rock



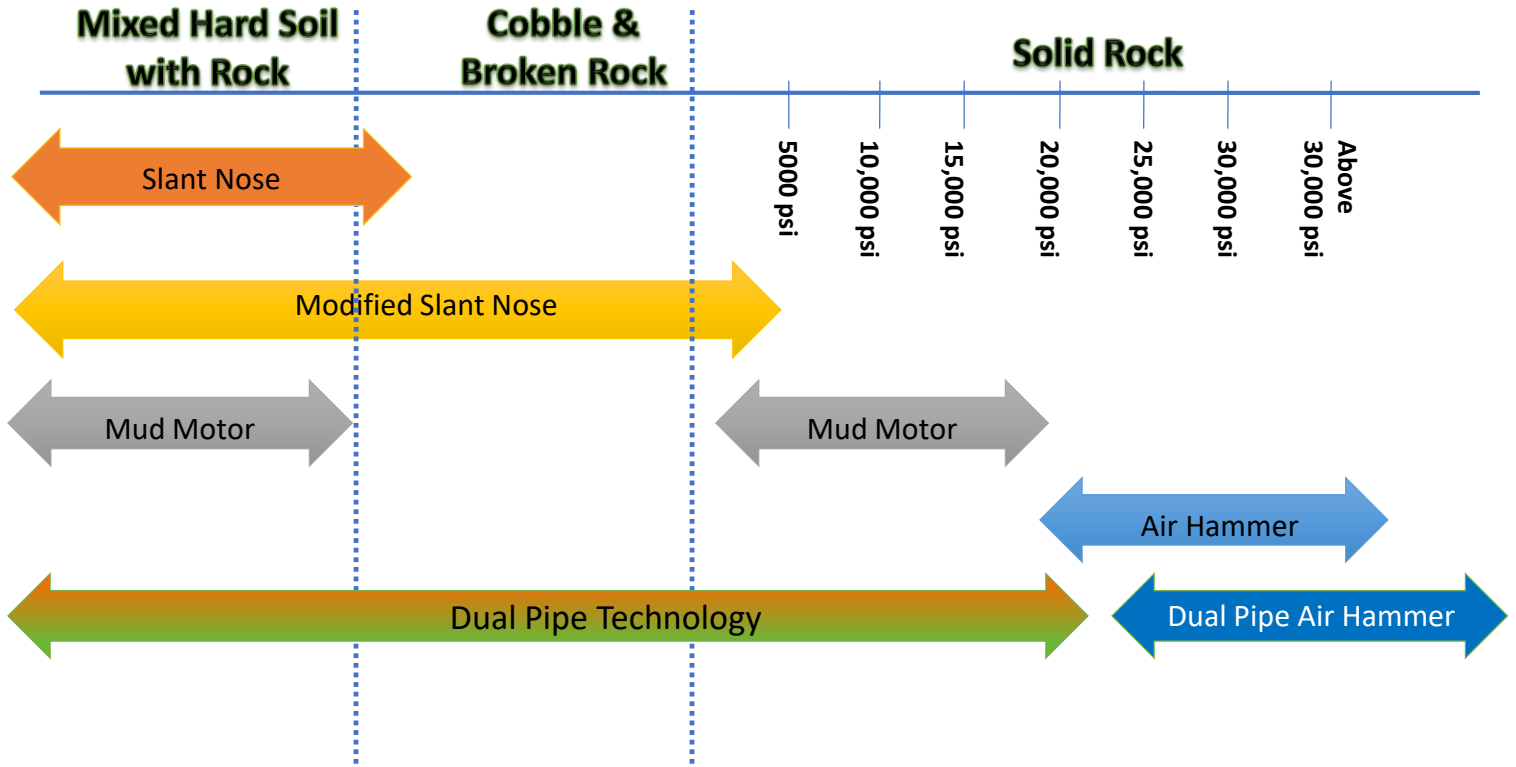
Dual Pipe Rock Tooling

- Mechanical motors with rotary bits and drag bits
  - Effective for use in cobble, layered or solid rock
  - Mechanical bit drive (inner rod)
  - Low drill fluid requirement (+/- 30 lpm)
  - Outer body rotation locked for steering
  - Outer body rotating to go straight

Dual Pipe Rock Tooling

- Dual pipe mechanical motor with air hammer system
  - Effective for use in solid rock

Drilling Technology Effectiveness



Backreaming in Diverse Ground Conditions

- PDC bit reamers
  - Solid formations:
    - RPM: high
    - WOB: manufacturers' spec
    - Fluid flow: determined by size

- Solid rock formations
  - Important factors:
    - RPM: low
    - WOB: manufacturers' spec
    - Fluid flow: determined by size

- Cobble and chunk rock formations
  - Important factors:
    - RPM: mid-range speed
    - WOB: manufacturers' specs
    - Fluid flow: generally determined by size