“Choosing the Right Drilling Method for Your Project”

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Overview

- Primary Methods - Overview
- Why are there so many methods?
- Choosing the Right Method – 5 Step Process
# Primary Drilling Methods Overview

<table>
<thead>
<tr>
<th>Method</th>
<th>Hole Size</th>
<th>Depth</th>
<th>Ground Conditions</th>
<th>Sample Quality/Type</th>
<th>Cost</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Rotary</td>
<td>3” – 30+”</td>
<td>2000’+</td>
<td>Overburden / Soft Rock</td>
<td>Return Fluid</td>
<td>Low/Med</td>
<td>Fast</td>
</tr>
<tr>
<td>Air Rotary</td>
<td>4” – 30”</td>
<td>1000’+</td>
<td>Overburden Bedrock</td>
<td>Return Fluid</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Dual Rotary</td>
<td>6” – 24”</td>
<td>500’+</td>
<td>All</td>
<td>Return Fluid</td>
<td>High</td>
<td>Med/Fast</td>
</tr>
<tr>
<td>Cable Tool</td>
<td>4” – 36”</td>
<td>2000’+</td>
<td>All</td>
<td>Bailer</td>
<td>Low</td>
<td>Slow</td>
</tr>
<tr>
<td>Hollow Auger (rotary,core)</td>
<td>3” – 12”</td>
<td>150’</td>
<td>Overburden</td>
<td>Shelby Tube/SSP</td>
<td>Low/Med</td>
<td>Fast/Slow</td>
</tr>
<tr>
<td>Sonic</td>
<td>3” – 12”</td>
<td>400’</td>
<td>Overburden / Soft Rock</td>
<td>Continuous</td>
<td>Med/High</td>
<td>FastSlow/depth</td>
</tr>
<tr>
<td>Direct Push</td>
<td>1” – 3”</td>
<td>75’</td>
<td>Overburden</td>
<td>Continuous</td>
<td>Low</td>
<td>Fast</td>
</tr>
<tr>
<td>Diamond Core</td>
<td>2” – 5”</td>
<td>5000’+</td>
<td>Bedrock</td>
<td>Continuous</td>
<td>Med</td>
<td>Slow/Med</td>
</tr>
</tbody>
</table>
Why so many kinds?

• All drill rigs and methods have one thing in common….they make holes in the ground.
• So why is there so many different kinds?
  • Different ground types…sand, clay, till, bedrock, boulders
  • Different hole sizes….1” to 24”+
  • Different requirement…sample quality/type, installation type, casing vs. no casing, data gathering
  • Depth requirements…2’ to 2000’
  • Site conditions…muddy/wet, open, low clearance, limited access
• Most rigs are designed to maximize performance in one specific drilling applications. However, most drills today can be used in multiple drilling applications.
Many Choices

Which do I choose?
Step 1- Purpose

Clearly define the purpose of the bore hole. Really only two reasons to drill a bore hole:

1. Extract
   - Define sub-surface strata
   - Gather geo-technical information
   - Extract soil/bedrock samples for analysis
   - Environmental impact analysis
   - Mineral exploration
   - Gravel search

2. Install
   - Water well or de-watering well
   - Monitoring well
   - Injection or vapor extraction wells
   - Install instruments – Slope indicator pipe etc..
   - Ground engineering – caissons, tie-backs, anchors, etc..
   - Geothermal/Heat Loop
   - Cathodic protection
Step 2 – Project Scope/Specifications

What are the project requirements?

- Soil/Ground conditions
- Approximate hole depth
- Hole diameter
- Sample quality
- Sample type (water, soil)
- Time frame
- Budget constraints

- PVC or steel casing
- Formation disturbance
- GPM
- Site conditions
- Etc…
Step 3 – Select Drilling Method(s)

Based on the purpose, scope, and specs choose the drilling method(s) that are best suited of completing the project.

• In most cases there are at least 2 or 3 different methods capable of completing the project

• All drilling methods have relative strengths and weaknesses

• Seek opinions from multiple drilling contractors

• Choose the method or methods which will provide the results you want
Step 4 - Bidding

- Utilize the help of experienced drilling contractors while drafting a proposal….help with terminology, language, project timing, required equipment, etc..

- Extend bid to contractors

- Low bid isn’t always the best bid

- Experience, equipment, method used, capability, referrals, local knowledge…are all valuable

- Give contractors an opportunity to discuss the bids and their proposed methods
Step 5 - Award Bid/Project Completion

- Things don’t always go as planned

- Formation changes, rig and tool breakdowns, weather…etc. can effect the outcome of the project
5 Step Process

Step 1 – Purpose

Step 2 – Project Scope

Drilling Project

Step 3 – Drilling Method

Step 4 – Bidding

Step 5 – Award Bid
Project Completion