Project design limitations for microtunneling

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About Aker Wirth

- Drilling technology “made in Germany” for more than 110 years
- Headquarters in Germany and more than 700 employees worldwide
- Part of Aker Solutions with about 22000 employees worldwide
- Products and solutions:
  - For the mining and construction industry
    - Tunnel boring machines
    - Microtunneling machines
    - Roadheaders
    - Pile Top drill rigs
  - Core components for drilling rigs to the oil and gas industry
Program - Considerations for microtunneling success

■ Microtunneling
  ● Advantages of microtunneling
  ● Utilities installation by microtunneling

■ Project limitations
  ● Distance between shafts
  ● Maximum depth of operation

■ Information transfer
  ● Information needed from the client
  ● Information available to the client

■ Project considerations
  ● Choosing the correct alignment – urban situation
  ● Choosing the correct alignment – soil interfaces
  ● Obstructions in the path of the machines
  ● Buried services – investigations
  ● Maximum soil strengths
Microtunneling: advantages

- Trenchless technology
- Remote non-man-entry
- Less disruption to traffic
- Compact footprint
- No disturbance of ground water table
- Less impact on environment
Microtunneling: utilities installation

Any installation requiring accurate on line and grade to high tolerances in soils of all types with minimal disruption to urban situations and environmental concerns.

- Gas lines
- Cable duct and service tunnels
- Sewerage lines and collectors
- Freshwater lines
- Sea outfalls
- Lake taps
- Pipe arch applications
Project limitations: distance between shafts

Machines with surface power pack

- Machine diameter: DN400 – 700

- Diameter prevents use of tunnel pump and Interjack Station, (IJS)
- Slurry flow
- Laser refraction through heat in the tunnel
- Skin friction – good lubrication
- Available jacking force

Drive length:
100 / 140m

Laser beam
Project limitations: distance between shafts

Machines with surface power pack

Machine diameter:
DN800 – 1200

- Diameter allows use of tunnel pump and Interjack Station, (IJS)
- Drive length increased by:
  - Use of tunnel pump
  - Use of IJS
  - Hydraulic pressure loss from surface container

Drive length:
240 / 300m

Laser beam
Project limitations: distance between shafts

Machines with tunnel power pack

Machine diameter:
DN1000 – 1500
DN1500 – >

- Drive length increased by:
  - Direct power to cutter head 950V
  - Tunnel slurry pump
  - Using IJS
  - Limited by volt drop, possible to increase using higher voltage supply and step up step down transformers and automatic bentonite lubrication system

Drive length:
400 / > 600m
400 / >1000m

Laser beam
Project limitations: maximum depth of operation

- Water table
  - Standard machines will work under a water table of no more than 35 m of head, or 3.5bar
  - Pipe seals on pipe joints, interjack seals

- Slurry pumping head
  - Standard slurry pumps can only lift 40m height, effectively 30m deep shaft plus 6m to separation tank
  - For deep shafts it is practice to install a tandem pump mid shaft to assist in overcoming the head!
  - Time for flushing slurry system when pipe jack cycle finished, ensure lines are cleared preventing spoil in pipe falling back down line blocking shaft pump.

- Ventilation
  - Ventilation to be provided to deep shaft
Project limitations: minimum clearances?

- Minimum pipe depth below street level
  - 1.5 – 2 pipe diameters below street level
Information transfer: client to manufacturer

- Soils information with soil reports and bore logs
- Depth of water over the intended axis for tunnel
- Shaft depth
- Total length of project
- Longest distance between shafts
- Pipe material and dimensions, length, ID, OD
- Straight or curved alignments required
- Delivery time on site
- Execution time for project
- Experience level of client
Information transfer: manufacturer to client

Microtunneling system must have, be capable of the following:

- Data recording with direct printing or electronic copy of drive record for:
  - Steering position
  - Laser position on target
  - Length driven, day date time
  - Torque cutter head and jacking force

- Working under water depth of maximum 3.5 bar
- Offer minimum 3 IJS stations controls
- Bearing lubrication system
- Automatic bentonite lubrication system
- Capacity of working in maximum MPa UCS material
- Straight or curved alignments required
Project considerations: urban situation

- Jacking shaft
- Receiving shaft
- Alignment

Map showing urban situation with distances:
- D=1200m
- D=1500m
- D=1500m
- D=1500m
- D=2000m
- D=1200m
Project considerations: soil interfaces
Project considerations: soil interfaces
Project considerations: buried services – investigations

- Check for buried services
- Bore holes
- Permissions from utility companies
- Know what is there!
Recap on today’s discussion

- **Microtunneling**
  - Advantages of microtunneling
  - Utilities installation by microtunneling

- **Project limitations**
  - Distance between shafts
  - Maximum depth of operation

- **Information transfer**
  - Information needed from the client
  - Information available to the client

- **Project considerations**
  - Choosing the correct alignment – urban situation
  - Choosing the correct alignment – soil interfaces
  - Obstructions in the path of the machines
  - Buried services – investigations
  - Maximum soil strengths
Merry Christmas and a safe journey home to your families
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