Auger Boring

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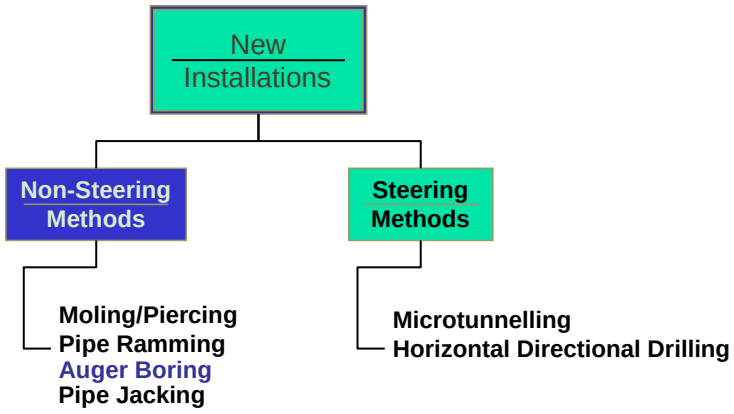
New Installations



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Auger Boring

Also known as:

- horizontal earth boring
- jack and bore

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Auger Boring

- Mechanical removal of soil via cutting head and augers
- Simultaneously jack casing as soil/rock is removed using screw augers

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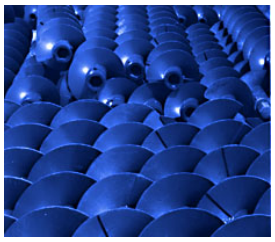
Auger Boring

- Augers placed inside of pipe (casing)

54" Dia. Auger



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Auger Boring

- Soil/rock cutting head is attached to the front of a flight of augers and casing
- Soil/rock cuttings (spoils) are removed towards the power source by turning a flight of augers coupled together

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Auger Boring

- Casing is pushed (jacked), without rotation, during the borehole excavation
- Major factors that control installation are machine:
  - Torque
  - Thrust

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Torque and Thrust

Torque

- rotates the augers that turn the cutting head
- create by a power source:
  - Pneumatic, hydraulic or combustion engine with a gear box

Thrust

- pushes pipe into the borehole
- Torque and thrust should be closely monitored

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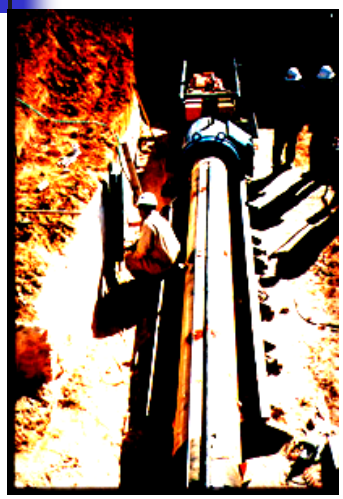
Auger Boring



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Auger Boring Equipment

Rock boring

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Auger Boring

Two types of auger boring systems:

- Track
- Cradle

- Track type system is most common method
- Cradle system can only be used when adequate area is available around the launch area

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Track Systems

Major components:

- Track system
- Boring machine
- Cutting head
- Augers

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Track Systems

Optional components:

- Lubrication system
- Grade control head
- Casing leading edge band
- Water level indicator

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Track Systems

- Operation is completed by working in a launching pit
- Cyclical operation - pipe and augers are added after a prescribed auger flight length is installed
- Requires carefully constructed and designed boring (launching) pit

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Track Auger Boring

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Track Systems

- Thrust is developed by hydraulic rams located at the rear of the boring machine
  - One end attaches to the boring machine
  - Other end attaches to lugs that attaches to the track system
  - Track get thrust capability by pushing off a thrust block located at the back of the boring pit

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Lubrication System

Lubrication lines

- Used to minimize required jacking thrust (reduce skin friction)
- Used to aid soil cutting and transport

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Lubrication System

- Fluid – water with additives
- Common additives:
  - Sand: Bentonite (swelling clay)
  - Clay: polymer and/or surfactant (soap)
- Requires mixing and pumping equipment

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Track System Pit Design

- Safe slopes or sides
- If sloping not possible then sheet piling walls with appropriate bracing should be considered
- Must be keep from flooding
  - Ensure adequate surface drainage during heavy rain
  - Provide dewatering systems where required

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Track System Pit Design

- Check for underground utilities before starting excavation
- Boring pit should be offset to the side of the bore line to allow for spoil removal
- Check soil stability:
  - Must be able to resist thrust on thrust block
  - Disturbance of utilities behind the thrust block
  - Weight of track, pipe, augers, and boring machine

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Track System Pit Design

- In most cases bore pit is excavated below grade and backfilled with crushed stone or concrete
- Pits should be designed to be open for a period much longer than expected
  - This will allow for completion of projects without unexpected problems

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Equipment Set-up

- Most critical part of bore is setting machine track on grade
  - If improper alignment started it will not improve with drilling
- Grade control head may be used to make minor corrections to only the vertical alignment

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Equipment Set-up

Steering Head Kit

- Grade control head may be used to make minor vertical alignment corrections only

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Equipment Set-up

- Water level indicators may be used with the grade control head to monitor bore alignment
  - Indicator consists of sensing head attached to the top of the leading edge of the casing
  - Measures water level at the front of the bore
  - Monitored in the pit
- Requires boring below the GWT

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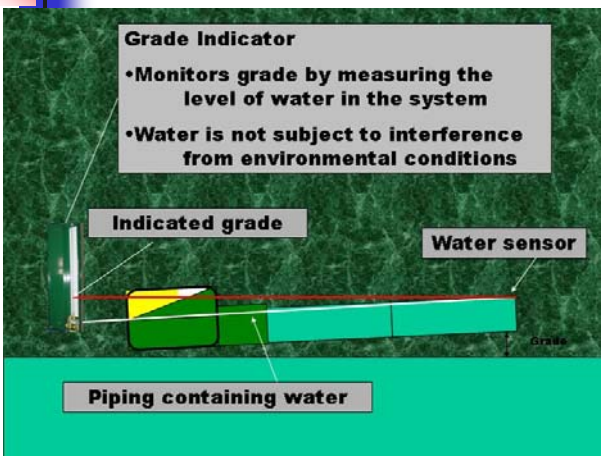
Grade Control Monitoring



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Equipment Set-up

- Casing should be of good quality and well prepared
  - Smooth, strong, ends prepared for proper connection and alignment
- Augers should be placed in the casing prior to arrival at the site (not for small bores)
- Smallest augers should not be less than three quarters of the pipe diameter

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Equipment Set-up

- Small augers can cause:
  - Decreased cutting and spoil removal efficiency
  - No forward advancement due to the lack of spoil removal
  - Auger stem bending that creates wind-up that pulls the cutting head off-line

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Equipment Set-up

- Use of banding on the casing is recommended for most soils
  - Consists of installing partial bands at or near the end of the casing
- Compacts the soil creating a larger gap between the casing and the bore
  - Less soil friction
  - Better fluid lubrication distribution around the pipe outer surface

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Equipment Set-up

- Wing cutters are devices that connect to the cutting head
- Open on clockwise rotation
- Close on counter clockwise rotation
- Allows approx. 25mm over excavation of the bore in front of the casing
  - Provide easier advance of casing in hard soil/rock

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Equipment Set-up

- Care should be used to ensure that wing cutters do not over excavate the bottom of the bore
  - Can create downward drift of bore
- Wing cutter is closed to allow auger and auger head removal

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Start of a Track Auger Bore

- Ensure proper start alignment
- Care must be taken to ensure that the track and casing does not lift
  - Use low thrust advance and slow auger rotation (RPM)
  - Install a saddle to keep alignment
- After installing 1.3m (4 feet) of casing stop and remove the saddle

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Start of a Track Auger Bore

- Check alignment
- If acceptable proceed to complete section installation
- If not repeat the starting process until alignment is acceptable
- Success of the bore depends greatly on the grade and alignment of the first section

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Cradle Auger Boring

- Entire length of casing with auger and cutting head is assembled outside of launching pit prior to start of bore
- Entire casing is suspended in the launch pit via cranes
- Power source is suspended and attached to the casing

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Advantages of Cradle Auger Boring

- No persons has to enter the launching pit
  - Simpler and less complicated design
- Continuous installation compared to cyclic track method
- Common for large Gas Distribution lines

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Disadvantages of Cradle Auger Boring

- Requires large assembly area
- Need for cranes or equipment to suspend power source and casing
- Poor bore alignment
  - More appropriate for pressure systems
- Generally not suitable for use with a steering head

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Auger Boring

- Types of pipes installed
  - Steel , reinforced concrete, GRP, vitrified clay
  - Pipe require high compressive strength to prevent joint leakage.
  - Also require special joint so do not get joint spalling due to stress concentrations

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Auger Boring

- Common pipe diameters 250 to 1500mm diameter
- Typical bore span 60 to 75m
  - Max length ~100m
- Pipe lengths 3 to 6m (10 to 20ft)

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Common Applications

- Road/highway crossings
- Railway crossings
  - No ground surface settlement?
- Cleaning out open-ended rammed pipe

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Auger Boring

Major advantages:

- Casing is installed as the bore excavation takes place
  - Minimal ground surface settlement
- Can be used in a variety of soil conditions
  - Not good in clean sand/gravel with high water table – running soil
- Proven method of pipe installation with well defined standards

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Auger Boring

Major disadvantages:

- Requires different size augers and cutting head for different casing sizes
- In the case of soils with boulder greater than 0.3 the casing diameter this method can not be used

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Auger Boring

Major disadvantages:

- Short drive lengths <100m
- Groundwater dewatering may be required
- Grade and alignment control
- Augers rotation inside the casing can wear interior pipe coatings
- A larger entrance pit than pipe ramming

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Safety Precautions

- Check for overhead wires in area of the launching pit
- Obtain utility clearances and locates before you start your project

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Safety Precautions

- Confirm critical utility locations by excavation before you start
  - Do not trust drawings
  - Cost of taking out utilities can be high
    - Cable, hydro, fiber optics
- Safe launching and exit pit slopes
- No workers allowed in exit pit during the boring operation

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Case Study Guelph, ONT

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Guelph Hydro

- Hydro for new subdivision
- Cross four lane highway
  - MTO will not permit excavation
  - Overhead tower expensive
- Site conditions:
  - Sand/gravel/cobble and boulders
  - High GWT
- Try Auger bore 36in dia. casing

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Guelph Hydro

- January 2000
  - Auger bore
  - Soil flows into bore during augering
  - Large void above pipe
- Road stable due to frost
- Completed bore and pump over 27m^3 of concrete to fill the void under the roadway

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