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Techniques for utility line installation, replacement, rehabilitation, renovation, repair, inspection, location and leak detection, with minimum excavation from the ground surface. (NASTT)

VS.



HATCH

Inspection

- Document condition of buried utilities
- Identify poor condition areas and prioritize future works

Rehabilitation

- Follows an existing utility alignment
- Extends the working life of an existing utility

New Construction

- Follows a new utility alignment



Inspection Methods

- Man-entry
- CCTV
 - Robotics, Floats, Zoom, etc.
- Sonar and Laser Scanning
- Geophysics
 - GPR, Seismic Tomography, etc.
- Leak Detection
 - Acoustic, Magnetic, etc.



Rehabilitation Methods

- Slip Lining
- Cured-in-Place Pipe
- Fold-and-Form Pipe
- Deformed Reformed Pipe
- Spiral Wound Lining
- Spray-on Lining
- Grouting
- Pipe Bursting
- Pipe Reaming

Pipe Replacement

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Pipe Lining







New Construction

- Auger Bore and Jack
- Open Shield Tunneling
- Tunnel Boring Machine (EPB/nef PB)
- Microtunnelling
- Direct Pipe
- Horizontal Directional Drilling (HDD)
- Pilot Tube Guided Boring
- Pipe Ramming
- Piercing Tools







Rehabilitation vs. New Construction

Rehabilitation

- Utilities without major sags or offset joints
- Utilities without capacity issues (lining methods)
- Utilities with capacity issues (pipe bursting or pipe reaming)

New Construction

- Where subsurface conditions or surface improvements make trenching difficult or cost-prohibitive
 - High social cost areas
 - Deep excavations (>6m)
 - Below groundwater
 - Unstable soils
 - Environmentally sensitive, congested utility areas, etc.

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(A few) Trenchless New Construction Methods



Horizontal Directional Drilling (HDD)

- Threestep method of pipeline installation
- Typically surface launched
- Capable of installing pipelines along alignments that are horizontally and vertically curved
- Suitable in wide range of ground conditions





Horizontal Directional Drilling



Source: DCCA

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Pilot Tube Guided Boring

- Threestep method of pipeline installation
- Shaft launched
- Capable of installing pipelines along straight alignments only
- Limited to installations under ~100m, and in "compressible" ground



Pilot Tube Guided Boring

STEP 1-Pilot Tube



Source: KBM



Microtunnelling

- One step method of pipeline installation which includes all of the following features:
 - Remote-controlled
 - Guided
 - Pipe jacking
 - Continuously supported face
- Straight or curved alignments
- Suitable in a wide range of ground conditions





Microtunnelling

Typical Setup





Trenchless vs. Tunnelling

METHOD		INSTALLATION DIAMETER (m)		
TRENCHLESS	 Horizontal Directional Drilling [HDD] 	0.1m to 1.2m	10 1	ר נ5
	 Pilot Tube Guided Boring (PTGB) Auger Boring (AB) Pipe Ramming (PR) 	0.3m to 1.8/2.1m	10 1	1 L5
	 Microtunnelling [MT] 	0.6m to 3.0m	10 1	1 L5
TUNNELS		2.4m to 7.0m 0 5	7.0m to 15.0m] 1 15

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Installation Cost Comparison



The fine print:

- Costs normalized to \$/m diameter/m length
- Costs do not include shafts, dewatering, etc.
- Soil/soft rock excavation
- Single-pass installations



Example Projects



Pier A-B Connector (YVR)

Pilot Tube Guided Boring

- Installation of 400mm fuel pipelines below active taxiways and aprons
- 3 separate installations, ranging from 50m to 100m in length
- Soft silts and clays, loose to compact sands, at/near groundwater table





Air Canada Ductbank (YYZ)

Microtunnelling

- Installation of a 1200mm pipe for an electrical duct bank below active apron
- 140m in length with cover depths locally less than 3m
- Fill, silt/clay mixtures, sand/silt tills, below groundwater table



Etobicoke Creek TSS (YYZ)

Microtunnelling

- Installation of an 1800mm sanitary sewer beneath a runway, taxiways and access roadways
- 600 m in length, with cover depths locally less than 3m
- Mix of glacial till soils and shale bedrock





REM (YUL)

Tunnelling

- Installation of a 6.9m
 internal diameter tunnel
 for a light metro rail system
- Alignment crossed under runways, taxiways and aprons
- 2,500m in length, with cove depths of approx. 30m
- Silts, sands and till overlying shaley limestone bedrock



Closing

- Trenchless technologies reading a group of construction techniques designed to limit the amount of surface excavation required for utility installation
 - Ideal for preserving airport pavements and operating surfaces
- Many methods are available, with selection based largely on utility size, installation length and ground conditions
 - Each method has unique strengths and risks
 - Even "perfect" methods still require good design and contractor workmanship



Thank You

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