THE 20TH INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES

SUSTAINABLE INNOVATION IN UNDERGROUND INFRASTRUCTURE CONSTRUCTION AND MAINTENANCE PRACTICES

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Outline

- Underground Infrastructure: Construction and Maintenance: A Challenge
- Population, Traffics, Pedestrians, Business, Pollutions, Cost, Time
- Current Practice: Open cut trenches method
- Problems associated with current Open trenches method
- Innovated Sustainable methods: Trenchless Technology
- Trenchless Technology vs. Open cut trenches method
- Conclusion

Underground Infrastructure

❖ Underground Infrastructure Services' Networks:

- Water pipelines
- Sewer and wastewater pipelines
- Electric power lines and cables
- Data communication cables
- Telecommunication cables
- Gas pipelines
- Oil pipelines

Infrastructure Challenges

- Increases in population and traffic
- Need for new underground Infrastructure services
- Aging Existing Infrastructure: Maintenance, Rehabilitation
- Traditional Open trenches method

Traditional Open-Trenches Method

Does it looks familiar?

Traditional Open-Trenches Method

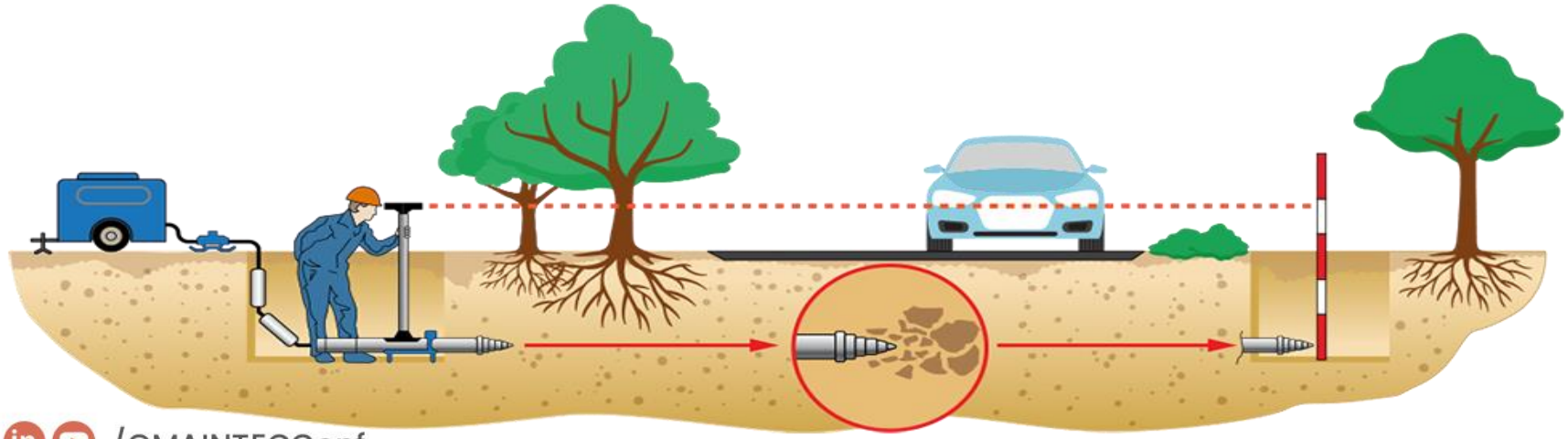
- Costly
- Time-consuming,
- Disturbing people
- Traffic congestion
- Business disturbance
- Pollute environment
- Potential for accidents: workers & public
- Damaging original pavements

Example: $$$ Cost Associated with Open-cut Trenches:

- Essential survey $
- Pavement saw cutting $
- Cutting trees and removing landscape $
- Excavation and shoring $
- Trucking spoil and dumping fees $
- Backfilling materials and transportation fees $
- Soil Compactions $
- Re-storing site conditions and re-asphalting
- Potential national social and economical cost due to the delays $
- Pollutions: Air and carbon emission in the neighborhood $
- Traffic / Pedestrian disturbance and Control $

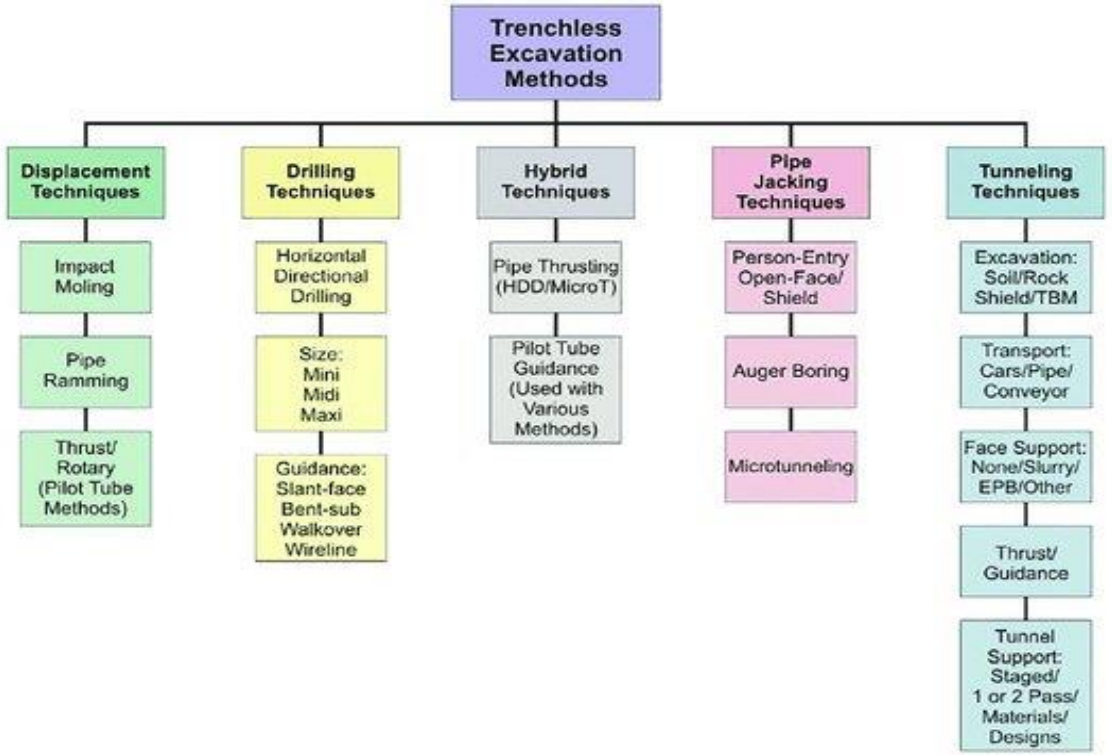
Sustainable Trenchless Technology

Sustainable Trenchless Technology is a family of methods, materials, and equipment capable of being used for the installation of new or replacement or rehabilitation of existing underground infrastructure services with minimal disruption to surface traffic, business, environment, and other activities".



Sustainable Trenchless Technology

Differing trenchless construction techniques are available:



- Relatively new technology
- Based on location
- Type of Infrastructure Utility
- Soil type

Trenchless Technology Methods

Horizontal Directional Drilling

- A steerable system for the installation of pipes, conduits, and cables using a surface launched drilling rig.

-Traditionally HDD is applied to crossings rivers and roads in which a fluid filled pilot bore is drilled

-Then enlarged by a wash over pipe and back reamer to the size required for the product pipe

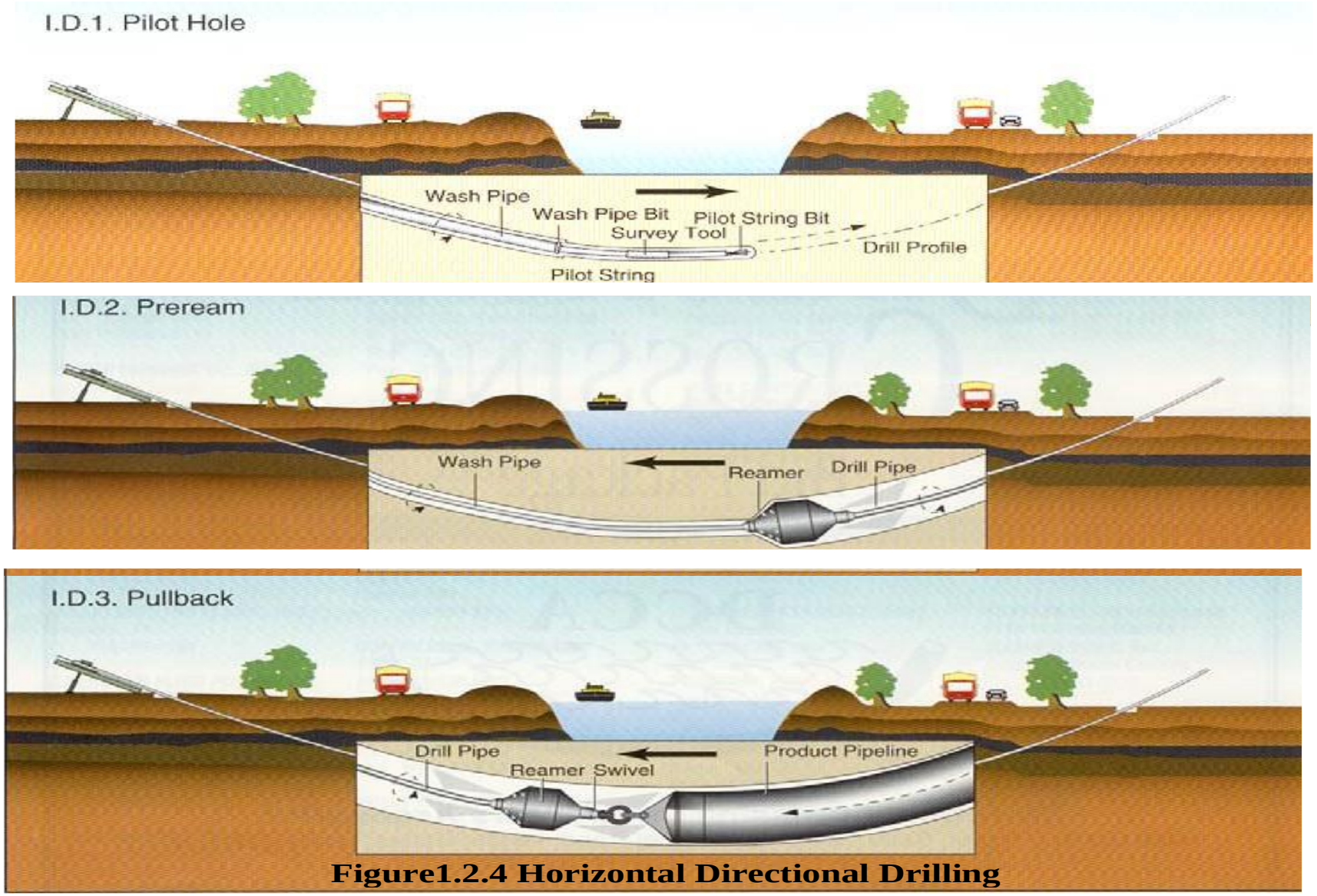
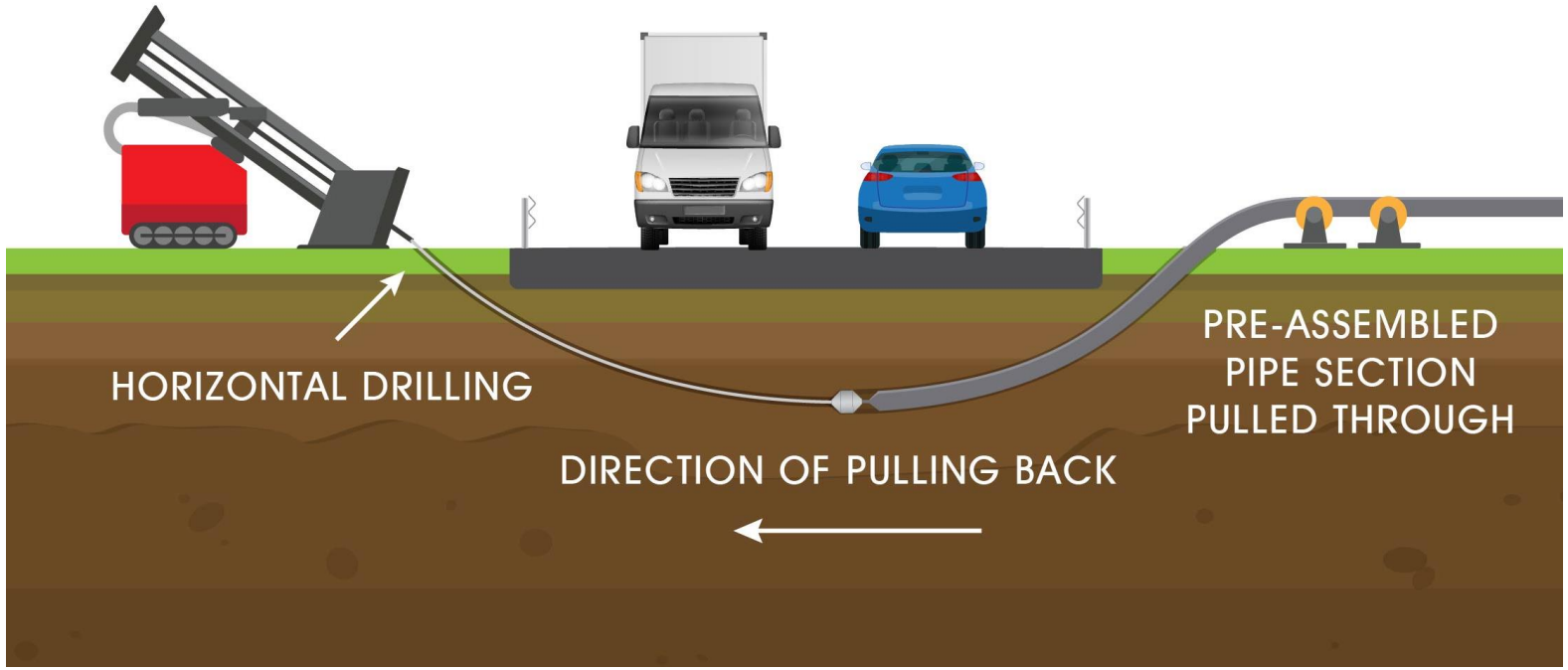


Figure1.2.4 Horizontal Directional Drilling

Sustainable Trenchless Technology

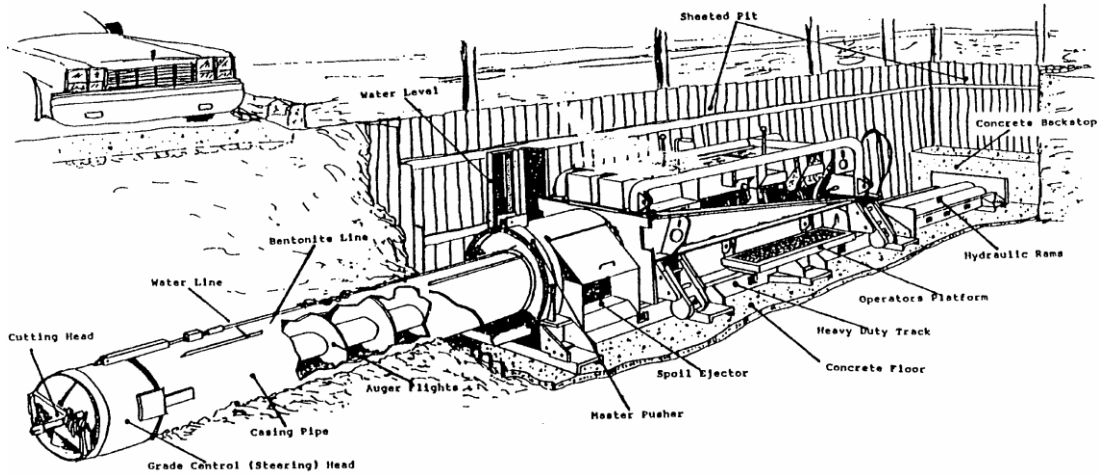
Horizontal Directional Drilling (HDD)



Sustainable Trenchless Technology

Horizontal Auger Boring

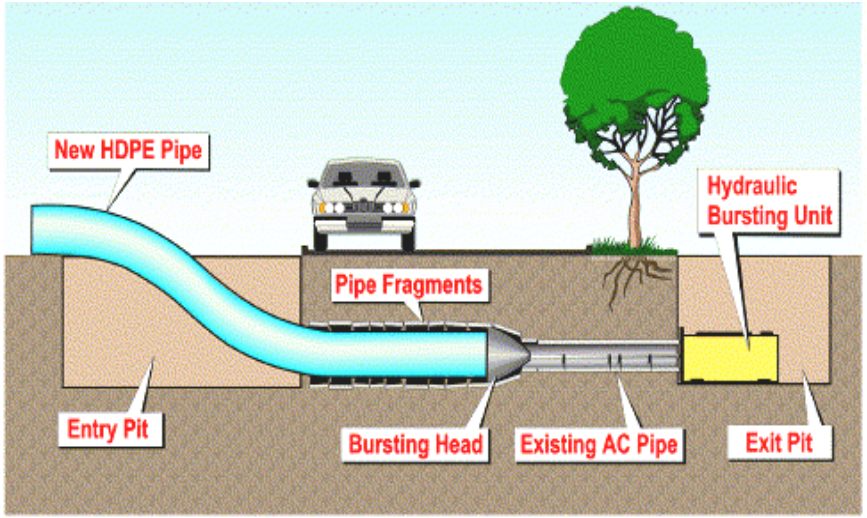
A technique for forming a bore from a drive pit to a reception pit, by means of a rotating cutting head. Spoil is removed back to the drive shaft by helically wound auger flights rotating in a steel casing. The equipment may have limited steering capability

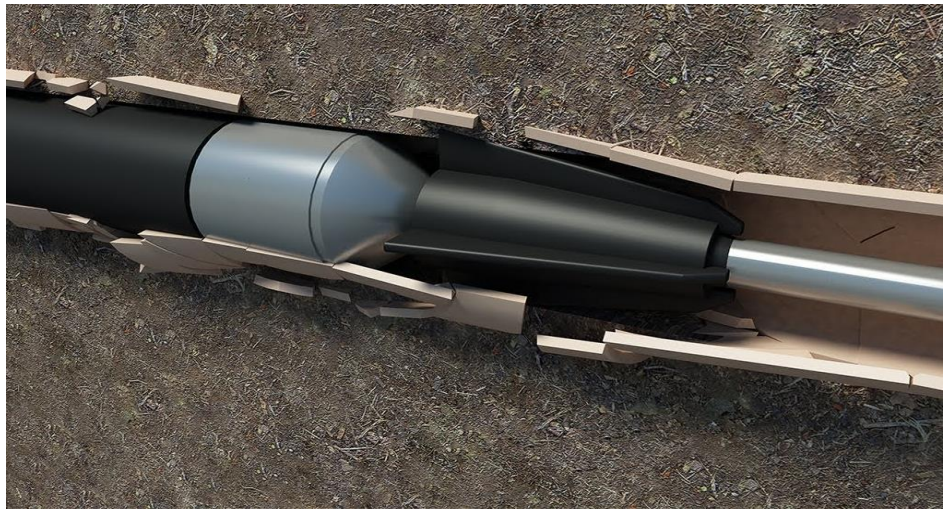


Sustainable Trenchless Technology

Pipe Bursting

A technique for breaking existing pipes by brittle fracture, using force from within, applied mechanically. Pipe remains are forced into the surrounding soil. At the same time a new pipe, of the same or larger diameter, is drawn behind the bursting tool

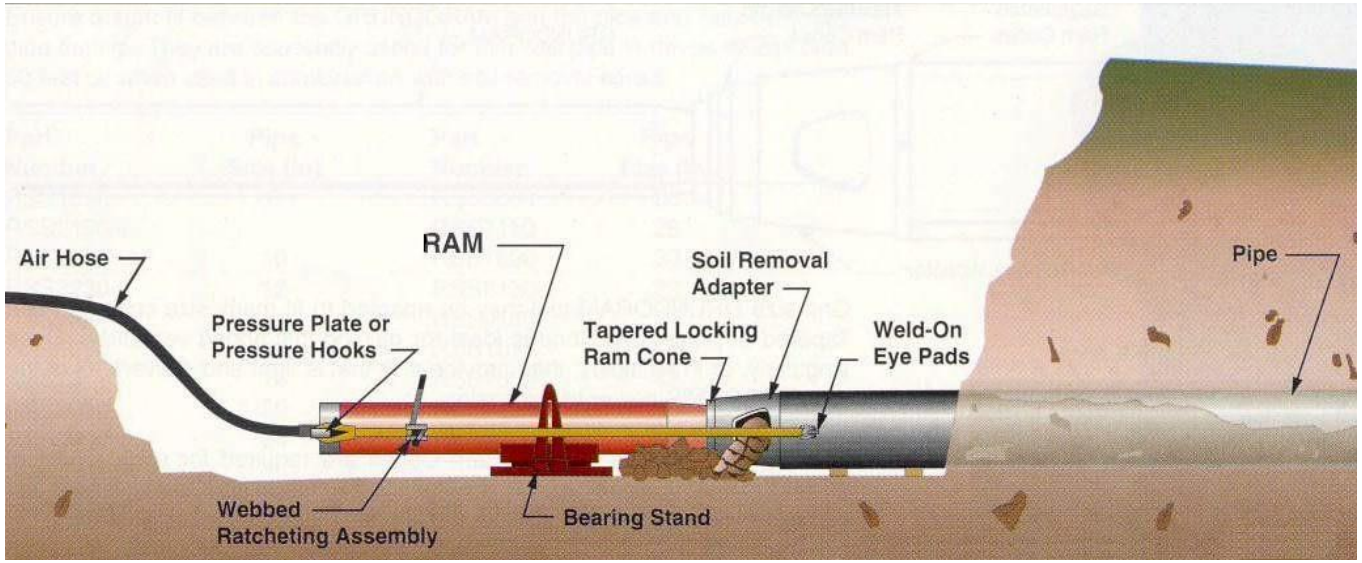




Sustainable Trenchless Technology

Pipe Ramming

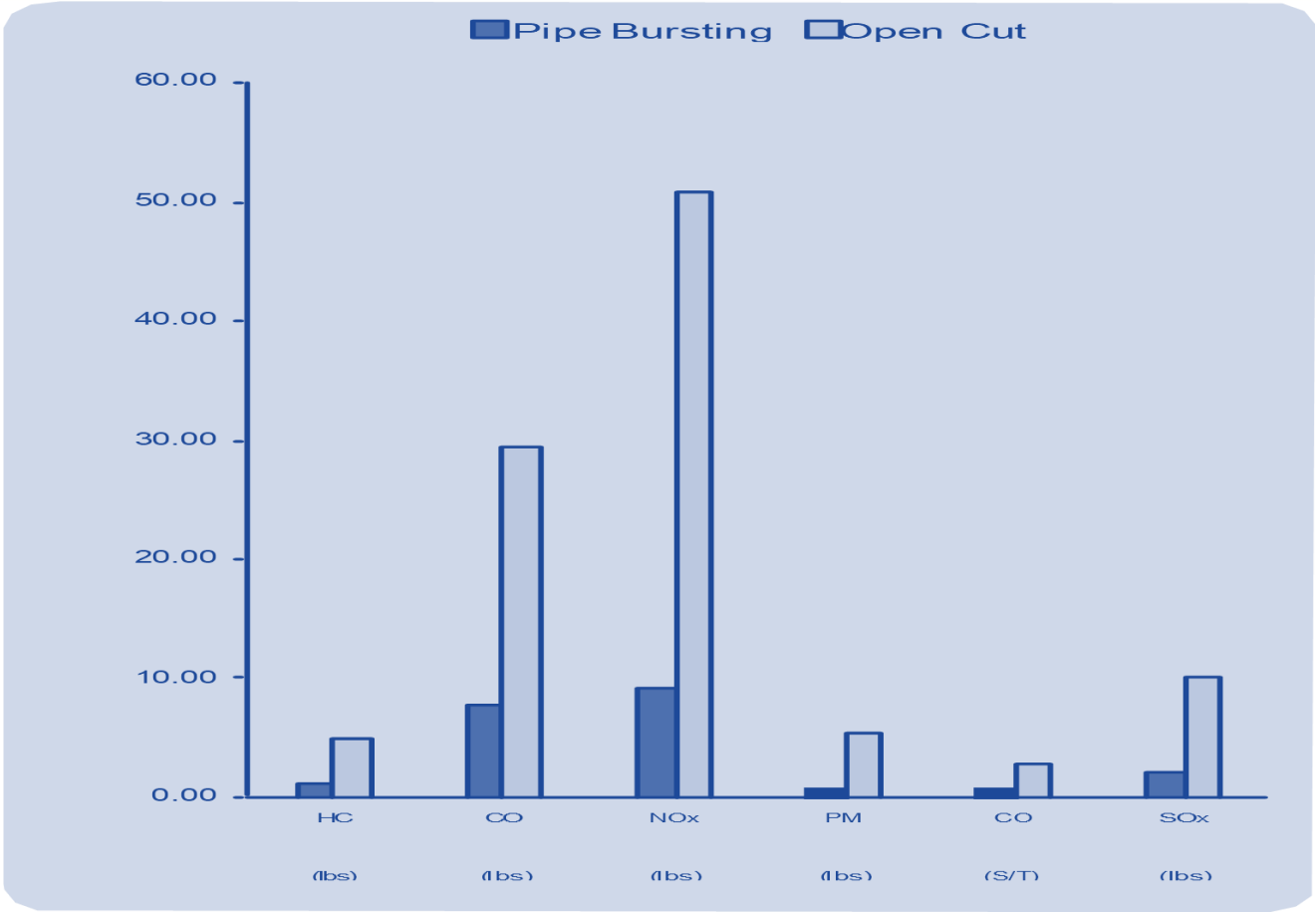
A technique for installing steel casing from a drive shaft to a reception shaft utilizing the dynamic energy from a percussion hammer attached to the end of the pipe. A continuous casing support is provided and over-excavation or water is not required. This is a 2- stage process



Sustainable Trenchless Technology

Pipe Ramming

Trenchless Technology vs. Open Trench Excavation



Sample Comparison for average reduction in gas emission between Open-cut and Sustainable Trenchless Technology

Trenchless Technology vs. Open Trench Excavation

$$$$ Cost by using open trench excavation method	$ Open Trench	$ Trenchless
closing roads and sidewalks	yes	No
Essential survey cost	yes	No
Pavement saw cutting cost	yes	No
Cutting trees and removing landscape	yes	No
Excavation and shoring cost	yes	No
Trucking spoil and dumping fees	yes	No
Backfilling materials and transportation fees	yes	No
Multi-layers compactions cost	yes	No
Restoring asphalt pavements and concrete sidewalks	yes	No
Potential national social and economical cost due to the delays	yes	No
Air and carbon emission in the neighborhood	yes	No
Traffic Control	yes	No

Some Sample Succes Case Studies

USA, Texas:

Crossing under the River of Rio- Grande (HDD)

The project involved boring and pulling back 2,200 ft of 36-in. pipe approximately 80 ft under the river's bed using Trenchless method of Horizontal Directional Drilling

Germany: Frankfurt Airport:

Installing pipes under Terminal 1

Using a combination of several trenchesless technology methods, the project team had managed to successfully repair almost two and a half miles of pipes under terminal 1 without a single trench being dug.

Poland: Krakow Airport:

Underneath Airport roads and Aircrafts' taxi-ways

Installing 5.85 km of sustainable Stormwater System underneath roads and Aircrafts' taxi-ways with many stretches underneath roads and Aircrafts' taxi-ways using trenchless method of Microtunneling.

Conclusions

- Underground Infrastructure: Challenge
- Open cut excavation methods: many drawbacks
- Trenchless technology: Promising sustainable innovated-methods
- Some Consideration for Engineers and Decision makers **(Michigan DOT): :**
  - **Relatively New Technology**
  - **Specialized Skilled and trained construction team**
  - **Thoughtful method selection : Based on type of the project, Site location, and soil type**
  - **Careful planning: Engineers & Decision-makers should corporate with Municipalities, … for specific information and guidelines at the pre-plan stages and starting excavation**

THANK YOU!