Case Study of Trenchless Technology

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Abstract- *The purpose of this study was to examine the current state of the practice of state highway agencies regarding methods and specifications for using trenchless technologies. From the perspective of the Virginia Department of Transportation (VDOT), the paramount concern associated with trenchless construction is the safety of the traveling public. Since such construction typically takes place without the re-routing of traffic, any sudden and substantial surface displacement of the overlying roadway has the potential for catastrophic consequences. Surface monitoring during and after construction is a critical activity to ensure successful installation.The study focused on the most commonly used trenchless methods for new construction, including the selection of the most appropriate trenchless technology for specific applications, the identification of minimum geotechnical investigation requirements, design considerations, construction monitoring, costs, and performance. The study did not address all potentially available methods of utility construction and rehabilitation.*

Keywords- VDOT trenchless technologies

I. INTRODUCTION

- A set of techniques for the remote installation, rehabilitation and repair of utilities, pipelines and small tunnels – executed without excavating continuous trenches.
- Depending on the specific situation trenchless methods can be cost-effective alternatives to the more conventional open excavation. The cost is insensitive to depth of cover meaning that work under high fills will be more economical using trenchless technology. Many times the cost is not the main concern; factors such as safety inconvenience of the motoring public and environmental impacts outweigh the initial costs.
- ODOT‟S (Oregon Department of Transportation) main application of this technology is in the rehabilitation, replacement, and installation of culverts and storm sewer lines in areas where open excavation is either more costly, not as environmentally friendly, or creates inconvenience for the motoring public.
- The trenchless technology process starts with the identification of a problem. There is a drainage structure that requires some sort of fix. It may need stabilization, rehabilitation, or replacement.

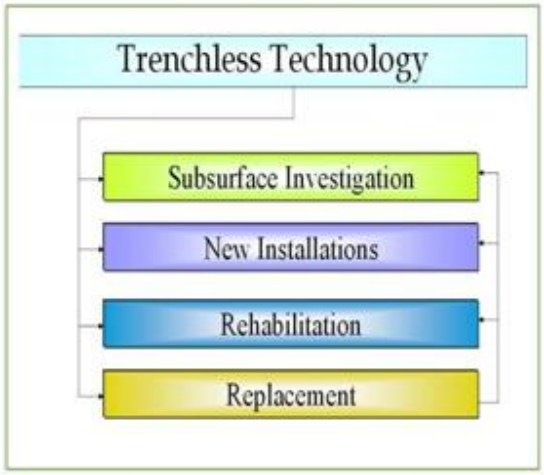

Figure 1.: Flow chart of Sections prior knowledge is nil or limited.

A. New Installations

- Under remote controlled operations, subsurface passage can be developed by either:
  - Shifting soil sideways;
  - Cutting the soil mechanically and removing it axially; or
  - Fluid assisted soil cutting and removing it axially.
- New Installation Trenchless Techniques use these three hole creation mechanisms individually or in combination.

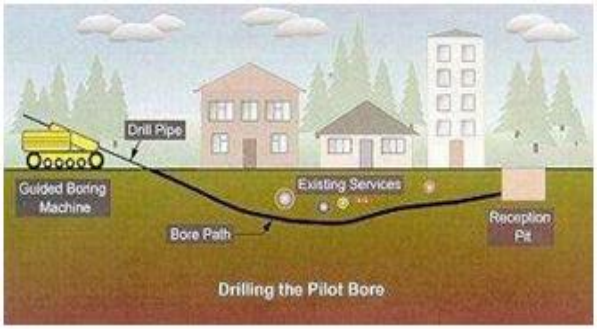

Figure 4: Impact Ramming

1. Rehabilitation

- CIPP, FFP, DRP are trenchless pipeline rehabilitation techniques.
- CIPP is a liquid thermosetting resin-saturated material that is inserted into the existing pipeline by hydrostatic inversion.
- The FFP/DRP process utilizes a thermoplastic pipe which is folded or deformed to reduce the cross-sectional area, then pulled into place, expanded and rounded using heat or pressure, to conform to the internal shape and size of the existing pipe.

Figure 5 : Rehabilitation Process

2. Replacement

The most applicable to the following methods of trenchless pipe replacement:

Pipe Bursting

Using pneumatic, hydraulic expansion, or static pull systems techniques that fracture a pipe and displace the fragments outwards allowing a new pipe to be drawn in to replace the old pipe.

Pipe Implosion

A technique that fractures the pipe inwards prior to the outward displacement of the pipe fragments.

Pipe Splitting

Used to split open existing ductile pipes to allow a new pipe to be drawn in to replace the old pipe.

Pipe Eating

Uses a specially-designed variant of a microtunneling machine that excavates the old pipe in fragments and removes them rather than displaces them - the new pipe is jacked into place as in a microtunneling operation.

Pipe Reaming

Uses a specially-designed variation of thereaming process used in horizontal directional drilling to excavate the old pipe in fragments and removes them rather than displaces them - the new pipe is pulled into position behind the reaming head.

Pipe Ejection

The old pipe is jacked out towards a receiving manhole or excavation where it is broken up and removed the new pipe is used to eject the old pipe.

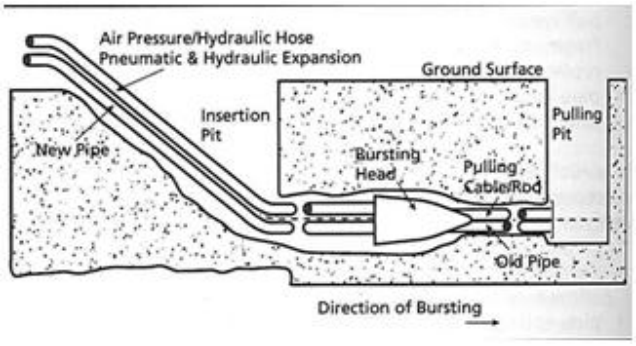

Figure 5: Replacement Process

3. Analyzing Indian Trenchless

Indian Trenchless Market

India is highly dense in terms of population. As the population continues to grow, it is estimated that almost half of India‟s 626 districts will require upgrades in utility infrastructures. Considering this population growth, the trenchless market in India is theoretically around 50,000 km of infrastructure across a total urban area of 77,370 km2. Around 63 cities identified in JNNURM (Jawaharlal Nehru National Urban Renewal Mission) are considered to be a priority for development.

In an effort to reduce the environmental impact of developing and operating sewage treatment networks, underground interceptors constructed using trenchless methods are being viewed as a positive solution in densely populated cities, especially those located along river banks. According to the JNNURM plan, the total value of trenchless projects being developed in the 63 priority cities is around USD 23 billion.

Trenchless work has already been initiated in the cities of Delhi, Mumbai, Kolkata, Bangalore, and Hyderabad. Primarily, these projects are for installing water and sewer pipes and are being constructed using pipe jacking or micro tunneling methods. HDD has been used for Optical Fiber Cable (OFC) laying for telecom and internet service provider companies.

Pipe rehabilitation projects using trenchless methods as well as pipe ramming and pipe jacking projects are also being carried out in the cities of Delhi, Kolkata, Bangalore, Chennai, Hyderabad, Cochin, Ahmadabad, and other Tier-II cities. Although HDD is a fairly popular trenchless method in India, other methods are not as widespread based upon the number of machines currently in use. For auger boring, there are currently no more than 60 auger machines in use across India. For micro tunneling, there are less than 30 micro tunnel boring machines (MTBMs) in use.

The Primary Challenges Facing The Indian Trenchless Market Can Be Summarized As Follows

- Lack of awareness about trenchless methods and their benefits;
- Cost comparisons against cut-and-cover methods that do not take into consideration the evaluation of social costs and benefits;
- A limited pool of specialty contractors skilled in trenchless construction, leading to monopolization of market; and
- Lack of supportive infrastructure.

4. Benefits of Trenchless Technology

Trenchless applications have achieved a very high level of precision due to the progressive development of equipment and method technology and this has made the execution of practically all types of supply and disposal lines possible, irrespective of their sizes or the geological and hydro geological limiting conditions in an ecologically friendly and enclosed method of underground construction.

Where employers have fully recognized and utilized the possibilities of this technology, they have not been slow in reaping the economic rewards. Crossings of major rivers for laying telecom cables and product pipelines for oil and gas across major rivers like Hooghly or Chambal at breakneck speeds have yielded good economic results for such employers. One look at such rivers and one can understand the importance and relative benefits of trenchless technology over the conventional construction methods.

A. By Using Trenchless Technology One Can Achieve Reduction of the Following

- Disruptions to traffic and movement.
- Danger to existing underground facilities while developing or managing networks.
- Easement requirements.
- Environmental impact - dust and noise.
- Potential for settlement damage.
- Potential of injuries due to openexcavations.
- Required time & time related costs.

B. Other Benefits of Using Trenchless Technology Are As Under

- They help in the effective use of geological settings;
- Provisioning for future use and sustainability is enhanced by Trenchless techniques;
- One can achieve the maximization of underground developable space;
- Deterioration of underground networks can be contained;
- Unlike the open cut projects there are generally no hindrances over the entire project length; Camouflage of the utility networks for security purpose can be done more efficiently.

5. Limitations of Trenchless Technology

Trenchless technique provides assistance to the utility developers and managers to execute works remotely. A substantial portion of work is done through mechanical means without physical entry of the operator at the exact work location. For an example in a micro tunneling and pipe jacking project the earth face of tunnel is excavated by the cutter and a slight error in the alignment or grade of the cutting shield can lead to tunnel/project deflection. Such errors can occur on account of any of the following causes:

A. Operator Failure

Operator skills are quite important. Untrained or undertrained operators may produce unsafe or failed structures. This is one of the most critical, but often ignored, aspects of any trenchless project. The fact is if a machine operator who is not properly trained on specific equipment operates the same, He may not be able to understand or feel the distress signals emanating from the equipment at the execution times and may operate the equipment in a completely incorrect way.

B. Specialized Nature

Trenchless techniques are State-of -art systems. Each projects needs to be conceived, planed, structured, designed, executed, and concluded in its entirely, incomplete or inadequate construction works will lead to unsafe or unsound structure.

C. Technique Selection

Improper or inadequate technology selection may lead to failures. Primary objective of these techniques is to develop, maintain or manage subsurface networks and

there are several competing techniques that appear to be suitable for a project but the best suited technique is to be selected.

6. Technique Applicability

The development of trenchless technology was initially undertaken to meet specific needs in different industries and in different parts of the world. For example, research into micro tunneling in Japan was in response to a Government initiative aimed at increasing sewer services in large cities. Similarly, in Singapore, government regulations and the need to provide services in densely populated areas lead to the promotion and use of micro- tunneling. In Europe research into micro- tunneling was sponsored by the German government for use in large cities on the North German Plain were ground conditions were favorable.

In the United Kingdom, where the large towns and cities had been built during the industrial revolution in the 19th century, the principal need was to replace and rehabilitate ageing sewers, water pipes and cast iron gas mains. In addition, the use of natural gas at higher pressures encourages the development of pipe -bursting techniques.

In North America horizontal Directional Drilling, developed from vertical oil wells after the reservoir yield reduced, became widely used for constructing long pipelines for the oil industry.

II. CONCLUSION

- Time duration for Open cut laying of pipeline in selected area is 18 months compared to 3 months for trenchless technology which outworks the cost benefits by open cut method.
- For small scale project work of laying pipeline by trenchless technology is costly but for large area of work trenchless technology is beneficial both in project cost and time as compared to open cut method
- Furthermore we know that excavation initiates air and noise pollution. Air pollution is wholly responsible for diseases like asthamaetc and noise pollution can cause hearing aids. Indirectly these costs get add up to open excavation and hence the cost of the project is going to increase.

The demands for alternative technology lead to the emergence of trenchless Technology, which includes a family of methods utilized for installing and rehabilitating underground utility systems with minimum ground surface disruption and destruction as compared to open cut excavation methods. Trenchless technologies and methods provide an effective, environmentally sound alternative for the installation, maintenance and repair of underground utility services.

The appropriate application of trenchless Technology for resolving both Engineering and Environmental problems can be viewed as an environmentally sound technologies. In addressing urban sanitation problems, Trenchless Technologies have the potential to yield significant environmental and other benefits such as employment opportunities reduced inconvenience to commuters, reduced fuel consumption and improved traffic flow.

III. CASE STUDY OF PIPE RAMMING

- Case Study: Laying Optical fibre cable in KDMC Area.
- Project Name: Horizontal Directional Drilling. Client: M/s. Reliance Jio Infocom ltd. Mumbai
- Requirements: Installation of 60mm diameter optical fibre cable to supply 4G line.
- Distance: 100m
- Crossing: Underneath the road and old Museum. Pit Size: 4m × 1.5m
- Constraints: This project carried out in KDMC area. Main constraints of this project was that information about

underground utilities was not available from some part of the city. Due to this small survey was carry out to identify underground utilities.

- Ground Conditions: Rock Strata InstallationTime:34days

Trenchless Solution: To allow all equipment to be moved to the job site through the museum by man power (High impact force in relation to size and weight) and each 12m cable was divided into three 4m long sections. Based on the calculated trajectory of the „Blind Shot" into the basement portable runners were placed in the launch excavation. Initial set-up was very quick allowing two complete 4m sections of cable to be installed by the end of the first day. Only 1 hour into the second day, welding of the final section of the first duct was complete and breakthrough into the basement was observed by a very happy client. Spoil removal was achieved by a combination of Air Pressure and High Pressure Jetting to remove final residues.

Figure 6: Pipe Ramming In KDMC

IV. ACKNOWLEDGMENT

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