Recent Scenario of Underground Utilities Installation

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***Abstract:*-For metropolitan cities and other fast growing State capitals & towns are congested and have out-grown their master-plans limits and developed in haphazard pattern. This has caused immediate need for rehabilitation, renovation, augmentation of existing old water supply and sewage pipelines &new installations. Various methods and modern equipments used in trenchless technology which are effective and convenient rather than manually operated method.**

Keywords:Recent Scenario,installation, Trenchless Technology, Methods, Underground, New installation, Rehabilitation.

I. INTRODUCTION

A family of methods, materials and equipments accomplished of being used for the installation of new or replacement or rehabilitation of existing underground infrastructures with minimal disruption to surface traffic, business and other activities.For rehabilitation and new installation of cables, gas and oil pipelines, sewage line and other amenities in metropolitan cities, if excavation is done than it requires diversion of traffic and due to diversion of traffic, various difficulties occur like delaying in travel, blockage of road etc.. Moreover excavation activity is more laborious and time *consuming*.

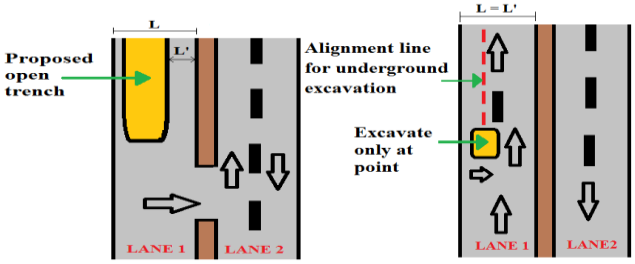


Figure 1. (A)Open trench cut Method

Figure 1. (B)Trenchless Technology

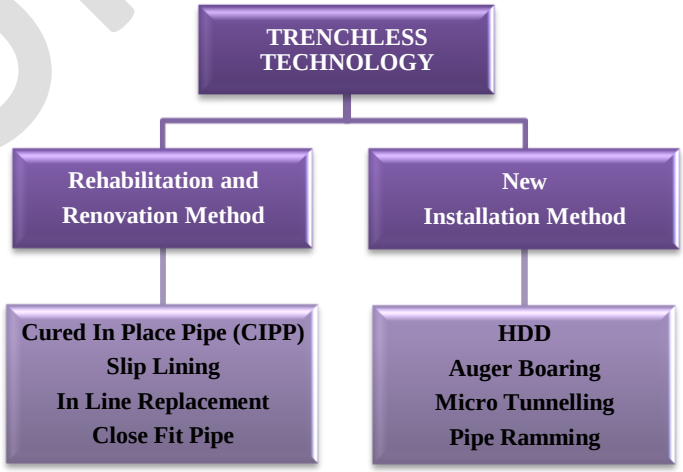
As show in fig. 1(A) if excavation is carried by open cut method, traffic is diverted & there is reduction in total length of road lane 1.

Hence, Effective length of lane-1 (L') < Total length of lane-1 (L)

As shown in fig 1(B) in Recent Scenario excavation is carried out only at a point so traffic is diverted only at a point.

Hence, Effective length of lane (L') = Total length (L)

So there is no traffic problem. Due to open cut vehicle stops on road. So it causes more fuel consumption and it also causes noise & air pollution. In open cut method after trench is filled, the upper surface of road remains uneven so it requires some maintenance works to regain the original position same as that of previous. Moreover open cut is time consuming and laborious method. In Recent scenario the Trenchless Technology is used for installation of underground amenities. This method is basically classified under two main parts.



A. Horizontal Directional Drilling Definition

Horizontal Directional Drilling is defined as a steerable system for the installation of pipes, conduits and cables in a shallow arc using a surfaced launched drilling rig.

Directional drilling methods utilize steerable soil drilling systems to install both small- and large-diameter lines. In most cases, HDD is a two-stage process. Stage 1 involves drilling a

pilot hole approximately 25 to 125 mm (1 to 5 in) in diameter along the proposed design centreline. In stage 2, the pilot hole is enlarged to the desired diameter to accommodate the pipeline. The pilot hole is drilled with a surface-launched rig with an inclined carriage, typically adjusted at an angle of 8 to 18 degrees with the ground for entrance and 8 to 12 degrees for exit angle. The preferred minimum radius in feet for steel pipe is typically 100 times the diameter of pipe in inch. For plastic pipe, the multiplication factor is 40, i.e., 40 times of diameter of pipe in inch.

Most systems adopt either fluid-assisted drilling or a high pressure fluid jetting method to create or enlarge the bore hole. In a few instances, some mini-HDD systems utilize dry bore systems (with compressed air) in hard, dry soils and calcified or soft rock formations.

The progress of the pilot hole is monitored by a specially designed surveying system, either a walkover system or an electromagnetic down-hole navigational system. In a walkover system, the drill head is equipped with a sonde (also called a beacon) transmitter behind the drill bit. The sonde is powered by battery and emits signals continuously. These signals can be picked up on the ground with a hand-held receiver. The receiver provides data on the position, temperature, depth, and orientation of the drill bit. An alternative detection system, the electromagnetic down-hole navigational system can be used in conjunction with a series of four electrical cables positioned directly above the desired path and secured in place. The cables, which can be laid directly on top of the street or highway, do not interfere with traffic flow. The cables transmit an electromagnetic signal that is picked up the navigational instruments in the drill head. These instruments determine the position of the drill head relative to the centre of the cables and relay this information continuously to a computer on the operator's console. In case of deviations from the desired path, the operator can make necessary adjustments

After the drill head (or pilot string and washover pipe) exits at the desired location, reaming devices are attached for the pullback operation. This stage involves enlarging the pilot hole to the desired diameter to accommodate the pipeline. The utility pipe is attached to the reamer, with a swivel to ensure that the rotation (torque) applied to the reamer is not transmitted to the utility. The reamer enlarges the bore hole to the required size, and the utility is installed. For large diameter (greater than 500 mm (20 in.)), an intermediate prereaming may be required before pulling the utility into place. Prior to the pullback operation, the pipeline is usually assembled to its full length and tested.

The drilling process in HDD can be described as follows:

1. Site preparation

The construction site is prepared before the main drilling operation. A drilling rig is set up at the proper location. Slurry is prepared to stabilize the borehole and to lubricate the surface of borehole. A transmitter is inserted into the housing provided on the pilot drilling string near the drill bit. Other equipment and facilities such as generators, pumps, storages, and offices are prepared at this stage.

2. Pilot hole drilling

Drilling the pilot hole can be the most important phase of a HDD project, because it determines the ultimate position of the installed pipe. A small diameter (25 to 125 mm (1 to 5 in.)) drilling string penetrates the ground at the prescribed entry point at a predetermined angle routinely between 8 – 18 degrees. The drilling continues under and across the obstacle along a design profile.

3. Prereaming

In general, the final size of the bore should be at least 50% larger than the outside diameter of the product pipe. This overcut is necessary to allow for an annular void for the return of drilling fluids and spoils and to allow for the bend radius of the pipeline. To create a hole that accommodates the required size of pipe, prereaming is necessary.

Typically, the reamer is attached to the drill string at the pipe side and pulled back into the pilot hole. Large quantities of slurry are pumped into the hole to maintain the borehole and to flush out the soil cuttings (DCCA 1994). The type of reamer varies based on the soil type. A blade reamer is used for soft soils, a barrel reamer for mixed soils, and a rock reamer with tungsten carbide inserts is used for rock formations.

4. Pullback

Once the prereaming is completed, the pipe or conduit can be pulled back into the reamed hole filled with drilling fluid. The pipe is prefabricated and tested at the pipe side. If the pipe is made of steel, it is recommended that the pipe be placed on rollers to reduce the friction and to protect pipe coating. However, this operation is usually not required for High Density Polyethylene (HDPE) pipe installation.

The drill pipe is connected to the product pipe using a pull head or pulling eye and a swivel. The swivel is a device used to prevent the rotation of the pipeline during pullback. A reamer is also located between the pull head and the drill string to ensure that the hole remains open and to allow lubricating fluid to be pumped into the hole during the pullback. The pullback operation will continue until the pipe or conduit surface at the drill rig. The pull head is disconnected, the drill rig removed, and clean-up and tie-ins are started. For small diameter pipes,

the prereaming process and pullback process can be performed at the same time.

B. Main Feature and Application Range

1. Diameter range

In maxi- and midi-HDD, the size of pipe installed can range from 75 mm (3 in.) to 1,200 mm (48 in.) in diameter. Multiple lines can be installed in a single pull, but only in the case of small-diameter pipes.

2. Depth of installation

Mini-HDD can install pipes up to 4.5 m (15 ft) in depth.

3. Type of pipe

The pipe to be installed is limited to one that can be joined together continuously, while maintaining sufficient strength to resist the high tensile stresses imposed during the pullback operation. In maxi- and midi-HDD, steel pipe is the most common type of casing used. However, butt-fused, high-density polyethylene pipe (HDPE) also can be used. HDPE pipe, small-diameter steel pipe, copper service lines, and flexible cables are some of the common types of pipe materials being used today in mini-HDD.

4. Soil condition

Clay is considered ideal for HDD methods. Cohesionless fine sand and silt generally behave in a fluid manner and stay suspended in the drill fluid for a sufficient amount of time; therefore, they are also suitable for HDD.

High-pressure fluid drilling systems (mini-HDD and midi-HDD) normally do not damage on-line existing utilities and thus are safe for subsurface-congested urban areas. Fluid cutting systems, which are most suitable in soft soil conditions, have been used widely in sand and clay formations. Although small gravel and soft rock formations can be accommodated by higher fluid pressure and more powerful jets, steering accuracy might suffer.

5. Productivity

HDD systems have the highest pilot hole boring rate of advancement among all trenchless methods for new installations. For mini-HDD rigs, a three-person crew is sufficient. In suitable ground conditions, a pipeline as long as 180 m (600 ft) can be installed in 1 day by a regular work crew.

II. INSTALLATION OF OPTICAL FIBER CABLE FOR 4G CONNECTIONS

The work of laying optical fiber wire from Zadeshwar road to reliance's tower carried out on date 27thJuly 2013, Sunday. The details of the projects are as following:

- Site location: Zadeshwar road, near Sai Temple, Bharuch
- Soil strata: yellow and black cotton soil
- Pipe length: 282 feet
- Hole diameter: 18cm
- Cost: ` 1,41,000/- (@ 500 Rs/feet)
- Duration: 3 to 4 hours
- Method used: HDD

Equipment Selection

- Ditch- witch JT:2020
- Digi track eclipse (IGPS system)

Site Location & Layout of pipe at site (Google Map)

Figure 2. Site Location & Layout of pipe at site (Google Map)

Following steps were carried out for installation of wire

Step:1 Equipment (ditch-witch JT:2020) was installed on site at starting pit (L-2) and excavation of small pits at location-1,2 and 3 were carried out as shown in map to install rod of equipment.

Figure 3.Installation of equipment

Step: 2 Now, rod started to rotation horizontally, go ahead in soil strata with high pressure water flow.


Figure 4.Rotation of Rod

Step: 3one man carrying IGPS systems, survived as installation progress IGPS system shows location of rod below the soil. At the front of the rod, there is installation of sensor, from which IGPS system can easily locate exact position of rod.


Figure **5.** IGPS System

Step: 4 During work, survey man continue sly connected to machine operator and told him how to move rod and its direction from IGPS system.

Steps: 5 Rod reached to destination pits (L-1) .at the front of the rod connection was made to connect the cables pipes with the front of rod by means of providing mechanical connections.


Figure 6. Connection between Rod & Pipe

Step: 6 After connection was made, reverse process were done. i.e. Pipes were pulled back now it reached at staring pit (L-2).


Figure 7 Completion of Pipe Installation

Step: 7sameprocedureswere made between pits located at L-2 & L-3.

Step: 8 After the completion of work, all pits were filled.

CONCLUSION

In a very short span of few years, the construction industry in WORLD has adopted the trenchless technology to a great extent, specifically in metropolitan cities and has benefited the society by minimizing the disadvantages of environmental and social impacts. However, the technology is still to be adopted by the construction industry for small projects for general awareness in common public towards trenchless construction for environment friendly urban development.

The use of trenchless technology will play a vital role in laying underground, specially, in pipelines installation in difficult geological situations. As discussed, the underground construction by various methods used under trenchless technology are very fast in comparison to open trenching methods, however, being mechanized process of construction, requires trained technical man power and modern equipment.

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