A Review on Trenchless Technology

K.Naveen Kumar[1], , Dr. K. Chandramouli [2], J.Sree Naga Chaitanya [3], B. Gowreswari [4]

[1]B. Tech Student Department of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India
[2]Professor & HOD of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India
[3]Assistant Professor Department of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India
[4]Research scholar of Civil Engineering, NRI Institute of Technology, Perecherla, Guntur, AP, India

Abstract: Trenchless technology is a type of subsurface construction work that requires few trenches or no continuous trenches. It is a rapidly growing sector of the construction and civil engineering industry. It can be defined as "a family of methods, materials, and equipment capable of being used for the installation of new or replacement or rehabilitation of existing underground infrastructure with minimal disruption to surface traffic, business, and other activities."

KEYWORDS: Tunneling, Installation, Canal's pipe, Ducts pipes, Renewing

DOI of the Article: https://doi.org/10.46501/IJMTST0707033

Available online at: http://www.ijmtst.com/vol7issue07.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: K.Naveen Kumar; Dr. K. Chandramouli; J.Sree Naga Chaitanya and B. Gowreswari.A Review on Trenchless Technology. *International Journal for Modern Trends in Science and Technology* 2021, 7, 0707072, pp. 202-207. https://doi.org/10.46501/IJMTST0707033

Article Info. Received: 14 June 2021; Accepted: 12 July 2021; Published: 21 July 2021

I.INTRODUCTION

The concept trenchless technology is a word used to describe a set or family of activities that are employed in construction work or in civil engineering. The set of works involves activities or techniques for making holes or conduit renovation or underground activity without disturbing the surface. The concept of trenchless construction method was started from 1900's. As time passed new method got added with new studies and innovation. The concept of no use trenches mainly during underground construction is to avoid problems and nuisance arising from subsurface disturbances. We have observed that when a small underground conduit goes off, it has to be repaired by open trenches causing a nuisance to the locality. If a road moves through the area, traffic and inconvenience to the public are further problems arising. In general, trenchless technology minimizes highway damage, environmental impacts, and traffic problems.

BACKGROUND OF TRENCHLESS TECHNOLOGY:-

The concept of trenchless construction method was started from 1900's. As time passed new method got added with new studies and innovation. The concept of no use trenches mainly during underground construction is to avoid problems and nuisance arising from subsurface disturbances. We have observed that when a small underground conduit goes Off, it has to be repaired by open trenches causing a nuisance to the locality. If a road moves through the area, traffic and inconvenience to the public are further problems arising. In general, trenchless technology minimizes highway damage, environmental impacts, and traffic problems.

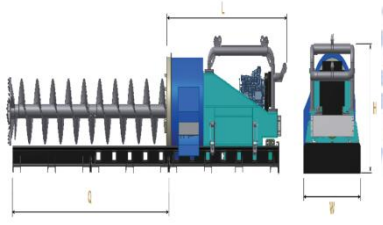
NEED FOR TRENCHLESS TECHNOLOGY:-

The demand for improved quantity and quality of community services such as utilities and communications has placed an ever-increasing burden on planning, engineering, installing, and maintaining these services. Further, the increased value and density of

Improvements above these underground services increase the complexity and cost of maintaining what may be an aging plant or expanding system capacity and the capability to meet new customer requirements. As the network of the systems grows, space to install them becomes increasingly competitive and the difficulty of working on them becomes increasingly complex. Such improvements as highways, streets, buildings, railroads, and so on make it almost impossible or prohibitively expensive to gain access to the facilities by open-cutting or to secure permission to disrupt the natural flow of the workplace for such excavations. Trenchless technology offers an alternative for these situations. In many cases. Since the 1950s, it has been relatively common (Trent 1959) to use jacking and rotary boring methods to bore horizontal holes to install pipeline and utility crossings under rights-of-way such as highways and railroads. Among the advantages of

Trenchless methods are those enumerated by Flaxman and O'Rourke(1985), Pittard and Kramer (1987), Schwartz (1988), and Thomson(1987),-namely, the reduction in the total cost of utility installations, including direct, indirect, and social costs by

- Reduction or elimination of restoration costs
- Labor cost reduction
- Urban operation simplification
- Improvement of customer relations
- Easier access to new utility customers



METHODOLOGIES:-

Trenchless technology consists of the methods, materials, and equipment used for replacing, rehabilitating, or installing pipes with little or no excavation of the ground above. It also makes it possible to install the utilities under rivers, highways, canals and other obstacles with no disruption of flow and with minimum or no damage to the environment. Given below is an insight of different types of trenchless technologies.

On an overall the trenchless technology methods (TT) can be classified into 2 main divisions:

- Trenchless Construction methods (TCM)
- Trenchless Renewal Methods (TRM)

TRENCHLESS CONSTRUCTION METHODS:-

1) *HORIZONTAL AUGER BORING (hab):-*

There are many ways to make a hole. Horizontal auger boring takes advantage of a helix-shaped device reminiscent of Archimedes' screw. The design attributed to him was used to raise water by turning the corkscrew-like machine using a hand crank.

Encasing an auger ensures that whatever is encountered by the cutting head has nowhere else to go but up or out. A machine placed securely into the entrance pit of a drilling operation uses both torque and thrust to move the auger with its casing forward along a horizontal path. The pipe casing is laid in sections, one after another, as forward sections progress through the hole. With horizontal auger boring, the making of the hole and the installation of the pipe are accomplished simultaneously.

Auger boring is best suited for softer ground conditions. An auger boring machine jacks the casing into the ground while the auger turns. Horizontal auger boring is a trusted method in the trenchless construction industry.

2) DIRECTIONAL DRILLING:-

Directional drilling (or slant drilling) is the practice of drilling non-vertical wells. It can be broken down into four main groups: oilfield directional drilling, utility installation directional drilling (horizontal directional drilling), directional boring, and surface in seam (SIS), which horizontally intersects a vertical well target to extract coal bed methane.

Directional drilling has been an integral part of the oil and gas industry since the 1920s. While the technology has improved over the years, the concept of directional drilling remains the same: drilling wells at multiple angles, not just vertically, to better reach and produce oil and gas reserves. Additionally, directional drilling allows for multiple wells from the same vertical wellbore, minimizing the wells' environmental impact

3) MICROTUNNELING:-

Micro tunneling is a digging technique used to construct small tunnels. These small diameter tunnels make it impossible to have an operator driving the machine itself. Instead, the micro tunnel boring machine (MTBM) has to be operated remotely from a control room. Micro tunnel boring machines are very similar to normal tunnel boring machines (TBMs), but on a smaller scale. These machines generally vary from 0.61 to 1.5 meters (2 ft. 0 in to 4 ft. 11 in) but smaller and larger machines have existed. Usually, the operator controls the machine from a control room on the surface. The Micro tunneling machine and jacking frame are set up in a shaft at the required depth. The operator is given constant feedback about the machine's location, orientation and hydraulic devices via a computer console or CCTV camera. Most machines also have video cameras set up to enable the operator to monitor activities in the jacking shaft and at the separation plant. The operator controls the MTBM and the jacking frame from the safety of the control room which is usually situated on the surface, next to the jacking shaft.

In most micro tunneling operations the machine is launched through an entry eye and pipes are pushed behind the machine. This is a process often called pipe jacking and is repeated until the Micro tunneling machine reaches the reception shaft. As the machine advances, more tunnel liner or pipe is pushed from the starting shaft, through the entry eye. Thus, the speed of the advancing machine is controlled by the speed at which the pipe is inserted into the entry eye via the extension of the hydraulic rams in the jacking frame.

4) **PILOT TUBE MICROTUNNELING:-**

Pilot Tube Micro tunneling is similar to the Micro tunneling method, except that crews will place steel tubes to guide the installation of the new sewer pipe. Crews dig a sending pit and a receiving pit. They place a pilot tube micro tunnel boring machine in the sending pit and install steel tubes between the sending pit and the receiving pit, without disturbing the surface above. As the machine installs the tubes, a jacking rig functions like a jack hammer to push the new sewer pipe in place behind the steel tubes.

5) **UTILITY TUNNELING:-**

A utility tunnel, utility corridor, or utilidor is a passage built underground or above ground to carry utility lines such as electricity, steam, water supply pipes, and sewer pipes. Communications utilities like fiber optics, cable television, and telephone cables are also sometimes carried. One may also be referred to as a services tunnel, services trench, services vault, or cable vault. Smaller cable containment is often referred to as a cable duct or underground conduit. Direct-buried cable is a major alternative to ducts or tunnels.

6) PIPERAMMING:-

Pipe ramming (sometimes also called pipe jacking) is a trenchless method for installation of steel pipes and casings. Distances of 30 m (150 feet) or more and over 1,500 mm (60 inches) in diameter are common, although the method can be used for much longer and larger installations. The method is useful for pipe and casing installations under the railway lines and roads, where other trenchless methods could cause subsidence or heaving. The majority of installations are horizontal, although the method can be used for vertical installations.

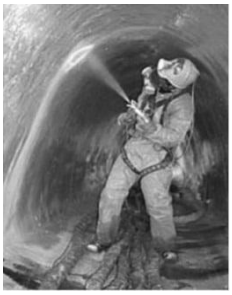
The method uses pneumatic percussive blows to drive the pipe through the ground. The leading edge of the pipe is almost always open, and is typically closed only when smaller pipes are being installed. The shape allows a small overcut (to reduce friction between the pipe and soil and improve load conditions on the pipe), and directs the soil into the pipe interior instead of compacting it outside the pipe. These objectives are usually achieved by attaching a soil-cutting shoe or special bands to the pipe. Further reduction of friction is typically achieved with lubrication, and different types of bentonite and/or polymers can be used (as in horizontal directional boring) for this purpose. Spoil removal from the pipe can be done after the entire pipe is in place (shorter installations). If the pipe containing the soil becomes too heavy before the installation is complete, the ramming can be interrupted and the pipe cleaned (longer installations). Spoil can be removed by auger, compressed air or water jetting.

7) MOLING:-

In the construction industry, moling is a trenchless method used to lay pipes. During the moling process, a pneumatically-driven machine known as a mole forces its way through the soil along the desired path of the pipe. Moling avoids the need to dig a trench and can be used to lay water pipes and the heating coils of heat pump systems.

Recently moles that are steerable have been developed allowing an operator to correct the track of the mole and to achieve curved bores. Mole The standard approach to moling is to dig a hole about 1 m square and 2 m deep. Such a hole is small enough that it can be dug by hand instead of by machine in inaccessible locations. The mole is then entered into the earth on the horizontal face at the bottom of this hole. A destination hole of similar proportions is also dug, and

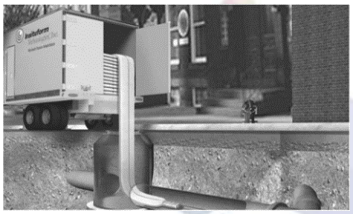
this is where the mole emerges. The mole itself is a steel cylinder about 60 cm long and 6 cm in diameter. It works as a pneumatic cylinder with pulsed compressed air causing the head of the mole to repeatedly hammer against the soil in front of the mole. Once the mole has passed through the earth the pipe can be pulled through the long horizontal hole.



TRENCHLESS RENEWAL METHODS:-

1) CURED-IN-PLACE PIPE:-

The method involves insertion of a tube made of fabric into an existing pipeline which has to be renewed. The insertion takes place either by means of water or by winching or by air inversion. The fabric has a peculiarity of being resin saturated. This enables filling of cracks, repairing the gaps by moving through the pipe defects. The Cured in place pipe method can be employed both for structural as well as non-structural purposes. The CIPP possess a higher strength that it behaves as a system which alone can sustain the whole pipeline system. The CIPP uses impregnated polyester resin or so-called ERC fiber glasses that have high corrosion resistance.



2) UNDERGROUND COATINGS AND LININGS:-

The mortar or resin can be used to fill up the lining or as coatings by spraying in trenchless renewal methods. These linings and coating would provide higher resistance against moisture and thus corrosion in pipes, where workers are not permitted. They do not have any role in increasing the structural integrity or curing the leaks or joints. The material used for this purpose may be a composition of either polyester, polyurethane, vinyl ester, concrete sealers, silicone. These are sprayed by means of remote-controlled sprayers which are portable and travelling type. The figure below shows a lining process done by UCL method in a pipe where workers can enter

3) SLIPLINING (SL) METHOD OF TRENCHLESS RENEWAL:-

This method is one of the oldest trenchless renewal methods which go for rehabilitation facility. This method can be used to help the system to restore its structural stability. We do not use this method if the system has any kind of settlement at the joints or any misalignments. The procedure in Slip lining is the insertion a new pipeline of smaller diameter into the existing one. There is gap created between the pipelines that are filled by means of grout. The method is very cheap and gains very much simplicity.

4) IN LINE REPLACEMENT (ILR)

The problem of pipeline systems relating to its capacity can be solved by in line replacement methods. There are three stages that represents in line replacement:

A. PIPE BURSTING:-

This stage involves the breaking of the old pipe by means of a hammer. A new pipe is pulled and placed on the position at the same time. There are several methods within pipe bursting. They are Pneumatic Pipe bursting which make use of pneumatic hammer to break the already existing pipe. The second is static pipe bursting, where a pulling machine is employed to remove the pipe. This is employed when the old pipe is very much ductile in nature. The method does not create any noise as in pneumatic bursting. Wherever the need of brute force is necessary, we can

go for this method. The third method is hydraulic pipe bursting, where the bursting head articulates thus creating burst. This method is also noise free

B. PIPE INSERTION:-

The pipe insertion method is also called as pipe expansion method. This method involves the insertion of a new pipe into the existing pipe. Mostly the pipes used are of clay or ductile iron.

C. PIPE REMOVAL:-

The method is also called as pipe eating. This method involves the complete destruction of old pipe and it is taken out in the form of a slurry. This is done by means of an HDD rig or an MT Machine.

5) PIPEEATING:-

Pipe eating is a replacement process similar to pipe jacking, where powerful hydraulic jacks force a pipeline into a bore as the bore is created. Also known as pipe replacing, in the pipe eating process, a drill destroys the pipe and removes its fragments while inserting a new pipeline or sewer – of the same size or large – in the original bore. Pipe eating is similar to pipe bursting and isn't as unappetizing as it sounds. The old pipe remains in the ground where it's ground into small pieces by drill while a hydraulic jack forcing a new pipe into place, The flow of drilling fluid from the BHA (bottom hole assembly) carries the fragments of the old pipe away while the drill and jack continue to ram the new — and possibly larger — pipe into place.

ADVANTAGES AND DISADVANTAGES :-

ADVANTAGES:-

- It reduces damage of valuable surface.
- It reduces the danger of improperly compacted excavations.
- It saves resources.
- It is accident free.
- It avoids traffic jams.
- It saves underground space.
- It reduces the impact on the environment.
- It provides the hassle-free road surface

DISADVANTAGES:-

- Special equipment is required
- Very high degree of operation skill is required.
- As the cost of equipment and the operation are high, bore length should be sufficient in order for it to be

CONCLUSION

The use of trenchless technology in your piping project can help save costs, protect the environment, and minimize surface disruptions. When it comes to Trenchless Technology, not having to dig a trench is the whole point. Trenchless technology is tunneling below the surface to install service lines like water or gas pipes, electric or telecommunication cables, without anyone noticing on the surface. This method also makes it possible to install utilities under rivers canals and other obstacles with no disruption of flow and with minimum or no damage to the environment. Trenchless methods have been used for the last 50 years, but these days, with advancements in technology for excavation and guidance systems, trenchless methods are becoming more commonly used around the world when soil conditions and location permits.

REFERENCES

1. "Study of Importance of Road Network in Rural Economic Sector" Review of Research; ISSN: 2249-894X; Volume- 08, Issue- 1; October-2018.
2. "A study on Water Bulb-used as a daytime light" North Asian International Research Journal of Sciences, Engineering & I.T.; ISSN: 2454-7514; Vol.4, Issue 10; October-2018.
3. Dr. K. Chandramouli "A Study on Artificial Moon" International Journal of Engineering Development and Research | Volume 6, Issue 4 | ISSN: 2321-9939; 2018.
4. Dr. K. Chandramouli"A Study on Flood Defence System" in International Journal of Current Research; ISSN: 0975-833X; Vol. 10, Issue10' pp. 74571-74574, October
5. Dr. K. Chandramouli"A study on Hyper loop- the envisaged & advanced means of transportation" International Journal of Research and Analytical Reviews (IJRAR),(E-ISSN 2348-1269, P- ISSN 2349-5138);Volume 5, Issue 4,December 2018.
6. Dr. K. Chandramouli"A Review on Programmable Cement" International Journal of Current Advanced Research ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614, Volume 7; Issue 11(C); Page No. 16302-16303; November 2018.