

Comparative Study of traditional method and innovative method for Trenchless Technology: A Review

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Abstract - The review included current and rising technologies and processes in trenchless pipe installation and rehabilitation for applications in water, sewer and gas lines. Therefore, a full range of trenchless installation technologies was reviewed for general applicability for replacing long runs of existing contaminated piping and/or installing new pipelines in potentially contaminated areas. Depending upon the specific situation trenchless method can be cost-effective alternative to the more conventional open excavation. Fully trenchless or partially trenchless technologies offer many benefits as a methodology for rehabilitating or renewing pipelines. But in open cut excavation the social and environmental impacts and the cost has considered. This paper shortly discusses the comparisons of cost and the factors that impact on a project and as per importance rating system developed between open cut and trenchless techniques

Key Words: Trenchless technology, open cut, rehabilitation, cost comparison, social cost, emissions, environment

1. INTRODUCTION

These techniques are currently used in urban areas in an age where environmental degradation has become an ever-increasing concern. It involves creating new networks or repairing existing ones (water, sanitary drainage, electricity, gas, etc.) by minimizing the impact on surface sites. This reduces the inconvenience caused to the users by "open trench" work, which requires an excavation along the full length of the area worked on.

It is necessary first it specify a definition which helps better determine the field of application of this work. Of course, the "trenchless" is opposite of "open trench" work, but it is also used for the installation of networks of small diameter, which are called "inaccessible", particularly where a worker cannot get into the networks in normal working condition: it is generally accepted that the upper limit is approximately 1,200 mm in diameter. We are interested in understand structures where the construction requires remote controlled techniques because the site can neither be accessed from the surface ("trenchless") nor accessed from the inside (inaccessible). TT techniques include methods of pipeline & utility installations with minimum amount of

surface excavation. TT techniques are mainly divided into two main areas:

- Trenchless Construction Methods(TCM)
- Trenchless Renewal, Rehabilitating, or Renovating Methods(TRM)

2. Why trenchless technique required?

- Less disturbing – By open cut method disturb local properties over agricultural land or disturbing local highways. But by use of Trenchless technology come out from these problems like landscape damage.
- Less time – open cut method is time consuming method. In this method time is required for the excavation and refilling of trenches. This process also means time is taken in site restoration, spoils storage and traffic control.
- Enhanced safety compared to steep excavations – by steep excavation Landslides can be occurs. Where the mud is likely to subside due to steep walls or water aggravation, protection needs to be taken with specialist equipment. By trenchless technology provided safety to the workers as there are no steep trenches involved in this work.
- Save time and cost related to survey and design – open cut method consist of preliminary survey, detailed survey etc. In detailed survey consist of the depth of the cut, the ground conditions where the trenches will run and also how much dewatering will need to take place, ensuring that conditions are safe to work. But in trenchless technique saved time and cost related to survey.
- Encountering fewer unknowns in the ground – in open cut method, approximately 70% of the cost required for excavating and replacing the ground during the process. As per unknowns come in the excavation or digging cost of excavation increases. By use of Trenchless technology reduced this problem.
- Minimize chance of disturbing existing utilities – at the time of open cut most important problem come in front of is disruption to above surface activities. As well as at the time of digging has to avoid existing

utilities. Trenchless technology comes with the ability to install new pipelines and rehabilitate existing pipelines with limited disturbance to traffic and business activities, reduce damage to existing paved surfaces.

- Problem to the public such as noise and air pollution – The indirect social costs of open cut projects consist of unhealthy, inconvenience to traffic, and noise pollution. But these problems can play a big part of local communities. These problems can be overcome with trenchless technology without the need for road closures, noise pollution.

3. Methods and Operation of “Trenchless Technology”:-

There are many new underground utility construction and repair technologies have become known that are grouped under the term trenchless technology. Without need for the excavation of trench, repairs or replacement, installation is carried out. Trenchless technologies classified into four main categories:

1. New pipe installation using pipes jacked from a jacking pit as the excavation lining and, if necessary, the thrusting force for a boring head. To removing the soil from the face of the pipe are affected by the nature of the soil, relationship to the water table, length of the project, etc. As per this conditions, pipe jacking, auger boring, micro tunnelling, pipe ramming, etc methods are used. Micro tunnelling machines are the most difficult but effective method for trenchless technology. This method can allow non-man entry tunnelling for lengths of several hundred meters with close control on line and grade Niranjana (2004),

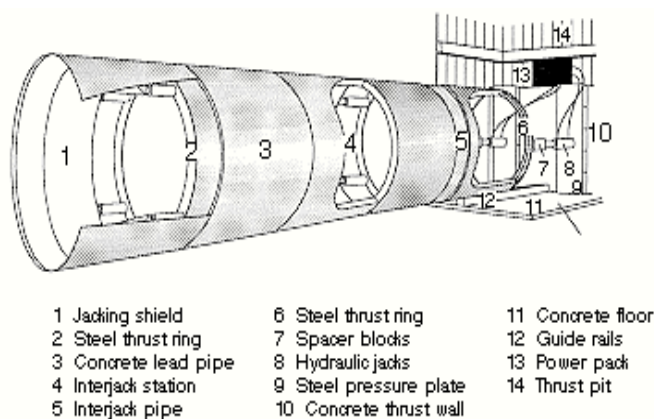


Figure 1. Elements of Pipe Jacking System (Kramer 1996).

2. New pipe, cable or conduit installation using horizontal directional drilling (HDD):- HDD is a trenchless construction method. This method consists of a small pilot hole. The pilot bore is launched from the surface at an angle between 8 and 20 degrees to the horizontal. At required depth change the direction or switch to horizontal. For minimum friction, the allowable curve radius for pipe alignment is gradual curvature or near-straight. By this overcome the problem

related pipeline “hung up” in the soil or damaging the pipe. The equipment and project conditions divide the use of these technologies into two main divisions: small, highly portable drilling equipment (mini- HDD) used for shorter, shallower installation of small conduits, and larger drilling equipment used for major river crossings (e.g. pipes up to 1.2 m diameter and over 1 km in length) Nathan(2011).

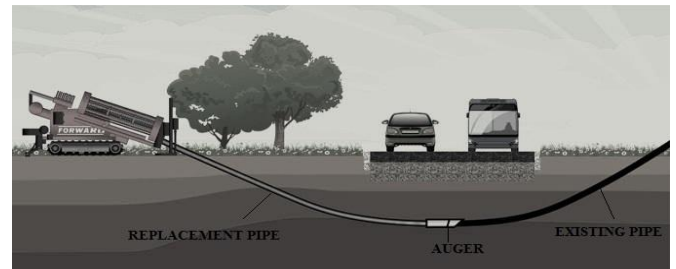


Figure 2 .horizontal directional drilling

3. Pipe and manhole rehabilitation techniques that can be carried out from within the existing structure. In this technique, to assess the condition of the lining and operational problems have used remote inspection system. The repairs may be done by robotic methods for local problems, installing simple slip linings, installing temporarily distorted linings that are restored to their original shape in place, and installing cured-in-place pipe linings (CIPP) Lindsay (2015).

4. Trenchless pipe replacement techniques. In this method, first breaking the existing pipe and after that new pipe is pulled along the same line as the old pipe. Because of this pulling broken pipe segments displaced into surrounding soil. The pipe breaking operation is done by simply pulling or pushing a cone shaped head consist of cutting blades through the old pipe. New pipes may be of the same diameter or a larger diameter than the old pipe thus allowing an increase in service capacity as well as avoiding the creation of a new utility location in the public right-of-way. An allied technique involves a micro tunnelling-type machine that grinds up the existing pipe rather than breaking and displacing pipe fragments Richard (2010).

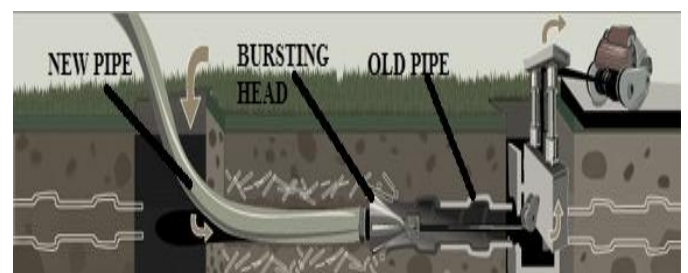


Figure 3. Trenchless pipe replacement techniques

4. Cost comparative study of TT and open cut-

Unfortunately it is very difficult to cost related comparison between trenchless construction and open cut construction. Because there are many factors affected on it like the location of the pipeline, its depth, size and also the local availability of the various trenchless technology methodologies. The cost of construction of pipeline or

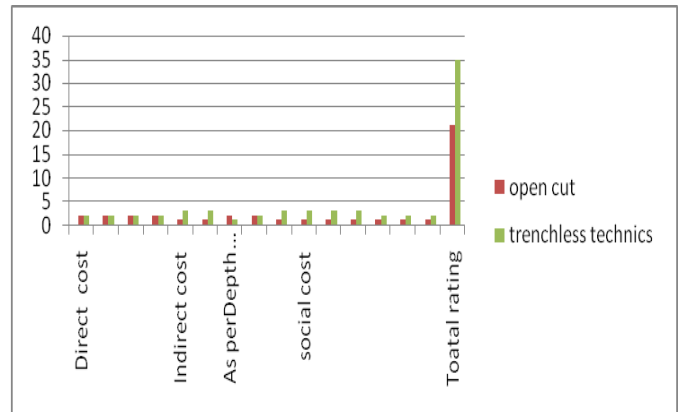
renewal project divided in two parts, one is cost paid by the utility and another paid by the society. These costs can be divided into several components, as described in Table no.1.

5. Rating system

This rating system mentioned as per the importance (1 – Bad ; 2 – good ; 3 – very good). In this table all values are related to the cost like indirect, direct, social cost. This rating system only considered between open cut and trenchless techniques.

Categories of cost	Case in point	Open cut	Trenchless techniques
Direct cost	contractor cost	2	2
	engineering cost	2	2
	bidding cost	2	2
	contract management	2	2
Indirect cost	compensation claims customers	1	3
	compensation for contingent damage to property	1	3
As per Depth construction cost	Shallow depth pipe	2	1
	Medium depth pipe	2	2
	Deep depth pipe	1	3
social cost	vehicle operating costs	1	3
	travel delay costs	1	3
	dust and dirt	1	3
	parking meter revenue	1	2
	decreased road surface value	1	2
	noise pollution costs	1	2
Total rating		21	35

Table no.1 Rating system



Graph no. 1. Rating system

6. Conclusion -

1. The benefits of trenchless technology clearly offset those of traditional open cut methods.
2. As compared to open cut pipeline installation, Trenchless Technology is a significantly cheaper and more socially acceptable method of construction.
3. Cost and benefit of construction impacts goes beyond simple cost of construction and includes other parameters such as total economic impact and public affairs.
4. As per rating system, conclude that trenchless techniques are very effective. In urban areas this technique most powerful as compare to open cut method as include environmental and social impact.

References

- [1] "Application of trenchless technology at army installations" Public works technical bulletin 420-49-10, 28 February 1999.
- [2] Niranjana swarup (2004), "Promotion of trenchless technology in low wage economics", North American society for trenchless technology (NASTT), Pg.no.1-8.
- [3] Richard w. Bonds (2010), "Horizontal directional drilling with ductile iron pipe", Ductile iron pipe research association, Pg.no.1-7.
- [4] Public works technical bulletin (28 February 1999), "application of trenchless technology at army installations", department of u.s. Army corps of engineers, pg.no.1-11.
- [5] Trenchless Technology-Social cost by R.K.Sharma, NBCC Ltd
- [6] "Portland Pipeline Provides Rehabilitation Challenge," Public Works, December 1996, pg.no. 51
- [7] Mohammad Najafi, Brett Gunnink,(October 2005), " Preparation of Construction Specifications, Contract Documents, Field Testing, Educational Materials, and Course Offerings for Trenchless Construction", Missouri Department of Transportation Organizational Results Division, Pg.No.4-13.
- [8] "Manual of Trenchless Technologies for the Construction of Water and Waste Water Infrastructure", (May 2011)German water partnership.

- [9] Nathan J.Ward, (Jan 2011), "TRENCHLESS TECHNOLOGY – AN OVERVIEW", International Conference on Underground Space Technology in Bangalore, India, Pg.No,1-10.
- [10] Vulkan-Verlag (2002), "Trenchless technologies in pipeline construction", erschienen 3R international Special Edition, Pg.No.1-17.
- [11] Lindsay Ivey Burden (2015), "Synthesis of Trenchless Technologies", virginia center for transportation innovation and research, Pg.No.1-25.