

## International Journal of Innovative Research in Science, Engineering and Technology

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# Piping Without Digging a Trench-A Case Study

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**ABSTRACT:** "Piping without digging a trench " is a technology for installation , maintenance and renewal of underground pipelines ,ducts and cables precluding any kind of excavation. .This mutated trend of usage of trenchless methods in piping projects has helped to satisfy the ever enhancing demands of better infrastructure and its maintenance made by the communities and the regulators. Preventing excavation averts the socio-economical and environmental damage and on the top of it provides an effective alternative to the traditional open trenching method of excavation. Trenchless technology offers a feasible solution to the pessimistic effects of open trenching. Depending upon a particular scenario, trenchless methods often prove to be cost effective than the mundane open trenching method. The indirect cost of environmental degradation, social disturbance and health hazards caused due to pollution facilitated by open excavation pile up with the total estimate of open trenching. This paper briefly highlights the cost comparison of Trenchless method of Horizontal Directional Drilling for a project in Kalyan City, Thane District ,Maharashtra.

**KEYWORDS:** Excavation, Trenchless technology, open excavation, open trenching , environmental degradation, social disturbance , Horizontal Directional Drilling.

### I. INTRODUCTION

Open trench laying of pipeline is the conventional method of installation, maintenance and removal of the underground utilities. Underground utilities include telecommunication network ,sewer network , storm water network, LPG or cooking gas network, irrigation network, fibre optic cable network , potable water network etc. Being the traditional method, open excavation is followed with noise pollution, air pollution, environmental degradation. To countervail these ravaging after effects of open trenching, new technology of "Piping without digging a trench" is developed .These techniques are being used in metropolitan cities where increasing traffic and environmental degradation due to population growth has become an ever increasing concern. Trenchless technology can be used for both new installation and rehabilitation of the underground utilities. There is a range of methods employed for rehabilitation and for new installation, Horizontal Directional Drilling is mainly used for new installation and Pipe bursting for rehabilitation projects on the virtue of the ease of handling and economy .India being a developing country should spur trenchless technology methods elimination the luddite attitude to accelerate the overall infrastructural development.

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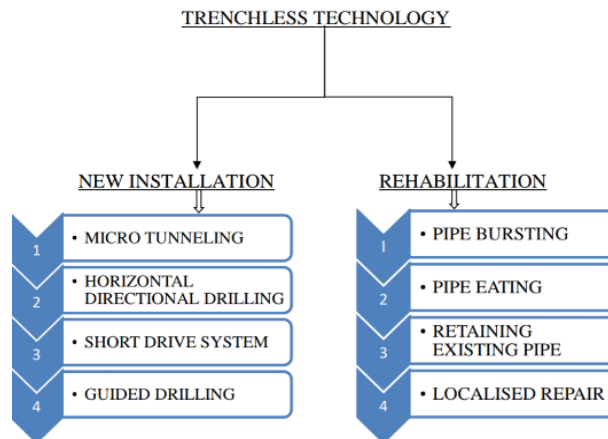
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## II. RELATED WORKS

The below given flow chat describes all the methods enlisted under trenchless technology

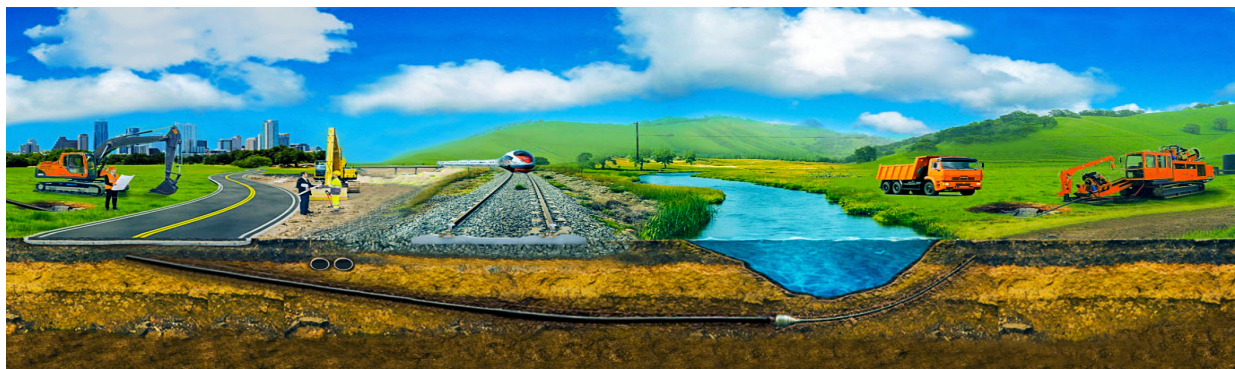


**Fig 1. Classification of trenchless technology**

**NEW INSTALLATION:** The following method is most likely adopted for new installation due to the ease in its operation and economy. Maximum projects in India adopt HDD method.

### HORIZONTAL DIRECTIONAL DRILLING (HDD)

HDD is a minimal impact trenchless method of installing underground pipes, conduits, or cables in a relatively shallow arc or radius, along a prescribed underground bore path, using a surface-launched drilling rig.



**Fig 2. Horizontal directional drilling**

Often, the term ‘directional boring’ is referred for mini/small sized drilling rigs, having small diameter bores, and crossing length of hundreds of feet; while, the term ‘Horizontal Directional Drilling (HDD)’ is referred for large/maximum sized drilling rigs, having large diameter bores, and crossing length of thousands of feet. Directional Boring and HDD being similar in process are quite different from the directional drilling associated with the oil industry.

As long as the pipe can withstand the installation process, the various pipe materials used are: PVC, high-density polyethylene (HDPE), polyvinyl chloride (PVC), ductile iron and steel. HDD being so versatile, is suited for a variety of soil conditions and obstacles including pavements (roads), landscapes (forest cover), wetland/marshes, river crossings, etc.

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HDD is generally accomplished in three principle phases. First, a small diameter pilot hole is drilled along the pre-determined path from one point to another. Next, the bore created by pilot hole drilling is enlarged to a diameter that will facilitate the installation of new pipeline. Lastly, the pipeline is pulled into the enlarged hole.

The technique has extensive use in urban areas for developing subsurface utilities as it helps in avoiding extensive open cut trenches. The use requires that the operator have complete information about existing utilities so that they can plan the alignment to avoid damaging those utilities. Since uncontrolled drilling can lead to damage, different agencies/government authorities owning the urban right-of-way or the utilities have rules for safe work execution. For standardization of the techniques, different trenchless technology promoting organizations have developed guidelines for this technique.

## Horizontal Directional Drilling Process

There are 4 Stages in the **Horizontal Directional Drilling Process**

Stage 1 – Drilling the Pilot Hole

Stage 2 – Pre-Reaming the horizontal boring

Stage 3 – Pullback Operations

Stage 4 – Installation of Conduits

### Stage 1 of the Horizontal Directional Drilling Process – Drilling the Pilot Hole

The first stage of a successful **Horizontal Directional Drilling Process** is drilling a pilot hole. A pilot hole is horizontally drilled and continues under and across the obstacle along a predetermined design path. An electronic transmitter is placed in a housing which is directly behind the directional drilling cutting head. The transmitter sends a signal to the surface which is read by the receiver, which then transmits the information back to the directional drill rig operator. The directional driller then, by using the relayed information, can steer the bore pathany desired direction.

#### FIRST STAGE - PILOT HOLE

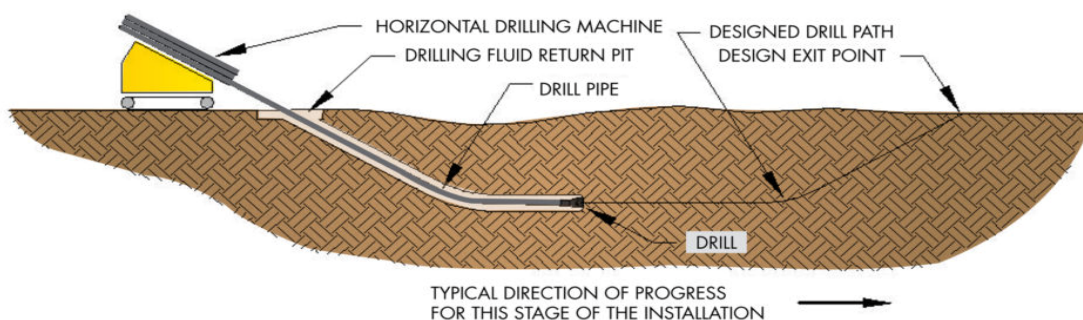


Fig 3. Drilling the Pilot Hole

### Stage 2 of the Horizontal Directional Drilling Process – Prereaming the Horizontal Boring

Once the pilot hole has been completed, the borehole must be enlarged to a suitable diameter for the product pipeline. This is accomplished in the second stage of the **Horizontal Directional Drilling Process** by “prereaming” the horizontal boring to successively larger diameters. Generally, the reamer is attached to the drill string on the opposite end of the borehole from the drill and pulled back into the pilot hole. Slurry is pumped into the directionally drilled borehole to maintain the integrity of the hole and to flush out cuttings.

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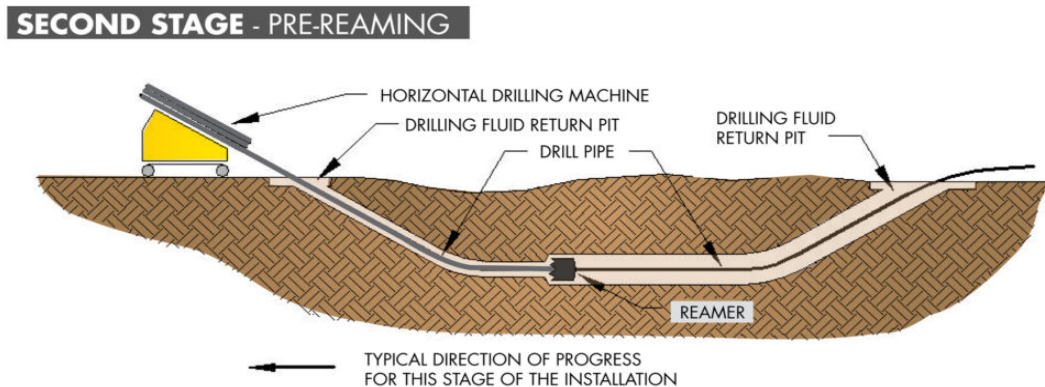


Fig 4. Pre-reaming

## Stage 3 of the Horizontal Directional Drilling Process – Pullback Operations

Once the directionally drilled hole is enlarged, the conduit can be pulled through it. The pipeline is prefabricated at the end of the bore opposite the drill rig. A reamer is attached to the drill string, and then connected to the product by a pulling head and swivel. The swivel allows for the reamer to turn without the product turning. The directional drilling rig then begins the pullback operation, rotating and pulling on the drill string as well as circulating drilling fluids. The pullback continues until the reamer exits the bore path by the directional drill rig and the pipeline is in place.

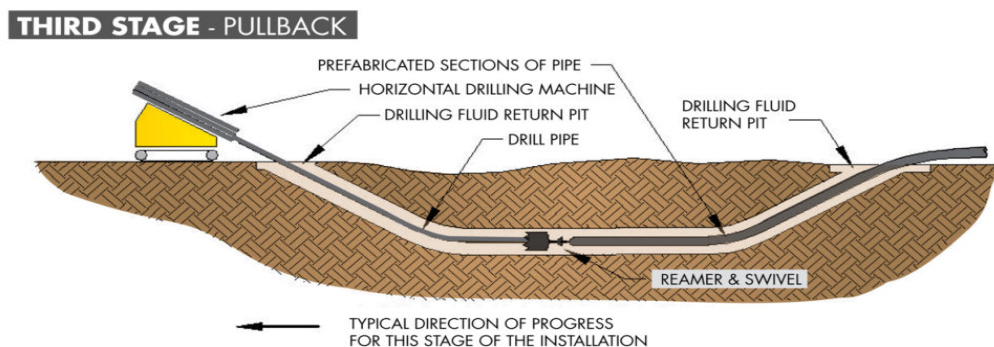


Fig 4. Pullback

## Stage 4 of the Horizontal Directional Drilling Process – Installation of Conduits

If the horizontally bored conduit is to carry power lines, fibre optic cable, or some other product, an aircraft cable is inserted into the pipe prior to pulling into position. After the pipe installation, the directional drill rig is used to pull the product into position within the pipe. This final step in the **Horizontal Directional Drilling Process** includes pressure testing to ensure the integrity of the pipe.

**Walk-over system:** A Sonde or a transmitter which is located behind the bore head, collects the data of angle, rotation, direction and temperature. This information is encoded via electromagnetic waves and transmitted to the ground surface. At the surface, a receiver (usually hand-held locator) is manually positioned over the Sonde. This signal is decoded and the steering directions are instructed to the machine operator.



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## III. CASE STUDY

**Project Name:** Horizontal Directional Drilling (HDD)

**Client:** M/s. Reliance Jio Infocom Ltd. Mumbai

**Name of work:** Laying Optical fibre cable in KDMC Area.

**Requirement:** Installation of 60mm diameter optical fibre cable to supply 4G line.

**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.

### General

Kalyan is heavily crowded city and traffic flow is high on main roads. So installing/laying of optical fibre cable by open trench method is not possible. Open trench method is so much time & cost consuming method and create obstacle to flow of traffic. So to avoid this problem Horizontal Directional Drilling method is adopted to install optical fibre.

**Objective** To install optical fibre line in Kalyan city without any disruption to traffic and in minimum cost and time.

Length Details					
Road No	Road Name	Permission as per KDMC/ CE	As per Reliance Record	Total length Depth more than 1 mtr.	Remarks
1.	Durgadi circle To Prem auto	5800 m	5762 m	910	Checked up to date 27-2-2019

Table 1. road length details

**Starting Point:** Durgadi Circle

**End Point:** Prem Auto

**Distance:** 5.8 Km

**Ground Condition:** Rock Strata

**Installation Time:** 34 days

**Installation Date:** 5<sup>th</sup> January 2018

**Start Pit Location:** Durgadi Circle

**End Pit location:** Prem Auto Bridge

**Pipe Material:** HDPE (High Density Polyethylene) Pipe

**Pipe Diameter :** 100 mm

**Cable Diameter:** 60 mm

**Machine name:** XZ320D

**Machine Pull Capacity:** 60 tonne

**Machine Operating Fuel:** Diesel

**Final Inspection Date by Government Agency:** 18<sup>th</sup> November 2018

**Cost Comparison of Project:** The following calculations are considered for a small length of 200m. The cost comparisons and the supporting bar graphs clearly state the effect of choice of methods on the economy and time of completion of project.

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### 4.3.1 Open trench method:

Total Length of Laying Pipeline = 5800m  
Total width of Excavation = 0.8m

Total Depth of Excavation = 1.5m  
Total duration of work = 18 Months

Sr. No.	Description	Qty.	Rates (Rs.)	Unit	Amount (Rs.)
1.	Excavation for pipeline trenches depth 1.00 to 1.50 mt.	5840	150	m <sup>3</sup>	8,76,000
2.	HDPE pipe (100mm dia.) with cable (60mm dia.).	5800	1200	m	69,60,000
3.	Conveying, lowering, laying and jointing HDPE Pipes.	5800	420	m	24,36,000
4.	Making lead joint.	1160	1450	Nos.	16,82,000
5.	Providing and fixing M.S manhole frame and a cover.	2920	70	kg	2,04,400
6.	Providing and laying C.C 1:2:4.	435	2850	m <sup>3</sup>	12,39,750
7.	Providing and constructing brickwork.	1160	2725	m <sup>3</sup>	31,61,000
8.	Providing and applying 10 mm thick cement plaster in a single coat.	580	120	m <sup>3</sup>	69,600
9.	Providing and laying M-20 nominal mix concrete.	290	5500	m <sup>3</sup>	15,95,000
10.	Recovery of damaged Bitumen road.	5840	1050	m <sup>3</sup>	6132000
Total Amount (Rs.)					2,43,55,750

**Table No 2. Rate Analysis of Open trench method**

Add 10% Contractor's Profit = Rs.24,35,575

Add 5% Contingencies and work charged establishment = Rs.12,17,787.5

Total Amount = Rs.2,80,09,113

- A) Total estimated cost of Bitumen Road to be resurfaced is Rs.6132000 + Extra materials, transportation charges, etc.
- B) Here, road warning signboard charges, if traffic congestion is there then vehicles fuel cost, loss of space for shops and buildings charges, etc. all charges are considered in the Open cut method.
- C) So, If OFC network laying by Open cut method then the total cost is Rs.28009112.5 + extra cost  $\cong$  2.85 Crore and cost of work is Rs.4915 per meter.

### Estimated cost of OFC network laying by HDD method:

Total length of pipeline = 5800m

Pit size= 4m \* 1.5m

Total duration of work = 3 months

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**Table No 3. Rate Analysis of HDD**

10% Contractor's Profit = Rs27,04,820

5% Contengencies= Rs 13,52,410

Total Amount (Rs.) = Rs 3,11,05,430

Therefore, Cost per metre= Rs 5380

## IV. RESULT

Sr. No.	Description	Qty.	Rate (Rs.)	Unit	Amount (Rs.)
1.	Drilling of the horizontal borehole for HDPE pipeline under the Road tracks in all the strata with required length including fixing of HDPE (as specified by Railway, Road authority) casing pipe to suitable size and thickness.	5840	2700	M <sup>3</sup>	1,57,68,000
2.	Laying HDPE pipe 100 mm dia. With cable (60mm dia.) by HDD method using HDD machines.	5800	1200	M <sup>3</sup>	69,60,000
3.	Providing and fixing M.S manhole frame and a cover.	2900	70	KG	2,03,000
4.	Providing and laying C.C 1:2:4	235	2900	M <sup>3</sup>	66,700
5.	Providing and constructing brickwork.	870	2750	M <sup>3</sup>	23,92,500
6.	Providing and applying 10mm thick cement plaster.	535	120	M <sup>3</sup>	63,000
7.	Providing and laying M-20 nominal mix concrete.	290	5500	M <sup>3</sup>	15,95,000
Total					2,70,48,200

The following table presents the final rates per metre by open trenching and HDD method.

Sr No	Open trenching	HDD
Cost per metre length	Rs 4915	Rs 5380

**Table No 4. Result**

## V. CONCLUSION

Lastly, we conclude with the proper understanding of trenchless technology bolstered by a case study rate analysis.

- 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 asthma etc 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.
- To encapsulate, the life span of pipes laid by trenchless technology is three times as compared to normal laid pipes as normal excavation is done upto 2 metres approximately while trenchless technology lays pipes upto 5 to 6 metres depth increasing the life of the pipeline. Hence the cost of open trenching should be taken thrice if we need to make comparison with trenchless technology.

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- For ideal situations like repairing of pipelines very near to building foundations, excavation may cause sliding of foundation and hence to avoid that sheet piling needs to be done and hence the expenses of sheet piling also add up to the project unlike trenchless technology.
- Initiation and encouraging such new technologies is very essential in developing countries like India and as the project work highlights, trenchless technology clearly outweighs open trenching.

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