Trenchless Horizontal Underground Directional Drilling Machine: Review

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Abstract: This paper includes detail literature review on Horizontal Underground Directional Drilling machine is used to lay any kind of utility from one part to another without disturbing nature. The trenchless technology is works on highly used drilling process without trenches. Here the traditional method often prove to be costly and troublesome, especially with today's congested and buried infrastructure. Utility laying Companies would like to adopt a method which is Quick & Effective. No doubt laying utilities by Trenching Process is cheaper and quicker as it needs just to dig up the road / area, bury the utility / pipe and backfill the area. However, this Cut and bury process on roads is a great national loss – Relaying process of roads increases asphalt usage, a petroleum product. Re-routing of traffic leads to traffic jams and increase in fuel consumption. Slow traffic movement results in a great loss to intellectual man hours. Cut and Bury Process is very expensive for Municipal bodies and the Government, besides the inconvenience caused to public. Roads once cut cannot be brought back to original shape even after spending double the cost. The present conditions of roads are comparable to a patient's body being operated one after another by different doctors.

Index Terms **– Trenchless Technology, Underground method, Directional position, Laying Utility.**

I. INTRODUCTION

Do you have problems of laying cables across the road / highway / railway crossings? If so, then Trenchless Technology is the answer. Any terrain of India can adopt this method. Do you need to lay cables along the highway? Trenchless Technology is also the best remedy. No special permissions are needed for laying cables: As Trenchless Technology does not cut up the Road Electronic Equipment's are used to detect underground utilities to reasonable extent. Only two pits: for Entry and Exit are to be made with 3' x 3' x 6'. Depth for laying cables as per trenchless technology. Cables can be laid in a single shot for large distances. Diameter and distances vary with capacity of machines. At least 1500 / 2000 m of work within 25 km radius at one location is required for making the operation commercially viable. Can there be any comparison between transporting Goods by Bullock Carts & Lorries. One Process is mechanized and the other is Manual. The same is case of Trenchless & Conventional Technology.

There are different size of rig are used to lay utility like duct to large drainage pipe lines. The machine has different size from 8 ton to 400 ton machine are there to laying work at large scale. There the whole circuit work on hydraulic cycle. The different research done on it process, bending stresses, thrust cycle, pulling capacity. The machine has large gear box to operate the main two system thrust and rotation the thrust is used to make the forward and backward process and the rotation is used to make the rotation of drill rods. In the machine high pressure mud pump is used to supply high pressure water to cut the soil and drill pipe get easily drill. The jaw are used to open the drill rods the machine works by the electronic devise which are connected by GPRS system the machine used to take the bending of drill rod to make the changes of drill hole position by making the change in drill rod direction on the clock. The pulling capacity of machine depends on ibs pullback capacity from 10,000 to 200,000 capacity.

Utility laying Companies would like to adopt a method which is Quick & Effective. No doubt laying utilities by Trenching Process is cheaper and quicker as it needs just to dig up the road / area, bury the utility / pipe and backfill the area. However, this Cut and bury process on roads is a great national loss – Relaying process of roads increases asphalt usage, a petroleum product. Re-routing of traffic leads to traffic jams and increase in fuel consumption. Slow traffic movement results in a great loss to intellectual man hours. Cut and Bury Process is very expensive for Municipal bodies and the Government, besides the inconvenience caused to public. Roads once cut cannot be brought back to original shape even after spending double the cost. The present conditions of roads are comparable to a patient's body being operated one after another by different doctors. Soil conditions vary from place to place, the best soil for trenchless technology is in the Gujarat Mainland, Punjab, Haryana, Part of Uttar Pradesh, and Kolkata.

The worst soils are in Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Madhya Pradesh. Presently Trenchless technology has been adopted in some of the toughest soil and rock strata in Andhra Pradesh, Karnataka, and Madhya Pradesh. Likewise Trenchless utility laying have also been done in Old Delhi and crowded areas of Kolkata. However, trenchless activities have been

successfully completed in the above areas. If could be done there, then it can be certainly done in other parts of the country also. We have to mentally prepare ourselves to do so**.** Having laid cables and ducts by open trenching process, which is easier and cheaper, agencies would not like to straightaway accept Trenchless Technology for obvious reasons. Municipal Corporations, Governments by adopting Trenchless Technology will protect their roads and regions from being cut by various cables/Ducts/Pipe laying agencies and give a safe motorable and environment friendly roads. Trenchless construction provides an opportunity to help us solve huge and complex underground infrastructure problems in a safe, economical manner with minimal inconvenience to the public and damage to the environment.

J.D.Hair&Associates,Inc, Inc. [1] Parametric study of pullback forces on pipelines installed by HDD. The tools and techniques used in the horizontal directional drilling (HDD) process are an outgrowth of the oil well drilling industry. The components of a horizontal drilling rig used for pipeline construction are similar to those of an oil well drilling rig with the major exception being that a horizontal drilling rig is equipped with an inclined ramp as opposed to a vertical mast. HDD pilot hole operations are not unlike those involved in drilling a directional oil well. Drill pipe and downhole tools are generally interchangeable and drilling fluid is used throughout the operation to transport drilled spoil, reduce friction, stabilize the hole, etc. Because of these similarities, the process is generally referred to as drilling as opposed to boring. Installation of a pipeline by HDD is generally accomplished in three stages as illustrated in Figure 1. The first stage consists of directionally drilling a small diameter pilot hole along a designed directional path. The second stage involves enlarging this pilot hole to a diameter suitable for installation of the pipeline. The third stage consists of pulling the pipeline back into the enlarged hole. Pilot hole directional control is achieved by using a non-rotating drill string with an asymmetrical leading edge. The asymmetry of the leading edge creates a steering bias while the non-rotating aspect of the drill string allows the steering bias to be held in a specific position while drilling. If a change in direction is required, the drill string is rolled so that the direction of bias is the same as the desired change in direction. The direction of bias is referred to as the tool face. Straight progress may be achieved by drilling with a series of offsetting tool face positions. The drill string may also be continually rotated where directional control is not required. Leading edge asymmetry can be accomplished by several methods. Typically, the leading edge will have an angular offset created by a bent sub or bent motor housing.

Kin Fun, Lam, Y.C Mui [2] Stress analysis required in designing of a pipe loader, HDD is a high end technology transferred from oil exploration industry to nowadays micro tunneling for installation of utilities such as power cables, telecom conduits, water mains and gas mains, etc. This specialized technique is featured with a drilling rig on surface and a mud motor to drive the cutting tools such as tri-cone bit and reamers. Before applying this technique for the HATS Stage 2A project, some key design procedures were carried out during the preliminary design stage, which are important to ensure a practical solution before tendering, and more importantly, all technical requirements and concerns for the HDD works could be specified under the Contract for the Design & Build Contractor to implement during the construction stage. Those key design procedures are discussed in the following sections and be followed by the discussion on the HDD construction aspects.

Hue, McLeod & Hair [3] Operational loads & governs the drilled path design, the load on drill rod occurs at the curvature of drill pipe the bending stress occurs. By stresses induces in it the pipe radius is fix to make curvature upto which the pipe takes bend axis. During the design phase, it is important for the Designer to collect accurate surface and subsurface information, and to distribute them to the Contractor so that the actual drilling operation can be planned with full assessment on all possible obstacles. A comprehensive pre-construction survey shall include the surface survey and subsurface survey, which can result in fewer installation problems during the course of HDD operation

II. DESIGN DATA FROM THE LITERATURE SURVEY

A.Pilot Hole

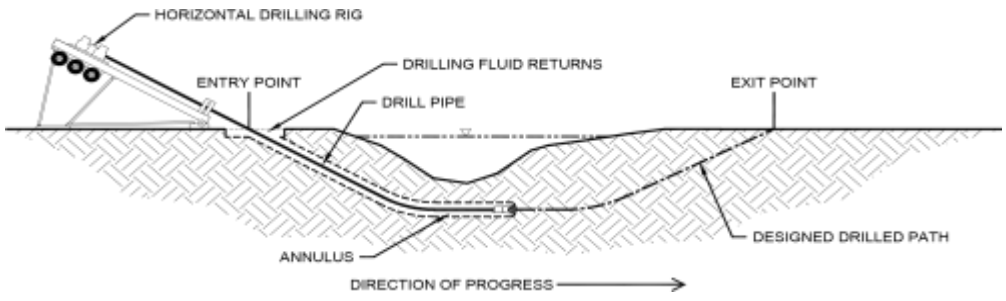

Figure-1 Pilot Hole

Pilot hole directional control is achieved by using a non-rotating drill string with an asymmetrical leading edge. The asymmetry of the leading edge creates a steering bias while the non-rotating aspect of the drill string allows the steering bias to be held in a specific position while drilling. If a change in direction is required, the drill string is rolled so that the direction of bias is the same as the desired change in direction. The direction of bias is referred to as the tool face. Straight progress may be achieved by drilling with a series of offsetting tool face positions. The drill string may also be continually rotated where directional control is not required. Leading edge asymmetry can be accomplished by several methods. Typically, the leading edge will have an angular offset created by a bent sub or bent motor housing. This is illustrated schematically in Figure 1.

B.Prereaming

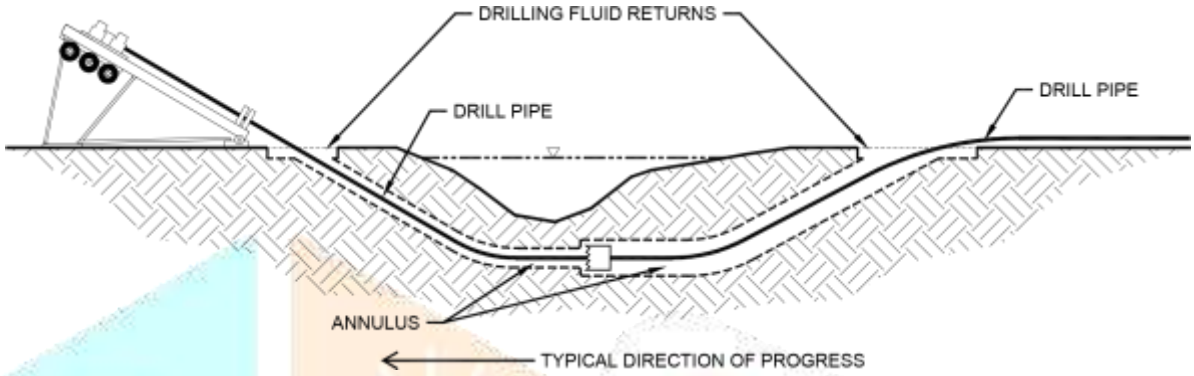

Figure-2 Prereaming

Most contractors will opt to prereaming a pilot hole before attempting to install pipe. For a prereaming pass, reamers attached to the drill string at the exit point are rotated and drawn to the drilling rig thus enlarging the pilot hole. Drill pipe is added behind the reamers as they progress toward the drill rig. This insures that a string of pipe is always maintained in the drilled hole. It is also possible to ream away from the drill rig. In this case, reamers fitted into the drill string at the rig are rotated and thrust away from it.

C. Pullback

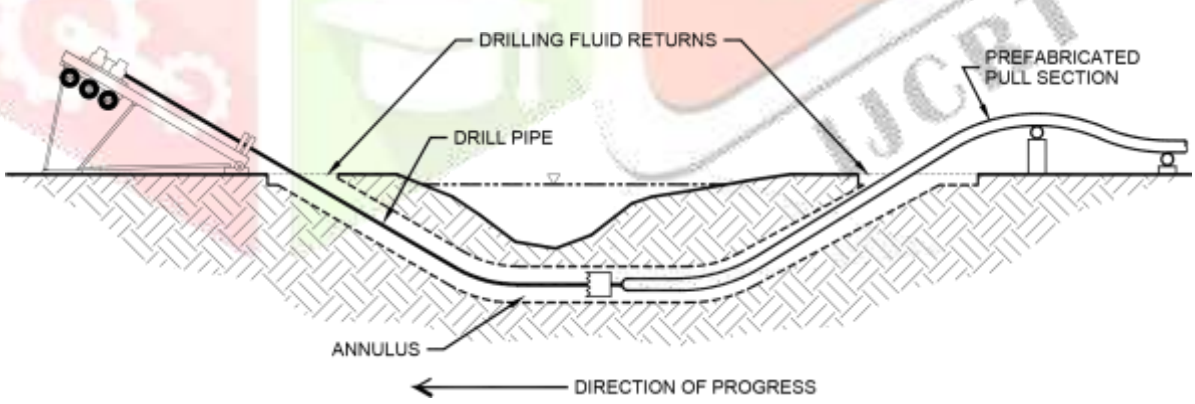

Figure-3 Pullback

Pipe installation is accomplished by attaching the prefabricated pipeline pull section behind a reaming assembly at the exit point and pulling the reaming assembly and pull section back to the drilling rig. This is undertaken after completion of prereaming or, for smaller diameter lines in soft soils, directly after completion of the pilot hole. A swivel is utilized to connect the pull section to the leading reaming assembly to minimize torsion transmitted to the pipe. The pull section is supported using some combination of roller stands, pipe handling equipment, or a flotation ditch to minimize tension and prevent damage to the pipe.

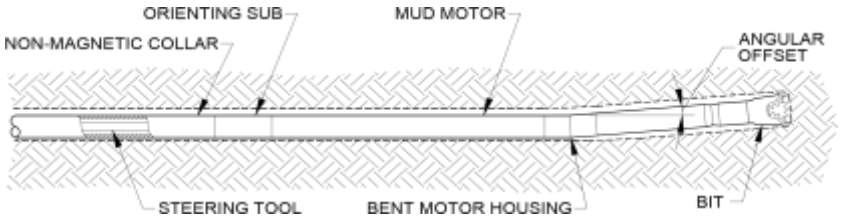

Figure -4 Bottom Hole Assembly

D. Surface Monitoring

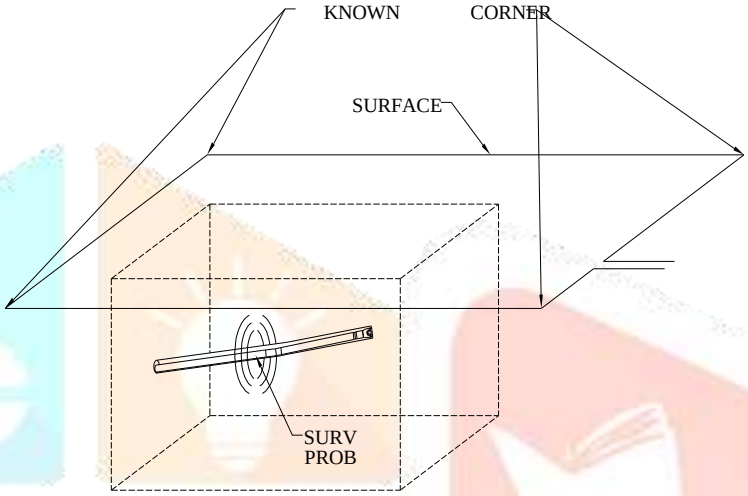

Figure -5 Surface Monitoring

The pilot hole path may also be tracked using a surface monitoring system. Surface monitoring systems determine the location of the probe downhole by taking measurements from a grid or point on the surface. An example of this is the TruTracker System. This system uses a surface coil of known location to induce a magnetic field. The probe senses its location relative to this induced magnetic field and communicates this information to the surface. This is shown schematically in Figure 5.

RESULTS AND CONCLUSION

From the above literature survey we are observe following conclusion HDD is a minimally-intrusive trenchless construction method suited for highly congested urban areas and high traffic zones. Horizontal Directional Drilling equipment is capable of installing a wide range of utilities. HDD will never replace traditional open-cut methods; however, they complement each other. The probe of senses the pulling process to reduce the time by load reduction by using cylinder method.

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