

## Keyhole Technology – House connections installed with minimal invasion using the trenchless method

The increasing sensitivity of the residents affected, impairment of local infrastructure and mobility restrictions caused by installation projects using open-trench method are the driving force behind further developments in trenchless installation technology. Increasing awareness of Green Tech aspects such as the reduction of emissions – especially CO<sub>2</sub>, noise and fine dust – gives further impetus towards installation techniques which cause only minimal disturbance along the bore path. This article focuses on a technically and market relevant new development practised by the companies Gaz de France Suez (GdF Suez) and Tracto-Technik (TT Group).

### Initial situation:

Trenchless technologies for the installation and renewal of pipes are generally characterized by minimal excavation and re-instatement work, low emissions and are more environmental friendly than the open trenching method. In cities such as Dortmund or Berlin for example, 50% of the pipe installations and renewals are already carried out using the trenchless method.

For pipeline projects it is common practise to include the trenchless method for advanced planning, for instance in ecologically valuable and sensitive areas, e.g. rivers, embankments or coastal areas. Even connections of offshore wind energy plants are installed trenchlessly over lengths of up to 2.000 metres without disturbing any ecologically sensitive areas.

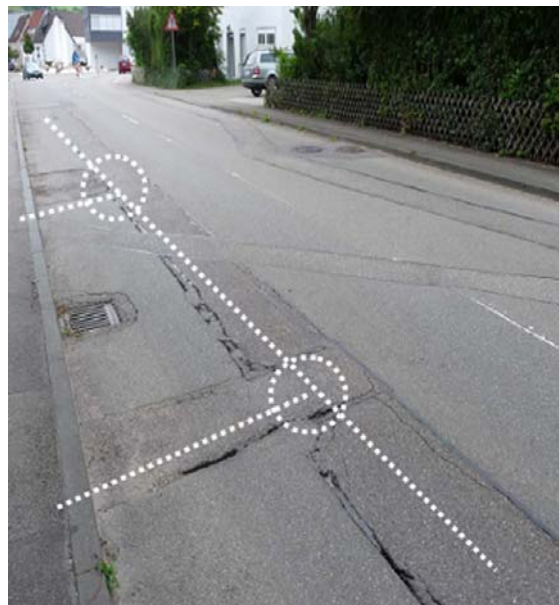


Fig. 1: Damages caused by open trenching.

For shorter, inner-city pipe installations or river crossings the HDD method is already a proven method. Civil engineering work is only required in this case for the starting and target pits, with minimal excavation work necessary. Thus there is no need for multiple transportations and work, such as re-filling, sealing and re-instatement of surfaces. Here the effect of the open trenching method on road surfaces can be clearly seen.

Such "malpractices" as seen in Fig.1 can be prevented in the future by consequently applying the HDD technology for parallel bores and the Keyhole technology for house connections. This way the public funds are not overstrained for the necessary disposal of surface damages and also for car owners for additional repairs caused by the poor road

surfaces. A study created by Gas Light Atlanta indicates the repair expenditure for vehicles, caused by surface damages, running to a total of approx. \$ 400 per vehicle (1).

### Keyholing in North America

In the USA the GTI – Gas Technology Institute was involved in the development of a technology with which work on service pipes can be carried out with only minimal break-up of road surfaces. By means of a „Keyhole“ access to the underground infrastructure is created. This has meanwhile been tested and exercised in practical use, numerous service companies in North America already carry out work on service pipes this way. A circular opening with the



minimal required diameter is created drilled the road surface using a special bore crown and the emerging bore core is taken out in one piece. A suction excavator removes the remaining soil up to the pipe requiring repair, which is repaired from the surface with long special tools. After re-filling, placing the previously extracted bore core back in place and the surface connection, this operation is completed with minimal damage to the road surface.

*Fig. 2: Corina and reinstatement process – establishing the core bore.*

This method (2.4) described as “coring” and re-instatement” (Fig. 2) has been applied for years for measures such as

- Pipeline search with “Search slot technology”
- Exposure of repair clamps
- Local pipe repairs

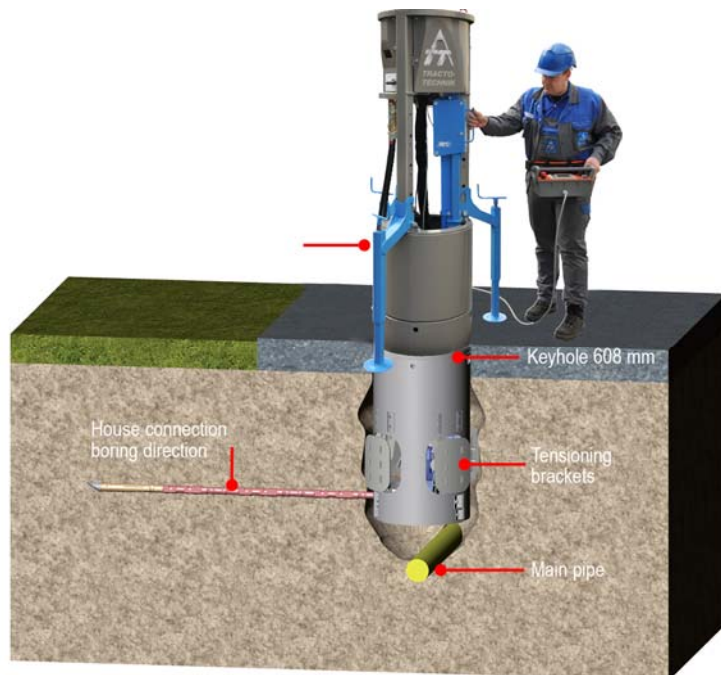
punctually close to surface and successfully executed a thousand times.

### Keyholing – Made in Europe

In Europe GdF SUEZ have initiated their own development and applied this together with Tracto-Technik, Lennestadt and introduced it for the first time at the BAUMA 2010 in Munich. With this new development – on the basis of a bore starting point created using the coring method with the smallest possible diameter (diameter only 600 mm) - an underground bore above the main pipe, including a connection from the surface, to the building of the residnet’s house is possible.



*Fig. 3: Application of a suction excavator.*



*Fig. 4: Illustration of the keyhole and the drilling unit.*

The objectives for this keyhole technology for the trenchless installation of service pipes are given by the pre-mentioned reasons and the restrictive behaviour of the road load carriers as well as the residents. Ore and more suppliers, for instance gas service companies, are experiencing that the potential customer requests a gas connection but not using the open-trench method. Under no circumstances does he want the premises appearance and use to be impaired. The responsible boards very often refuse any large scale excavations, even if they are only planned for a few days.

### Characteristics of the keyhole method

The characteristics of this minimally invasive working technology can be described as follows:

- Work on service pipes can be carried out with short interruptions and minimal restrictions or the private and public traffic
- Surfaces are only slightly utilised, asphalt work and follow-on work are not required, the extracted materials can usually be re-used.
- The inevitable soil and surface work can be carried out safer and in a reduced proportion and more productively
- Damages to available pipes are prevented by applying a suction excavator (Fig. 3)
- For the Grundopit-K bore rig only a bore setting point is required, from where the underground bore (Fig. 4) is driven forward.
- Bore work is carried out fully automatic and safer from the surface
- The connection of the installed new house connections is also carried out from the surface.

The above mentioned characteristics very often prove to have economical and ecological advantages.

- Simple, quick and environmental sensitive execution of work carried out underground on service pipes
- The working area, which has been required, is free to use again approx. 30 minutes (4) after re-instatement and sealing of the extracted bore core (Fig. 5).
- Damages to already existing pipelines are prevented
- Extensive cost reduction as opposed to the conventional open trenching method
- Constant execution, without the surface damages and follow-on costs well known with the open trenching execution.
- Reduction of the usual emissions by application of lighter and quieter working devices

With Keyhole and the developed bore technology house connections in the service field can be carried out with minimal invasive and automatically, as described in the following.

#### GRUNDOPIT-K method of operation

The Grundopit-K is a bore rig which carries out the normal bore process fully automatic. After the set-up of the bore rig, the operator at the surface only needs to insert the required drill rods. The automated bore mode is only interrupted to carry out any necessary direction alterations. The operator can handle the bore rig safely from the surface by means of a remote control.



*Fig. 5.1: The bore core is re-instated.*

*Fig. 5.2 (left): The surface has been sealed and is free to use again.*

For the complete process, from establishing the access point in the form of a secured mini construction pit to the production of the underground bore for pulling in a protection or media pipe, the following equipment and single working steps are required:

1. Core bore device, self-driven or as an additional unit, forestablishing a core bore of 608 mm diameter; the core retrieved from the road is taken out in one piece.
2. Suction excavator for the production of the bore opening and to carefully open the service pipelines.
3. GRUNDOPIT-K(eyhole) bore rig for the steerable installtion and pulling in of protection and media pipes up to 63 mm OD. The bore rig itself is stored inside a guiding pipe, OD 580 mm, which simultaneously functions as an support unit and which is fixed to the pre-adapted bore opening with tensioning brackets. The height adjustment, the bore depth to be precise, is carried out with adjustable stabilisers. Available lifting devices on site are sufficient for the installation and execution.
4. The bore device works its way forward according to the wet-bore principle, supported by the proven detection and steering devices, towards the connection point. The 230 m long drill rods are placed in a lift by the operator at the surface, transported down to the bore rig and there swung fully automatic in bore direction and screwed in place. The bore can either be carried out semi- or fully automatic.
5. After diassembling the Grundopit-K the protection or media pipe is installed simultaneously using the reverse mode of the drill rods.
6. With manipulators (Special tool (Fig. 6), which can reach into a depth of up to 1,50 m, the necessary connection work for the new house connection can be carried out from the surface.
7. The bore opening is re-filled with the excavated material or fluid soil, the core from the surface is re-instated and the circular grouting is re-filled with sealing material.

To bring the trenchless execution to perfection a method can be applie which is well known from the practice. This way there is no need for an assembly pit near the building wall to produce a wall duct.

From the room in the building the detection device us used to determine the exact position of the sonde at the tip of the first drill rod in front of the outer wall. With centimetre precision a core bore is carried out through which the drill rod can drive into the building (Fig. 7). In the usual manner the wall duct (5) is then installed and grouted with a two-component adhesive – even in fissured brickwork. The precise sealing off of the outer wall can be seen in cases where check openings have been made.



*Fig. 6: Connections works using special tools.*



*Fig. 7.1: Exposed wall duct*



*Fig. 7.2: Core bore in the building's basement.*

**Result:**

The Keyhole technology introduced here is an important step towards minimally invasive and fully automatic working bore technologies and towards the production of new house connection pipes from the surface is made. Impairment of the infrastructure and the public as well as emissions related to the already well advanced trenchless bore technologies are reduced even more. Less expenditure and no requirement for any follow-on work can immensely reduce the time consumption and costs as opposed to a pipe installation using the open trenching method.

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