Drilling Interlocked O-Pile Walls with DTH
Down-the-Hole (DTH) Drilling Update in the Construction Industry

Development of new Down The Hole (DTH) techniques, especially the introduction of new air control bits, is making DTH drilling safer and more environmentally friendly than ever before. Using DTH in urban areas and in sensitive ground is now possible; plus, there is no danger of overdrilling or air escaping, which could otherwise cause settlements to existing structures.
New Business Opportunity with O-Pile: DTH

Improved drilling tools, along with the increasing utilization of DTH in construction markets, have resulted in the innovation of using special connection elements and oversized drill bits to construct interlocked pipe walls. As with DTH, you can also drill them through the hardest boulders and right into bedrock!

New DTH tools bring the U.S. an economical and reliable solution that suits all ground conditions.
Interlocked O-Pile walls consist of spirally or longitudinally welded steel pipe piles and their welded interlocking connector elements.
O-Pile Wall Connector Elements

Interlocking elements consist of male and female elements where an oversized ring bit reams the space wide enough for male element to follow.

The female element that reaches further out than the area cut by ring bits is always either in pre-drilled material or in a cavity created by a previously drilled ring bit.
O-Pile Wall Connector Vs. Other

WOM/WOF-S from PilePro
WOM/WOF-S connectors have been tested in pipe pile wall connections, and test projects in Scandinavia, from 2008 to 2011.
PilePro WOM/WOF-S interlocks have been proven to have no assembly failures (when used with proper ring bits).

RM/RF from Ruukki
RM/RF has been developed by Ruukki for similar applications. But Ruukki’s connection element also has hollow channels originally intended for the possible grouting of the rock sockets. It thus requires a bottom section with one-way valves, in order to work properly.
Interlocked O-Pile Wall Components

- WOM/WOF-S connection profiles. They are sturdy, hold their direction, and do not open; but they do allow for installation angles. The rails need to be welded, 2 seams per rail. This should be done on site rather than in the factory, as they should be longitudinally straight.

- Ring bit OD should be casing OD + 56 mm, while the advance of the wall line is around casing OD + 60 mm.

- The advance is more than the ring bit OD, since the ring bit must not drill against the rail under any circumstances.
O-Pile Wall Installation by DTH

Interlocked casings can be drilled in any ground conditions with the use of Down the Hole hammer and overburden drilling systems with extra large ring bits.

Casings can be drilled through boulder clusters and into the bedrock; drilling depths can vary.
O-Pile Wall Application Ideas

With interlocked casings, we can make walls to be used as:

- Dock construction and quay walls
- Flood control and support walls
- Vertically sealed enclosure walls
- Pollution or water control walls
- Site excavations
- Etc.

O-Pile walls can bring considerable savings in construction time, with the added possibility of completely eliminating the need for temporary retaining walls.
O-Pile Wall Application Examples

Interlocked pipe pile wall techniques, together with horizontal drilling, open new possibilities for horizontal O-Pile wall structures.

All urban areas have requirements to build under existing street structures such as transport tunnels, pedestrian underpasses, etc. Interlocked O-Pile walls offer a new, economical way to build under streets without cutting off vital traffic.
O-Pile Wall Drilling Tools

The drill bits, designed for interlocked pipe pile walls, feature an oversized ring bit; but they also include notable differences compared to normal casing advancement tools. Most important is the air flow balance between the flush face and the direct flow back to the casing. Much of the air needs to be directed straight into the casing to ensure that the air does not escape through the large cavity around the previously drilled casing and, thus, prevent cuttings from blocking the casing and then getting the hammer stuck inside while trying to rotate the casing with drill rods.
Installation of O-Pile Walls with DTH Casings in Bedrock

In cases where the O-pile wall application is based on drilling the casings into bedrock, please note the following:

The rock socket depth should be 3 times the diameter of the casing because of possible rock inclination.
Installation of O-Pile Walls with DTH Casing

The new casing is drilled/interlocked into the previous casing. The ring bit will pass the previously drilled casing, pulling the female element into locking position, yet passing the previously drilled element without touching it. Drilling can continue deeper than what the previous casing was drilled into.

Please also note that even though the ring bit can pass the previously drilled ring bit, it cannot be drilled past the previously drilled casing’s ring bit!
Installation of O-Pile Walls with DTH

Wing Bit Warning

Almost all pipe pile walls done with wing bits have had many connector element breakages and other failures. This is due to the wing bit’s tendency to deviate from hard layers and boulders and the casing’s natural turning to the right, especially if the casing is poorly flushed and full of soil, which turns the casing right and down, under the drill rig.
Installation of O-Pile Walls with DTH Grouting

Sometimes installation requires grouting of the rock socket and/or the possible void around the casing. Whatever is the requirement, the easiest way to get the grout in place is to use double packers and one-way valves.
Installation of O-Pile Walls with DTH Sealing

Interlocked pipe pile walls can be sealed against water leakage up to a 5 bar pressure difference, which means 50 meters in wall depth!

Wadit® sealant is applied hot to the female connector rail.
Installation of O-Pile Walls with DTH

Casing Joints

Best case scenario: The most feasible and economic solution is for all casings to be drilled single pass, given that welding time is not productive.

However, if welding does need to be done (and is allowed at the site), then casings can be extended by welding.
Installation of O-Pile Walls with DTH Drill Rig

Any DTH rig will work with the addition of this tool -- a casing-holding device to prevent casing rotation movement, which thus keeps the wall in the desired direction and setting.
Installation of O-Pile Walls with DTH Horizontal Drilling

While vertical walls are assembled with standard DTH piling rigs, horizontal applications require special HZ rigs that can handle long element lengths as the space allows.
Installation of O-Pile Walls with DTH

Horizontal Drilling Example
Installation of O-Pile Walls with DTH

Work Order

Lines, corners and curves need to be designed before the welding of the rails. Rails will allow some $10^\circ$ corrections but no more, and the method should be decided before construction.
O-Pile Wall Cost Vs. Casing Diameter

Casing size requirements vary according to the load requirements. Applications typically vary from 168 mm to 1016 mm casings, while the lowest total material costs are in between 406 and 610 mm.

Small sizes, from 168 mm to 273, can be drilled with a water hammer, too, utilizing outside flushing bits that minimize water requirement.
O-Pile Wall Site Photos
Working for the Future of Down-the-Hole Drilling

www.ppvfinland.com  |  www.o-pile.com
Thank You

info@opile.com | Toll Free Nationwide: (866) 666.7453 ext. 1 | +1-512-243-1228

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