Dry Directional Drilling™
a trenchless technology with low environmental impact and high productivity for underground utility installation

Dr. Ing. Renzo Chirulli
SE Industries, Inc.

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Dry Directional Drilling™

1. Origin
2. Technology
3. Conclusion

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1. DDD origin
1. DDD origin

Horizontal Directional Drilling (HDD) origin

- Oilfield directional drilling technology
- Bentonite mud
- First "horizontal" application - (1970)

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1. DDD origin

Negative effects of the conventional open trench-digging method:

1. **interference with the transportation infrastructure and mobility** (*motor vehicles, other means of transport, pedestrians*)
2. **social costs** (*trade interference – stores, restaurants, banks, etc. – living and recreational activities, discomfort, etc.*)
3. **the cost of risks** (*associated with the method used*)
4. **environmental impact** (*air and noise pollution*)
5. **visual pollution**
Directional drilling reduces or eliminates these negative effects and the associated costs.

Such benefits impact the project economics and the entire community.

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The traditional HDD technology (wet boring) has some disadvantages, which are basically related to the characteristics of the technology that was originally used in the oilfields.
mud-related environmental problems of the “traditional” directional drilling technology (wet boring methods)

the mud can:

- **erupt to the surface**, fracturing the ground (“frac-out” phenomenon)
- **flood underground spaces** (garages, basements, storage areas)
- **pollute groundwater, and make surface water muddy** (rivers, lakes, ponds), with serious environmental implications
mud-related environmental problems of the "traditional" directional drilling technology (wet boring methods)

• Jet Boring
  40-80 gal./min
  at 1000-4000 psi

• Mud motors
  40-660 gal./min
  at 500-750 psi

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1. DDD origin

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1. DDD origin

underground utility installation market

- telecommunication
- power lines
- gas systems
- waterworks
- sewer

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underground utility installation market

**United States**

Breakdown of TLC programmed network

(source Underground Construction - Dec. 1999)

**Total = 39,335 route miles**
1. DDD origin

underground utility installation market

United States

GAS Systems - New Mains

(source - Pipeline & Gas Journal - Dec. 1999)

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1. DDD origin

underground utility installation market

United States

Proportion of New Main by Diameter in Undeveloped Areas

- 2-inch: 84%
- 3-inch: 4%
- 4-inch: 4%
- 1¼ inch: 8%

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1. DDD origin

underground utility installation market

United States

Proportion of New Main by Diameter in Developed Areas

- 2-inch: 95%
- 6-inch: 5%

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underground utility installation market

90% urban areas

HDD potential market

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1. DDD origin

**SOCRATE project**

1995

13,000 ITL bn

(≈6 US$ bn)

for cabling the biggest Italian cities

TELECOM ITALIA

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1. DDD origin

No-Dig technology requirements:

1) low environmental impact
2) mudless
3) rock drilling capability
4) high productivity
5) low operational costs (to compete with traditional open-cut methods)

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2) mudless
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### Table 2/L.38 – General classification of guided boring/directional drilling techniques (see Appendix I) with respect to the type of terrain

<table>
<thead>
<tr>
<th>Type of ground</th>
<th>Drilling technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt, clay, sand</td>
<td>Low pressure jetting</td>
</tr>
<tr>
<td></td>
<td>Dry boring</td>
</tr>
<tr>
<td>Gravel, marl, spoil, shale, clays</td>
<td>High pressure jetting</td>
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<td>Double tube/head casing systems</td>
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<td>Marl, spoil, clays, limestone, sandstone</td>
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<td>Dry boring (percussion and water mist lubrication)</td>
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<tr>
<td>Limestone, sandstone, some granites, spoil, gneiss</td>
<td>Mud motors with tungsten carbide or diamond inserts</td>
</tr>
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<td></td>
<td>Dry boring (percussion/rotation and water mist lubrication)</td>
</tr>
</tbody>
</table>

Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation.
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Dry Directional Drilling™

**DRY** because the rigs are provided with drilling equipment powered by compressed air at a low pressure.

**DIRECTIONAL DRILLING** because the rigs are equipped with a down-the-hole guidance and steering system to control the underground drilling and the installation of pipes and ducts along any path.
2. DDD™ technology

Dry Directional Drilling™ operating phases

PILOT BORE

- rig
- drill pipes
- down the hole tool
- drilling path

BACK REAMING & PULL BACK

- reamer
- swivel
- pipe to be installed

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drilling head steering
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drilling fluids

- bentonite mud
- water-polymers mixing
- water
- air

wet boring

dry directional drilling™

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with DDD™ the drilling fluid is compressed AIR at a low pressure. (12 bar – 175 psi)

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2. DDD™ technology

compressed air

air compressor performance for a 24 t rig (53,000 lb)

15,000 l/min at 12 bar
540 ft³/min at 175 psi

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2. **DDD™ technology**

**air functions**

- cleaning the down-the-hole
- debris circulation
- down the hole tools cooling
- down the hole tool power

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down the hole (DTH) percussive tool

The DTH tool performs an high frequency percussive action (900-1,400 blows/min)

It is capable to drill a wide range of soil condition.

It is particularly effective in very hard rock(*).

(*) compressive strength >200 MPa – 29,000 psi
2. DDD™ technology

**Air additives**

They improve:

- the DTH tools cooling
- the hole lubrication
- the debris circulation

**Water + foam(∗) + polymers(∗)**

0,5-20 gal/h

(∗) biodegradability (>95%)
## 2. DDD™ technology system performances

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<td>1,15</td>
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**imperial units**

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**Metric units**
2. DDD™ technology

air advantages

1. zero supply costs, because air is a free resource;
2. the supply is practically inexhaustible;
3. it is non-polluting; and
4. there are no disposal costs.
2. DDD™ technology

Operational cost reduction

1. No need to purchase, prepare, pump, recover, filter, and dispose the bentonite mud.
2. No increased costs related with the use of special equipment, like mud motors to drill through hard materials.
3. No costs associated with damages that can result from the use of mud.
4. Greater overall productivity on the job site.
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2. DDD™ technology

**SCORPIO 503**
- Pull back: 13.3 ton
- Torque: 5400 Nm

**SCORPIO 903**
- Pull back: 24.2 ton
- Torque: 9025 Nm

**SCORPIO 1203**
- Pull back: 36.5 ton
- Torque: 11772 Nm

**SCORPIO 250**
- Pull back: 5.5 ton
- Torque: 2550 Nm

**SCORPIO 250 PL**

**SCORPIO 250 T**

**SCORPIO 250 PL**

**SCORPIO 3003**
- Pull back: 55 ton
- Torque: 30000 Nm

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3. Conclusion

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3. Conclusion

Dry Directional Drilling

1. This technology makes it possible to operate on a wide range of soil conditions, without having to substitute or use expensive drilling tools.

2. Rigs are designed to be compact, resulting in reduced sizes, yet robust, with a remarkable power generated in the pull back and torque.

3. DDD systems cost less to operate than the “traditional” wet boring system.

4. The use of DDD technology eliminates mud-related problems (flooding of underground rooms, mud eruptions).

5. Air does not generate any physical or chemical pollution, nor does it disturb existing water-bearing strata or surface streams and it is abundantly available.
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DDD™ photo gallery

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DDD™ photo gallery

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DDD™ photo gallery

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