



# Description of the different kind of sondes and installation techniques. Pilot at Padova. Description of the Hydra-RED sonde

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## Innovations were developed in



## Cheap-GSHPs

(6/2015-5/2019)

Reduction of costs due to increased heat exchanger performance combined with faster drilling methods

*Cheap-GSHPs Project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement number 657982*



## and continued in



## GEO4CIVHIC

(4/2018 – actual)

Development of compact drilling machines and innovative heat pumps for built environment including historic buildings

*GEO4CIVHIC Project has received funding from the European Union's Horizon 2020 research and Innovation Programme under Grant Agreement Number 792355*





# Co-axial heat exchangers and drilling method innovations



	State of art	Cheap- GSHPs
External diameter	50 mm	80 mm
Drilling head	Rotating with high frequency vibrations	Rotating with low frequency vibrations
Water injection	No	Yes, trough drill bit
Drill bit	No	Tri-lame, Tri-cone
Material	SS304L	SS304L
Junction	Orbital welder	Conventional welding

Vibrasond



Putte Belgium

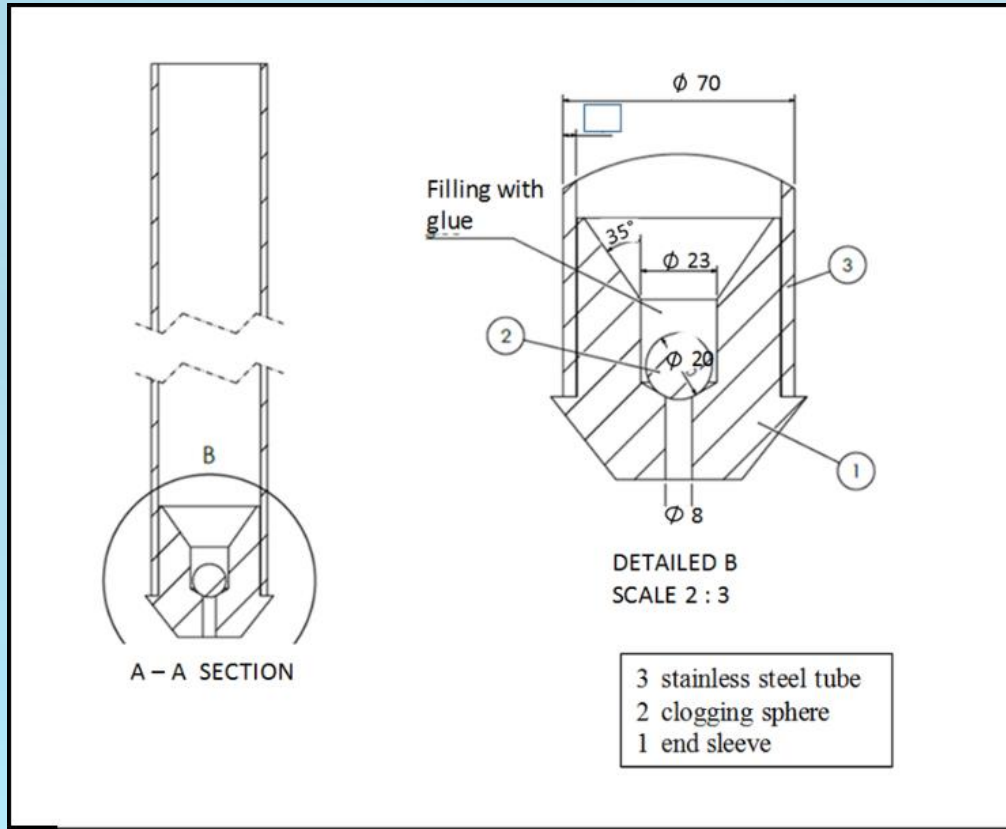




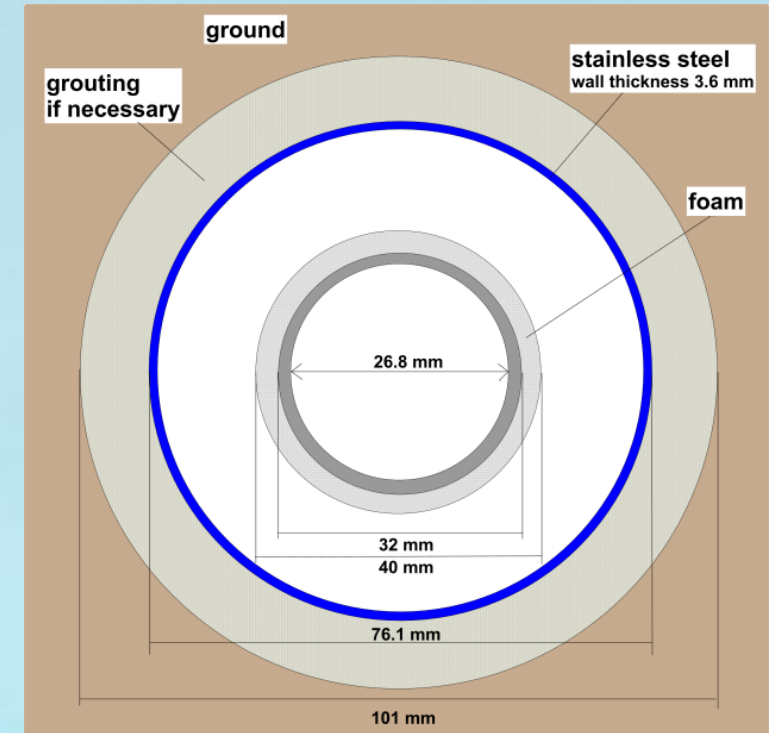
# Other innovations of the Heat Exchanger and drilling method



drill bit  
entrained by the shaft



Example of closure of water injection nozzle



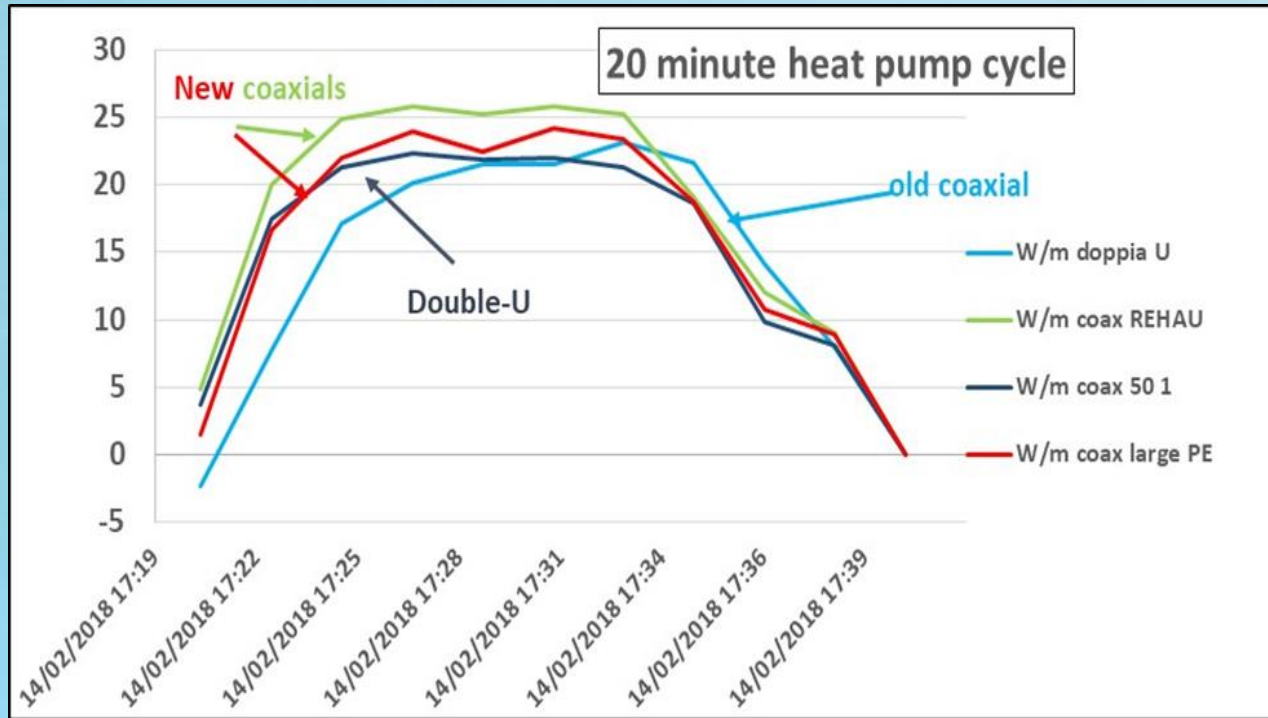
section of the coaxial BHE

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# Heat exchanger and drilling method innovations



## Piled coaxial heat exchangers out of steel

Cheap-GSHPs: Molinella (IT), Valencia (ES), Pikermi (GR), Putte (BE))

GEO4CIVHIC: Molinella (IT), CNR-Padova (IT), Mechelen (BE)

The thermal performance measured at the demonstration site in Putte (BE)

### Results:

- Higher energy exchange rates 10%-20% (highly conductive external tube, low borehole resistance)
- High rate of penetration 1-2 m/min with moderate torque
- Patent request granted in November 2020 in Italy
- 20-30% drilling cost reduction in unconsolidated soil (clay, sand) when supporting casing is

← needed →



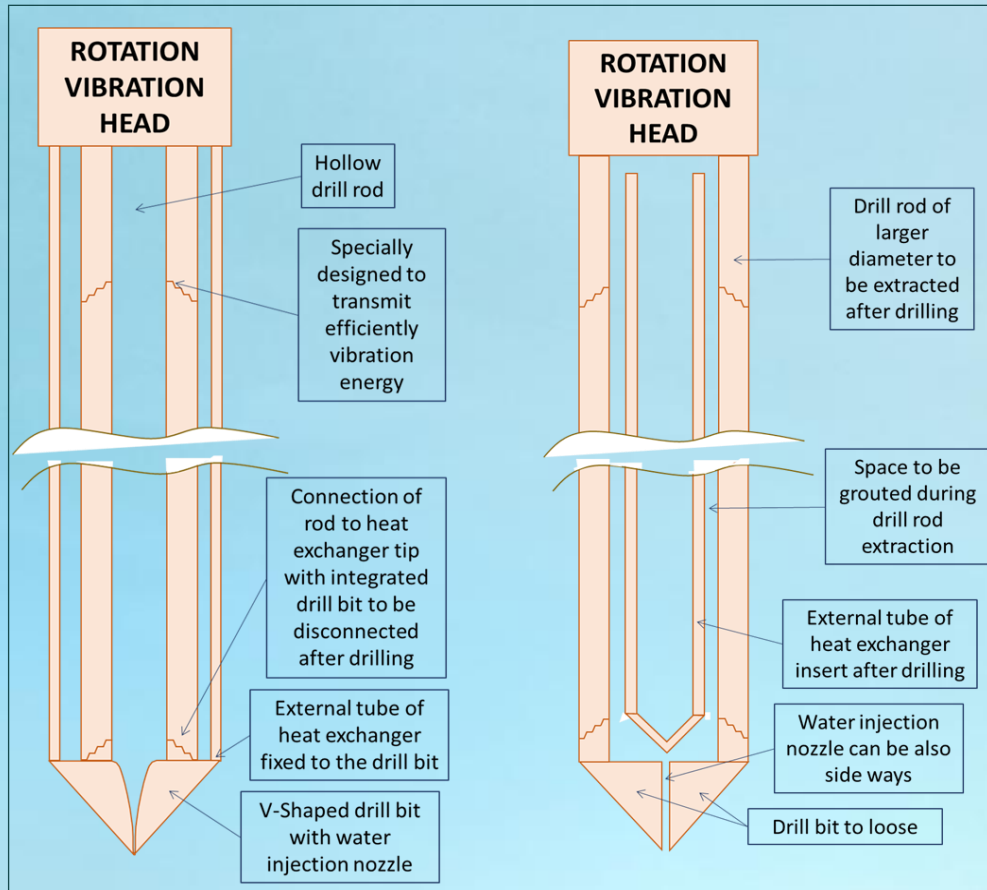
# Further developments in GEO4CIVHIC

## Coaxial steel heat exchanger and compact drilling machine for built environment



### HYDRA-RED

### TKI



### HYDRA-RED

### TKI

Method	Piling	Piling
Drill head	Rotating, high speed	Vibrating, rotating, high power
Fluid	Water	Compressed air or water
External diameter	90 mm	60 mm

### Drilling machine features:

- Reduced size and weight
- Removable power pack
- Telescopic and rotating mast
- Magnetic clamps for shaft changes using an excavator


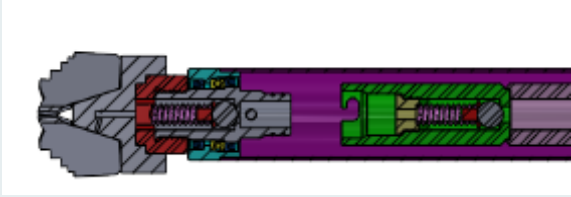


# Coaxial steel heat exchanger and compact drilling machine for built environment



TKI

HYDRA-RED

Drill bit		
Application	Hard consolidated soils	Unconsolidated soils (clay, sand)
Demo's done	Quarries in Italy and Germany R.O.P. 2-3 m/min Low air consumption, low bit wear	Pilots in Molinella (IT), CNR-Padova (IT), demo in Mechelen (BE)
Demo's to do	Dublin (IR), La Valletta (MALTA)	Padova 2 (IT)





# FUTURE DEVELOPMENTS



## Method TKI

- ✓ Alternative to DTH drilling
- ✓ Application in soft soils needs further work to lose drill bit

## Method HYDRA-RED

- ✓ More reliable closure of injection nozzle after drilling
  - Deformation of lead cone (HYDRA)
  - Threaded closure tap (HYDRA)
  - Sealing grout (UNIPD)
- ✓ Innovative junction without threads or welds
  - Suitable also for plastic material
  - Opens the road to hybrid heat exchangers (Hybrid= plastic and carbon steel)





## PILOT IN CNR PADOVA (IT)



- ❖ Drilled up to 72 m depth in about 3 hours
- ❖ Home made drill bit blocked
  - ✓ At later stage, during conventional drilling, at same depth lot's of difficulties encountered to unblock casing
  - ✓ Redesign of drill bit with industrial tri-lame (chevron bit)
- ❖ One of the threaded junctions loosened
  - ✓ Redesign of junction to a system without threading
- ❖ Tested in Mechelen (BE) and Padova 2 (IT) demo cases



# CONCLUSIONS



- ✓ The developments in the geometry and composition of the coaxial heat exchanger improve the thermal exchange yields with 30-40%.
- ✓ The installation methodology potentially reduces the installation time in the order of 30 – 50 %.
- ✓ The cost reduction potential of 20 -30 % is the result of less meters to install, thanks to the higher yields, the use of smaller machines and reduced installation times
- ✓ The velocity of installation, compactness of the drilling machine and high energetic performance make this technology particularly interesting for the application in narrow spaces in built environment and in historical buildings.



Many thanks for your kind attention

Luc Pockelé



<http://www.geo4civhic.eu>

