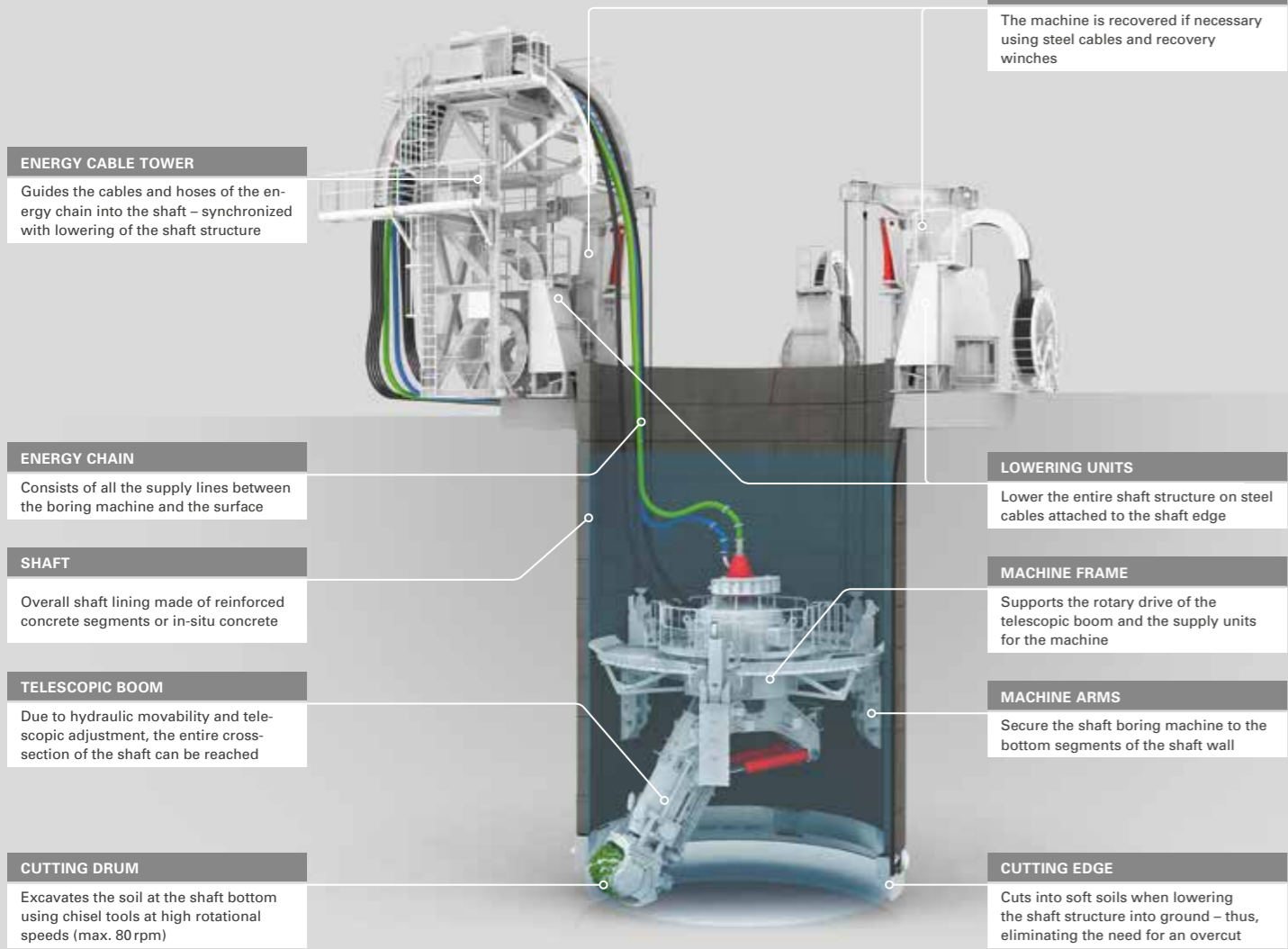


Illustration of a Vertical Shaft Sinking Machine



EXCAVATION DIAMETERS



GEOLOGY



Soft ground
Heterogeneous ground
Rock

TECHNICAL DATA

Machine:	VSM Basic	VSM	VSM Deep
> Torque cutting drum:	35 kNm	80 kNm	80 kNm
> Stroke of telescopic boom:	500 mm	1,000 mm	1,000 mm
> Weight:	approx. 65 t	approx. 185 t	approx. 120 t
> Min. footprint for VSM equipment:	300 m ² *	500 m ² *	500 m ² *
Shaft:			
> Diameter range:	4.5–9 m	4.5–18 m	5.9–12 m
> Max. depth:	up to 30 m	up to 90 m	up to 150 m
> Max. water pressure:	4 bar	10 bar	18 bar

*flexible arrangement of components

FUNCTIONALITY

Excavation: A cutting drum equipped with excavation tools loosens the soil on the shaft bottom.

Removal: Hydraulic removal of the excavated material to the surface using a submersible pump.

Thrust: Controlled lowering of the shaft structure using the lowering units.

Shaft construction: Shaft construction at the surface with pre-cast reinforced concrete segments or in-situ concrete casting.

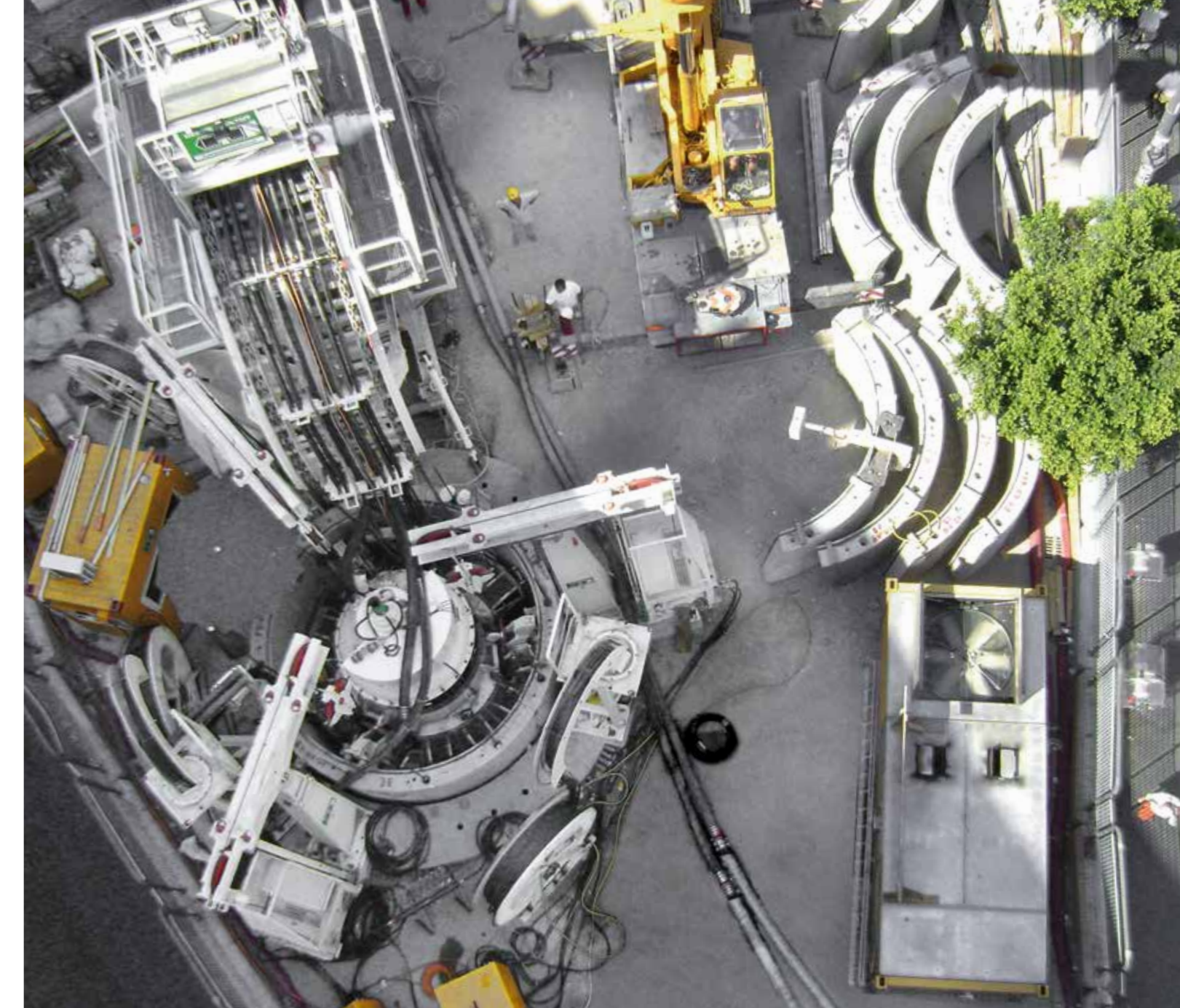
Herrenknecht

A world leader in groundbreaking tunnelling technology

Herrenknecht is a professionally positioned and internationally oriented family enterprise. As the only company worldwide, Herrenknecht delivers cutting-edge tunnel boring machines for all ground conditions and in all diameters – ranging from 0.10 to 19 meters. Under the umbrella of the Herrenknecht Group, a team of innovative specialists has formed to provide integrated solutions around mechanized tunnel construction with project-specific additional equipment and services. Pioneering technology by Herrenknecht is always involved when paving the way for the future underground – whether for tunnelling, mining or exploration. Herrenknecht ensures safe and fast progress when constructing modern infrastructures in all areas of application. Exactly where they are needed.



Headquarters in Germany, active worldwide. With more than 3,700 project references, we are a market leader all around the globe.



VSM – VERTICAL SHAFT SINKING MACHINES

SHAFT SINKING FOR ALL GROUND CONDITIONS

PIONEERING UNDERGROUND TECHNOLOGIES

Do not hesitate to contact us directly for your special requirements or request our “VSM” video animation.

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Herrenknecht VSM

A wide range of applications and flexible arrangements of components.

For quick and reliable construction of vertical shafts, Herrenknecht developed its VSM (Vertical Shaft Sinking Machine) technology, today an established product on the market. This unique mechanized shaft sinking equipment shows its strengths particularly below groundwater. In general, it can be used in soft and stable soils with compression strengths of up to 80 megapascal. Shafts constructed using Herrenknecht VSM technology have a wide range of applications. With diameters ranging from 4.5 to 12 meters, they can be used as launch and reception shafts for tunnelling operations, access and ventilation shafts for traffic tunnels, or service and access points for all kinds of under-

ground structures and buildings. Furthermore, special solutions such as inner-city, underground parking shafts (under-ground parking towers) or exploration and ventilation shafts for mining extend the range of applications of these flexible machines. Customized solutions for even larger diameters of up to 16 meters are possible. The innovative VSM technology has demonstrated its advantages in several projects. It allows for safe, fast, and environmentally-friendly production of vertical shafts of all kinds. Its advantages become particularly clear in difficult geologies beneath groundwater and where space on the jobsite is constrained.



The flexible arrangement of the individual components makes it possible to lower shafts even in narrow streets that are only a few meters wide.

71 SHAFTS HAVE ALREADY BEEN SUNK SUCCESSFULLY TO DEPTHS OF DOWN TO 160 METERS

PRODUCT HIGHLIGHTS

Quick: Simultaneous excavating and lining. High advance rates of up to 5m per shift due to parallel work processes.

Accurate: Controlled lowering of the shaft using hydraulic strand jacks.

Safe: No personnel is needed in the shaft. Controlled shaft sinking and positive ground water pressure to avoid settlements.

Controlled: All operational processes are controlled and monitored from the surface.

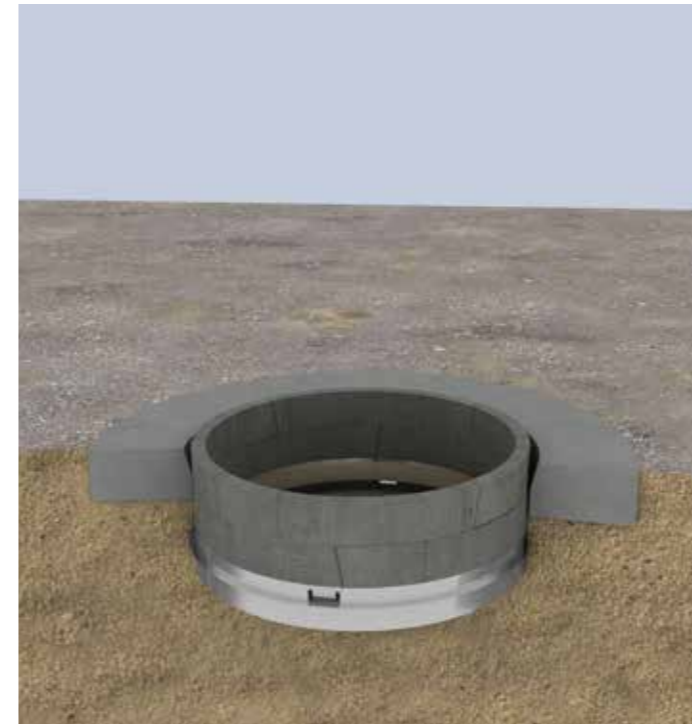
Cost saving: Applicable below groundwater.

Space-saving: Flexible arrangement due to the modular structure of the machine equipment enables use even under tight and inner-city space constraints.

Step by step to a finished shaft

1. Start section

The first step of the jobsite installation is the excavation of a cavern. In the excavated cavern the start section with cutting edge and segment rings is installed. Then, the ring foundation is concreted around the start section to carry the shaft and machine load. The costs can be reduced by using a segmented ring foundation that can be reused on the next shaft.



2. Installation of lowering unit and shaft sinking machine

The lowering unit consists of the strand jacks itself and coiled strands on a drum. For each specific project, the number of strands is calculated before. The strands are fed through the strand jacks and lowered through the annulus from the surface. Thereby the strand wires are connected to the cutting edge. In a next step the shaft sinking machine is lifted into the start section and attached firmly to the shaft wall with its three machine arms. By integrated levelling cylinders the VSM can be adjusted to three positions in the shaft. The rest of the shaft sinking equipment can now be installed and is adapted specifically to suit the situation on site.

Simultaneous excavation and shaft construction

3. Shaft sinking process

After flooding the shaft with water the rotating cutting drum, which is attached to a telescopic boom, can excavate and break the soil at the base of the completely submerged shaft. The excavated material is carried out by a slurry system and is transported to the separation plant on the surface. The lining is done with segments in parallel to the excavating process or by in-situ concrete casting. Due to the simultaneous working processes high advance rates of up to 5 meters per shift can be achieved. The shaft sinking

process is permanently controlled by strand jacking cylinders, which are holding the entire shaft structure and lowering it upon to the excavated level. When the desired depth of the shaft has been reached, the VSM is removed by recovery winches. Subsequently, the shaft bottom is sealed by an underwater concrete plug and the annular gap is filled up with grout, creating a frictional support locking the shaft in place. Finally, the shaft construction has been completed without affecting the groundwater or the surrounding soil and is now ready for further use.

