TECHNOLOGY

Cased Augered Piles

soilmec
Drilling and Foundation Equipment

CAP/CSP (Cased Augered/Secant Piles) technology was conceived for lined piles with the continuous flight auger method.
A particularly efficient method of building secant piles for the formation of continuous structural and/or sealed bulkheads.

This technique allows to drill piles of a nominal diameter of 600 to 1200 mm.
The max depth achievable by the casing is 21 m, whereas the max depth technically admitted by the auger is roughly 28 m (depending on drilling diameter and tool).

Boring without bentonite support

Allow to minimise the job site installation plant

No vibration or impulse during construction

High productivity

Rock drilling
up to resistance of 80 MPa
(unconfined compressive strengh - UCS)

Technology

CAP Cased Augered Piles is a type of drilled foundation in which the pile is drilled to its final depth in one continuous process using a continuous flight auger coaxial to an external casing . CAP piles are a replacement and cast in place piles type. The same technique can also be used to drill secant piles, the CSP Cased Secant Piles.
The construction procedure consists of three steps, the drilling phase (demolition), auger and casing extraction (spoil removal and concreting) and the cage insertion (reinforcing).

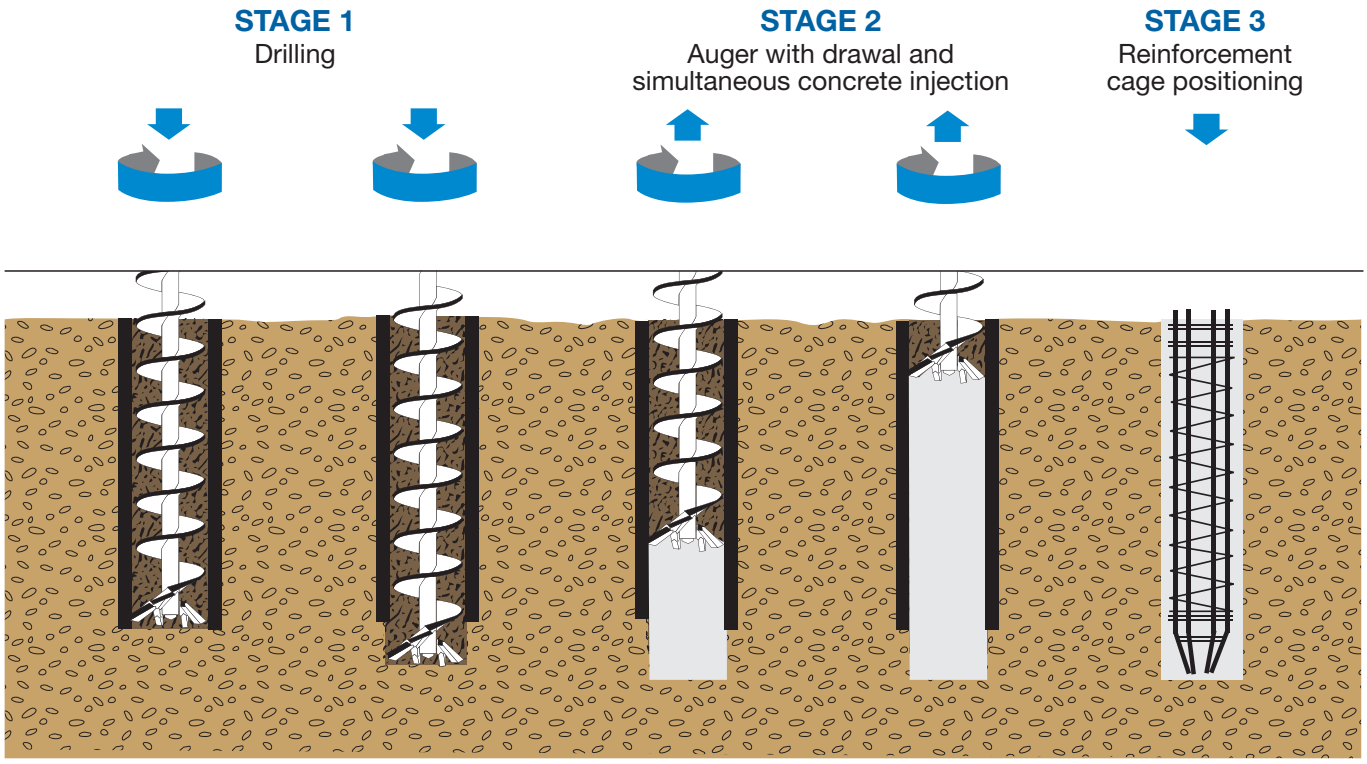
Construction stages

Drilling

Drilling is performed by an auger, with a central hollow stem, and a casing operated by two independent rotary tables which mutually counter-rotate and travel along the mast of the drilling rig. The continuous flight auger is moved vertically through a four-fall reeving of the main rope. The casing is handled vertically through a two-fall reeving of the service rope acting on a sliding cradle. Soil penetration into the hollow stem is prevented by a disposable bit or plug fixed at the bottom.

The rotary tables travel along the mast independently: as a result it is possible to penetrate the auger and casing to different depths, depending on soil type. Generally speaking, in case of cohesive or fine non-cohesive soils, the auger bit and the casing shoe are maintained at the same level; however, in the event of coarse non-cohesive materials the auger penetrates more deeply than the shoe in order to lighten the soil and make it easier to move it within the casing. In case of rocky soil, the casing advances as a core barrel, whereas the auger bit fitted with teeth suitable for rocks breaks up the “core” created by the casing. Both the auger bit and casing shoe are fitted with teeth, depending on the type of material to drill.

Once the max casing penetration depth has been reached, it is possible to continue to drill to the design depth using the continuous flight auger only.



Construction stages

Extraction and concreting

During extraction, the sliding cradle rests under the casing rotary and the rope falling from the cathead passes through the cradle and goes back up to the cathead on the opposite side. The casing usually rotates counter-clockwise, say the direction opposite to the auger rotation to allow for the spoil to come up. Should the casing rotate in the auger's direction, cuttings would accumulate and create a plug that would make it impossible for them to move upward. The envisaged concreting procedure consists in pumping concrete, through the central hollow stem, by extracting the auger up to the work level. The casing is usually extracted once the auger has been lifted by a few metres inside it.

Reinforcing

Once extraction is completed, a steel cage is inserted in the hole filled with concrete. A shovel or vibrator is often needed to advance the cage through concrete.

The CSP system

Based on CAP technology, the Trevi Group has developed a system for the construction of secant pile diaphragms, named CSP (Cased Secant Piles), which represents an alternative to standard diaphragm walls.

Cased Secant Piles are ideal when grab or hydromill-based technologies cannot be used due to soil stratigraphy, induced vibrations or, in general, jobsite logistics.

The CSP construction sequence entails the drilling of primary and secondary piles; when drilling the latter, the adjacent primary piles concrete is partially destroyed.

By modifying the pile diameter and the distance between them it is possible to obtain the best compromise between the real final thickness of the wall (pile cross-section) and the concrete to cut when constructing secondary piles.

To ensure the correct planimetric positioning of the piles, it is necessary to construct a guide wall identifying the position of all piles. The guide wall serve as a vertical guide during the initial steps of drilling.

The piles forming the secant pile diaphragms can be reinforced with different techniques and methods: the primary pile is not usually reinforced; however, if needed, reinforcement can be made by means of a reinforcement with a shape that allow the partial demolition of the primary elements when the secondary pile is excavated.

The primary and secondary piles can be constructed using different concrete types. For instance, it is possible to use a plastic mixture for primary piles: in this case they have a hydraulic retaining function only, whereas reinforced secondary piles assure the structural function of the diaphragm wall.

The CSP system

Concrete and reinforced cage

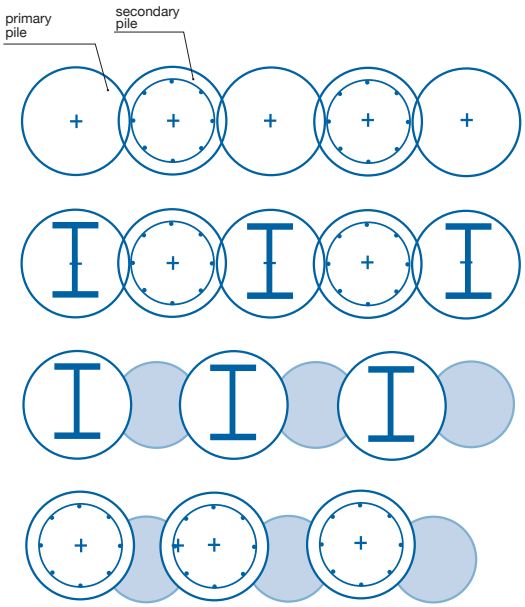
To ensure the fast positioning of the cage into fresh concrete, the latter should have the following features:

• The concrete used has to be prepared with aggregates of fine gravel (max size 18 mm) and sand ranging from 0 to 4 mm in size;

• The cement contents vary from 350 to 450 kg/cum with a water cement ratio equal to 0,45 approximately

• S5 or SCC slump classes shall be used. When using S5 concrete (slump > 220 mm), the max cage positioning depth is usually 12-15 m, whereas when using SCC it is possible to apply reinforcement cages to piles as long as 300 m.

• Pile concreting is carried out by means of a tracked concrete pump with an output ranging from 80 to 120 m3/h.



The reinforcement cages must be assembled respecting a number of principles:

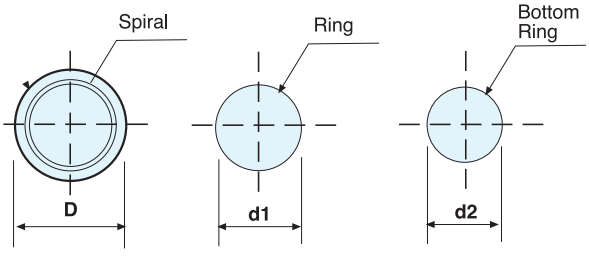
• Cages have to be properly manufactured and well assembled (preferably welded).

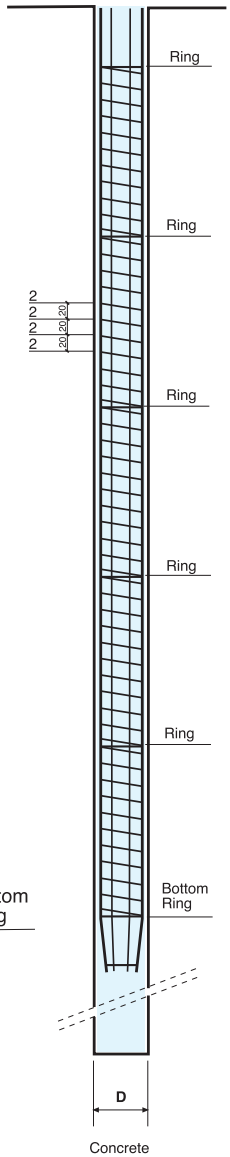
• The external dimension has to be maintained smaller than for standard bored piles, to grant a sufficient cover.

• A conic shape at the bottom of the steel cage is obtained by adopting a bottom ring smaller in size than the standard ones.

S5 Concrete_ Slump > 220 mm

S5 Concrete_ Pile diameter > 650 mm. Time to get 500 mm < 5 sec.





On-site logistics

Auger cleaner and spoil conveyors

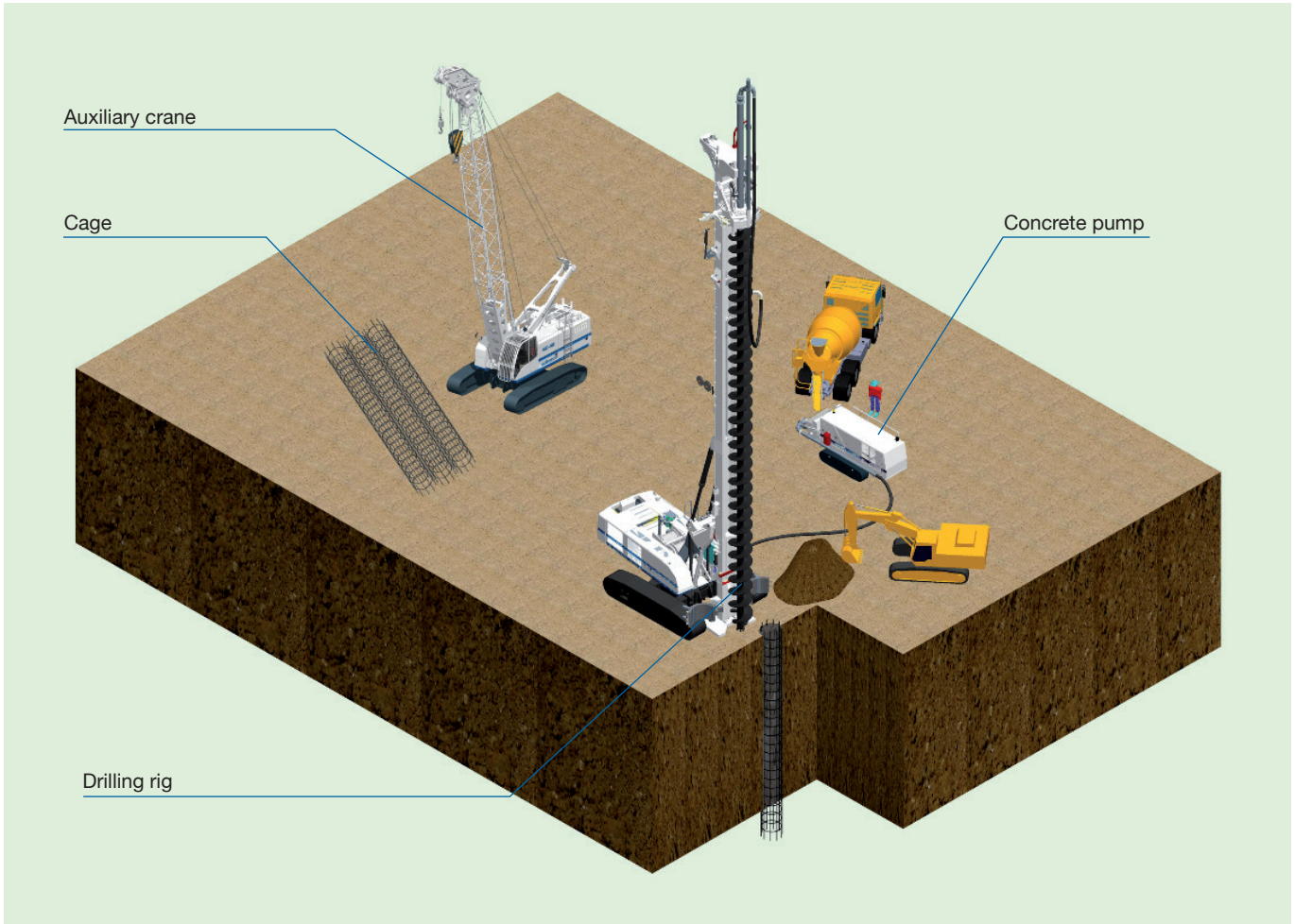
In order to ensure safety in job-sites the target has been to improve and simplify the conveying system with a mechanically operated telescopic spoil discharge chute. A double roller auger-cleaner (that works thanks to gravity by using its own weight or hydraulically operated) scrapes the auger surface and convey the cuttings into the chute through a discharge port. The system is composed by a telescopic column of pails connect to each other by a rope and moved by means of a proper winch. The spoil collecting and conveying system is characterized by simplicity and the fact that it does not hinder the drilling stroke, which can still reach the maximum depth afforded by the machine.

Auger and casing

Type of casing and auger tip and type of teeth depend on soil nature and its abrasiveness. Different design of drill tools are available, to drill into rock with UCS up to 80 Mpa. The auger/casing system guarantees high stiffness and deviations from the theoretical axis of the pile that are considerably lower than the ones obtained with the Kelly system or continuous flight auger. The deviation measured with CAP-CSP does not usually exceed 1%

Jobsite logistic

For the construction of CAP/CSP piles, the jobsite has to include a drilling rig, a small-sized tracked hydraulic pump, a backhoe excavator for debris handling and an auxiliary crane for cage positioning, whether needed.



Technology advantages

The main advantages of CAP and CSP technology are the following:

- **Suitable for any soil type and soft rocks** with max unconfined compressive strength (UCS) of 25-30 MPa.
- **No drilling slurry is used**: the debris has the same features of on-site soil.
- **Possibility to overpass pre-existing structures** - both masonry and concrete structures.
- **No vibrations or impulses** typical of percussion systems.
- **No trenches or open-cut excavation** resulting in soil decompression. The technology is especially suitable for the construction of diaphragm walls next to existing buildings and structures.
- **No cumbersome mixing and desanding plants** needed on-site for the construction of standard diaphragm walls or by means of hydromill.
- **Doubled production rate**, under the same geological conditions, with respect to standard cased Kelly method.
- **Reduced jobsite costs** compared to standard pile construction.

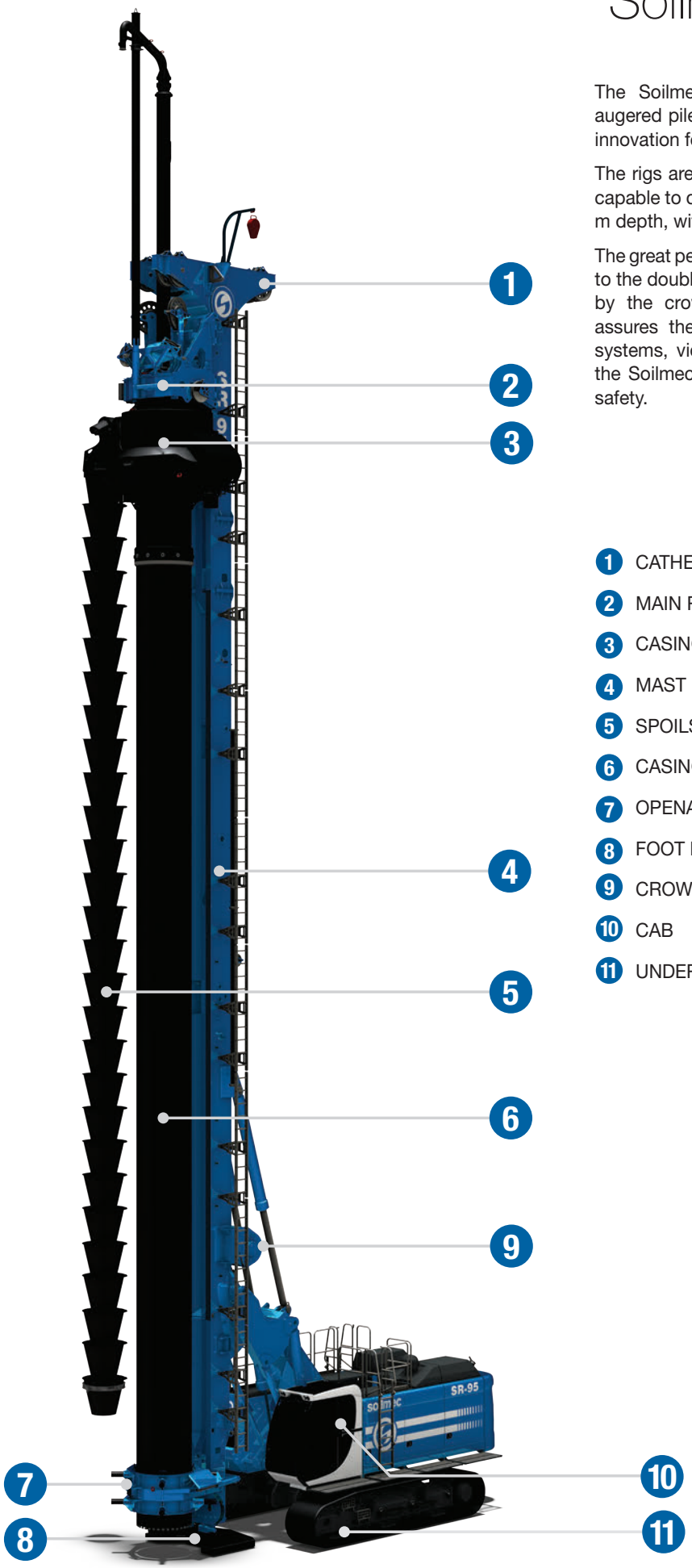

FISKET
COPENHAG
R-100

Soilmec Equipment

The Soilmec rigs dedicated to the secant and augered piles represent the top in performance and innovation for this technology.

The rigs are self-mounting, easily transportable and capable to drill piles up to 1200 mm diameter and 30 m depth, with 23 m cased.

The great performance of the rig is guaranteed thanks to the double independent rotary head that, assisted by the crowd-force of the crowd-winch system, assures the best production rate. The conveying systems, video camera attachments, cat-walk and the Soilmec cab assure the operators comfort and safety.

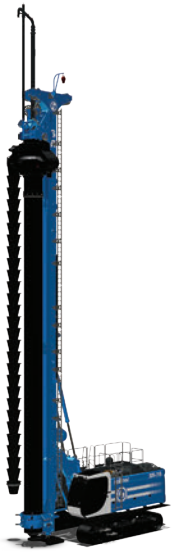


1. CATHEAD
2. MAIN ROTARY HEAD
3. CASING ROTARY DRIVE
4. MAST
5. SPOILS OPPER
6. CASING
7. OPENABLE AUGER GUIDE
8. FOOT ELEMENT
9. CROWD SYSTEM
10. CAB
11. UNDERCARRIAGE

Soilmec Equipment

ADV

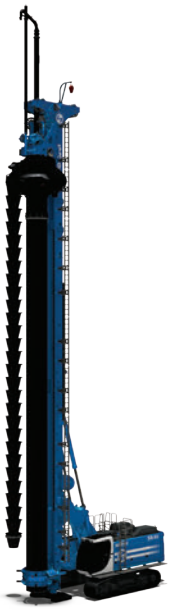
Multipurpose drilling rig equipped with double independent rotary heads for cased augered and secant piles method

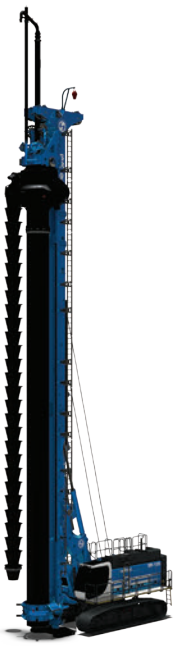


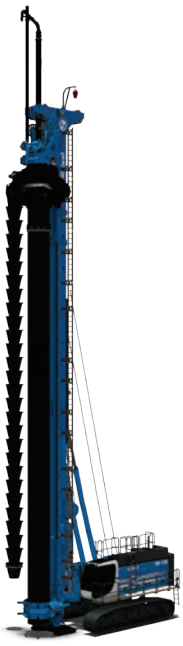
Model	SR-75
2nd rotary max torque	268 kNm
Max diameter	800 mm
Max pile depth	24,5 m
Max cased depth	18,4 m

HIT

Multipurpose drilling rig equipped with double independent rotary heads for cased augered and secant piles method







Model	SR-95	SR-125	SR-145
2nd rotary max torque	335 kNm	508 kNm	508 kNm
Max diameter	1000 mm	1200 mm	1200 mm
Max pile depth	27,3 m	29,3 m	29,3 m
Max cased depth	20,8 m	22,8 m	22,8 m


SR-100

All technical data are purely indicative and subject to change without notice

Cased Augered Pile 002 02/2016

SOILMEC Spa distributes machinery and structures all over the world, supported by SOILMEC Spa subsidiary companies and dealers.
The complete Soilmec network list is available on the web site www.soilmec.it

www.soilmec.it

soilmec
Drilling and Foundation Equipment