Seabed Operation

General description

Fugro gathers high quality soil data with the help of experienced personnel and state of the art techniques. With the geotechnical information Fugro consults in foundation engineering, interpretation, scientific projects and geohazard advice.

The data is collected in-situ by performing Piezo Cone Penetration Tests (PCPT), or other probe tests, and by taking (core) samples. The samples are tested in the laboratory and combined with the PCPT results, provide a detailed profile describing the soil characteristics.

Fugro has two distinguished geotechnical investigation methods: downhole operation and seabed operation. This folder describes the seabed operation.

Seabed Operation

During seabed deployment operations, PCPT’s and other probe tests can be performed to a maximum of 60 m below seabed (b sb), and soil can be sampled to 25 m b sb, depending on the system and the soil conditions. Seabed operations are well suited for investigations for shallow foundation types and pipeline routes.

A geotechnical site investigation is generally performed from a specialised geotechnical vessel or a vessel of opportunity such as a survey or supply vessel. The vessel is positioned above the testing location and the seabed unit or sampling system is deployed with the aid of an A-frame, a crane, through the ship’s moonpool or with a special deployment structure over the side of the vessel. After the seabed unit or sampling device is placed on the seabed, the test is performed and/or a sample is collected. The approach and programme is optimized to meet client requirements and site conditions, such as water depth, heave, current, seabed slope and weather conditions. Two basic subsystems can be identified in seabed operation mode: probing systems using hydraulic thrust and sampler systems using gravity.
Systems using hydraulic thrust

SEACALF®

The SEACALF® system is an electronic testing platform able to perform continuous PCPT’s and other probe tests to 40 m bsb if the soil allows. This can be done in water depths up to 2,500 m and is mainly used for geotechnical site investigation for seabed structures, jack-up rigs, production platforms, suction cans, anchors and other offshore structures.

The SEACALF® system consists of Fugro’s Seabed Frame (SBF) with an integrated drive unit, either a Wheel Drive Unit (WDU) or a Block Drive Unit (BDU). The drive unit uses two or four hydraulic powered wheels which are pushed against a sounding rod (string) using hydraulic cylinders. The rod, equipped with a cone or probe, is pushed into the soil by the rotating wheels at a controlled rate. A standard WDU or BDU provides 10 tons of thrust. If additional thrust is desired, two drive units can be stacked, resulting in 20 tons of thrust. Electric power, data and real-time communication are transmitted via an Underwater Power Cable (UPC) to the vessel. The SEACALF® system is usually deployed from the moonpool of the vessel and can also be equipped with additional equipment such as a camera and a frame settlement gauge.

2.5 ton Wheel Drive Unit (WDU)/Block Drive Unit (BDU)

The 2.5 ton WDU/BDU is used to perform PCPT’s and other probe tests to 15 m bsb in 300 m water. A seabed frame can be equipped with one or more stacked drive units according to the required thrust.

SEAROBIN®

The SEAROBIN® is a conical lightweight reaction frame, designed to perform 3 m PCPT’s using a small drive unit. An integrated push and grab sampler allows soil sampling during the same deployment. Deployment time is short, thus this system is particularly suited for investigations involving a high number of test runs, such as for pipeline and cable routes. The maximum water depth in which the SEAROBIN® can operate is 2,000 m.

The SEAROBIN® is controlled through a combined power and data umbilical cable, which also is used for hoisting the frame. The SEAROBIN® can be deployed from specialised geotechnical vessels or vessels of opportunity.

SEASCOUT 10/35

The SEASCOUT is a lightweight in-situ Cone Penetration Test (PCPT) system that is primarily used for cable route investigations. It has a very small, fast deployed spread for rapid and accurate determination of the subsurface soil conditions. The system works with a drive unit that pushes a coiled rod with a probe attached into the soil. The SEASCOUT can be deployed using an A-frame or crane in 2,500 m water, depending on the winch capacity.

There are two versions of the SEASCOUT, the SEASCOUT 10, a 1 tons version using a 5 cm² cone and can push to 10 m bsb. The SEASCOUT 35 is the 3,5 tons version and is an evolution of the successful SEASCOUT 10. The standard cone application of the system is a 5cm² piezo-cone, however 10cm² cones, T-Bars, ball probes and a range of other specialist cones are compatible. It can push to 25 m bsb.

¹: For detailed information of this seabed system please consult the specific brochure.
**FUGRO SMARTPIPE®**

FUGRO SMARTPIPE® is developed for in-situ testing to model flow lines and pipe-soil interaction with very soft soils in water depths to 2,500 m depending on the winch capacity. It is an in-situ testing system which consists of an instrumented pipe segment. This pipe segment directly measures the interaction forces in all directions. In addition, pore water pressure is measured at several discrete points along the underside of the pipe.

**SMARTSURF**

The SMARTSURF is used for geotechnical investigations to 2,500 m water depth. The SMARTSURF can perform PCPT’s and other probe tests, mini T-bar and take a sample in a single deployment, which is ideally suited for cable and pipeline routes.

**Gravitational systems**

Fugro uses a range of gravity seabed sampling systems such as corers and bulk samplers. The sample systems are used to retrieve high quality and relatively undisturbed samples in very soft to soft soils.

Some of the systems are lowered quickly on the wire to retrieve the sample or push the probe into the soil; others have a trigger release mechanism that allows the corer or probe to free-fall once suspended a couple of meters above the seabed. Most of the corers also have a stationary piston that prevents the sample flush away when the corer is retrieved.

**Fugro Seabed Dart**

The Fugro Seabed Dart is a semi free fall SI tool that can perform PCPT’s in the top 0.5-6m of the seabed. It is deployed in a similar method as the gravity corer. The tool has some unique features:

- The Seabed Dart provides complementary data of the (very) soft top layer, where conventional systems are relatively insensitive to these soft top layer.
- It is a ‘fast probing’ system and acquired data is based on de-acceleration when the probe is penetrating the soil.

**Gravity (Piston) Corers**

The STAtionary Piston Gravity CORer or STACOR® is a piston sample corer able to retrieve, large diameter (105 mm) and long samples in very soft to soft soils. It can sample in water depths to 3,000 m and the maximum sample length is 25 m. The STACOR® has a trigger release mechanism and is deployed with a specialised deployment system.

The Jumbo Piston Corer and the Piston Corer work in a similar way as the STACOR, having a trigger release mechanism and a stationary piston. The Variable Weight Gravity Corer doesn’t have these features but is lowered on the wire. The Jumbo Piston Corer has a sample length of 20 m, the Piston Corer and the Gravity Corer 2, 4 or 6 m. These corers are deployed either from the side or from the back of the vessel with an A-frame. Depending on the winch capacity these tools can retrieve soil samples in water depth to 3,000 m.

The SMARTSURF is often used in conjunction with FUGRO SMARTPIPE® for investigations on pipeline and cable routes investigations. Both systems use the same base reaction frame which is controlled through a combined power and data umbilical cable, which also is used for hoisting the frame.

**High Performance Corer - HPC™ (Vibrocorer)¹**

The HPC™ is a sampling device with an electric motor that creates vibrations which drives the core barrel into the soil. The working water depth is 350 m and it can retrieve samples in stiff, granular soils. The maximum sample length is 6 m.
Bulk Samplers

The Seabed Box Corer and the Grab sampler are bulk samplers, sampling devices for sampling the seabed top soil. These samples of the very soft, cohesive top layer are very suitable for sub-sampling, laboratory testing and mini T-bar testing. The Seabed Box Corer has weight blocks which pushes a square box into the ground. When the box corer is lifted, a lid closes below the sample box to retain the sample.

The Grab sampler is a bulk sampler that is triggered when touching the seabed. Grab samples are disturbed and are used for examining mineral deposits, aggregate prospecting and environmental and pre-dredging research. When the sampler is lifted, the scoops close around the soil.

¹: For detailed information of this seabed system please consult the specific brochure.

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<thead>
<tr>
<th>Max. water depth</th>
<th>Max. penetration depth</th>
<th>Mass (underwater)</th>
<th>Max. thrust</th>
<th>Soil type</th>
<th>Probes applicable</th>
<th>Sample tubes</th>
<th>High Performance Corer - HPC™</th>
<th>Jumbo/Piston/Gravity Corers</th>
<th>Bulk Samplers</th>
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<td>SEACALF®</td>
<td>2,500 m</td>
<td>40 m</td>
<td>13/26 tons</td>
<td>Soft/stiff/dense soils</td>
<td>10 cm Digital piezo-cone/ 10 cm Digital piezo-cone/ 10 cm Digital piezo-cone/ 5 cm Digital piezo-cone/ 10 cm Digital piezo-cone</td>
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<td>6 cm Digital piezo-cone</td>
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<td>10/25 m</td>
<td>1/3.5 tons</td>
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<td>Instrumented pipe segment</td>
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<td>PCPT, In-Situ Vane and T-Bar: 3 m, Piston sampler: 2 m, Mini T-Bar: 1 m</td>
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