

# Suction Caisson Track Record 2019



**CATHIE**



Client	Project Name	Description	Date	Region	Sector
Genesis Oil and Gas Consultants Ltd	Design experience	Detailed design and seismic assessment of suction caissons for a manifold & fishing protection structure.	2019	Middle East	Oil & Gas
Total E&P	Third-party review	Third party driveability analysis for CP and assessment of suction-assisted penetration of CAN-ductor (composite CP and suction can).	2018-2019	Northern Europe	Oil & Gas
SBM Offshore	Design experience	FPSO mooring anchor concept selection (driven or suction pile), FEED-stage sizing and installation analysis of selected concept (suction caisson), including inverse catenary assessment and effect of seismic loading/liquefaction.	2018-2019	Oceania	Oil & Gas
SBM Offshore	R&D and development of design methods/guidelines	Development of philosophy and design standard documents for geotechnical anchor systems, which will be part of SBM Corporate Specifications, Geotechnical discipline.	2018-2019	Northern Europe	Oil & Gas
Technip U.K.	R&D and development of design methods/guidelines	Update seismic design guidelines to address specific Technip queries (including design of caisson foundations).	2018-2019	Northern Europe	Oil & Gas
Mc Dermott Inc	Foundation design review	Design review of skirted mudmat and bucket foundations .	2018	Mediterranean	Oil & Gas
ExxonMobil	Third-party review	Holding capacity analysis accounting f.or chain trenching for different configurations.	2018	Africa	Oil & Gas

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Van Oord	Third-party review	Geotechnical design review of 2 Universal Foundation monobucket designs for Deutsche Bucht site in Germany. The review covers document review and independent installation and in-service design calculations.	2018	Northern Europe	Offshore Renewables
Confidential	Third-party review	Suction pile holding capacity re-assessment, accounting for effects of chain trenching and including centrifuge test results.	2017-2018	Africa	Oil & Gas
Carbon Trust	R&D and development of design methods/ guidelines	Developing design guidelines for suction can foundations.	2017 - 2018	Northern Europe	Offshore Renewables
SBM Offshore	Design experience	Preliminary sizing and detailed design of suction piles used as anchor solution for a spread moored FPSO offshore Ghana.	2017	Africa	Oil & Gas
Total E&P	Third-party review	SHR foundation design review. Review of Saipem calculation note to verify possibility to immediately connect riser to anchor.	2017	Africa	Oil & Gas
Confidential	Third-party review	Anchor feasibility study for floating wind farm foundations in France.	2016-2017	Northern Europe	Offshore Renewables
Saipem Italy	Design experience	Identifying the VH envelopes for the Capping Stack foundation. The study will be performed with the software Caisson.	2016	Mediterranean	Oil & Gas
Confidential - EPCI contractor	Installation Support	Provision of Survey Services for Offshore Geotechnical Survey including onshore survey management, offshore client representative survey services and QA/QC of geotechnical interpretation, suction caisson design and jack-up leg penetration calculation.	2016	Northern Europe	Offshore Renewables

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Total E&P	Installation Support	<p>Subsea7 Norway (SS7) have prepared the foundation design of three subsea structures, i.e. the SSIV, PLEM and WYE to be installed as part of the Martin Linge Field development. All three structures are subjected to high horizontal and torsional loads caused by tie-in and installation tolerances. These loads can in certain load cases lead to sliding/torsional failure of the foundation.</p> <p>The contractor therefore tried to demonstrate that the foundations would fail in sliding/torsion and not in bearing capacity, i.e. under relaxation of the tie-in loads, the foundations would mainly slide and rotate over short distances and would not tilt. Additionally cumulative displacements are not expected as tie-in load relaxation is a single occurrence. A Plaxis 3D analysis was performed to demonstrate this behaviour.</p>	2015	Northern Europe	Oil & Gas
Total E&P	Installation Support	Supervision of the installation of the SWPS wellhead protection structure founded on 4 caissons.	2015	Northern Europe	Oil & Gas
SBM Offshore	Design experience	<p>Field observations have revealed that trenching and tunnelling around mooring chains has occurred in some cases at the anchor end when using a semi-taut mooring system with suction cans and anchor chain embedded in the soil for some FPSOs.</p> <p>Therefore, SBM have commissioned Cathie to investigate this phenomenon through a combination of physical and numerical modelling, combined with field measurements on the trenches created at the anchor end (to be undertaken by SBM). The objectives will be:</p> <ul style="list-style-type: none"> <li>- to develop a full understanding of the mechanisms occurring during anchor chain trenching: a) determining if a limiting (steady state) trench shape can be expected for existing mooring systems, b) developing models and tools to predict rates of trenching.</li> <li>- to investigate potential remedial measures.</li> </ul>	2014-2015	Africa	Oil & Gas

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Total E&P	Installation Support	Geotechnical specialist during installation of two manifold suction caisson foundations.	2014	Africa	Oil & Gas
Confidential	Design experience	FEED level geotechnical design of suction caisson foundations for a PLEM structure.	2014	Northern Europe	Oil & Gas
Confidential	Third-party review	Design review	2014	Africa	Oil & Gas
Confidential	R&D and development of design methods/ guidelines	Conceptual level SICA design in the North Sea.	2014	Northern Europe	Oil & Gas
Genesis Oil and Gas Consultants Ltd - Aberdeen	Design experience	FEED level geotechnical design for a Fishing Protection Structure.	2013-2014	Northern Europe	Oil & Gas
Fabrication contractor	Geotechnical Design	A subsea foundation fabricator has requested Cathie to perform foundation design for the conductor pile template at a deepwater field in West-Africa. The conductor pile template has to provide support for all conductor piles while maintaining a reasonable weight. Hence an optimized foundation design is essential. Both suction caissons and driven piles are investigated as foundation options.	2013-2014	Africa	Oil & Gas
Confidential - EPCI contractor	Design experience	A major Oil&Gas Contractor required mooring the system to 3 independent points, to install a tool weighting around 130t. The structure is moored with ropes to Dead Man Anchors. Currently, this Contractor is developing the mooring by means of DMA, in which the necessary holding capacity is provided in essence by the self-weight of the DMA. Cathie provided assistance in the geotechnical design of the anchor and in particular of the foundation system. In addition, we also assisted in the geotechnical design for different mudmats for the subsea storage of items.	2013	Mediterranean	Oil & Gas

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Confidential - EPCI contractor	Geotechnical Design	<p>Cathie assisted a major EPCI contractor for the geotechnical design of riser-base suction caissons on a deepwater West-African field. Building on our experience with suction caisson design, Cathie is involved in the following tasks:</p> <ul style="list-style-type: none"> <li>-Review of soil conditions at the site and implications for design</li> <li>-Preparation of geotechnical design brief for design basis</li> <li>-Suction caisson capacity analysis</li> <li>-Suction caisson response specification</li> <li>-Suction caisson penetration extraction analysis</li> </ul> <p>This work is executed in the client's office on a 2day/week secondment. Using the in-house software CAISSON, Cathie is able to make quick and reliable assessments of suction caisson capacity, reducing the time required for calculations.</p>	2013	Africa	Oil & Gas
Carbon Trust	R&D and development of design methods/ guidelines	<p>Undertake a scoping study to collate the research undertaken to date on suction caisson foundations, perform a gap analysis and propose a plan for future research and development projects. The objectives of this work are to:</p> <ul style="list-style-type: none"> <li>- Collate and understand the research regarding the applicability of suction caissons to offshore wind structures undertaken to date.</li> <li>- Collate and understand the research regarding suction caissons by other industries which may be applicable to offshore wind.</li> <li>- Undertake a gap analysis and determine which areas require further de-risking</li> </ul> <p>- Define follow up research and development projects which can be commenced based upon current understanding</p>	2013-2014	Northern Europe	Offshore Renewables

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Confidential	Third-party review	Verification of holding capacity of a suction caisson for FPSO anchoring using Plaxis 3D	2013	West Africa	Oil & Gas
GMC Ltd	Design experience	To assess the viability of deep skirted caissons for future offshore wind developments in the UK, to provide indicative caisson sizes and to consider installation issues associated with the caissons.	2013	Northern Europe	Offshore Renewables
Confidential	Design experience	<p>As part of the Concept Validation &amp; FEED studies required for the new deepwater subsea development of an oil field in the Bay of Bengal (Offshore India), Genesis Oil &amp; Gas commissioned Cathie to provide foundation design and geotechnical assistance services for representative Subsea Assemblies founded on caisson foundation structures and In-Line Structures founded on mudmats.</p> <p>The stability analyses were performed for single suction caisson foundations (8m to 10m diameter) of three subsea foundation structures, including pseudo-static seismic loads.</p> <p>The foundation settlements of the caissons have also been assessed. Additionally, static stability analysis and/or geotechnical assistance has been undertaken for the ILS structures as follows:</p> <ul style="list-style-type: none"> <li>- R SSIV: Assessment of the bearing pressures.</li> <li>- ILS (2no.): Static Stability and Settlement Analysis.</li> </ul>	2013	Central Asia	Oil & Gas

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Genesis Oil and Gas Consultants Ltd	Design experience	Detailed geotechnical design of suction caissons for Fishing Protection Structures (FPS) including holding capacity, settlement, interaction effects and penetration calculations.	2012 - 2013	Northern Europe	Oil & Gas
Fabrication contractor	Third-party review	Cathie SA/NV has been asked to provide mediation services in order to understand and close-out apparent misunderstandings between the geotechnical designer and the certifying body regarding the design assumptions used in the design of an offshore substation founded on suction caissons.	2012	Northern Europe	Offshore Renewables
Fabrication contractor	Design experience	Conceptual suction caisson design.	2011-2012	Northern Europe	Offshore Renewables
Keppel Verolme BV	Design experience	To provide design expertise for the substation foundation, consisting of suction caissons for the offshore wind farm in German Bight, North Sea. Furthermore, a monitoring system has been designed to perform regular, weather-independent scour development monitoring. The project represents the first self-installing platform in Germany, and the suction caissons are the first successfully installed as a platform foundation in Germany. Design has been performed in full accordance with German legislation (BSH).	2011-2013	Northern Europe	Offshore Renewables



Client	Project Name	Description	Date	Region	Sector
Suction Pile Technology BV	Geotechnical Design	To finalize the detailed in-place and installation design of the suction caisson foundations for the Global Tech 1 offshore wind farm in the German North Sea. The GT1 substation is the first-ever substation founded on SICAs, and also the first self-installing platform and the first SICAs successfully installed in Germany. The platform has been successfully installed in May 2013 within pre-determined design limits.	2011-2013	Northern Europe	Offshore Renewables
Confidential	Conceptual Geotechnical Design	Techniekontor Bremerhaven GmbH (tkb) is developing a concept for the offshore substation (OSS) for a German wind farm. Cathie SA/NV was contracted by to provide preliminary design calculations for the concept of suction installed caisson foundations for the OSS, to be performed as required by BSH (2007 and 2008).	2011	Northern Europe	Oil & Gas
Technip U.K.	R&D and development of design methods/ guidelines	Technip required design of predominantly vertically loaded anchors subject to cyclic environmental and sustained tension loads e.g. anchors to hold down risers connected to buoyancy modules, free standing hybrid risers (FSHR) and Mid Water Arches (MWA), etc. Therefore, Technip UK have asked Cathie to provide detailed guidelines to carry out optimum design of vertically loaded anchors considering the degradation of soil during installation and under the various load types specific to these types of structures, as well as the beneficial effect of time dependant gain in soil shear strength.	2010-2011	Northern Europe	Oil & Gas

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Benthic Geotech Pty Ltd	Design experience	<p>Cathie were subcontracted by Benthic to provide geo consulting support for the project, including :</p> <ul style="list-style-type: none"> <li>- Provision of the lead geotechnical engineer for the offshore phase</li> <li>- Preparation of the factual report with Benthic</li> <li>- Preparation of the design parameter report for the design of mooring anchors, subsea structure foundations and pipeline-soil interaction analyses.</li> <li>- Preparation of the engineering report presenting the preliminary design calculations performed for the envisaged anchor and foundation geometries for the following structures: <ul style="list-style-type: none"> <li>* FPSO anchor pile clusters</li> <li>* Offloading Buoy anchor pile clusters</li> <li>* Riser tower pile anchors</li> <li>* Single Hybrid Riser (SHR) pile anchors</li> <li>* Manifold caisson foundations</li> <li>* Several mudmat foundations for the Flowline End Termination (FLET) and inline tee (ILT) subsea structures.</li> </ul> </li> </ul>	2009-2010	Africa	Oil & Gas
Genesis Oil and Gas Consultants Ltd	Third-party review	Genesis Oil and Gas Consultants Ltd (GOGC) designed five types of sub-sea structures founded on one to four suction caissons. Cathie performed the stability, settlement installation and retrieval analyses for these subsea structure foundations (including seismic loading).	2009-2010	Mediterranean	Oil & Gas
EnCana Corporation	Third-party review	A geotechnical review of the NGI/SBM skirted foundation design for the PFC was initially performed. Scour protection design was required and CA assisted Encana with supervision of the scour testing performed by SBM at Deltares. An independent review of the designers scour limit was then required since piping around the skirts during storm loading was the controlling mechanism. CA then assisted Encana with reviewing the contractors basis for changing the dimensions of the skirted foundation and providing support for their claim management.	2009-2010	Northern America	Oil & Gas

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Technip U.K.	R&D and development of design methods/guidelines	<p>Guidelines for seismic design for various foundation types (gravity base, caisson, piles) and for pipelines are provided:</p> <ul style="list-style-type: none"> <li>- A review of various existing design codes was done with the purpose of establishing a seismic design basis for the design earthquake and seismic action.</li> <li>- The seismic design analysis methods available for shallow and deep foundations and pipelines are then described.</li> </ul>	2008-2009	Northern Europe	Oil & Gas
Technip U.K.	Design experience	<p>Development of the calibrated limit equilibrium tool CAISSON for Technip OED. The development consisted of a three-phase development of a rapid sizing tool for suction anchor in soft clay. The tool implements a calibrated limit equilibrium solution which is validated against 3D FEA and published cases from the literature.</p> <p>The program is implemented as Python stand-alone software and is used throughout the Technip and Genesis group of companies. The software was presented to the international geotechnical community at the 2013 OMAE conference in Nantes.</p>	2006-2013	Northern Europe	Oil & Gas
Technip U.K.	R&D and development of design methods/guidelines	<p>Cathie were asked by Technip UK to establish design basis and general design guidelines providing a detailed geotechnical engineering methodology for the foundation design of the three-legged TPG 500 structure for generalised soil conditions and different foundation types (spudcan, caisson, caisson cluster). Methodology encompassed ultimate, serviceability, fatigue and accidental limit states.</p>	2006	Northern Europe	Oil & Gas
Technip U.K.	Third-party review	<p>Seismic design review of the riser hold-back anchors including an evaluation of the liquefaction susceptibility or strength loss of the soils under seismic loading in carbonate soils, and recommendations of how to verify the seismic stability of the anchors.</p>	2006	Oceania	Oil & Gas



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