# Geotechnical Design Considerations

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**ISO 19901-4:2025 (Modified), Oil and gas industries including lower carbon energy—Specific requirements for offshore structures—Part 4: Geotechnical design considerations**









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## Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 7, *Offshore structures*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 19901-4:2016), which has been technically revised.

The main changes are as follows:

— guidance extended on representative and design values for soil parameters (Clause 5);

— guidance added for geotechnical design of intermediate foundations for fixed structures and clause renamed to "Design of Shallow and Intermediate Foundations for Fixed Structures" (Clause 7);

— requirements added on installation resistance, yield envelope approaches for ultimate limit state, and performance-based design for shallow skirted and intermediate foundations (Clause 7);

— new unified CPT method for axial capacity in sands to replace the former main text method, new TZ curve definition in sands, new unified CPT method for clays introduced into the Clause A.8, new PY curve methodology for clays to replace the existing method (Clause 8);

— new requirements added on reassessment of pile capacity for existing structures (Clause 9);

— a new clause for pipelines, conductors, and risers (Clause 10);

— references have been reviewed, updated, and reduced where possible.

A list of all parts in the ISO 19901 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

## Introduction

The API offshore structures standards constitute a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum and natural gas industries worldwide. Through their application the intention is to achieve reliability levels appropriate for manned and unmanned offshore structures, whatever the type of structure and the nature of the materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of all offshore structural systems.

The offshore structures International Standards are intended to provide a wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgment is therefore necessary in the use of these International Standards.

The overall concept of structural integrity is described above. For foundations, some additional considerations apply. These include the time, frequency and rate at which actions are applied, the method of foundation installation, the properties of the surrounding soil, the overall behavior of the seabed, effects from adjacent structures and the results of drilling into the seabed. All of these, and any other relevant information, need to be considered in relation to the overall reliability of the foundation.

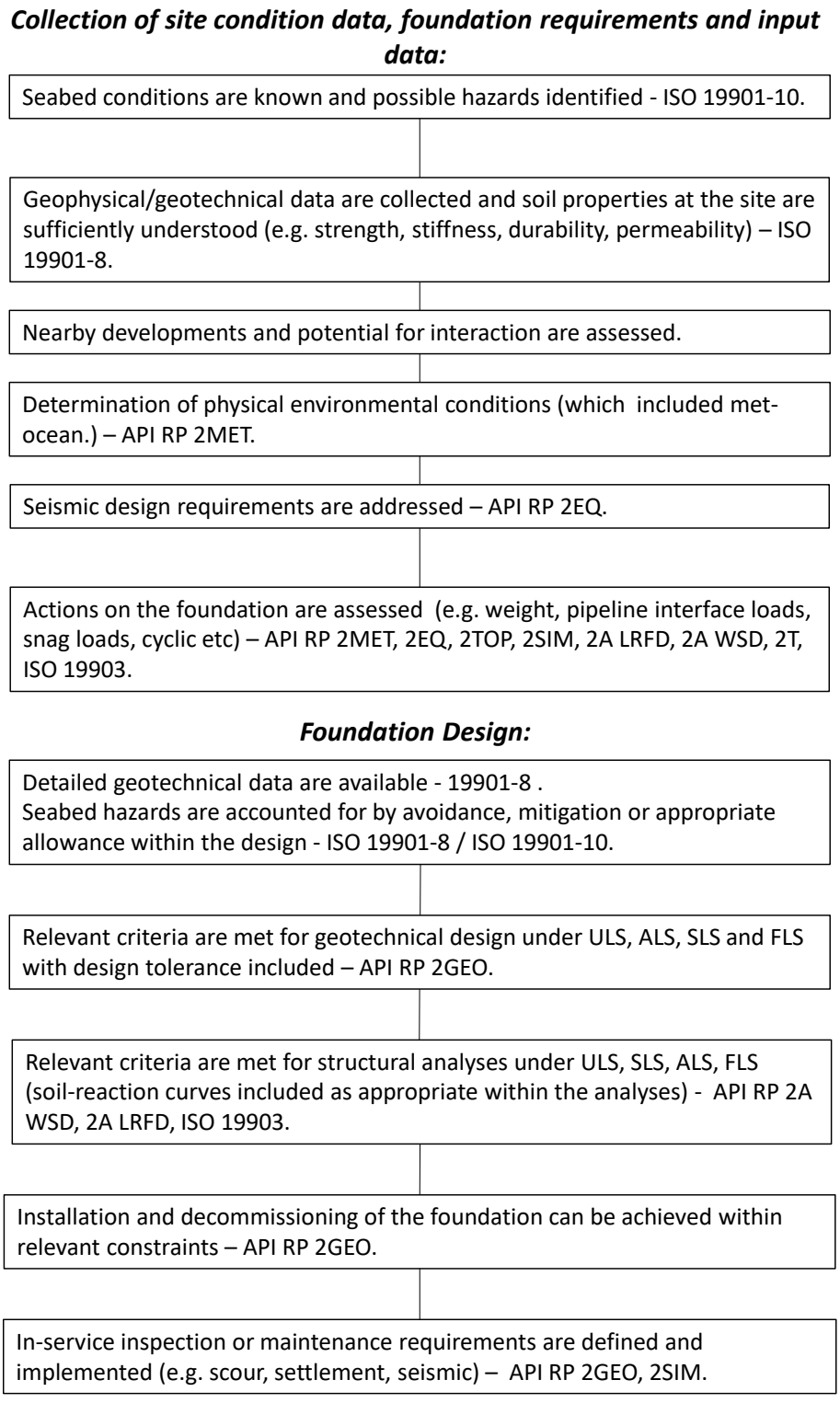
The design practice for the foundations of offshore structures has proved to be an innovative and evolving process over the years since the 1950s. This evolution is expected to continue and is encouraged. Therefore, circumstances can arise when the procedures described herein (or elsewhere) are insufficient on their own to ensure that a safe and economical foundation design is achieved.

Seabed soils vary. Experience gained at one location is not necessarily applicable at another. The scope of the site investigation for one structure is not necessarily adequate for another. Extra caution is necessary when dealing with unfamiliar soils or foundation concepts. This document is intended to provide wide latitude in the choice of site investigation techniques and foundation solutions, without hindering innovation. Sound engineering judgment is therefore necessary in the use of this document.

For an offshore structure and its foundations, the action effects at the interface between the structure’s subsystem and the foundation’s subsystem(s) are internal forces, moments and deformations. When addressing the foundation’s subsystem(s) in isolation, these internal forces, moments and deformations may be considered as actions on the foundation’s subsystem(s) and this approach is followed in this document.

Some background to and guidance on the use of this document is provided in Annex A.

Figure 1 set outs a typical workflow for design of offshore foundations with reference to other relevant International Standards.




NOTE Specific design and installation constraints can apply for structures in arctic regions (see API RP 2N), for mobile offshore units, especially for jack-ups (see API RP 2JU) and for anchors for floating units (see API RP 2SK). Design can be an iterative process from concept (initial feasibility and applicability study), basic to final design. Different level of details and objectives are required in the various design stages.

**Figure 1—Flowchart Showing Typical Design Process for Offshore Foundations**

# Geotechnical Design Considerations

## 1 Scope

This document contains provisions for geotechnical engineering design that are applicable to a broad range of offshore structures, rather than to a particular structure type. This document outlines methods developed for the design of shallow foundations with an embedded length ($L$) to diameter ($D$) ratio $L/D < 0.5$, intermediate foundations, which typically have $0.5 \leq L/D \leq 10$ (see Clause 7), and long and flexible pile foundations with $L/D > 10$ (see Clauses 8 and 9).

This document also provides guidance on soil–structure interaction aspects for flowlines, risers and conductors (see Clause 10), and anchors for floating facilities (see Clause 11). This document contains brief guidance on site and soil characterization, and identification of hazards (see Clause 6).

This document can be applied for foundation design for offshore structures used in the lower carbon energy industry.

## 2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API RP 2A-WSD, *Planning, Designing, and Constructing Fixed Offshore Platforms—Working Stress Design*

API RP 2A LRFD, *Planning, Designing, and Constructing Fixed Offshore Platforms—Load and Resistance Factor Design*

API RP 2JU*, Site-Specific Assessment of Mobile Offshore Units—Part 1: Jack-Ups: Elevated at a Site*

API RP 2N, *Recommended Practice for Planning, Designing, and Constructing Structures and Pipelines for Arctic Conditions*

API STD 2RD, *Design of Risers for Floating Production Systems (FPSs)*

API 2SIM, *Structural Integrity Management of Fixed Offshore Structures*

API RP 2SK, *Recommended Practice for Design and Analysis of Stationkeeping Systems for Floating Structures*

API RP 2T, *Recommended Practice for Planning, Designing and Constructing Tension Leg Platforms*

API RP 16Q, *Design, Selection, Operation, and Maintenance of Marine Drilling Riser Systems*

ISO 19901-8, *Oil and gas industries including lower carbon energy—Offshore structures—Part 8: Marine soil investigations*

DNV-RP-F110, *Global buckling of submarine pipelines*

DNV-RP-F114, *Pipe-soil interaction for submarine pipelines*