CAN/CSA-ISO 19901-4:17
(ISO 19901-4:2016, IDT)
National Standard of Canada

CAN/CSA-ISO 19901-4:17
Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations
(ISO 19901-4:2016, IDT)

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National Standard of Canada

CAN/CSA-ISO 19901-4:17

Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations

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Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations
(ISO 19901-4:2016, IDT)

CSA Preface

This is the second edition of CAN/CSA-ISO 19901-4, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations*, which is an adoption without modification of the identically titled ISO (International Organization for Standardization) Standard 19901-4 (second edition, 2016-07-15). It supersedes the previous edition published in 2006 as CAN/CSA-ISO 19901-4 (adopted ISO 19901-4:2003). At the time of publication, ISO 19901-4:2016 is available from ISO in English only. CSA will publish the French version when it becomes available from ISO.

For brevity, this Standard will be referred to as “CAN/CSA-ISO 19901-4” throughout.

This Standard specifies that the resistance of foundations be computed either by applying a material factor to the soil strength or a resistance factor to the foundation capacity. The methodologies are two variations of partial factor design and are accepted in different parts of the world. However, experience with design codes in Canada (in which both approaches have been tried and tested) has resulted in adoption of the resistance factor approach in general practice. Designers are encouraged to use the methods proposed in this Standard to harmonize Canadian and international practice. Adoption of material factors requires practitioners to use sound engineering judgment, precedent, and their own experience to obtain a similar design outcome.

Standards development within the Canadian Offshore Structures sector is harmonized with international standards development.

This Standard was reviewed for Canadian adoption by the harmonized Canadian Advisory Committee and CSA Technical Committee to ISO/TC 67/SC 7, Offshore Structures. This Standard has been formally approved by the CSA Technical Committee on Design, Construction, and Installation of Offshore Structures, under the jurisdiction of the CSA Strategic Steering Committee on Offshore Structures. This Standard has been approved as a National Standard of Canada by the Standards Council of Canada.

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Second edition
2016-07-15

Petroleum and natural gas industries — Specific requirements for offshore structures —

Part 4: Geotechnical and foundation design considerations

Industries du pétrole et du gaz naturel — Exigences spécifiques relatives aux structures en mer —

Partie 4: Bases conceptuelles des fondations

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ISO 19901-4:2016(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The committee responsible for this document is ISO/TC 67, *Materials, equipment and offshore structures for the petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

This second edition cancels and replaces the first edition (ISO 19901-4:2003), which has been technically revised.

ISO 19901 consists of the following parts, under the general title *Petroleum and natural gas industries — Specific requirements for offshore structures*:

— *Part 1: Metocean design and operating considerations*

— *Part 2: Seismic design procedures and criteria*

— *Part 3: Topsides structure*

— *Part 4: Geotechnical and foundation design considerations*

— *Part 5: Weight control during engineering and construction*

— *Part 6: Marine operations*

— *Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

— *Part 8: Marine soil investigations*

The following part is under preparation:

— *Part 9: Structural integrity management*

ISO 19901 is one of a series of standards for offshore structures. The full series consists of the following International Standards which are relevant to offshore structures for the petroleum and natural gas industries:

— ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

— ISO 19901 (all parts), *Petroleum and natural gas industries — Specific requirements for offshore structures*

— ISO 19902, *Petroleum and natural gas industries — Fixed steel offshore structures*

— ISO 19903, *Petroleum and natural gas industries — Fixed concrete offshore structures*

— ISO 19904, *Petroleum and natural gas industries — Floating offshore structures*

— ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups*

— ISO/TR 19905-2, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 2: Jack-ups commentary and detailed sample calculation*

— ISO 19905-3, *Petroleum and natural gas industries — Site specific assessment of mobile offshore units — Part 3: Floating units (under preparation)*

— ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*

Other ISO standards can have implications for the geotechnical design of foundations for offshore structures, in particular:

— ISO 13623 (all parts), *Petroleum and natural gas industries — Pipeline transportation systems*

— ISO 13628 (all parts), *Petroleum and natural gas industries — Design and operation of subsea production systems*

Introduction

The International Standards for offshore structures, ISO 19900 to ISO 19906, 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.

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 behaviour 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.

These International Standards are intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. The design practice for the foundations of offshore structures has proved to be an innovative and evolving process over the years. This evolution is expected to continue and is encouraged. Therefore, circumstances can arise when the procedures described herein or in ISO 19900 to ISO 19906 (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, and extra caution is necessary when dealing with unconventional soils or unfamiliar foundation concepts. Sound engineering judgment is therefore necessary in the use of this part of ISO 19901.

For an offshore structure, 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 can be considered as actions on the foundation's subsystem(s) and this approach is followed in this part of ISO 19901.

Some background to and guidance on the use of this part of ISO 19901 is provided for information in Annex A. Guidance on foundations in carbonate soils is provided for information in A.6.4, but there is, as yet, insufficient knowledge and understanding of such soils to produce normative requirements.

In this part of ISO 19901, in accordance with the latest edition of the ISO/IEC Directives, Part 2, the following verbal forms are used:

— 'shall' and 'shall not' are used to indicate requirements strictly to be followed in order to comply with the document and from which no deviation is permitted;

— 'should' and 'should not' are used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited;

— 'may' and 'need not' are used to indicate a course of action permissible within the limits of the document;

— 'can' and 'cannot' are used for statements of possibility and capability, whether material, physical or causal.

Petroleum and natural gas industries — Specific requirements for offshore structures —

Part 4: Geotechnical and foundation design considerations

1 Scope

This part of ISO 19901 contains provisions for those aspects of geoscience and foundation engineering that are applicable to a broad range of offshore structures, rather than to a particular structure type. Such aspects are:

— site and soil characterization;

— identification of hazards;

— design and installation of shallow foundations supported by the seabed;

— design and installation of pile foundations;

— soil-structure interaction for auxiliary structures, e.g. subsea production systems, risers and flowlines (guidance given in A.10);

— design of anchors for the stationkeeping systems of floating structures (guidance given in A.11).

Particular requirements for marine soil investigations are detailed in ISO 19901-8.

Aspects of soil mechanics and foundation engineering that apply equally to offshore and onshore structures are not addressed. The user of this part of ISO 19901 is expected to be familiar with such aspects.

ISO 19901-4 outlines methods developed primarily for the design of shallow foundations with an embedded length (L) to diameter (D) ratio $L/D < 1$ (Clause 7) and relatively long and flexible pile foundations with $L/D > 10$ (Clause 8). This part of ISO 19901 does not apply to intermediate foundations with $1 < L/D < 10$. Such intermediate foundations, often known as 'caisson foundations', comprise either shallow foundations with skirts penetrating deeper into the seabed than the width of the foundation, or shorter, more rigid and larger diameter piles than those traditionally used for founding offshore structures. The design of such foundations can require specific analysis methods; it is important that any extrapolation from the design methods described in this part of ISO 19901 to intermediate foundations be treated with care and assessed by a geotechnical specialist.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations*

ISO 19901-2, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria*