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Simplified design of prestressed concrete tanks for potable water

Conception simplifiée du réservoir pour l'eau potable en béton pré-armé

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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.

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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and prestressed concrete*, Subcommittee SC 5, *Simplified design standard for concrete structures*.

This second edition cancels and replaces the first edition (ISO 18407:2018), which has been technically revised.

The main changes are as follows:

— design flow has been added;

— informative annexes providing particular local conditions have been deleted;

— terms and symbols have been corrected to keep consistency;

— errors have been corrected in some formulae.

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.

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Introduction

The aim of this document is to provide rules for the design and construction of prestressed concrete water tanks to be built in less-developed areas of the world. The design rules are based on simplified worldwide-accepted strength models. This document is self-contained; therefore actions (loads) and simplified analysis procedures are included, as well as minimum acceptable construction practice guidelines.

A great effort was made to include self-explanatory tables, graphics and design aids to simplify the use of this document and provide procedures. Notwithstanding, the economic implications of the conservatism inherent in approximate procedures as a substitution to sound and experienced engineering should be a matter of concern to the designer who employs this document and to the owner who hires him.

A prestressed concrete tank for potable water generally comprises the roof, wall and base slab. The roof is made to entirely cover the top of the cylindrical wall to protect the water from contamination with rainwater, etc. In many cases, it is made in the form of a dome shaped like a convex circular plate cut off from a sphere. The wall is a vertical cylinder that forms a container for water in combination with the flat base slab. Only the wall of a prestressed concrete water tank is made with prestressed concrete, while the roof and base slab are made with reinforced concrete. Prestress is generally applied to the wall using prestressing steel in the vertical and circumferential directions, but in some cases, prestress is applied only to the circumferential direction. For this reason, this document defines a prestressed concrete cylindrical tank as a structure having prestressing steel at least in the circumferential direction of the wall to apply prestress, to cover both types. Therefore, the roof, base slab and wall in the vertical direction may not necessarily be of prestressed concrete construction but may be of reinforced concrete construction.

A prestressed concrete water tank construction is generally adopted to preserve a water storage facility with the aim of preventing severe secondary disasters and allowing the standing water to be used as an emergency water supply. For this reason, it is required to be designed as a rule as a high degree of importance.

The minimum dimensional provisions contained in this document are intended to account for undesirable side effects that will require more sophisticated analysis and design procedures. Material and construction provisions are aimed at site-mixed concrete, as well as ready-mixed concrete and steel of the minimum available strength grades.

The earthquake-resistance provisions are included to account for the fact that numerous developing regions of the world occur in earthquake-prone areas. The earthquake resistance is based upon the employment of structural concrete walls (shear walls) that limit the lateral deformations of the structure and provide for its lateral strength.

This document contains provisions that can be modified by a national standards body due to local design and construction requirements and practices. The national standards body is expected to review the values (numerical values related to physical properties, limits, coefficients, and various construction procedures for each material) and may substitute alternative definitive values for these elements for use in the national application of this document.

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Simplified design of prestressed concrete tanks for potable water

1 Scope

This document provides guidelines for the planning, design and construction of a cylindrical tank constructed on the ground with prestressed concrete (PC) for use with potable water tank.

This document is applicable to PC tanks for potable water with a capacity of 30 000 m^3 or less and the diameter-to-height ratio (D/H) from 1,0 to 3,0.

NOTE 1 The D/H ratio within the range of 1 to 3 is generally considered as a reasonable shape for a PC water tank. However, even if the ratio exceeds 3, this document is applied for design purposes except for applying the Hausner method.

NOTE 2 When designing and constructing a tank not covered by this document (reinforced concrete tanks, underground tanks, elevated tanks, etc.), a designer can refer to this document for common elements where possible.

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.

ISO 1920-3, *Testing of concrete — Part 3: Making and curing test specimens*

ISO 1920-4, *Testing of concrete — Part 4: Strength of hardened concrete*

ISO 3010, *Bases for design of structures — Seismic actions on structures*

ISO 6934-1, *Steel for the prestressing of concrete — Part 1: General requirements*

ISO 6934-2, *Steel for the prestressing of concrete — Part 2: Cold-drawn wire*

ISO 6934-3, *Steel for the prestressing of concrete — Part 3: Quenched and tempered wire*

ISO 6934-4, *Steel for the prestressing of concrete — Part 4: Strand*

ISO 6934-5, *Steel for the prestressing of concrete — Part 5: Hot-rolled steel bars with or without subsequent processing*

ISO 6935-1, *Steel for the reinforcement of concrete — Part 1: Plain bars*

ISO 6935-2, *Steel for the reinforcement of concrete — Part 2: Ribbed bars*

ISO 6935-3, *Steel for the reinforcement of concrete — Part 3: Welded fabric*

ISO 12439, *Mixing water for concrete*

ISO 14654, *Epoxy-coated steel for the reinforcement of concrete*

ISO 14824-3, *Grout for prestressing tendons — Part 3: Test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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