International Standard

ISO 18407

Second edition
2026-06

Simplified design of prestressed concrete tanks for potable water

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

Sample Document

get full document from standards.iteh.ai

Reference number
ISO 18407:2026(en)

© ISO 2026

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

Sample Document

get full document from standards.iteh.ai

COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

Contents

Page

Sample Document
get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

Sample Document
get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

Sample Document

get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

Sample Document

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.

get full document from standards.iteh.ai

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.

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

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.

Sample Document

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.

get full document from standards.iteh.ai

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.

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

Sample Document
get full document from standards.iteh.ai

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.

Sample Document
get full document from standards.iteh.ai

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.

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
bending analysis
method for determining the membrane force and bending moment in consideration of the boundary conditions at the base of the dome

3.2
clearance
distance between the designed high-water level and the upper edge of the tank wall

3.3
convective pressure
pressure produced by oscillation of the water as the consequences of *impulsive pressure* (3.16)

3.4
cylindrical prestressed concrete tank
concrete tank comprising the roof, cylindrical wall and base slab, for which prestressing steel is provided at least in the circumferential direction to apply prestress

3.5
dome ring
circular beam provided along the base of the roof of a spherical or other shape of the dome to control radial displacement at the base of the roof

Sample Document

3.6
dynamic water pressure
water pressure excited by earthquake motion

get full document from standards.iteh.ai

3.7
embedded system
system of applying prestress, whereby circumferential prestressing steel is provided within concrete members

3.8
fixed support
wall-bottom connection, whereby the rotation or horizontal displacement of the wall with respect to the bottom is not allowed

3.9
foundation slab
reinforced concrete or prestressed concrete slab provided in contact with the bottom surface of the base slab

3.10
freely sliding support
wall-bottom connection, whereby the rotation and horizontal displacement of the wall with respect to the bottom are allowed

3.11
hinged support
wall-bottom connection, whereby the rotation of the wall with respect to the bottom is allowed

3.12
hoop tension
circumferential axial tensile force generated by such loads as water pressure

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

3.13
horizontal thrust
horizontal component of the axial force in the meridian direction of the dome at the base of the dome

3.14
Housner method
conventional approximate analysis method for liquid vibration proposed by G. W. Housner

3.15
imposed load
load of portions not directly included in the design calculation as structural members and load applied to the roof for such purposes as inspection

3.16
impulsive pressure
pressure associated with *inertia force* (3.17) produced by impulsive movements of the tank wall

3.17
inertia force
force given by the product of the mass of the structure and the structural response acceleration due to ground motion by earthquake

3.18
in-plane shear force
shear force that acts parallel to the shell surface

3.19
membrane floor
part other than the ring plate of the base slab that does not resist bending moments

Sample Document

3.20
membrane force
in-plane axial force of a shell structure

get full document from standards.iteh.ai

3.21
out-of-plane shear force
shear force that acts at a right angle to the shell surface

3.22
particular load
special load that acts depending on the natural conditions of the tank construction site

Note 1 to entry: Particular load is judged as a *primary load* (3.24) or a *subsidiary load* (3.29) on a case-by-case basis.

3.23
pilaster
rectangular projections from the tank wall along its generatrix lines for anchoring circumferential prestressing steel

3.24
primary load
load that constantly acts

3.25
ring plate
peripheral part of the base slab for transmitting forces primarily from the tank wall to the ground

3.26
sloshing
vibration of a solid oscillating surface generated in response to relatively long-period components of an earthquake

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

3.27
spherical dome
curved shell in the form of a part of a sphere cut off by a plane

3.28
subsidiary load
load other than those considered as primary load

3.29
tank empty
state in which no water is present in the tank

3.30
tank full
state in which the water level in the tank reaches the design high water level

3.31
velocity potential method
method for a theoretical solution to irrotational vibration of a non-compressive and non-viscous fluid

3.32
waterstop
plate inserted in joints between concrete lifts and the wall-bottom joints for waterstopping

4 Symbols

Sample Document
get full document from standards.iteh.ai

A	projection area
A_{ep}	area subjected to the effect of anchorage set
A_{b}	area of concrete subjected to bearing load
A_{c}	cross-sectional area of member
A_{c}	cross-sectional area of concrete
A_{c}	total area of concrete surface
A_d	surface area of dome
A_i	cross-sectional area of element i
A_{p}	cross-sectional area of prestressing steel
A_{s}	cross-sectional area of tensile reinforcement
b	member width
C	wind force coefficient
C_{e}	earth pressure coefficient
C_{s}	structure characteristic coefficient
C_{z}	correction factor by region
c	concrete cover depth
D	inner diameter of tank
D_{he}	correction factor dependent on damping constant

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

D_i	flexural stiffness of node *i*
D_η	response reduction ratio due to plastic deformability
E	elastic modulus
E_c	elastic modulus of concrete
E_p	elastic modulus of prestressing steel
E_s	elastic modulus of steel reinforcement
F_d	prestressing force applied to dome ring
f'_{cd}	design compressive strength of concrete
f'_{ck}	characteristic compressive strength of concrete
f_{pu}	tensile strength of prestressing steel
f_{py}	yield strength of prestressing steel
f_{sy}	yield strength of steel reinforcement
f_t	tensile strength of concrete
f_{ud}	design tensile strength of prestressing steel
f_{yd}	design yield strength of steel reinforcement and structural steel
g	gravitational acceleration
g_0	uniform pressure
H	height of tank
H	design depth of water from the base
H_G	distance from the lower edge of tank wall to the point of action of the dome inertia force or other partial weight inertia force
H_h	length of thickened zone of tank wall (haunch height)
H_s	total height of earth pressure action
H_t	horizontal thrust
h	height from the ground surface
h_d	rise of dome
h_{rE}	height above the base of the wall to the centre of gravity of the impulsive lateral force excluding base pressure
h_{rI}	height above the base of the wall to the centre of gravity of the impulsive lateral force including base pressure
h_{sE}	height above the base of the wall to the centre of gravity of the convective lateral force excluding base pressure
h_{sI}	height above the base of the wall to the centre of gravity of the convective lateral force including base pressure

Sample Document
get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

h_{th}	virtual thickness of member
I_i	second moment of area of element i
J_1	vessel function
K	flexural stiffness
K_h	design horizontal seismic coefficient
K_{h01}	standard horizontal seismic coefficient for Level 1 ground motion
K_{h02}	standard horizontal seismic coefficient for Level 2 ground motion
K_{h1}	design horizontal seismic coefficient for Level 1 ground motion
K_{h2}	design horizontal seismic coefficient for Level 2 ground motion
K_s	horizontal subgrade reaction modulus
K_v	vertical subgrade reaction modulus
K_{vi}	vertical spring constants of node i
K_{v1}	design vertical seismic coefficient for Level 1 ground motion
K_{v2}	design vertical seismic coefficient for Level 2 ground motion
$K_{\theta i}$	rotational spring constants of node i
k	spring constant of bearing
k_α	coefficient considering the characteristics of foundations
k_β	coefficient considering the rigidity of base slab
L_{rp}	ring plate length
L_w	water depth
l	length from the tension end of prestressing steel to the design cross-section
l_d	basic development length
l_{max}	maximum spacing of prestressing steel
l_p	length of prestressing steel
l_1	distance from the upper edge of tank wall to the starting point of the action of distributed load
l_2	distance from the upper edge of tank wall to the end point of the action of distributed load
M_a	corrected vertical bending moment
M_d	vertical bending moment of member
M_e	vertical bending moment at the bottom of tank wall generated by changes in the curvature radius of tank wall
M_{ri}	bending moment per unit length in the radial directions at node i
M_{ud}	design flexural fracture capacity

Sample Document
get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026

M_x	vertical bending moment
M_{xi}	bending moment at node *i* determined by planar frame analysis
$M_{x\phi}$	torsional moment
M_{x0}	vertical bending moment
M_0	restraining moment at the bottom of tank wall
M_{0c}	vertical bending moment at the bottom of tank wall with a constant thickness
M_{0e}	vertical bending moment at the bottom of tank wall generated by curvature changes when wall thickness is constant at *t*
M_{0f}	vertical bending moment at the bottom of tank wall
M_{0h}	vertical bending moment at the bottom of tank wall considering an increase in wall bottom thickness
$M_{0T}(x)$	moment at distance, *x* from the lower edge of tank wall
$M_{0\nu}$	vertical bending moment at the bottom of tank wall generated by the effect of Poisson's ratio due to vertical prestress when wall thickness is constant
$\overline{M_x}$	vertical bending moment obtained from axisymmetric analysis under equivalent load
M_ϕ	circumferential bending moment
$M_{\phi x}$	torsional moment
$M_{\theta i}$	bending moment per unit length in the circumferential directions at node *i*
M_ξ	vertical bending moment at ξ from the top of the wall
N_x	axial force in the vertical direction
$N_{xo}(x)$	vertical axial force at distance, *x* from the lower edge of tank wall
$N_{x\phi}$	in-plane shear force
N_ϕ	membrane force in the meridian direction
$N_{\phi d}$	membrane force per unit length of dome in the meridian direction
$N_{\phi x}$	in-plane shear force
$N_{\phi 0}$	circumferential axial force due to non-axisymmetric loads
N_θ	membrane force in the parallel direction
$N_{\theta d}$	membrane force per unit length of dome in the parallel direction
n	elastic modulus ratio ($=E_p/E_c$)
P	prestressing force in the vertical direction
P_{Fi}	concentrated load acting on node *i*
$P_{br}(r)$	maximum impulsive pressure acting on base slab
$P_{bs}(r)$	maximum convective pressure acting on base slab

Sample Document
get full document from standards.iteh.ai

© ISO 2026 – All rights reserved

ISO 18407:2026 • https://standards.iteh.ai/catalog/standards/iso/be026df9-4d0e-4a45-a3f1-f487087e1d78/iso-18407-2026