## ISO 18407:2018 (E)

## Simplified design of prestressed concrete tanks for potable water

## Contents

	Forev	vord				
	Intro	duction				
1	Scop	е				
2	Norm	Normative references				
3	Terms	Terms and definitions				
4	Symb	pols				
5	Design principles					
6	Load					
	6.1 6.2 6.3 6.4 6.5 6.5.1 6.5.2 6.5.3 6.5.4 6.6 6.7 6.8 6.9 6.10 6.11 6.12 6.13	General Deadweight Imposed load Hydrostatic water pressure Prestress General Prestressing force immediately after prestressing Effective prestressing force Indeterminate forces due to prestress Creep and drying shrinkage of concrete Effect of temperature Seismic action Wind load Snow load Earth pressure Uplift pressure force Other loads				
7	7.1 7.2 7.2.1 7.2.2 7.2.3 7.2.4 7.2.5 7.3 7.3.1 7.3.2 7.3.3 7.4	Calculation of member force Concrete Strength Modulus of elasticity Poisson's ratio Drying shrinkage Creep Steel Strength Modulus of elasticity Relaxation Calculation of tensile reinforcement				
8	Stres 8.1	s limit General				
	8.1 8.2 8.2.1 8.2.2 8.3 8.3.1	Stress limit of reinforced concrete members Stress limit of concrete Stress limit of reinforcement Stress limit of prestressed concrete members Stress limit of concrete				

8.3.2	Tensile stress limit of prestressing steel
8.3.3	Stress limit of reinforcement
8.3.4	Augmentation of tensile stress limit of concrete
Verifi	cation of safety against earthquake
9.1	Principles of seismic design
	General
	Ground motion levels
	Levels of earthquake resistance
	Effects of earthquake
	Seismic design procedure
	Input earthquake motion
	Seismic design method
9.2.2	Design seismic coefficients for the seismic coefficient method for Level 1 ground
	motion
9.2.3	Design seismic coefficients for the seismic coefficient method for Level 2 ground
	motion
	Seismic input for design by dynamic analysis
	Verification of structural safety
	Effects of earthquake
•.•	General
9.3.1.2	Inertia force derived from deadweight, etc
9.3.1.3	Dynamic water pressure during an earthquake
9.3.2	Combination of loads
9.3.3	Calculation of member forces
9.3.4	Safety verification
9.4	Investigation for foundation
Gene	ral structural details
10.1	Prestressing steel
	Clear distance
	Concrete cover
	Arrangement of curved prestressing steel
	Arrangement of anchorages and couplers
	Protection of anchorage zone
	Reinforcement of concrete near anchorages
	Steel reinforcement
	Clear distance
	Concrete cover
	Bend configurations of reinforcement
	Splices in reinforcement
	•
	Anchoring of reinforcement Welded wire fabric
	Concrete joints Construction joints
	Joints between precast concrete members
10.4	Reinforcement for opening
	gn of members
11 1	Method of calculating member force
	<del>-</del>
11.1.1	Analysis method
11.1.1 11.1.2	Analysis method Analysis model
11.1.1	Analysis method
11.1.1 11.1.2 11.2 11.3	Analysis method Analysis model Component division Roof
11.1.1 11.1.2 11.2 11.3 11.3.1	Analysis method Analysis model Component division
11.1.1 11.1.2 11.2 11.3	Analysis method Analysis model Component division Roof
11.1.1 11.1.2 11.2 11.3 11.3.1	Analysis method Analysis model Component division Roof Structural types
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2	Analysis method Analysis model Component division Roof Structural types Design in general
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2 11.3.2.1 11.3.2.1	Analysis method Analysis model Component division Roof Structural types Design in general Loads for roof design Design of a spherical dome
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2 11.3.2.1 11.3.2.2 11.3.2.3	Analysis method Analysis model Component division Roof Structural types Design in general Loads for roof design Design of a spherical dome Design of the dome ring
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2 11.3.2.1 11.3.2.2 11.3.2.3 11.3.2.4	Analysis method Analysis model Component division Roof Structural types Design in general Loads for roof design Design of a spherical dome
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2 11.3.2.1 11.3.2.2 11.3.2.3 11.3.2.4 11.4	Analysis method Analysis model Component division Roof Structural types Design in general Loads for roof design Design of a spherical dome Design of the dome ring Design of slab roof Tank wall
11.1.1 11.1.2 11.2 11.3 11.3.1 11.3.2 11.3.2.1 11.3.2.2 11.3.2.3 11.3.2.4	Analysis method Analysis model Component division Roof Structural types Design in general Loads for roof design Design of a spherical dome Design of the dome ring Design of slab roof
	8.3.4  Verifi  9.1  9.1.1  9.1.2  9.1.3  9.1.4  9.1.5  9.2  9.2.1  9.2.2  9.2.3  9.2.4  9.3  9.3.1  9.3.1.1  9.3.1.2  9.3.1.3  9.3.2  9.3.3  9.3.4  Gene  10.1  10.1.1  10.1.2  10.1.3  10.1.4  10.1.5  10.1.6  10.2  10.2.1  10.2.2  10.2.3  10.2.4  10.2.5  10.2.6  10.3  10.3.1  10.3.2  10.4

	11.4. 11.4. 11.4. 11.4.	.2.3 .2.4 .2.5 .2.6	Combinations of loads Design of the tank wall Method of applying prestress Pilasters Design of the tank wall bottom
	11.5		Base slab
		.1	Structural types
		.2	Design in general
		2.1	Loads for base slab Load combinations
		.2.2	
		.2.3 .2.4	General design of base slab One-layer base slab structure
	11.5		Two-layer base slab structure
12		Materi	·
	12.1		Quality of materials
	12.1		General
		.2	Concrete materials
		.2.1	Cement
	12.1	.2.2	Water
	12.1	.2.3	Fine aggregate
		.2.4	Coarse aggregate
	12.1	.2.5	Admixtures
	12.1	-	Concrete
		.3.1	General
		.3.2	Strength
		.4	Prestressing steel
		.5	Steel reinforcement
	12.1 12.1	.6 7	Welded wire fabric
	12.1		Anchorages and couplers Sheath
	12.1	-	Coating materials for protecting prestressing steel
	12.1		Grout for prestressed concrete
	12.1		Coating materials for unbonded prestressing steel
13		Tank a	appurtenances
	13.1		Ladders/stairs and handrails
	13.2		Manhole and water pilot hole
	13.3		Ventilators
	13.4		Lightning rods
	13.5		Piping
	13.6		Catch basin
	13.7		Water-level gauge
	13.8		Rainwater treatment
	13.9		Protection equipment
Annex	Α	(infor	native) Reference design flow
Annex	В	(infor	native) Design seismic coefficients for the seismic coefficient method
	B.1		Level 1 ground motion
	B.2		Level 2 ground motion
Annex	С	(infor	native) Seismic input for design by dynamic analysis
Annex	D	(infor	mative) Example of material specifications
	D.1		Concrete
	D.1.		Modulus of elasticity
	D.1.2		Drying shrinkage
	D.1.	3	Creep
	D.2		Steel Medulus of electicity
D.2. <sup>2</sup> D.2. <sup>2</sup>			Modulus of elasticity Relaxation
	D.2.2 D.3	-	Stress limit
	D.3	1	Stress limit of reinforced concrete members

D.3	.1.1	Stress limit of concrete
D.3	.1.2	Stress limit of reinforcement
D.3	.2	Stress limit of prestressed concrete members
	.2.1	Stress limit of concrete
	.2.2	Tensile stress limit of prestressing steel
	.2.3	Stress limit of reinforcement
	.2.4	Augmentation of tensile stress limit of concrete
D.3	.2.4	Augmentation of tensile stress limit of concrete
Annex E	(inforr	native) Example of design calculation
- 4		Outline.
E.1		Outline Outline
E.1.		Outline of design
E.1.		Outline of the structure
E.2		Design conditions
E.2.	.1	Basic dimensions and general shape
E.2.	.2	Construction site and ground conditions
E.2.	.3	Design loads
E.2.	.3.1	Classifications of design loads
E.2.	.3.2	Load type and load intensity
E.2	.4	Materials properties
E.2	.4.1	Concrete
F.2	.4.2	Prestressing steel
	.4.3	Reinforcing bars
	.4.4	Stress loss of prestressing steel
E.2		Stress limit
E.2.		Material strength
	. •	
E.2.		Material factor
E.2.		Minimum reinforcement and minimum cover depth
E.3		Design of the dome roof
E.3.		Design conditions
E.3.	.2	Cross-section force acting on the dome
E.3.	.2.1	Calculation of the dome load
E.3.	.2.2	Stress generated in the dome
E.3.	.3	Steel reinforcement arrangement of the dome
E.4		Design of the dome ring
E.4.	.1	Design conditions
E.4.	.2	Calculation of horizontal thrust
E.4.	.2.1	Loads on the dome
	.2.2	Dome horizontal thrust
E.4		Design of prestressing force
	.3.1	Centre positions of prestressing steel
	.3.2	Section size of pilaster
	.3.3	Required prestressing force
	.3.4	Calculation of the effective tensile force of prestressing steel
	.3.5	Prestressing steel arrangement in the circumferential direction
E.5		Design of wall
E.5.		Design conditions
E.5.		Calculation of cross-section force
E.5.		Basic formula and solution
E.5.	.2.2	M0 and Q0 at the wall bottom
E.5.	.2.3	Bending moment, shearing force and circumferential axial force at an arbitrary point
E.5.	.2.4	Stress due to deadweight
E.5.	.2.5	Stress due to imposed load
E.5.	.2.6	Cross-section force incorporating the effects of the haunch at wall bottom and elastic
		fixation
E.5	.3	Design of circumferential prestressing force
E.5	_	Centre positions of prestressing steel
E.5		Section size of pilaster
	.3.2 .3.3	Calculation of the effective tensile force of prestressing steel
	.3.4	Required prestressing force
E.5.		Arrangement of circumferential prestressing steel
E.5.		Design of vertical prestressing force
E.5.		Calculation of effective prestressing force
	.4.2	Axial force and eccentric moment due to vertical prestressing steel
E.5	.4.3	Cross-section force and stress at wall bottom for selecting vertical prestressing steel

E.5.4.4	Required prestressing force
E.5.4.5	Number of vertical prestressing steel required
E.5.4.6	Stress due to vertical prestressing force
E.5.5	Cross-section force and stress of the tank wall
E.5.6	Combined stress
E.5.7	Verification regarding shear
E.5.7.1	General
E.5.7.2	Shear stress
E.5.7.3	Diagonal tensile stress
E.5.8	Verification of safety against an earthquake
E.5.8.1	Calculation of cross-section force
E.5.8.2	Verification with respect to Level 1 ground motion
E.5.8.3	Verification with respect to Level 2 ground motion
E.5.8.4	Verification of sloshing height
E.6	Design of base slab
E.6.1	Design of base slab
E.6.2	Ring plate length
E.6.3	Calculation of cross-section force
E.6.3.1	Design load
E.6.3.2	Modelling
E.6.3.3	Calculation of cross-section force
E.6.4	Bar arrangement of base slab
E.6.4.1	Minimum reinforcement content
E.6.4.2	Calculation of reinforcement content
E.6.4.3	Calculation of reinforcement content
E.6.5	Verification of safety against an earthquake
E.6.5.1	Verification with respect to Level 1 ground motion
E.6.5.2	Verification with respect to Level 2 ground motion
E.7	Stability calculation
E.7.1	Horizontal force and overturning moment
E.7.1.1	Deadweight
E.7.1.2	Overturning moment due to dynamic water pressure
E.7.2	Verification of bearing capacity
E.7.3	Verification regarding sliding
E.7.4	Verification regarding overturning

Page count: 174