

Australian Standard™

Concrete structures for retaining liquids



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This Australian Standard was prepared by Committee CE-022, Concrete Structures for Retaining Liquids. It was approved on behalf of the Council of Standards Australia on 17 November 2000 and published on 13 March 2001.

The following interests are represented on Committee CE-022:

Australian Pre-mixed Concrete Association
Institution of Engineers Australia
University of Queensland
Water Services Association of Australia

Additional interests participating in the preparation of this Standard:

Association of Consulting Engineers Australia
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Australian Post Tensioning Association
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Melbourne Water
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PREFACE

This Standard was prepared by the Standards Australia Committee CE-022, Concrete Structures for Retaining Liquids, to supersede AS 3735—1991.

The objective of this standard is to provide designers of reinforced concrete structures used for retaining liquids at ambient temperatures with specifications for design and installation.

For structures that specifically relate to concrete structures used for retaining liquids at ambient temperature, this Standard supplements and takes precedence over the requirements of AS 3600, Concrete structures.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

This draft Standard has been prepared from the previous edition of AS 3735—1991. The Standard is limited to concrete with a concrete stress limited in the range of 20 MPa to 50 MPa at 28 days.

A Commentary, published as Supplement No.1 to AS 3735, provides background information and explanation on the application of this Standard.

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STANDARDS AUSTRALIA

Australian Standard
Concrete structures for retaining liquids

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION**1.1.1 Scope**

This Standard specifies requirements for concrete structures and members that include reinforcing steel or tendons, or both, used for retaining liquids at ambient temperature.

The Standard supplements and takes precedence over the requirements of AS 3600.

The principles of concrete design and construction embodied in this Standard apply to structures and members made of concrete—

- (a) with a characteristic compressive strength at 28 days (f'_c) in the range of 20 MPa to 50 MPa; and
- (b) of saturated, surface-dry density in the range of 1800 kg/m³ to 2800 kg/m³.

The Standard does not apply to the design of—

- (i) dams;
- (ii) aqueducts, hydraulic tunnels or similar structures;
- (iii) small septic tanks (see AS 1546.1);
- (iv) portable precast concrete water tanks of less than 25 000 L capacity;
- (v) fibre-impregnated concrete that does not comply with the design requirements and procedures of AS 3600; or
- (vi) precast concrete pipes (pressure and non-pressure) (see AS 4058).

1.1.2 Application

This Standard applies to concrete structures for the storage of liquids where the exposure conditions for concrete are within the specified limits. Such structures include those retaining water or sewage, public swimming pools, and swimming pools the area or overall length of which are greater than that specified in AS 2783. However, where applicable, the specifications of the relevant authority shall be used.

NOTE: It is intended that the design of a structure or member to which this Standard applies, be carried out by, or under the supervision of, an engineer as defined in Clause 1.6.2.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- 1012 Methods of testing concrete
- 1012.13 Part 13: Determination of drying shrinkage of concrete for samples prepared in the field or in the laboratory
- 1170 Minimum design loads on structures
- 1170.1 Part 1: Dead and live loads and load combinations
- 1170.2 Part 2: Wind loads
- 1170.4 Part 4: Earthquake loads
- 1379 Specification and supply of concrete
- 3582 Supplementary cementitious materials for use with portland (and blended) cement
- 3582.1 Part 1: Fly-ash
- 3582.2 Part 2: Slag—Ground granulated iron blast-furnace
- 3582.3 Part 3: Silica fume

AS/NZS

- 1546 On-site domestic waste water treatment units
- 1546.1 Part 1: Septic tanks
- 2783 Use of reinforced concrete for small swimming pools
- 2841 Galvanized steel wire strand
- 3600 Concrete structures
- 3610 Formwork for concrete
- 3735 Concrete structures for retaining liquids—Commentary
- 4058 Precast concrete pipes (pressure and non-pressure)
- 4680 Hot-dipped galvanised (zinc) coatings on fabricated ferrous articles
- HB
- 79 Alkali Aggregate reaction—Guidelines on minimising the damage to concrete structures in Australia

NZS

- 3106 Code of practice for concrete structures for the storage of liquids

ASTM

- A 775M Specification for epoxy-coated reinforcing steel bars

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 3600 apply.

1.4 NOTATION

Unless a contrary intention appears the following applies:

- (a) The symbols used in this Standard shall have the meanings ascribed to them below, with respect to the structure, or member, or condition to which a clause is applied.
- (b) Where non-dimensional ratios are involved, both the numerator and denominator are expressed in identical units.
- (c) The dimensional units for length, force and stress in all expressions or equations are to be taken as millimetres (mm), Newtons (N) and megapascals (MPa) respectively.

<i>Quantity symbol</i>	<i>Definition</i>
$A_{c, \text{eff}}$	= effective concrete area (see Figure 3.1)
A_s	= the cross-sectional area of reinforcement
a_1, a_2	= a distance (see Figure 3.1)
D	= the overall depth of a cross-section in the plane of bending
d_b	= the nominal diameter of a bar, wire, or tendon
F_{ep}	= the earth pressure load
F_{eq}	= the earthquake action calculated in accordance with Appendix A of AS 3600
F_{lp}	= the liquid pressure load
F_{sh}	= the loads, or their related moments and forces, resulting from shrinkage
F_{sw}	= the loads, or their related moments and forces, resulting from swelling
f_{cp}	= the compressive strength of concrete at transfer
f_s	= the tensile stress in non-tensioned reinforcing steel
f_{so}	= the nominal limiting tensile stress in reinforcing steel
f_{sv}	= the yield strength of the reinforcing steel
f'_c	= the characteristic compressive cylinder strength of concrete at 28 days
$f'_{s \text{ max.}}$	= the effective limiting tensile stress in reinforcing steel
$f_{ct.3}$	= the direct tensile strength of the concrete at 3 days
G	= the dead load
P	= the force in the tendons; or = the maximum force in the anchorage
p	= a reinforcement ratio
Q	= the live load (including impact, if any)
T	= temperature; or = the load due to temperature variation
W	= the wind load calculated, in accordance with AS 1170.2, from a wind velocity with the appropriate return period
Y_1, Y_2, Y_3	= exposure coefficients
$\Delta_{\sigma s}$	= increase in tendon stress once decompression occurs in a partially prestressed member
ϵ_{sh}	= a shrinkage strain
ϵ_{sw}	= a swelling strain

1.5 USE OF ALTERNATIVE MATERIALS OR METHODS

1.5.1 General

Provided that the requirements of AS 3600 are met, this Standard shall not be interpreted so as to prevent the use of materials or methods of design or construction not specifically referred to herein.

1.5.2 Existing structures

Where the strength or serviceability of an existing structure is to be evaluated, the principles of this Standard and AS 3600 may be applied.

1.5.3 Ferrocement

1.5.3.1 General

Ferrocement shall be thin-walled, reinforced cement mortar construction in which the reinforcement comprises closely spaced layers of straight wire mesh from 1 mm to 6 mm diameter and in which the cement mortar is pneumatically placed or plastered in layers.

NOTE: Other arrangements of ferrocement are not covered by this Standard.

1.5.3.2 Material

The material requirements for ferrocement shall be as specified in NZS 3106.

1.6 DRAWINGS AND SPECIFICATIONS

1.6.1 Design data

The following design data shall be shown in the drawings:

- (a) Reference number and date of issue of applicable design Standards.
- (b) Live loads used in design.
- (c) Exposure classification for durability.
- (d) Fire resistance level, if applicable.
- (e) Class and, where appropriate, grade designation of concrete.
- (f) Grade and type of reinforcement and tendons.

1.6.2 Design details

The drawings or specification for concrete members and structures should include, as appropriate, the following:

- (a) The shape and size of each member.
- (b) The finish and method of control for unformed surfaces.
- (c) Class of formwork for the surface finish specified in accordance with AS 3610.
- (d) The size, quantity and location of all reinforcement, tendons and structural fixings and the minimum cover to each.
- (e) The requirements for concrete (see Clause 4.3).
- (f) The curing procedure and duration.
- (g) The force required in each tendon, the maximum jacking force to be applied and the order in which tendons are to be stressed.
- (h) The location and details of planned construction or movement joints, connections and splices, and the method to be used for their protection.
- (i) The minimum period of time before stripping of forms and removal of shores.
- (j) Any constraint on construction assumed in the design.
- (k) Any special protective coatings.
- (l) Other design requirements.