



Built-in components for masonry construction

Part 1: Wall ties



AS 2699.1:2020

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- Australian Stainless Steel Development Association
- Australian Steel Institute
- Bureau of Steel Manufacturers of Australia
- Concrete Masonry Association of Australia
- Galvanizers Association of Australia
- Housing Industry Association
- Materials Australia
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Preface

This Standard was prepared by Standards Australia Committee BD-028, Masonry Wall Ties and Accessories, to supersede AS/NZS 2699.1:2000.

This Standard is the first part of a three-part series on masonry wall ties, connectors and accessories, and lintels and shelf angles. The series comprises the following:

AS 2699.1, *Built-in components for masonry construction, Part 1: Wall ties*

AS 2699.2, *Built-in components for masonry construction, Part 2: Connectors and accessories*

AS 2699.3, *Built-in components for masonry construction, Part 3: Lintels and shelf angles (durability requirements)*

The objective of this Standard is to provide manufacturers with requirements for the classification of wall ties into three duty ratings.

Changes to the previous edition include the following:

- (a) Type A cavity wall ties and veneer wall ties are classified according to mean strength only.
- (b) Previous editions of this Standard included Type B ties, which were specified in New Zealand only. These have been removed from this edition of the Standard.
- (c) All ties are classified for their corrosion resistance.
- (d) Provisions are also included for remedial (retrofitted) ties.
- (e) Test methods are given for determination of —
 - (i) resistance to water transfer;
 - (ii) mean strength; and
 - (iii) corrosion resistance.

The types and spacing of ties necessary to meet design requirements are specified in AS 3700, *Masonry structures*, and AS 4773.1, *Masonry in small buildings, Part 1: Design* and, AS 4773.2, *Masonry in small buildings, Part 2: Construction*.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Notes to clauses in this Standard are for information and guidance only and conformance with them is not a requirement of the Standard.

This Standard includes a commentary on some of the clauses and tables. The commentary directly follows the relevant clause or table, is designated by “C” preceding the clause/table number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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Australian Standard®

Built-in components for masonry construction

Part 1: Wall ties

Section 1 Scope and general

1.1 Scope

This Standard specifies requirements for wall ties for use in tying together —

- (a) the leaves of cavity masonry walls;
- (b) masonry veneer walls and loadbearing frames; and
- (c) masonry veneer walls against a strong backing wall.

This Standard applies to wall ties used in masonry described in AS 3700, AS 4773.1, and AS 4773.2, including those used in thin-jointed masonry [for example, autoclaved aerated concrete (AAC) blockwork].

NOTE 1 Type B wall ties are not used in this Standard. For Type B wall ties, refer to AS/NZS 2699.1:2000, which provides definitions, embedment, movement and tolerance requirements, marking, and methods of testing.

NOTE 2 AS 2699.2 specifies the durability performance and test procedures for structural performance of connectors and accessories used in masonry construction.

NOTE 3 AS 2699.3 specifies the requirements for durability of lintels and shelf angles.

NOTE 4 This Standard gives categories of wall ties, and classifies wall ties by mean strength and durability.

NOTE 5 The durability classifications employed in this Standard are compatible with the environments specified in ISO 9223, AS 4312—2008, AS 3700, AS 4773.1 and AS 4773.2.

NOTE 6 Design and installation of wall ties are specified in AS 3700 and AS 4773.1 (design) and AS 4773.2 (construction).

1.2 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:

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1397, *Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium*

AS 2193, *Calibration and classification of force-measuring systems*

AS 2331.1.4, *Methods of test for metallic and related coatings, Method 1.4: Local thickness tests—Magnetic induction and eddy current methods*

AS 3700, *Masonry structures*

AS 3894.3, *Site testing of protective coatings, Method 3: Determination of dry film thickness*

AS 4773.1, *Masonry in small buildings Part 1: Design*

AS 4773.2, *Masonry in small buildings Part 2: Construction*

AS/NZS 4455, *Masonry units and segmental pavers*

AS/NZS 4534, *Zinc and zinc/aluminium-alloy coatings on steel wire*

AS/NZS 4680, *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 19840, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces*

ASTM A240/A240M, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

1.3 Terms and definitions

For the purpose of this Standard, the definitions below apply.

1.3.1

batch

clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound to the same specification

1.3.2

cavity tie

wall tie designed to connect two leaves of masonry that are separated by a clear cavity of any width

1.3.3

corrosivity category

C

standardized rating of corrosivity of atmosphere in relation to the one-year corrosion effect on steel and zinc

Note 1 to entry: The classifications C1 to C5 and CX are individually defined by reference to corrosivity of the atmosphere according to ISO 9223 and AS 4312—2008.

Note 2 to entry: A method for estimating corrosivity category is given in [Appendix D](#).

1.3.4

design life

period for which the wall tie is expected to fulfil its intended function

Note 1 to entry: See Clauses [1.3.27](#), [1.3.28](#) and [1.3.29](#).

1.3.5

distributor

any business entity that provides a point/source of supply of a wall tie to the market

1.3.6

durability class

R

identifies the level of corrosion protection provided to a tie to meet the performance condition for the design life of a structure

Note 1 to entry: The classifications R1 to R5 are individually defined by reference to exposure conditions given in AS 3700, AS4773.1 and AS 4773.2.

1.3.7

duty classification

classification that identifies the mean strength rating for wall ties

Note 1 to entry: The identification of mean strength rating for wall ties is given in [Clause 2.6](#).

1.3.8**face loads**

loads applied normal to the face of the wall, which impose compressive or tensile forces on the ties

1.3.9**factory production control****FPC**

comprises operational techniques and all measures necessary to regulate and maintain the conformity of the product to the requirements of a Standard

1.3.10**galvanized coating**

protective zinc coating alloyed to the steel substrate and applied by hot-dip immersion in molten zinc of at least 98 % purity

1.3.11**lot**

group of wall ties of a single type with specific characteristics and dimensions, presented for sampling at the same time

1.3.12**manufacturer**

business entity providing the total, substantive or final production/assembly process of the wall tie

1.3.13**manufacturing lot****manufacturing batch**

quantity of wall ties of a single type with specific characteristics and dimensions, processed through the same or similar steps at the same time or over a continuous time period from a process with FPC

1.3.14**manufacturing lot number**

unique alphanumeric code assigned by the wall tie manufacturer to a manufacturing lot enabling its traceability throughout the entire production operation, including incoming materials control and all processes defined in the FPC

1.3.15**masonry couplet**

two stack-bonded masonry units joined by a bed of mortar or adhesive, as appropriate

1.3.16**mean strength of a tie****(F_t)**

mean strength of a tie appropriate to its duty rating

Note 1 to entry: The mean strength of a tie is calculated in accordance with [Appendix F](#) for Type A ties and is consistent with the requirements of AS 3700

1.3.17**purchaser**

organization or person who buys wall ties, but is not necessarily the user

1.3.18**sample**

one of more units of product drawn from a batch or lot, selected at random without regard to quality

Note 1 to entry: The number of units of product in the sample is the sample size

1.3.19**shall**

indicates that a statement is mandatory

1.3.20**should**

indicates a recommendation

1.3.21**specimen**

specially prepared item for testing, consisting of masonry wall tie or ties embedded in a masonry couplet, possibly affixed to a length of timber or metal stud or embedded in another couplet, to simulate the various service conditions or, where more than one type of service condition applies, the most demanding

1.3.22**statistical process control****SPC**

application of statistical methods to the monitoring and control of a process to ensure that it operates at its full potential to produce conforming product

1.3.23**supplier**

organization that provides wall ties

Note 1 to entry: The supplier may be the manufacturer, an importer or a distributor.

1.3.24**trace lot number**

unique alphanumeric code assigned by a wall tie manufacturer or distributor, which identifies the original manufacturing lot number in an unequivocal manner

1.3.25**type testing**

testing performed to prove that the wall tie is capable of conforming to the requirements of this Standard

1.3.26**veneer tie**

wall tie designed to connect an outer masonry skin to an inner wall of timber, metal or other relevant material

1.3.27**wall tie, Type A cavity**

tie, together with its fixings or anchorages, used to transfer face loads between skins (leaves) of a cavity wall while being capable of accommodating differential in-plane horizontal and vertical deflections between the attached elements

Note 1 to entry: The requirements for the use of Type A wall ties are given in AS 3700 and AS 4773.1 and AS 4773.2.

1.3.28**wall tie, Type A remedial**

tie manufactured for installation after a masonry leaf has been erected

Note 1 to entry: Type A remedial ties may be either cavity ties or masonry veneer ties and are usually used to replace defective ties, or where ties have been omitted.

Note 2 to entry: The requirements for the use of Type A wall ties are given in AS 3700 and AS 4773.1 and AS 4773.2.

1.3.29**wall tie, Type A veneer**

tie, together with its fixings or anchorages, used to transfer face loads from a veneer to a structural backing while being capable of accommodating differential in-plane horizontal and vertical deflections between the attached elements

Note 1 to entry: The requirements for the use of Type A wall ties are given in AS 3700 and AS 4773.1 and AS 4773.2.

1.4 Product conformity evaluation

Product conformity to this Australian Standard shall be evaluated in accordance with [Appendix B](#).

If the evaluation of the product conformity is not completed, or the product does not fulfil the requirements stated in this Standard, claims shall not be made that products meet the requirements of this Standard.

1.5 New technologies

This Standard shall not be interpreted as preventing the use of materials or methods of manufacture not specifically referred to herein, provided the specified performance criteria are met.

Section 2 Performance criteria

2.1 Scope of section

This Section sets out specific requirements for the design and manufacture of wall ties.

Categories of wall ties are as follows:

- (a) Cavity ties
- (b) Veneer ties
- (c) Remedial ties

2.2 Aim

The performance criteria set out in this Section are intended to ensure that —

- (a) wall ties are durable and serviceable, and have adequate strength, while satisfying other relevant criteria such as resistance to water transfer; and
- (b) there is no loss of function of wall ties or adverse effect on the masonry over a design life of not less than 50 years.

No specific test methods are available for durability class R5. An alternative means of conformance with the durability criteria set out in this Standard shall be demonstrated (see [Clause 3.2](#)).

2.3 Durability

2.3.1 General

Materials for the manufacture of masonry wall ties shall be either inherently corrosion resistant or coated to impart adequate corrosion resistance to achieve the design life.

2.3.2 Damage

Each wall tie shall be free from fracture or surface cracks. Where ties are fabricated from coated sheet, wire or bar, the manufacturing process shall not materially damage the corrosion-resistant coating.

Cut exposed edges that are galvanically protected by the adjacent zinc for wall ties fabricated from coated sheet, wire or bar shall be deemed to be conforming.

C2.3.2 *The galvanic protection footprint of zinc on steel relies on current flow in surface films and does not extend beyond approximately 3 mm from the zinc.*

2.3.3 Classification of materials

Ties shall be identified as durability classes R1 to R5, as defined in AS 3700, AS 4773.1, and AS 4773.2, by application of the acceptance criteria in [Clause 2.3.4](#).

2.3.4 Durability criteria for wall ties

Wall ties shall suffer no loss in serviceability over the design life of the structure (see [Clause 2.2](#)) when subjected to the following in-service conditions:

- (a) *R1 and R2* —
 - (i) all interior locations;

- (ii) exterior locations more than 1 km from a non-surf coast and not classed as industrial;
 - (iii) exterior locations more than 10 km from a surf coast and not classed as industrial;
 - (iv) protected exterior locations with a coating above the damp proof course (DPC) or a membrane below the DPC in any atmospheric environment; or
 - (v) locations not subject to wetting or soil exposure.
- (b) *R3* —
- (i) exterior location 100 m to 1 km from a non-surf coast;
 - (ii) exterior locations 1 km to 10 km from a surf beach;
 - (iii) exterior locations subject to non-saline wetting and drying; or
 - (iv) below a DPC in contact with the ground and in non-aggressive soils.
- (c) *R4* —
- (i) exterior locations less than 100 m from a non-surf coast;
 - (ii) exterior locations less than 1 km from a surf coast;
 - (iii) exterior locations subject to saline wetting and drying; or
 - (iv) below a damp-proof course in contact with the ground and in aggressive soils.
- (d) *R5* — locations outside the above criteria which show severe corrosion.

The design solutions for the durability criteria of this Clause shall be as specified in [Table 3.1](#).

NOTE 1 Examples of R5 durability class are CX atmospheric environments, acid sulfate soils, enclosed swimming pools, fertilizer sheds, tanneries, chemical plants, piggeries, poultry sheds and similar environments, which may require special materials or coatings.

NOTE 2 [Appendix D](#) relates the durability classes R1 to R5 to the ISO 9223 corrosivity categories and locations described in AS 4312—2008.

2.3.5 Alternative materials

Where alternative materials are used in the production of wall ties, conformance to the durability criteria set out in this Standard shall be demonstrated as specified in [Clause 3.2](#).

2.3.6 Galvanic and chemical compatibility criteria for ties and fasteners

In addition to meeting the requirements of [Clause 2.3.4](#), wall ties and fasteners shall be galvanically and chemically compatible, and the combination shall have a corrosion resistance of at least that of the wall tie alone.

2.4 Resistance to water transfer

Wall ties shall be manufactured such that, when tested in accordance with [Appendix G](#), no tie from the sample permits water transfer across the cavity.

2.5 Embedment, movement and tolerance

Wall ties shall be manufactured such that the following criteria are met:

- (a) For wall ties designed to be embedded in mortar:
 - (i) The anchorage section of a wall tie shall be capable of being bedded on, and completely surrounded by, mortar.
 - (ii) Wall ties shall be capable of being easily immobilized within the mortar bed, with a layer of mortar under and above the anchorage section of the tie.
 - (iii) Wall ties shall be capable of being mechanically keyed within the mortar bed.
 - (iv) The seating anchorage in the mortar shall be not less than the following, within ± 5 mm:

(A) For solid or cored units up to 100 mm wide	half the width of the unit.
(B) For solid or cored units 100 mm or wider	50 mm.
(C) For hollow units with face-shell bedding	50 mm.

NOTE 1 In a hollow-unit masonry construction, it may be necessary to obtain the required embedment by filling the appropriate cores with mortar.
 - (v) The part of a wall tie that provides anchorage to the mortar bed joint in masonry shall have an overall height of the anchorage section, including any crimping or bending, not exceeding 70 % of the design joint thickness. This limitation shall not apply to ties used with autoclaved aerated concrete blockwork constructed with thin-bed mortar; however, provision shall be made to accommodate the thickness of the tie.
- (b) Wall ties that are designed to be fixed to non-rigid members shall be capable of being fixed by impact and non-impact methods (for example, screwing).

Ties and fasteners shall be supplied as an integral system.

NOTE 2 Tests have shown that nail fixing for face-fixed ties in timber veneer construction and clip-on ties in steel stud veneer construction do not provide the required attachment to the structural backing under earthquake loading (see AS 3700).

NOTE 3 Screw fixings do not suffer or produce the same problems as do impact fixings such as nails.

NOTE 4 Galvanic compatibility between the tie and fastener is required by [Clause 2.3.6](#).
- (c) The tolerance between any moving parts of veneer ties in the direction of the face loads shall be such as to allow no movement.
- (d) Remedial ties shall be manufactured to satisfy the performance requirements for Type A wall ties. Remedial ties used to upgrade cavity wall buildings shall conform to the requirements of [Clause 2.6.2](#) for Type A cavity ties.

2.6 Structural performance

2.6.1 Strength

Wall ties shall be tested in accordance with [Appendix F](#). The mean tie strength (F_t) of Type A veneer wall ties shall be not less than the values given in [Table 2.1](#) for the applicable duty classification.

2.6.2 Classification of Type A ties

Cavity and veneer ties shall be classified in accordance with their mean strength (F_t) as specified in [Table 2.1](#).

The duty classification is as follows:

- (a) Light duty (L)
- (b) Medium duty (M)
- (c) Heavy duty (H)

Table 2.1 — Type A veneer ties and Type A cavity ties mean strength (F_t)

Duty classification	Mean strength, kN	
	Tension	Compression
Light duty (L)	0.30	0.36
Medium duty (M)	0.60	0.72
Heavy duty (H)	1.50	1.80
NOTE A lower bound value on stiffness is imposed on ties by the test method. This places an upper limit of 1.5 mm on the tie deflection at ultimate load.		