



NEW ZEALAND STANDARD

CONCRETE INTERLOCKING ROOFING TILES

Part 1 – GENERAL

Part 2 – Specification for
TILES AND ACCESSORY TILES

Part 3 – Code of practice for
LAYING AND FIXING OF TILES

Superseding NZS 4206:1973

UDC 691.42 - 033.3

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COMMITTEE REPRESENTATION

This Standard was prepared under the direction of the Building and Civil Engineering Board (30/-) for the Standards Council, established under the Standards Act 1988.

The Concrete Interlocking Roofing Tiles Committee (P4206) was responsible for the preparation of the Standard, and consisted of representatives of the following organizations:

Building Research Association of New Zealand
Cement and Concrete Association of New Zealand
Monier Brickmakers Limited
New Zealand Institute of Building Inspectors
Roofing Systems Limited

ACKNOWLEDGEMENT

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RELATED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARDS		Clause reference herein
NZS 2295:1988	Building papers (breather type)	3.2.3
NZS 3103:1991	Sands for mortars and plasters	3.11.3
NZS 3113:1979	Chemical admixtures for concrete	2.1.4
NZS 3117:1980	Pigments for portland cement and portland cement products	2.1.6, 3.11.5
NZS 3121:1986	Water and aggregate for concrete	2.1.2, 2.1.3
NZS 3122:1990	Portland cement (ordinary, rapid hardening, moderate heat and sulphate resisting)	2.1.1, 3.11.3
NZS 3123:1974	Specification for portland pozzolan cement (type PP cement)	2.1.1
NZS 3125:1991	Portland – limestone filler cement	2.1.1, 3.11.3
NZS 3601:1973	Metric dimensions of timber	Table 2
NZS 3602:1990	Specifying timber and wood-based products for use in building	3.5.1
NZS 3604:1990	Light timber frame buildings not requiring specific design	3.2.1, 3.4.1, 3.11.1
MP 3640:1992	Minimum requirements of the N.Z. Timber Preservation Council	3.5.1

BRITISH STANDARD

BS 1521:1972	Waterproof building papers	3.2.3
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OTHER DOCUMENTS

The New Zealand Building Code (NZBC)

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards are the latest revisions or include the latest amendments. Such amendments are listed in the annual SANZ Catalogue which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of SANZ.

FOREWORD

This Standard was written with particular reference to concrete tiles manufactured by an extrusion process and relying principally on end overlap and underchecks to ensure end sealing. However, many provisions of the Standard are not related to this particular feature and most of these are equally applicable to other forms of tile, such as moulded tiles with a headcheck. This is especially true of the provisions for testing and laying and the use of waterproof underlays.

This revision of NZS 4206:1973 provides for ongoing production control testing, includes a test for water absorption, makes recommendations on the use of underlay and makes other minor alterations to the Standard.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards Association of New Zealand, Private Bag, Wellington.

NEW ZEALAND STANDARD

CONCRETE INTERLOCKING ROOFING TILES

PART 1 GENERAL

1.1 Scope of Standard

1.1.1

This Standard applies to concrete interlocking roofing tiles of the general type shown in figure 1 and to their associated accessory tiles and also to the laying and fixing thereof. The Standard is in three parts:

Part 1 **General** – contains general clauses.

Part 2 **Specification for tiles and accessory tiles** – establishes minimum standards for fit and finish, for quality of materials used in manufacture and for dimensional requirements related to side lap and location of fixings without restricting overall design or size of tiles and accessories.

Part 3 **Code of practice for laying and fixing of tiles** – provides for the laying and fixing of tiles to specified timber battens.

1.2 Interpretation

1.2.1

In this Standard, the word “shall” or the imperative mood indicates a requirement that is to be adopted in order to comply with the Standard. The word “should” indicates a recommended practice.

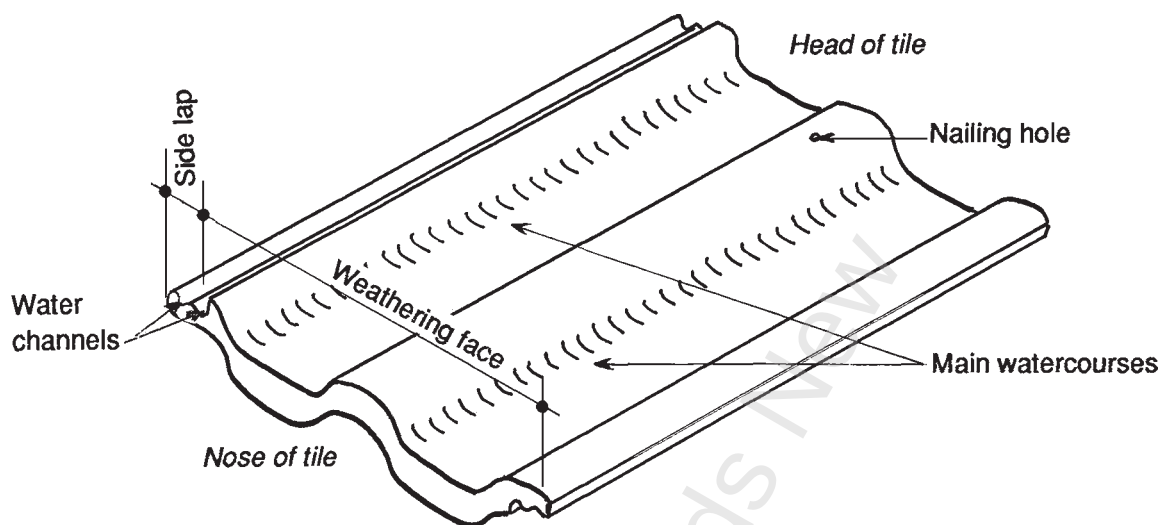
1.2.2

The full titles of reference documents cited in this Standard are given in the list of Related Documents immediately preceding the Foreword.

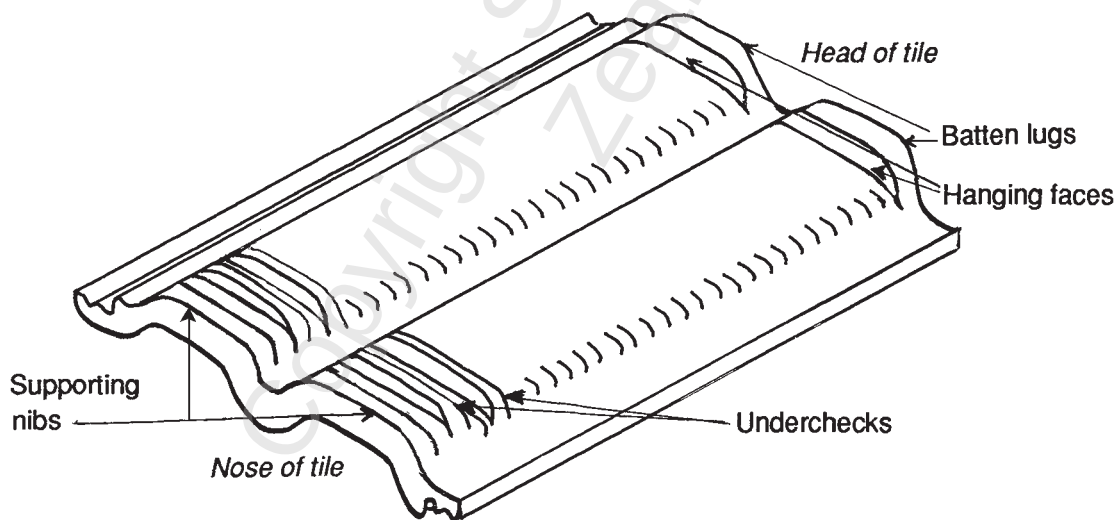
1.3 Definitions

1.3.1

In this Standard, terms relating to tiles shall be interpreted with reference to figure 1 where applicable.



TOP SIDE



UNDERSIDE

Figure 1 – Diagram of tile illustrating terms used

NOTE – This figure is intended only to illustrate terms used. It is not intended to restrict shape or to show design details.

PART 2 SPECIFICATION FOR TILES AND ACCESSORY TILES

2.1 Materials

2.1.1 *Cement*

Cement used in the manufacture of tiles and accessories shall comply with NZS 3122, NZS 3123 or NZS 3125.

2.1.2 *Aggregate*

Aggregate used in the manufacture of tiles and accessories shall comply with the requirements of NZS 3121 for sand.

2.1.3 *Water*

Water used in the manufacture of tiles and accessories shall comply with the requirements of NZS 3121.

2.1.4 *Admixtures*

Concrete admixtures shall comply with the requirements of NZS 3113.

2.1.5 *Mineral fillers*

Mineral fillers, including pozzolans, may be incorporated in the body or the surface coating of tiles and accessories provided that the resulting tiles and accessories comply in all other respects with this Standard.

2.1.6 *Pigments*

Any pigments mixed with cement in the body or the surface coating of tiles or accessories shall comply with NZS 3117.

2.2 Dimensions

2.2.1

The length and width of tiles and accessories shall be as agreed between the purchaser and the vendor for the type of tile supplied.

2.2.2

The thickness of tiles shall not be less than 8 mm, except in the interlocking portion where the thickness shall not be less than 6 mm.

2.2.3

Dimensional variation between tiles and accessories of similar nominal type and size shall not be such as will prevent proper laying on a roof in accordance with the requirements of 3.8.

2.2.4

When tiles are tested by the method described in Appendix A, the twist shall not exceed 3 mm.

2.3 Side laps

2.3.1

Side laps shall not be less than 25 mm in width and shall include at least one adequate main water channel not less than 3 mm deep. Any additional subsidiary water channels shall not be less than 2 mm deep.

2.4 Underface

2.4.1 *Batten lugs*

2.4.1.1

On the underside of each tile there shall be one or more lugs designed to engage over the upper edge of the tiling batten to provide for the horizontal alignment and vertical restraint of the tile when fixed.

2.4.1.2

Lugs shall have a bearing width of not less than 18 mm and shall be not less than 12 mm thick at their base. The depth of their hanging face shall be such as will permit not less than 10 mm engagement with the tiling batten.

2.4.1.3

When tiles are tested by the method described in Appendix B, the shape and position of the batten lugs shall be such that each of the test specimens is self-supporting and the difference between the distances of the top and bottom corners of the specimen adjacent to either side of the stand is not more than 6 mm.

2.4.2 Supporting nibs

At the underside of the nose of each tile there shall be an arrangement of projecting nibs contoured to fit into the watercourses of the tile immediately below in such a manner as to provide adequate load-bearing and to inhibit the entry of wind-driven rain.

2.4.3 Underchecks

Any lateral rib or ribs incorporated in the underside of the tile body to form underchecks designed to restrict water penetration through end laps of tiles in the finished roof shall be shaped to provide a reasonable fit to the watercourses of the tiles immediately below, and shall measure not less than 5 mm in depth by 6 mm in thickness. The clear distance between underchecks, or between an undercheck and a supporting nib, shall be not less than 10 mm. Measurements shall be made at the deepest point or at the centre of the main watercourse.

2.5 Provision for fixing

2.5.1 General

Tiles shall incorporate one or both of the provisions for fixing described in 2.5.2, and 2.5.3.

2.5.2 Nailing and screwing

Provision for nailing or screwing shall be by means of one or more holes centred not less than 15 mm or more than 25 mm from a line joining the hanging faces of the batten lugs and suitably positioned in the width of the tile. Holes shall not be larger than 7 mm nor smaller than 5 mm in diameter. They may be partially closed or plugged with concrete through which a nail or screw can readily be driven without damage to the tile.

2.5.3 Clipping

Provision for the attachment of fixing clips to tiles shall be such that the tiles are restrained from lifting or displacement as effectively as by nailing or screwing.

2.6 Workmanship and finish

2.6.1

All tiles and accessories shall be regular in shape, dense and thoroughly compacted and shall interlock whether laid in straight or broken bond.

2.6.2

The surface of tiles shall be free from irregularities or excrescences which would detract from the function or appearance of the finished roof.

NOTE –

- (1) Some minor surface marks and blemishes are inherent in the manufacturing process.
- (2) Because of possible variations in decorative features such as colour, gloss level and texture, it is recommended that a note be included in the manufacturer's literature advising the consumer accordingly, and recommending that agreement be reached on acceptable variations in these features at the time of purchase.

2.6.3

Tiles shall be free from distortion to the extent necessary to permit compliance of the roof with the provisions relating to interlocking.

2.7 Branding

2.7.1

All tiles shall be clearly and permanently marked with the manufacturer's name or brand.

2.8 Physical properties

2.8.1 General

2.8.1.1

At the time of delivery, tiles shall have physical properties complying with the requirements of 2.8.2, 2.8.3 and 2.8.4.

2.8.1.2

A manufacturer claiming to be producing tiles and accessories to this Standard shall consistently carry out production control testing to demonstrate compliance with 2.8.1.1.

2.8.1.3

The manufacturer shall keep a testing record which sets out, for every sample of tiles and accessories (as applicable) tested, the following:

- (a) Date of manufacture and lot number
- (b) Date of test
- (c) Type of unit tested
- (d) Twist in tiles
- (e) Squareness of tiles
- (f) For strength of tiles:
 - (i) Transverse breaking strength of each tile
 - (ii) Mean breaking strength of sample
 - (iii) Whether a retest was performed
- (g) For absorption of tiles and accessories:
 - (i) Percentage water absorption of each specimen
 - (ii) Mean water absorption of sample
- (h) For permeability of tiles:
 - (i) The number of tiles complying
 - (ii) Whether a retest was performed
- (j) Details of consignment, where applicable.

2.8.2 Transverse breaking strength

2.8.2.1

Except as allowed by 2.8.2.3 the mean transverse breaking strength ($\bar{W}$) of a sample of 6 tiles selected in accordance with 2.9 and tested as described in Appendix C shall not be less than the greater of 600 N or the value, to the nearest 50 N, given by the equation:

$$\bar{W} = \frac{KB}{L} \dots\dots\dots \text{N}$$

where

B = the breadth of the weathering face, in mm to the nearest 2 mm

L = the unsupported span as tested, in mm to the nearest 5 mm (see figure 2)

K = a factor related to the overall height (T) of the profile of the tile at the centre of the unsupported span, in mm to the nearest 1 mm and given by the table in figure 2. (Intermediate values shall be interpolated).

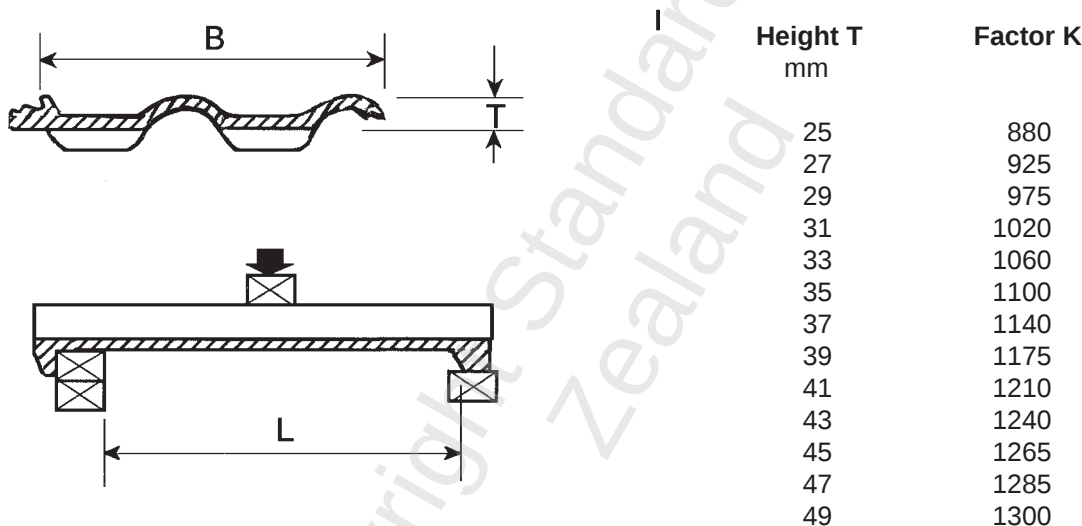


Figure 2 – Transverse breaking strength

2.8.2.2

Except as allowed by 2.8.2.3 the transverse breaking strength (W) of any tile comprising a sample selected for testing shall not be less than the greater of 450 N or 80 % of the value of W given by the equation in 2.8.2.1.

2.8.2.3

A retest shall be permitted in the event of the mean transverse breaking strength being less than the minimum required under 2.8.2.1, or one only of the test specimens failing to comply with the individual minimum required under 2.8.2.2.

2.8.2.4

If such retest is required, the results from the specimens originally tested shall be discarded and the test shall be repeated on 12 further specimens selected at random from the same lot.

2.8.2.5

If the mean breaking strength of the 12 retest specimens is less than the required minimum or if any one of the retest specimens has a breaking strength less than the required individual minimum, the lot shall be deemed not to comply with the Standard.

2.8.3 *Water absorption*

2.8.3.1

The mean water absorption of test pieces taken from each of the 6 tiles tested under 2.8.2.1 for transverse breaking strength shall not be greater than 10 % when tested as described in Appendix D.

2.8.3.2

The mean water absorption of test pieces each of mass not less than 2.0 kg taken from each of three accessory tiles shall not be greater than 10 % when tested as described in Appendix D.

2.8.4 *Permeability*

2.8.4.1

Except as allowed by 2.8.4.2, the permeability of a sample of 3 tiles selected in accordance with 2.9 and tested as described in Appendix E shall be such that no water shall have dripped from the underside of any of the specimens during the course of the test.

2.8.4.2

A retest shall be permitted in the event of one only of the specimens tested failing to comply with the requirement of 2.8.4.1. If such retest is required, the results from the specimens previously tested shall be discarded and the test shall be repeated on 6 further specimens, selected at random from the same lot.

2.9 *Sampling for production control testing*

2.9.1 *Production lots*

2.9.1.1

For the purposes of subsequent identification, a production lot shall consist of the tiles or accessory tiles of one type manufactured during a single shift.

2.9.1.2

Each stack of tiles or units stockpiled on the premises of the manufacturer or his selling agent shall be marked with its appropriate lot number.

2.9.2 *Method and frequency of sampling*

2.9.2.1

Samples, each consisting of the number of specimens set out in table 1, shall be selected at random from production lots at no lesser frequency than that specified in the table. Where more than one shift is worked in a day, the production of each shift shall be sampled at the frequency specified.

NOTE – The most important aspect of sampling is to ensure that units are selected at random. The sample must comprise units that are distributed throughout the lot. A convenient sampling plan may be established in respect of either time or place using a set of random whole numbers between 1 and 100, or some other convenient number obtained from tables or by drawing lots of numbered marbles. For example, the length of time required for stacking may be divided into 100 equal intervals. The randomly selected numbers can be used to designate the number of those intervals after starting time at which a unit should be selected.

2.9.2.2

Samples selected as in 2.9.2.1 for testing shall be taken before or during the process of stacking after manufacture. Each shall be indelibly marked so that it can be identified with the lot it represents and the date of manufacture. Marking shall not cover more than 5 % of the surface area.

2.9.3 Storage of specimens for testing

The units shall be stored until tested for a period of not more than 28 days at ambient temperature and humidity, protected from sun and rain and not in contact with the ground.

Table 1 – Numbers of specimens for testing and frequency of sampling

Test	Method of test	Number of specimens		Frequency of sampling per shift
		Regular tiles	Accessory tiles	
Test for twist	Appendix A	9*	–	Weekly
Test for batten lugs and squareness (see 2.4.1.3)	Appendix B	9*	–	Weekly
Transverse breaking strength (see 2.8.2)	Appendix C	6	–	Daily
Water absorption (see 2.8.3)	Appendix D	6†	3	Daily
Permeability (see 2.8.4)	Appendix E	3	–	Weekly

* Each specimen shall be tested for twist and squareness before being subjected to other tests.

† Test pieces shall be taken from the tiles tested for transverse breaking strength.

2.10 Disputes as to compliance

2.10.1 Notice

If the purchaser disputes that tiles sold as complying with this Standard do comply, he shall give notice in writing to the vendor prior to completion of fixing or as soon as practicable thereafter.

2.10.2 Examination and testing

2.10.2.1

To resolve the dispute, the tiles shall be examined by the purchaser in the presence of the vendor and, subject to the provisions of 2.10.2.2, 2.10.2.3 and 2.10.2.4 the purchaser may reject any tiles not complying with the Standard.

2.10.2.2

For the properties specified in clauses 2.4.1.3, 2.8.2, 2.8.3 and 2.8.4, tests shall be carried out on a sample taken from each production lot disputed and the results thereof shall be deemed to be representative of that lot.

2.10.2.3

The sample shall consist of 9 tiles or 3 accessories selected at random by the purchaser in the presence of the vendor and tested by an independent authority by the methods specified for production control. Retests as permitted for production control shall be allowed where applicable.

2.10.2.4

Unless otherwise agreed the cost of sampling and testing of tiles under dispute shall be borne by the party shown to be in error.

2.10.3

Replacement

If tiles shown by examination, or a consignment shown by sample testing, to be defective have been delivered or fixed, they shall on demand by the purchaser be removed and replaced by the vendor at his expense with tiles complying with the Standard.

PART 3 CODE OF PRACTICE FOR LAYING AND FIXING OF TILES

3.1 Scope

3.1.1

This Part specifies requirements for the placement and fixing of tiles and accessory tiles manufactured to comply with Parts 1 and 2.

3.2 Underlay

3.2.1

Roofing underlay shall be laid under the tiling battens in the following situations:

- (a) Where the roof pitch is 17° or less
- (b) On all skillion roofs. A skillion roof is defined as a pitched roof where the ceiling lining is parallel and close to the roof cladding.
- (c) Where the building wind zone as determined by NZS 3604, clauses 2.6.2 to 2.6.6 is designated VH (Very High wind speed) or requiring specific design, that is where the design wind speed exceeds 44 m/s.

NOTE –

- (1) NZS 3604 sets out the details relating to region, roughness of terrain and topographical features that influence the wind speeds flowing around the building. These effects are illustrated in Table 2.4 of NZS 3604.
- (2) Condensation that may infrequently form on the underside of the tiles is by design shed onto the upper surfaces of the tiles of the course below.

3.2.2

Where used, roofing underlay shall comply with 3.2.3 to 3.2.6 inclusive.

3.2.3

Underlay shall be breather type building paper complying with NZS 2295, provided that an underlay complying with BS 1521 may be used, if in addition it is shown to have a surface absorbency exceeding 100 g/m² net absorption.

NOTE – A test for surface absorbency of underlay material is given in section 11 of NZS 3604.

3.2.4

Underlay shall be lapped not less than 150 mm except that this figure may be reduced to 75 mm where the lap occurs under a tiling batten. Where the underlay is laid longitudinally, the upper sheet shall be lapped over the lower sheet.

3.2.5

Except where self supporting underlay is used, underlay shall be supported at not more than 300 mm centres in either direction by galvanized wire, galvanized wire netting or other suitable corrosion-resistant material. Where the rise of the fascia above rafter top could cause ponding, an anti-ponding board as shown in figure 3 or a device serving the same purpose shall be provided. Where the roof pitch is greater than 17°, the anti-ponding board or device may be omitted and the underlay shall be stretched tight.

3.2.6

If damaged, underlay shall be repaired or replaced before the roof is completed.

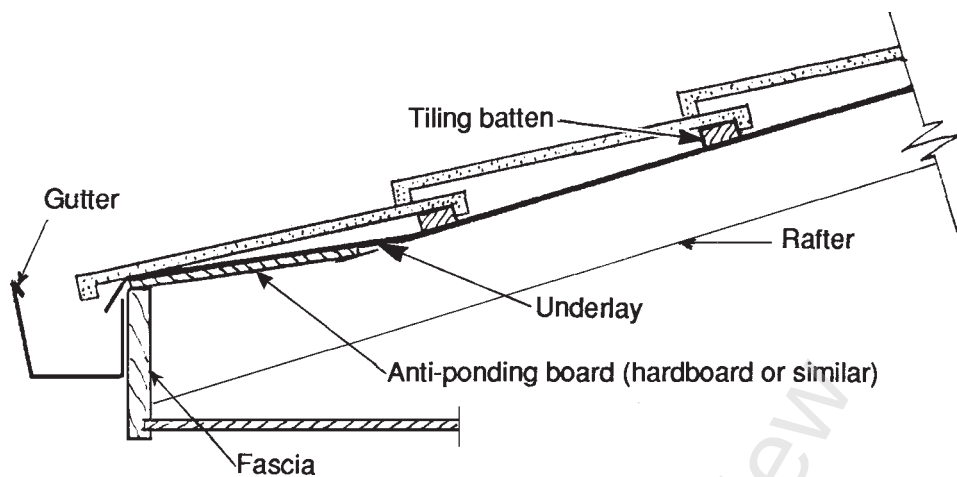


Figure 3 – Anti-ponding board

3.3 End lap of tiles

3.3.1

For roofs with a rafter pitch exceeding 12.5° , the minimum end lap of tiles shall be 75 mm.

3.4 Low pitched roofs

3.4.1

Tiles shall not be laid on roofs with a rafter pitch of 12.5° or less, except in accordance with a method approved in writing by the tile manufacturer for the particular job.

NOTE – Low pitches should be used with caution on buildings exposed to “High” wind speeds as defined in NZS 3604, table 2.4, or worse.

3.5 Tiling battens

3.5.1

Batten timber shall be selected according to NZS 3602, table 2. If of *Pinus radiata* it shall be of No. 1 or No. 2 Framing, treated H1 as specified in MP 3640.

3.5.2

Battens shall be not less than the sizes shown in table 2, except that other sizes may be used provided that a proof load of 900 N distributed over the span of the intended rafter or truss spacing does not cause a deflection of the batten of greater than $1/300$ of the span.

Table 2 – Size of tiling battens

Rafter or truss spacing	Call size to NZS 3601
mm	mm
Up to 450	50 x 25
Between 450 and 600	50 x 37
Between 600 and 900	50 x 50

3.5.3

Battens shall be laid parallel to the associated ridge or eaves line and shall be spaced along the rafters or trusses to give the required tile end lap.

3.5.4

Where battens are jointed, they shall be butted over rafters or trusses provided that no two adjacent battens shall be jointed over the same support.

3.5.5

Except as permitted by 3.5.6 battens shall be fixed to every rafter or truss top chord with at least one nail of 2.5 mm minimum diameter and of sufficient length to penetrate not less than the batten thickness into the rafter or truss. Battens of more than 50 mm call width shall be fixed with two such nails to each rafter or truss.

3.5.6

The use of power driven nails for the fixing of battens is acceptable provided that penetration into the rafter or truss top chord is not less than 80 % of the batten call thickness, and provided that no nail shall penetrate less than 25 mm.

3.5.7

Where an underlay is laid on sarking, or in any other case where ponding behind normally laid tile battens could occur, the roof shall be counter-battened or other measures taken to ensure that no such ponding can occur.

3.6 Preparatory work

3.6.1

All chasing and raking for overflashings and all preparatory work of underflashing and fixing of gutters shall be completed and all tiling battens shall be fixed in position before the tiler commences to lay tiles.

NOTE – Tiles placed on the roof framing prior to laying should be well distributed in small stacks to avoid excessive concentrated loads which could damage the tiling battens or roof framing.

3.7 Concentrated water discharge

3.7.1

Gutters and downpipes from other roof areas shall not discharge a concentrated water flow directly onto a tiled roof, except from small areas such as dormer windows.

3.7.2

Spreaders or other means of distributing such flow over a sufficient width of roof shall be provided, or alternatively the flow shall be piped to a discharge point clear of the tiled area.

3.8 Setting out and interlocking

3.8.1

Tiles shall be set out with courses straight and parallel and with tiles in each course, or in alternate courses, kept in vertical alignment so that the roof presents a regular and even appearance. They shall be laid to interlock and adjoining tiles shall be fitted together within the tolerances of 3.8.2.

3.8.2

The distance between the underside of supporting nibs or over-lapping underchecks of any tile and the upper side of the tile over which it is laid shall not exceed 5 mm. The side gap between adjoining tiles shall not exceed 5 mm.

3.8.3

All joints within the main body of the roof shall be formed with tiles having full side lap. Where it is necessary to cut a tile to form the correct length of course, the cut edge shall be located at the verge.

3.9 Methods of fixing

3.9.1

Tiles required to be fixed shall be secured by one of the following methods:

NZS 4206:1992

- (a) Nailing or screwing. Nails shall be cloutheaded and nails or screws shall be not less than 2.5 mm in diameter. They shall be hot dipped galvanized or of corrosion resisting metal. they shall penetrate not less than 18 mm into the tile batten but the points shall not project beyond the underside.
- (b) Clipping. The clip and its attachment to the batten shall be made of suitable corrosion resisting material.

NOTE – The manufacturer's recommendations for fixing by clips should be followed.

3.10 Tiles to be fixed

3.10.1

All perimeter tiles shall be fixed: that is to say each tile at a roof edge adjoining a ridge, verge, hip, valley or eaves. Any perimeter part-tile of half or more the area of a full tile shall be deemed a sufficient "tile" for this purpose. Any perimeter part-tile of less than half the area of a full tile shall be fixed, if reasonably practicable, and in addition the adjoining tile in the same course shall be fixed.

3.10.2

In the body of the roof inside the perimeter tiles referred to in 3.10.1, not less than every second tile in each row of tiles shall be fixed, the pattern ensuring the unsecured tiles interlock with fixed tiles.

3.10.3

Where it is not reasonably practicable to fix the eaves course of tiles, fixing of every tile in the next course above shall be accepted as compliance with the eaves fixing requirement of 3.10.1.

3.10.4

In the case of projecting unlined eaves or a projecting unlined gable end, every tile in the overhanging portion shall be fixed.

3.11 Fixing of hip and ridge caps

3.11.1

On buildings exposed to "Very High" wind speed as defined in NZS 3604, table 2.4 all hip caps, ridge caps and apex caps shall be mechanically fixed.

3.11.2

In situations not covered by 3.11.1 all hip caps, ridge caps and apex caps shall be bedded in mortar unless adequate mechanical fixing is provided. In addition, apex caps and end tiles of hips and ridges shall be mechanically fixed.

3.11.3

Mortar mixes for bedding and pointing of tiles shall be as follows:

Bedding – 1 part cement : 5 parts sand

Pointing – 1 part cement : 3 parts sand.

Cement shall be portland cement complying with NZS 3122 or portland – limestone cement complying with NZS 3125. Sand shall be mortar sand complying with NZS 3103.

3.11.4

Bedding and pointing may be carried out in one operation if desired.

3.11.5

Where bedding mortar is to be coloured, this shall be achieved by the use of coloured cement or by the addition of mineral oxide pigment complying with NZS 3117. Dosage of mineral oxides shall not exceed 3 % by weight of cement.

3.11.6

Where cap tile joints are pointed with a coloured mortar the pointing mortar shall comply with 3.11.5 except that the dosage of mineral oxides shall not exceed 10 % by weight of cement.

3.12 Eaves**3.12.1**

Provision shall be made for tilting the eaves tiles, at least sufficiently to maintain the normal pitch of the roof, by using either the fascia or a tilting batten. The tiles shall overhang the fascia or tilting batten by an amount sufficient to ensure that rain water discharges into the gutter. Usually this will mean an overhang of a minimum of 40 mm.

3.13 Hips**3.13.1**

Provision shall be made for the support of tiles at hips by one of the following methods;

- (a) The tile battens shall be mitred over the hip rafter and skew nailed to it. Tapered timber wedge pieces shall be cut from 25 mm material and nailed to either side of hip rafters to support cut edges of tiles where necessary.
- (b) As for method (a) except that in lieu of timber wedges, pieces of 50 mm by 25 mm batten shall be fixed on flat between the mitred tile battens over the hip.
- (c) As for method (a), except that the cut edges of tiles shall rest on a galvanized nail driven into the hip board in such a way that the cut tile is supported in the same plane as adjoining full tiles.

3.14 Fire stopping**3.14.1**

Any space between the top of a wall which acts as a fire separation, as defined in the New Zealand Building Code, and roof tiles shall be filled with or closed off at each side of the wall by close fitting fire stopping having a fire resistance rating no less than that of the fire separation. A typical arrangement is shown in figure 4.

3.15 Birdproofing at valleys**3.15.1**

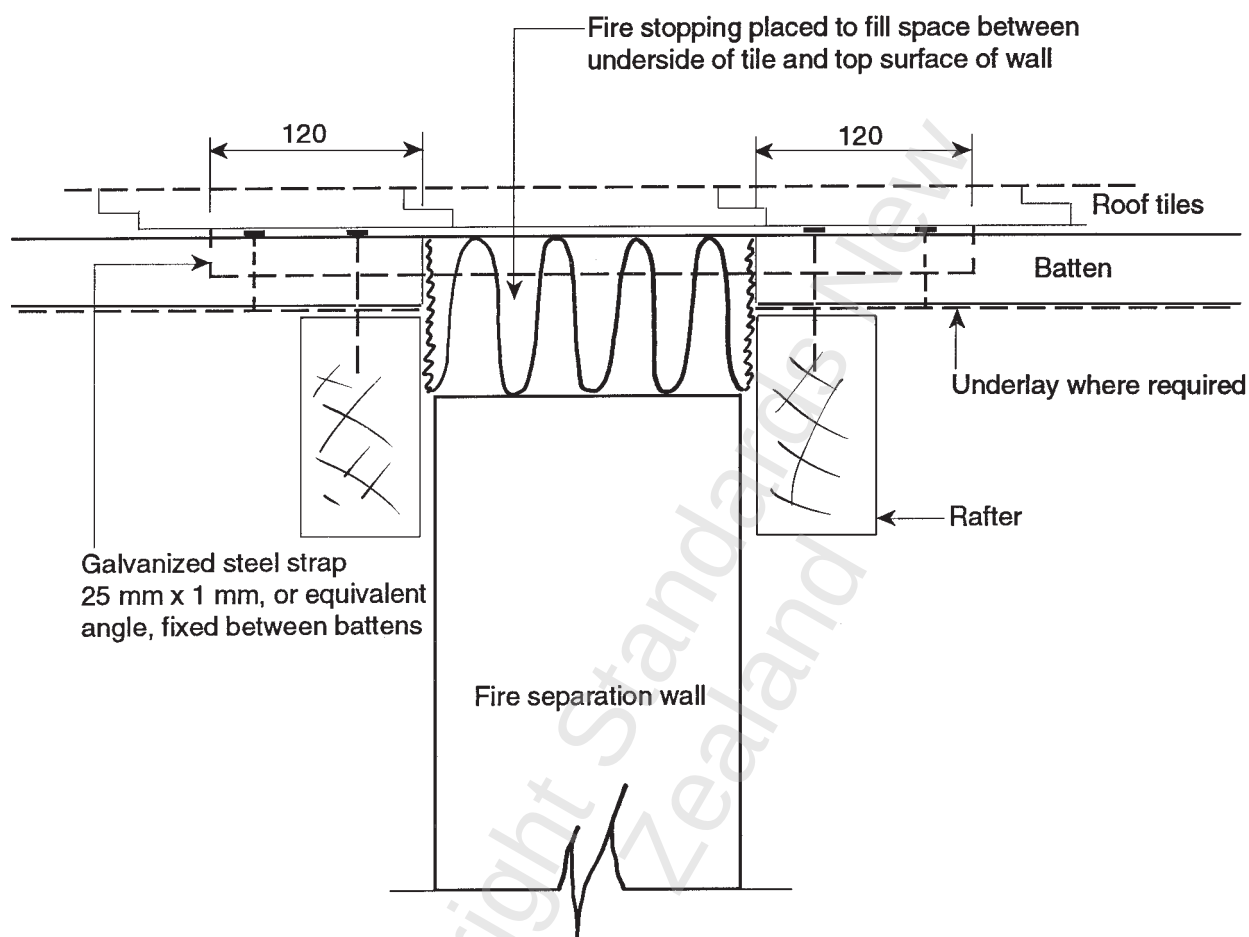
Any gaps which occur through the cutting of tiles at valleys shall be made birdproof either by use of tapered wooden filler pieces or by other effective means such as the provision of galvanized mesh birdwire fixed to valley battens and in contact with the underside of tiles.

3.16 Workmanship**3.16.1**

The cutting of tiles at ridges, verges and valleys shall be done neatly and in a workmanlike manner. Tiles at ridges and hips shall continue beneath the ridge and hip capping to not less than 50 mm, and valley tiles shall overlap valley gutters by not less than 100 mm.

3.16.2

All gutters and roof channels shall be cleared of debris on completion of the work and the roof left sound and weatherproof.



NOTE – The use of independent rafters or trusses and a flexible non-combustible filling, such as fire resistant batts, at the fire wall position ensures a consistent ridge line to the roof.

Figure 4 – Typical arrangement of fire stop at the top of a fire separation

APPENDIX A TEST FOR TWIST IN TILES

A1 Scope

This Appendix sets out the test procedure for the determination of twist in concrete tiles.

A2 Apparatus

- (a) A test stand of steel or other durable rigid material consisting of a base plate into which are set four pegs 8 mm nominal in diameter with hemispherical upper ends. The pegs shall be positioned at the corners of a rectangle with their upper ends in the same plane, such that a tile can be laid upside down upon them with the outer ridges of the tile bearing upon them at distances of not more than 15 mm from the ends of the tile. (See figure A1).
- (b) A steel feeler gauge 3 ± 0.1 mm in thickness.

A3 Procedure

- (a) Place the test stand on a surface that is approximately horizontal. Place each of the 9 tiles to be tested in turn with top side down upon the four pegs so that the pegs bear against the outer ridges of the tile at distances of not more than 15 mm from the ends of the tile as shown in figure A1.
- (b) With the tiles touching the tops of at least 3 of the pegs, check with the feeler gauge whether or not the gap between the fourth peg and the tile exceeds 3 mm.

A4 Recording of results

For each tile, record whether or not the twist in the tile as measured in A3(b) exceeds 3 mm.

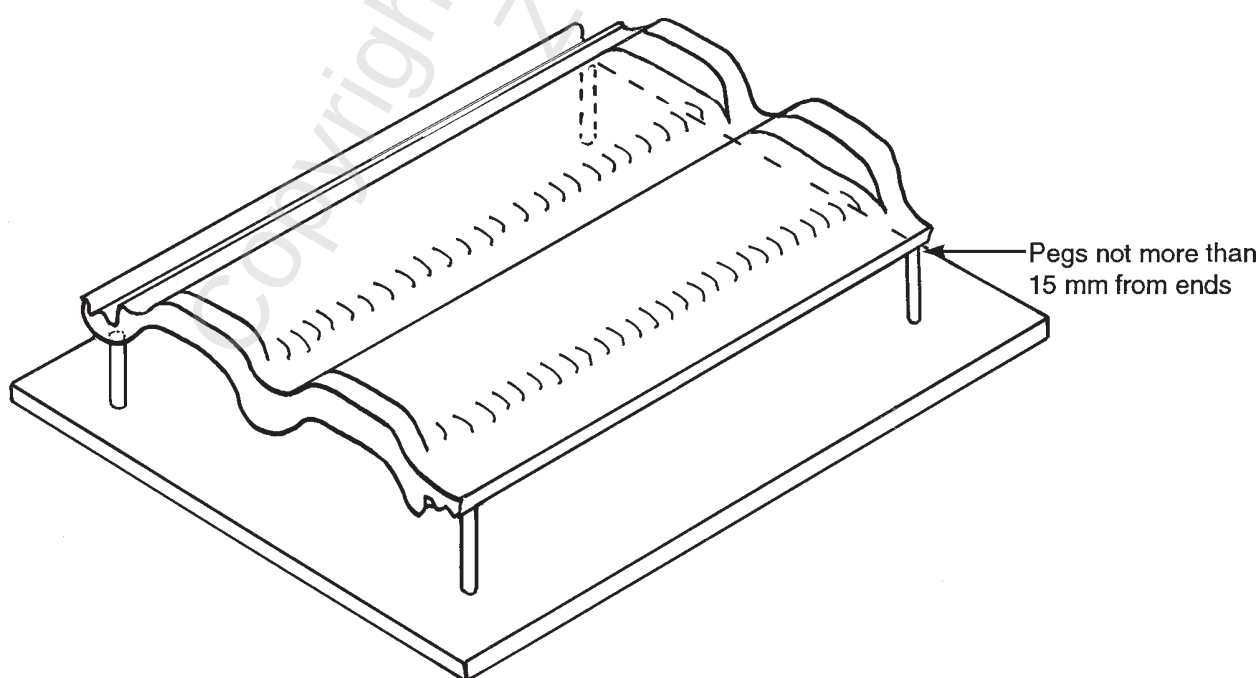


Figure A1 – Stand for testing twist in tiles

APPENDIX B TEST FOR BATTEN LUGS AND SQUARENESS

B1 Scope

This Appendix sets out the test procedure for the determination of shape and squareness of batten lugs of concrete tiles.

B2 Apparatus

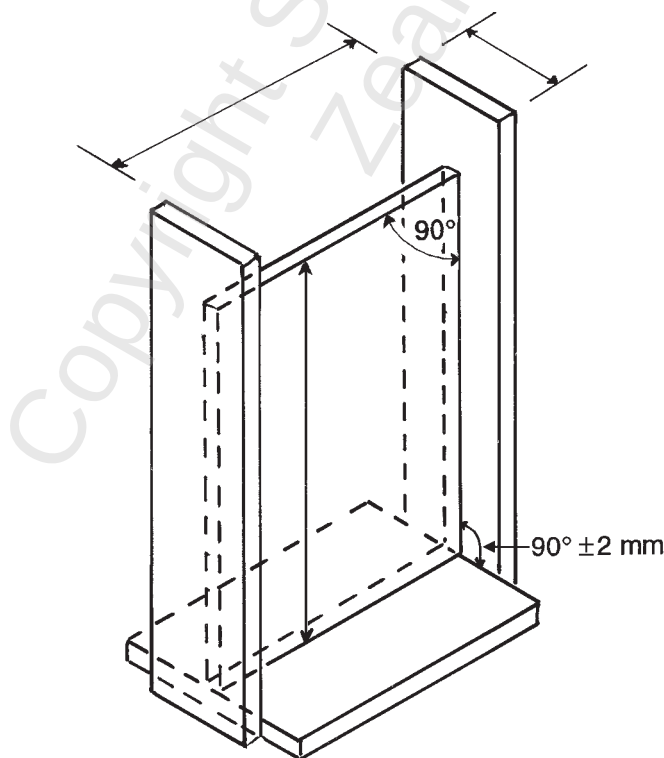
- (a) A test stand. A suitable stand is shown in figure B1.
- (b) A rule or other means of length measurement readable and accurate to 1 mm.

B3 Procedure

- (a) Place the test stand on a surface that is approximately horizontal. Hang each of the 9 tiles to be tested in turn so that its batten lugs rest fully on the top edge of the centre plate of the stand.
- (b) Measure the distances between the top and bottom corners of the tile and the adjacent side of the stand.

B4 Recording of results

For each tile, record the difference between the distances of the top and bottom corners to each side of the test stand to the nearest millimetre.



Dimensions to suit size of tile under test

Figure B1 – Stand for testing batten lugs and squareness

APPENDIX C

TEST FOR TRANSVERSE BREAKING STRENGTH

C1 Scope

This Appendix sets out the test procedure for the determination of the transverse breaking strength of concrete interlocking roofing tiles.

C2 Apparatus

- (a) A test rig enabling a tile to be supported at each end and loaded at its mid-section and with means for measuring the load applied (see figure 2)
- (b) A water bath of suitable capacity to fully immerse the tiles to be tested and with means for maintaining the temperature of the water at 20 ± 5 °C.

C3 Procedure

Each tile selected for testing shall be immersed in the water bath for a period of 24 hours, then removed and immediately tested in a saturated condition as follows:

- (a) Place the tile in the test rig centrally under the load to be applied. Support it at one end by a wooden batten 50 mm wide and not less than 25 mm thick and resting against the batten lugs in a position similar to that which a tile occupies in relation to a batten on the roof. At the other end, rest the supporting nibs on the centre of a similar batten, taking care that the underchecks, if any, are clear of the batten and are not supported.
- (b) With the tile thus supported in a horizontal position, place a third wooden batten 50 mm wide and having a layer of felt or similar material 6 mm thick on its underside, on the top face of the tile midway between and parallel to the supporting battens.
- (c) Apply the test load vertically to the centre batten. Increase the load at a uniform rate not greater than 800 N/min until fracture occurs. record the load at fracture.
- (d) Calculate the mean breaking load for the sample of tiles tested.

C4 Recording of results

Record the following:

- (a) For each tile tested, the load at fracture (N)
- (b) The mean breaking load for the sample to the nearest 50 N.

APPENDIX D TEST FOR WATER ABSORPTION

D1 Scope

This Appendix sets out the method for determining the water absorption of concrete interlocking roofing tiles and accessory tiles.

D2 Apparatus

- (a) A ventilated drying oven of appropriate size capable of maintaining a temperature of 105 °C to 110 °C.
- (b) A balance of suitable capacity readable and accurate to 0.1 % of the test specimen mass.
- (c) A water bath of suitable capacity to fully immerse the test specimens and with means for maintaining the temperature of the water at 20 ±5 °C.

D3 Procedure

Test pieces taken from each of the 6 tiles fractured in the transverse breaking test shall be tested for water absorption, the test being commenced while the pieces are still in a saturated condition.

For accessory tiles, test pieces of mass at least 2000 g taken from each of the 3 units selected for testing shall be fully immersed in the water bath for a period of 24 hours.

- (a) Weigh each of the test pieces in a saturated condition and record the mass (M_1).
- (b) Dry the test pieces in the drying oven for a period of 24 hours, cool to room temperature and reweigh each test piece and record the mass (M_2).
- (c) Calculate the water absorption (w) of each test piece as the decrease in mass expressed as a percentage of the oven dry mass from the formula:

$$w = \frac{M_1 - M_2}{M_2} \times 100 \dots\dots\dots \%$$

D4 Recording of results

Record the water absorption of each test piece and the mean water absorption for the sample of tiles or accessories tested.

APPENDIX E

TEST FOR PERMEABILITY

E1 Scope

This Appendix sets out the method for determining permeability of concrete interlocking roofing tiles.

E2 Apparatus

A metal frame able to be fitted around a tile in a horizontal position and made waterproof around the edges. The frame shall extend from below the underside of the tile to not less than 50 mm above the invert of the main watercourse. A suitable arrangement is shown in figure E1.

E3 Procedure

- (a) Seal one of the 3 tiles to be tested in the metal frame making all edges waterproof and ensuring that the inverts of the side water channels are not covered by the sealant. Seal any nail or screw holes in the tile.
- (b) Support the frame in a horizontal position at a convenient height for making observations of the underside of the tile. Take care that the tile is not in contact with the supports.
- (c) Pour water over the tile until the water level is at a height of 50 mm above the invert of the main watercourse. Maintain the head of 50 mm for a period of 2 hours, adding water from time to time as necessary.
- (d) Note whether any water drips from the underside of the tile during the 24 hour period and record. Should the underside of the tile become damp only, such dampness shall not be deemed failure to pass the test.
- (e) Repeat the above procedure for the remaining tiles to be tested.

E4 Recording of results

For each tile, record whether or not water dripped from the tile.

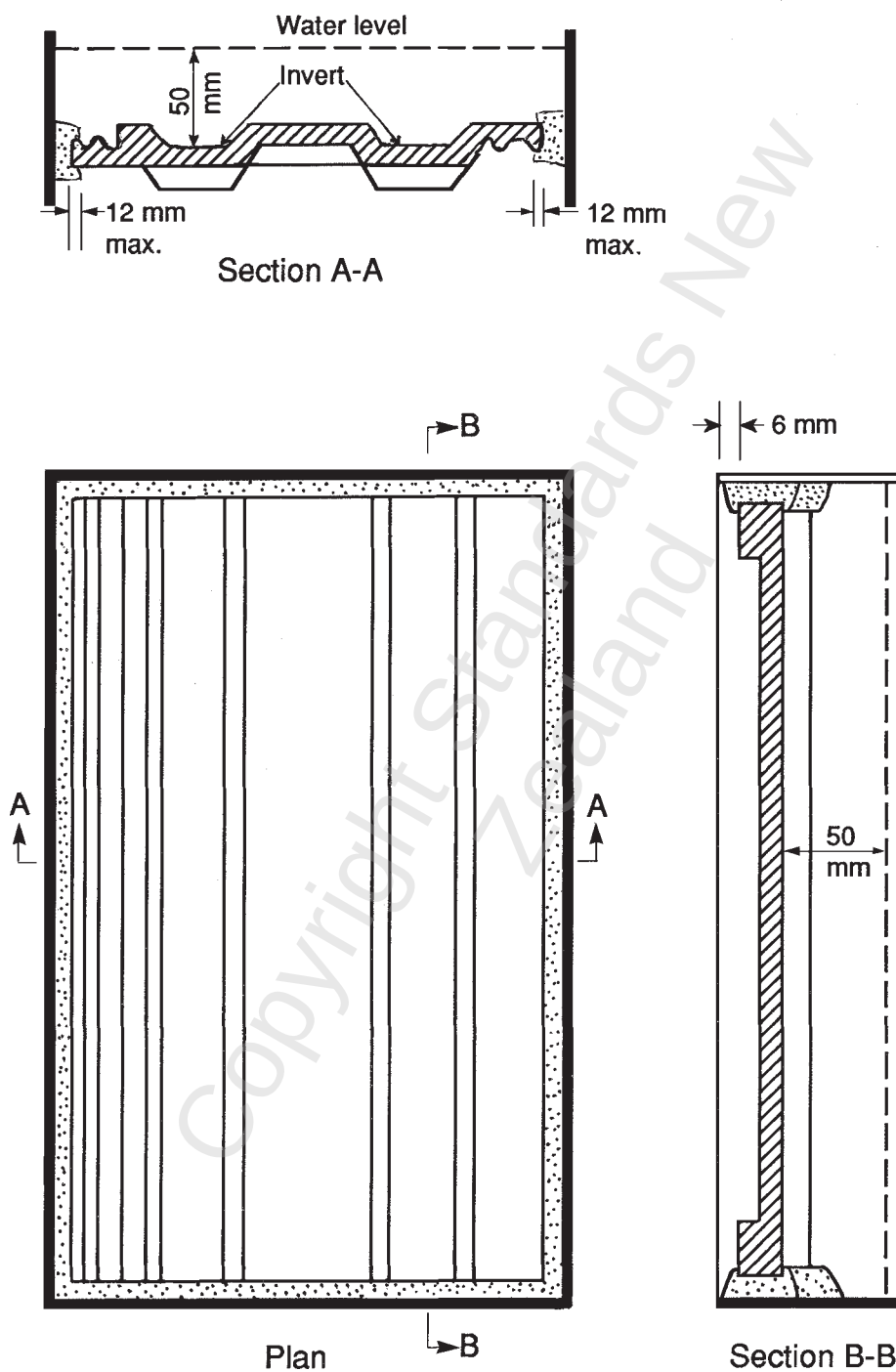


Figure E1 – Sealing of tile in metal frame for permeability test

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