

AS 3958:2023



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Australia



Installation of ceramic and stone tiles



AS 3958:2023

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- Australian Tile Council
- Master Builders Australia
- Swimming Pool and Spa Association of Australia
- TAFE NSW
- Tiles and Tiling Industry Association Australia

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Installation of ceramic and stone tiles

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Preface

This Standard was prepared by the Standards Australia Committee BD-044, Fixing of Ceramic, Natural and Reconstituted Stone Tiles, to supersede AS 3958.1:2007, *Ceramic tiles, Part 1: Guide to the installation of ceramic tiles*, and AS 3958.2:1992, *Ceramic tiles, Part 2: Guide to the selection of a ceramic tiling system*.

The objective of this document is to specify requirements and provide instruction on the preparation of the background and the bonded fixing and grouting of floor and wall tiles, including mosaic tiles and panels. It also provides information on the application of tiles in swimming pools, gradients on floors, screeds and rendering, cleaning and maintenance.

The major changes in this edition are as follows:

- (a) Amalgamation of AS 3958.1 and AS 3958.2 into one document.
- (b) Change from purely a guidance document to one that includes requirements.
- (c) Inclusion of requirements for stone, reconstituted stone and glass, in addition to ceramic, tiles.
- (d) Inclusion of requirements for panels.
- (e) Inclusion of greater detail on adhesive types and information regarding reaction resin adhesives, low modulus adhesives and reaction resin grout.
- (f) Major revision of methodologies, as a result of the inclusion of current materials.

Standards Australia thanks the International Concrete Repair Institute (ICRI) for permission to reproduce [Figure J.1](#) from ICRI Technical Guidelines 310.2R.

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.

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NOTES

Australian Standard®

Installation of ceramic and stone tiles

Section 1 Scope and general

1.1 Scope

This document provides instruction on the preparation of the background and the bonded fixing and grouting of floor and wall tiles, including mosaic tiles and panels. It also provides information on the application of tiles in swimming pools, gradients on floors, screeds and rendering, cleaning and maintenance.

Specialized applications, such as the need for industrial chemical resistance, are not considered in detail.

This document applies to all work involved in the internal and external laying of ceramic and stone wall and floor tiles. It covers the types and classes of backgrounds and substrates, as well as their suitability to receive a bedded finish, using the following fixing methods:

- (a) Bedding in sand and cement mortar on an intermediate substrate or by direct fixing.
- (b) Bedding in proprietary adhesives on an intermediate substrate or by direct fixing.

Mosaic tiles and large panels constitute specialized forms of tiling and those aspects of fixing that require particular treatment are dealt with in this document.

WARNING — Products used in the installation of tiling systems may contain crystalline silica and/or other hazardous materials. The use of tools and equipment may also present hazards. This document does not address the safety concerns associated with the installation of tiles. It is the responsibility of the user of this document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to its use.

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 1379, *Specification and supply of concrete*

AS 1478.1, *Chemical admixtures for concrete mortar and grout, Part 1: Admixtures for concrete*

AS 1684.2, *Residential timber-framed construction, Part 2: Non-Cyclonic Areas*

AS 1684.3, *Residential timber-framed construction, Part 3: Cyclonic areas*

AS 1684.4, *Residential timber-framed construction, Part 4: Simplified—Non-Cyclonic Areas*

AS 1720.3, *Timber structures, Part 3: Design criteria for timber-framed residential buildings*

AS 2870, *Residential slabs and footings*

AS 3600, *Concrete structures*

AS 3610, *Formwork for concrete*

AS 3700, *Masonry structures*

AS 3740, *Waterproofing of domestic wet areas*

AS 4654.2, *Waterproofing membranes for external above-ground use, Part 2: Design and installation*

AS 3972, *General purpose and blended cements*

AS 4654.1, *Waterproofing membranes for external above-ground use, Part 1: Materials*

AS 13006, *Ceramic tiles — Definitions, classification, characteristics and marking (ISO 13006:2018 (ED.3.0) MOD)*

AS 13007.6, *Ceramic tiles — Grouts and adhesives, Part 6: Requirements, test methods, evaluation of conformity, classification and designation for waterproof membranes used with the installation of ceramic tiles (ISO 13007-6:2020, MOD)*

AS 14448, *Low modulus adhesives for exterior tile finishing (ISO 14448:2016, MOD)*

AS 1859.1, *Reconstituted wood-based panels—Specifications, Part 1: Particleboard*

AS/NZS 2270, *Plywood and blockboard for interior use*

AS/NZS 2271, *Plywood and blockboard for exterior use*

AS/NZS 2588, *Gypsum plasterboard*

AS/NZS 2589, *Gypsum linings—Application and finishing*

AS/NZS 2908.2, *Cellulose-cement products, Part 2: Flat sheets*

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

AS/NZS 4858, *Wet area membranes*

AS ISO 13007.1, *Ceramic tiles — Grouts and adhesives , Part 1: Terms, definitions and specifications for adhesives*

AS ISO 13007.3, *Ceramic tiles — Grouts and adhesives, Part 3: Terms, definitions and specifications for grouts*

AS ISO 13007.5, *Ceramic tiles — Grouts and adhesives, Part 5: Requirements, test methods, evaluation of conformity, classification and designation of liquid-applied waterproofing membranes for use beneath ceramic tiling bonded with adhesives*

ASTM C847, *Standard Specification for Metal Lath*

EN 14647, *Calcium aluminate cement - Composition, specifications and conformity criteria*

NASH Standard, *Residential and Low-Rise Steel Framing, Part 1: Design Criteria (NS 100)*

1.3 Terms and definitions

For the purposes of this document, the following terms definitions apply.

1.3.1

adhesive

proprietary bedding material used as a bond coat

1.3.1.1

cementitious adhesive

C

mixture of hydraulic binding agents, aggregates, and organic additives, to be mixed with water or liquid admix just before use

1.3.1.2**cementitious adhesive — fast setting****CF**

cementitious adhesive that has a tensile strength not less than 0.5 N/mm² after no more than six hours, with an open time of not less than 10 min as measured by a tensile adhesion strength of not less than 0.5 N/mm², and conforming to all other requirements for normal setting C1 adhesives

1.3.1.3**dispersion adhesive****D**

ready for use mixture of organic binding agent(s), that is in the form of aqueous polymer dispersion, organic additives and mineral fillers

1.3.1.4**low modulus adhesive**

adhesives curing to elastomeric rubbery film, which has minimum of 35 % elongation at the tensile testing break point

1.3.1.5**reaction resin adhesive****R**

single or multi-component mixture of synthetic resin, mineral fillers and organic additives in which curing occurs by chemical reaction

1.3.2**admixture**

additive used with cementitious products to modify or improve the properties

Note 1 to entry: See [Clause A.9](#) for requirements regarding admixture.

1.3.3**background**

structural surface on which bedding or the separating layer is laid

Note 1 to entry: Also known as the “base”.

Note 2 to entry: See [Figures 1.1](#) and [1.2](#) for illustrations of definitions associated with floors and walls.

1.3.4**bedded finish**

tile finish including its bond coat

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.5**bedding**

layer of specified materials in which the tile is set and which bonds the tiles to a substrate

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.6**bond breaker**

system that prevents the membrane bonding to the substrate, bedding or lining

1.3.7**bond coat**

material used to adhere a tile, screed or render to its respective substrate

Note 1 to entry: See definitions for *slurry bond coat* ([1.3.41](#)) and *adhesive* ([1.3.1](#)).

1.3.8**back butter**

to spread an adhesive or bedding material on the back of a tile just before the tile is placed

1.3.9**ceramic tile**

thin slab made from clays and/or other inorganic raw materials, generally used as covering for floors and walls, usually shaped by extruding or pressing at room temperature, then dried and subsequently fired at temperatures sufficient to develop the required properties

Note 1 to entry: Tiles may be glazed or unglazed; they are incombustible and are not affected by light.

1.3.10**creep**

slow inelastic deformation or movement of material under stress

1.3.11**concrete**

mixture of cement, aggregates, and water with or without the addition of chemical admixtures

1.3.12**contact coverage**

proportion of the adhesive that is in contact with the surface of —

- (a) the tile back; and
- (b) the substrate after the tile has been fixed into position

1.3.13**direct bedding**

application of a bedded finish to a substrate

1.3.14**drainage mat**

loose laid mat placed under tiles to remove excess water

1.3.15**drying time**

period of continuous air-drying at the end of concrete curing, before tiling can commence

1.3.16**expanded metal**

mesh that acts as a key and reinforcing agent for the scratch or mortar coat

1.3.17**flatness**

degree of deviation from a planar surface

1.3.18**glass tile**

tile having an overall non-crystalline microstructure with SiO₂ as the primary constituent and manufactured by one or more of three primary processes, including: cast, fused, or low temperature-coated

Note 1 to entry: See ANSI A137.2 for classifications and specifications.

1.3.19**grouting****grout**

operation of, or material used in, filling the joint cavities between tiles other than at movement joints

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.20**honed surface**

surface of a stone tile that has been given a smooth matte finish

1.3.21**joint**

space between the edges of adjacent tiles

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.22**lippage****lipping**

condition where one edge of a tile is higher than the edge of an adjacent tile, giving the finished surface an uneven appearance

Note 1 to entry: Any cushioning or bevelling of tile edges is to be ignored when measuring lippage.

1.3.23**modified mortar**

mortar containing a specified organic additive in a specified quantity in accordance with the additive manufacturer's instructions

1.3.24**mosaic tile**

tile that can fit into a square the sides of which are less than 7 cm

Note 1 to entry: Mosaic tiles are typically mounted into sheets for ease of handling and storage.

1.3.25**movement accommodation factor****MAF**

maximum movement that a sealant is capable of tolerating throughout its working life, expressed as a percentage of the joint width

1.3.26**movement joint**

joint, usually wider than the typical joint between tiles or slabs, designed to accommodate lateral movement in the background or bedded finish, and filled with materials having special properties

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.27**nominal size**

size used to describe a tile

1.3.28**performance levels**

categories of anticipated loading and wear parameters

1.3.29**porcelain tile**

fully vitrified ceramic tile with a water absorption coefficient that is less than or equal to a mass fraction of 0.5 %, belonging to groups AI_a and BI_a

Note 1 to entry: Tile groups AI_a and BI_a are defined in AS 13006.

1.3.30**porcelain tile panel**

ceramic tile that is less than 6.6 mm in thickness, and has a porcelain composition of greater than or equal to 1 m² in size

1.3.31**primer**

substance used to coat substrate to seal its surface and reduce its water vapour permeability, or improve its adhesive bonding characteristics

1.3.32**reconstituted stone**

industrial product manufactured from a mixture of aggregates of various sizes and natures, typically coming from natural stones, sometimes mixed with other compatible materials, additions and binders

Note 1 to entry: The binder can be resin, hydraulic cement or a mixture of both. Aggregates consist of natural and/or recycled stones, and/or different additions, such as crushed ceramics, glass, mirrors. They are bound via resin and filler, or cement and water, or a mixture of both.

1.3.33**render**

layer of material, usually cement based, which sets in situ and which may be interposed between the structural background and the bedded finish typically used in vertical applications

1.3.34**rendering**

application of render, typically to a vertical background

1.3.35**scratch coat**

preparatory layer of mortar applied to walls or floors to improve the bonding of a subsequent layer

Note 1 to entry: Generally used where the excessive thickness of one layer will provide insufficient bond. The surface is left "scratched" in order to allow a mechanical key for the next coat.

1.3.36**screed**

cured and compacted layer of material that provides a defined level and surface regularity in preparation for the floor finish, composed of —

- (a) a binder and aggregate, traditionally cement and sand; or
- (b) of proprietary engineered material, which is placed on the structural background

1.3.37**screeding**

act of spreading, compacting and levelling a layer of mortar to provide a true floor surface

1.3.38**sealant**

elastomeric material used to fill and seal joints, preventing the passage of moisture and allowing horizontal and lateral movement at the joint

1.3.39**separating layer**

layer of material that isolates the background from the bedded finish

Note 1 to entry: See [Figure 1.1](#) for illustrations of definitions associated with floors.

1.3.40**shall**

indicates that a statement is mandatory

1.3.41**should**

indicates a recommendation

1.3.42**slurry bond coat**

semi-liquid mixture of a proprietary adhesive or cement with either water or an admixture used to improve adhesion between surfaces

Note 1 to entry: Slurry bond coats need to remain wet when the screed or tiles are applied to them.

1.3.43**spacer lugs**

small crushable projections on the edges of tiles, which, when in contact with each other on adjacent tiles, regulate the joint width

Note 1 to entry: Spacer lugs should not be confused with other non-crushable projections.

1.3.44**spatter dash**

rich mixture of cement and sand, mixed with either water or an admixture, dashed onto a masonry or concrete wall surface and allowed to harden, in order to provide the key for subsequent coats of render

1.3.45**substrate**

material over which a tile is to be fixed

1.3.46**may**

indicates the existence of an option

1.3.47**medium-bed adhesive**

adhesive bedding that is able to be applied to a thicker depth to accommodate variation in the surface of a substrate or a tile

Note 1 to entry: Note to entry: Typically, medium-bed adhesive is between 6 mm and 19 mm in thickness.

1.3.48**thin-bed adhesive**

adhesive bedding that is not required to accommodate major variation in surface of substrate or tile

Note 1 to entry: Typically, thin-bed adhesive does not exceed 6 mm in thickness.

1.3.49**trueness**

deviation at a point on the surface from a fixed datum point on the surface

1.3.50**underlay**

purpose made product applied to a structural background to provide a smooth, functional, even surface suitable for the installation of tiles

Note 1 to entry: Examples of underlays include fibre-cement sheets, acoustic mats, uncoupling mats, drainage mats, sheet membranes and liquid applied membranes.

1.3.51**underlayment**

smoothing or cementitious levelling compound

Note 1 to entry: Underlayments are normally proprietary mixed products.

1.3.52**waterproof membrane**

layer, usually of seamless polymeric material, placed beneath tiling to prevent the penetration of liquid water into the background

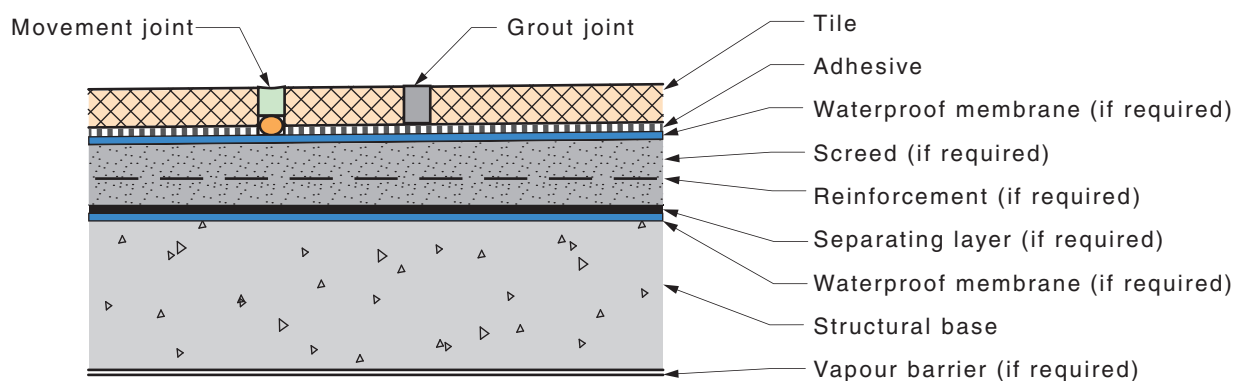
Note 1 to entry: Some waterproofing membranes are incompatible with adhesives and, if used, the tile system would become an unbonded system.

1.3.53**wet area**

area within a building supplied with water from a water supply system, which includes bathrooms, showers, laundries and sanitary compartments and excludes kitchens, bar areas, kitchenettes or domestic food and beverage preparation areas

1.3.54**work size**

size of a tile specified for manufacturing, within the specified permissible deviations



NOTE 1 The waterproof membrane or vapour barrier may be used directly under tiles or substrate. Where this document shows the membrane applied to flat surfaces, it is for illustrative purposes only. They are not intended to replace the provisions of relevant waterproofing Standards AS 3740 and AS 4654.2.

NOTE 2 This figure depicts the typical elements in a tiling system. It is not a construction detail. If the upper layer of waterproof membrane and/or underlay is not installed, the movement joint needs to continue through the screed.

Figure 1.1 — Illustration of definitions associated with floors



Section 2 Materials

2.1 Tiles

2.1.1 General

The tiling referred to in this document consists of glazed and unglazed ceramic tiles, glass tiles, stone tiles, porcelain tile panels and mosaic tiles of various types.

2.1.2 Ceramic tiles

Where first quality ceramic floor and wall tiles are specified, they shall conform to AS 13006.

NOTE AS 13006 requires that conforming tiles, or their packaging, bear marks indicating first quality.

2.1.3 Glass tiles

ANSI A137.2 may be used as guide for glass tiles. Further detail is provided in [Appendix L](#).

2.1.4 Porcelain tile panels

ANSI A137.3 may be used as a guide for porcelain tile panels.

2.1.5 Natural stone tiles

EN 12057 and EN 12058 may be used as a guide for natural stone tiles. Further detail is provided in [Appendix M](#).

2.1.6 Reconstituted stone tiles

EN 15285 and EN 15286 may be used as a guide for reconstituted stone tiles. Reconstituted stone is also known as agglomerated stone (as in EN 14618) or engineered stone. Further detail is provided in [Appendix N](#).

2.1.7 Mosaic tiles

There are several different types of mosaic tiles available in a variety of shapes and sizes, including glazed and unglazed ceramic mosaics and glass. To facilitate ease of handling, mosaic tiles are assembled as sheets, and the separate pieces of tile are face mounted, back mounted or edge connected. Face mounted mosaics have paper or a plastic film attached to the face of the tiles. Back mounted mosaics have nylon adhesive strips, nylon fabric net, paper lattices or other mesh material glued to the back of the tiles. Edge connected mosaics are attached to one another by means of compressible polymeric materials.

Where mosaics are mounted on curved surfaces, the width of the grout joint at the face of the tiles will change depending on the radius of curvature and whether the sheet is front or back mounted. Joints will narrow when fixed to concave surfaces and widen for when fixed to convex surfaces. Front mounted mosaics can retain a constant joint width. Back mounted mosaics will not. Edge connected mosaics can have slight changes in grout width. Before selecting a particular system, advice regarding the appropriate fixing method and the suitability of a particular type of mosaic for a particular environment should be obtained from the mosaic tile supplier or fixing specialist.

When sheets are back or edge mounted, the backing will be embedded in the bedding medium, i.e. mortar or adhesive. Where the backing material inhibits the adhesive from forming a permanent bond with the mosaic tile, the mosaic will not be suitable. However, where the backing material is designed to form part of a permanent bond with the mosaic tile installation system, it is suitable for most applications.

Unsuitability can arise when —

- (a) the exposed areas of individual mosaic tiles are not sufficient to permit the bedding from making contact over an adequate proportion of the area of each mosaic tile;
- (b) the strips, net, or glue used to bond them are of types that will deteriorate in service or are not compatible with the adhesive; and
- (c) the mounting glue is spread on to the backs of individual mosaic tiles instead of being confined to the strips or mesh.

NOTE In the absence of any advice from the tile manufacturer, the exposed (glue-free and mesh-free) areas of individual mosaic tiles should be a minimum of 80 %. See [Clause 5.6.5.2](#) for the application requirements for tiling adhesive coverage.

2.2 Primers

Many manufacturers of tiling system components recommend the use of primers. Where primers are used, they shall be —

- (a) compatible with the substrate to which they are applied;
- (b) compatible with subsequently applied materials; and
- (c) used and applied in accordance with the manufacturer's instructions.

NOTE Adequate time should elapse between the application of the sealers or primers and the adhesive in order to enable drying and, where necessary, curing of the materials prior to the application of the subsequently applied materials.

2.3 Proprietary screed and render

Proprietary screed and render are typically dry mix powders and should be used in accordance with manufacturer's instructions.

2.4 Adhesives

2.4.1 General

Adhesives for the fixing of ceramic, natural stone, reconstituted stone and glass tiles and mosaics shall conform to —

- (a) AS ISO 13007.1; or
- (b) AS 14448, for low modulus adhesives.

The adhesive manufacturer's instructions shall be followed. Instructions may include the type of trowel, the mixing procedure, the working time after spreading, and the suitability of the background.

Some adhesives carry a warning that they may react adversely with certain types of tiles. If these adhesives are to be used, they should be tested for compatibility prior to use.

Where adhesives are required to have permanent immersion properties, the extent of these properties should be confirmed. Refer to the manufacturer for additional information.

NOTE The properties of a tile adhesive are not solely represented by its AS ISO 13007.1 classification.

2.4.2 Selection criteria

The selection of an adhesive is a process of progressively considering the various issues that relate to the work and identifying which factors are most important, as show in [Figure 2.1](#).

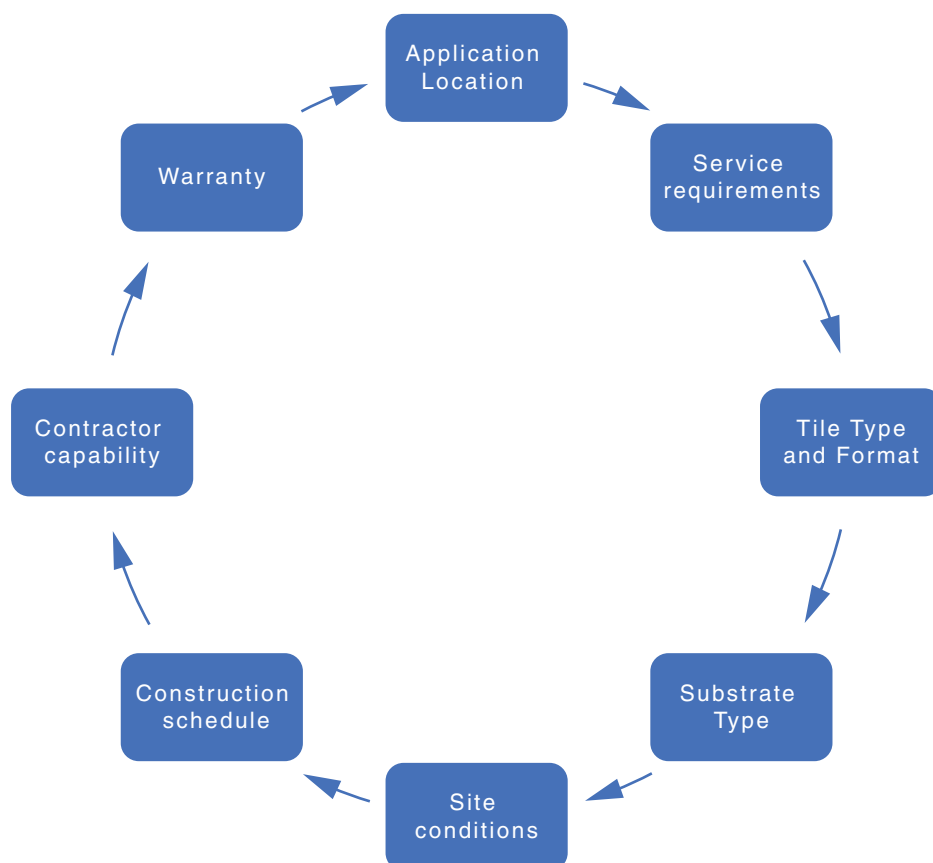


Figure 2.1 — Adhesive selection process

2.4.3 Cementitious

Cement-based adhesives are suitable for use on mature cement-rendered surfaces, concrete, brickwork, plywood, plaster board and fibre-cement sheeting. They are not recommended for use on plaster, metal, or painted surfaces.

Unless otherwise required by the manufacturer, the background should be dry and the surface should not be dampened before the adhesive is applied. Dry backings should only be dampened if necessary to achieve the required working properties and the cure.

2.4.4 Reaction resin

Reaction resin adhesives are suitable for use where the substrate is difficult to bond to or where tiles are moisture sensitive. They should also be used where high mechanical strength is required.

2.4.5 Dispersion

Dispersion adhesives are suitable for use on a wide range of backgrounds, including mature cement-rendered surfaces, concrete, brickwork, plaster surfaces, various sheets and boards. Dispersion adhesives are suitable for porous substrates or tiles not subject to continual wetting or full immersion.

Use of dispersion adhesives where both the tile and substrate are non-porous will result in prolonged drying and is therefore not recommended. An example of this would be where porcelain tiles are installed on waterproof membranes.

2.4.6 Low modulus

Low modulus adhesives are suitable for use where substantial shear stress may be experienced in the exterior walls, for example in earthquake prone or cyclonic regions. Low modulus adhesives accommodate greater expansion and distortion than standard adhesives.

2.5 Grouting materials

2.5.1 General

Grouting materials should have working characteristics such as low shrinkage and adhesion to the sides of the joints. The colour of grout should be as designated in the project specifications.

2.5.2 Non-proprietary cementitious grout

Non-proprietary cementitious grout should be mixed and applied in accordance with the following recommendations:

- (a) *Ceramic and stone tiles* — Grout should be one part Portland cement, and two to four parts sand, mixed with water to a stiff consistency that can be forcibly compressed into the joints. Up to 1/5 part lime by volume may be added if additional workability is required. Other admixtures should only be used in accordance with the manufacturer's recommendations.
- (b) *Mosaic tiles* — Grout for mosaic tiles should be one part Portland cement and two to four parts fine sand, mixed with water to a creamy consistency.
- (c) *Glass tile* — Not recommended.

Where flexibility is required, a latex additive may be added to sand and cement grouts.

2.5.3 Proprietary cementitious grout

Cementitious grouts are a mixture of hydraulic binding agents, aggregates, as well as inorganic and organic additives. Proprietary cementitious grout shall conform to the requirements of AS ISO 13007.3. It shall be mixed in accordance with the manufacturer's instructions. Cementitious grouts may be used for most wall and floor grouting.

2.5.4 Proprietary reaction resin grouts

Reaction resin grouts are single or multi-component mixtures of synthetic resin, aggregates, as well as inorganic and organic additives in which hardening occurs by chemical reaction. Proprietary reaction resin grout shall conform to the requirements of AS ISO 13007.3. Where required, it shall be mixed in accordance with that manufacturer's instructions.

Proprietary reaction resin grouts may be used in lieu of cementitious grouts.

NOTE Some reaction resin grouts may block moisture vapour transmission.

2.5.5 Proprietary hybrid grouts

Hybrid grouts are ready-for-use mixtures of organic binding agents that are in the form of an aqueous polymer dispersion, organic additives and mineral fillers. There are no product standards for this type of grout. Manufacturer's instructions shall be followed.

2.6 Substrate materials

2.6.1 General

Substrate materials shall be suitable for tile systems in accordance with the background manufacturer's instructions.

Sheet backgrounds shall be sufficiently rigid to prevent tile debonding. See [Table 4.1.2](#) for requirements regarding substrate deflection. Requirements for substrates are specified in [Section 4](#).

2.6.2 Plywood

Plywood that is to be used as a substrate for floor and wall tiling shall conform to the following:

- (a) AS/NZS 2270 where it is to be used in dry-area applications.
- (b) AS/NZS 2271 where it is to be used in wet areas.

2.6.3 Structural particleboard flooring

Structural particleboard flooring that is to be used as a background for floor tiling shall conform to AS/NZS 1859.1.

2.6.4 Fibre-cement sheet

2.6.4.1 General

Fibre-cement sheets that are to be used as substrates for tiling shall conform to AS/NZS 2908.2 and be of a type specified by the sheet manufacturer for this application. Not all types of fibre-cement sheets are recommended for tiling.

2.6.4.2 Underlay sheets for floor tiling

Fibre-cement sheets that are to be used as an underlay for floor tiling shall have a minimum thickness of 6 mm, unless otherwise specified by the sheet manufacturer.

2.6.4.3 Fibre-cement wall sheets

Fibre-cement sheets that are to be used for wall tiling shall have a minimum thickness of 6 mm, unless otherwise specified by the sheet manufacturer.

For heavy-duty commercial applications other than external façade tiling, fibre-cement sheets for wall tiling shall have a minimum thickness of 9 mm, unless otherwise specified by the sheet manufacturer.

For external façade tiling over fibre cement sheet, the sheet manufacturer should be referred to regarding the suitability of the product for the application. Specialised systems may be required for this application.

2.6.4.4 Fibre-cement ceiling sheets

Refer to the sheet manufacturer for advice regarding the suitability of tiling over fibre cement sheet on ceilings. Specialized systems may be required for this application.

2.6.5 Compressed and low density fibre-cement sheets

Compressed fibre-cement (CFC) sheets that are to be used as a substrate shall conform to AS/NZS 2908.2 and have a minimum thickness of 15 mm for floor tiling.

Low density tongue and groove fibre-cement flooring sheets shall have a minimum thickness of 19 mm. These sheets are typically coated and have specific installation instructions that differ from standard compressed sheets.

NOTE 9 mm CFC sheets are not intended for wall tiling, but are painted and have a specialized coating on them.

2.6.6 Gypsum plasterboard sheets

Gypsum plasterboard sheets that are to be used as a substrate for wall tiling should have recessed linerboard-bound longitudinal edges and a minimum thickness of 10 mm. Gypsum plasterboard shall conform to AS/NZS 2588.

2.6.7 Furring and studs

The material that is to be used for furring or studs should conform to the sheet manufacturer's specifications, including the dimensions of the material.

2.6.8 Composite board

The term "composite board" is generic and applies to many combinations of cores and linings. Therefore, no single set of requirements may apply and manufacturer's recommendations should be sought for applicability.

2.6.9 Extruded and expanded polystyrene

Extruded and expanded polystyrene is generally used as an insulation material. Tiles should only be bonded to it on walls and only where the polystyrene manufacturer recommends that tiles can be fixed to it.

2.6.10 Autoclaved aerated concrete

Autoclaved aerated concrete (AAC) is a lightweight aerated material used for wall and floor construction, which can be tiled.

Heavy (>32 kg/m²) tile finishes may adhere to the AAC but failure may occur due to the low cohesive strength of the AAC resulting in the face of the panel separating away.

2.7 Movement joint materials

2.7.1 General

Movement joints are used to enable movement between adjacent building components. Movement joints may comprise —

- (a) prefabricated movement joints that are installed prior to the laying of the tiles; or
- (b) an *in situ* joint that is formed between the building components and filled with either of the following:
 - (i) Formed, polymeric back-up material or gasket with a suitable sealant.
 - (ii) Sealant alone.

2.7.2 Prefabricated movement joints

The selection of the most suitable systems will depend on the design considerations. In all cases, the manufacturer's advice should be taken into account.

2.7.3 Back-up materials

The purpose of the back-up material is to prevent three-sided adhesion of the sealant and in some cases to provide elliptical shape and the correct sealant depth. The back-up material in the joint should be compatible with the sealant being used. The back-up material should be compressible, support the sealant and not exude bituminous or oily products. In particular, it should assist the seal in carrying traffic loads and its compressibility should be such that, when the joint closes, the sealant is not forced out. Suitable materials include cellular rubber and plastics, such as cellular polyethylene.

2.7.4 Pre-formed strips

Pre-formed strips are suitable for use in stress-relieving or compression joints where a watertight seal is not critical. Cork and cork/rubber compound strips are suitable for use in light traffic areas. Synthetic-rubber strips with metal-edge supports and PVC are suitable for use in heavy traffic areas. Prior to installation, polymeric backing strips should have a width of not less than 120 % of the width of the open joint.

2.7.5 Sealants

Sealants shall meet the requirements of the particular application in terms of chemical resistance, abrasion resistance, movement and adhesion.

2.8 Slurry bond coat and spatter dash

Slurry bond coats used on floors and spatter dash predominantly used on walls differ in their properties, depending on the constituents in each. This is particularly so in resistance to moisture. The correct material for the application should be selected and used in accordance with the manufacturer's recommendations.

Various proprietary materials are available as follows:

- (a) *Polymer-based admixtures* — These include materials based on polymeric resins. They will need to be mixed with cement and sand, or cement only. Application of the admixture as a neat film is not recommended.
- (b) *Cement-based adhesives* — These are premix tile adhesives applied prior to the application of the mortar.

Slurry bond coats are generally applied as a wet coating or a stipple immediately prior to the application of the mortar. Spatter dash is generally applied wet and allowed to dry prior to application of mortar.

A non-proprietary slurry bond coat or spatter dash is a mixture of cement and water or cement, sand and water. This type is usually only used with porous materials and for low duty, non-critical applications.

2.9 Cement, sand and lime

2.9.1 Cement

The cements referred to in this document shall be used in accordance with the manufacturer's instructions. The cements shall conform to AS 3972.

Other cements, such as high-alumina cement conforming to EN 14647 may be used where more rapid strength gain is required.

High-alumina cement should not be mixed with other types of cement.

Cement showing signs of deterioration (e.g. hard lumps) shall be rejected.

2.9.2 Sand

All sand used should be washed. All sand should conform to AS 2758.1. Sand used for grouting should be of a quality and grade suitable for plastering.

2.9.3 Lime

Lime should conform with AS 1672.1 and be properly hydrated or slaked.

Lime may be measured either as —

- (a) putty prepared from quicklime, hydrated lime or by-product lime; or,
- (b) dry hydrated lime.

Equal volumes of the lime putty and the dry hydrated lime are regarded, for practical purposes, as containing the same amount of lime.

2.10 Water

Water shall conform to the mixing water requirements in AS 1379 and be of potable quality. All containers used for storing or carrying water or for soaking tiles should be clean.

2.11 Separating layer for unbonded screeds

Polyethylene or polypropylene film should be a minimum thickness of 100 microns.

Some waterproofing membranes may inhibit the bond of the tiling systems, however, they should not be considered as separating layers.

2.12 Underlays

2.12.1 Acoustic mats

An acoustic mat is used under floor tiles for reducing impact sound transmission to occupied spaces below. Acoustic mats are mainly made from recycled rubber, but several other sound-attenuating materials may be used. Typically, the acoustic mat is adhered directly to the substrate, while the other components are applied on top of the matting.

NOTE Acoustic mats should not be used for small format or mosaic tiles.

2.12.2 Uncoupling mats

An uncoupling mat is a geometrically configured plastic membrane which provides an air space between the tile and the background to allow independent movement between the two and limit stress in the tile system. Some may be used as waterproof layers or include integral channels for use with heating cables. See [Appendix H](#) for requirements and information regarding mats incorporating radiant heating.

2.12.3 Crack isolation membranes

Crack isolation membranes isolate the tiling from minor in-plane background cracking, preventing it from reflecting into the tile finish. They can be liquid applied membranes or mats but are not generally suitable for use over movement joints. They have a versatile range of characteristics and manufacturers' recommendations should be sought to identify the most appropriate system.

2.12.4 Radiant heating systems

Radiant floor heating generally consists of electric cables, often built into mats that are installed within the tiling installation. The use of insulation under these systems make them more efficient in heating the room. See [Appendix H](#) for requirements and further information.

2.12.5 Drainage mats

Drainage mats are used under floor tiles to enable drainage and to minimize the risk of efflorescence. They are mainly made from plastic and placed directly on the substrate.

2.12.6 Unsuitable underlay material

Hardboard and medium density fibre-board (MDF) shall not be used as underlay sheets for tiling systems because they are generally incompatible with tile adhesives.

2.13 Underlayments

2.13.1 Levelling compounds

Smoothing cements, formally known as underlayments, are proprietary cementitious materials that are applied to concrete floors or to types of framed flooring substrate specified by the manufacturer.

These materials create a smooth surface, fill depressions and can also be used to improve or remedy surface planarity, where it is out of specification.

The manufacturer's recommendations concerning service conditions, permitted thickness, substrates and substrate moisture levels shall be adhered to.

2.13.2 Feathering compounds

Feathering compounds are predominantly proprietary mortars, which are typically cementitious and non-flowing. Feathering compounds are classed as underlayments and are applied by trowel to floors and walls. The primary purpose of these mortars is to smooth surfaces, repair damage or holes, and to create ramps between differing floor heights.

The manufacturer's recommendations concerning service conditions, permitted thickness, substrates and substrate moisture levels shall be adhered to.

It is possible to feather down these products to less than a millimetre in thickness, at their edges.

2.14 Waterproof membranes

Waterproof membranes shall conform to the following:

- (a) AS/NZS 4858, when used in internal wet areas.
- (b) AS 4654.1, when used in external wet areas.

Waterproofing membranes used in tiling systems shall conform to AS ISO 13007.5 for liquid applied membranes and AS 13007.6 for sheet membranes. Tile adhesives shall be tested for compatibility with the applied waterproofing membrane, prior to being put into use.

NOTE Some liquid applied membranes are regarded as unbonded underlays or separating layers unless they are adhered to both the substrate and the overlying finish.

2.15 Reinforcement

2.15.1 Welded wire mesh

Welded wire mesh should have a mesh size of between 25 mm × 25 mm and 75 mm × 50 mm. It should be fabricated with wire of between 1.2 mm and 2.0 mm in diameter.

NOTE “Chicken wire” is often used to provide an improved key, but should not be used in place of reinforcement. Metal reinforcement shall be galvanized in accordance with AS/NZS 4534.

2.15.2 Expanded metal lath

Expanded metal lath shall meet the requirements of ASTM C847. For tiling purposes, the sizes are either —

- (a) 1.4 kg/m² (or heavier); or
- (b) 9.5 mm high rib of 1.8 kg/m² (or heavier).

Both are self-furring.

Where used, metal lath, fixings and accessories should be galvanized or made from austenitic stainless steel. The use of unprotected ferrous materials is not recommended in external or wet area installations.

Fasteners that are resistant to corrosion, including that caused by electrolysis, shall be used for the selected lath. Fasteners should have heads large enough not to pull through the secured lath. The type and size of fasteners that are to be used will depend on the background that will need to support the lath and tiling load. Fastening selection should be confirmed with the fastener manufacturer.

2.16 Storage

All tile installation materials should be stored in moderate conditions prior to installation, i.e. in frost-free environments and in temperatures not exceeding 35°C. Adhesives, in particular, should not be stored in areas susceptible to high temperature.

Other than sand used in sand and cement mortar, materials should be kept dry. Sand for mortar should be stored in a damp environment so that it is able to retain its shape when cut vertically. Sand should also be protected from the weather in order to ensure that it is kept clean.

Materials should be kept at a temperature and moisture content that enable it to be suitable for immediate use when retrieved from storage.

Section 3 Tiling systems

3.1 General

This section provides details of tiling systems based on substrate, tile type, installation materials and intended service requirements. The use of waterproof membranes is required under some circumstances (see [Clause 2.14](#)). Refer to the National Construction Code for these requirements. In other cases, the tiling specification may specify the use of waterproof membranes. Installation of waterproof membranes shall conform to AS 3740 for wet areas or AS 4654.2 for external above ground areas.

For information regarding the installation of waterproof membranes in swimming pools and spas, see [Appendix E](#).

AS 3740 does not cover kitchens or commercial and industrial applications. While the general principles of AS 3740 apply to these applications, refer to the membrane manufacturer for confirmation that that the membrane is suitable for these applications and instructions regarding installation.

NOTE A tiling system without a membrane is not waterproof.

See [Appendix G](#) for information regarding other specific tiling conditions, such as in industrial and institutional environments.

See [Appendix F](#) for information regarding the selection of appropriate tiles for the application and performance level.

For suitability of substrates, see [Section 4](#).

For installation of movement joints, see [Clause 5.4.7](#).

For the method of installation, see [Section 5](#).

For substrate maximum deflection requirements, see [Table 4.1.2](#).

All proprietary materials shall be selected and installed in accordance with manufacturers' instructions.

3.2 Floors

3.2.1 Drainage of water

All tiling systems, including on stairs, shall be designed and constructed to maximize the drainage of water from the surface and subsurface, to enable the egress of water without causing damage to the structure.

NOTE Damage to the structure may be exacerbated by salts contained in subsurface water.

Guidance on the gradients for drainage in wet area and external floor tiling finishes is described in [Appendix D](#).

3.2.2 Floor tiling systems

[Table 3.2.2](#) provides a summary of the service requirements for five performance level categories of floor tiling systems.

Table 3.2.2 — Floor tiling installation systems

Performance level category	Service requirements	Concrete floor systems Clause number	Framed floor systems Clause number
5	For extra heavy and high impact use, e.g. in food plants, commercial kitchens and industrial use, etc.	3.2.4.1 3.2.4.2 3.2.4.3 3.2.4.5a 3.2.4.6a	N/A
4	Able to withstand heavy loads, high traffic, shock from scissor lifts, ride on cleaning machines and low speed vehicles with larger rubber tyres, e.g. in mass transit streetscapes and shopping centres, etc.	3.2.4.1 3.2.4.2 3.2.4.3 3.2.4.5a 3.2.4.6a 3.2.4.7	N/A
3	Able to withstand moderate loads and impacts, e.g. in public spaces, restaurants, and shopping centres, etc.	3.2.4.1 3.2.4.2 3.2.4.3 3.2.4.4 3.2.4.5 3.2.4.6 3.2.4.7	3.2.5.1 3.2.5.2 3.2.5.3 3.2.5.4
2	Able to withstand light loads and impacts, e.g. in small commercial office spaces, reception areas, kitchens and bathrooms, etc.	3.2.4.1 3.2.4.2 3.2.4.3 3.2.4.4 3.2.4.5 3.2.4.6 3.2.4.7	3.2.5.1 3.2.5.2 3.2.5.3 3.2.5.4
1	Able to withstand residential loads, e.g. in kitchens, bathrooms, and foyers, etc.	3.2.4.1 3.2.4.2 3.2.4.3 3.2.4.4 3.2.4.5 3.2.4.6 3.2.4.7	3.2.5.1 3.2.5.2 3.2.5.3 3.2.5.4

^a Where specified by manufacturers, this system may be used for performance level categories 4 and 5.

NOTE 1 Any system may be used for a lighter duty application.

NOTE 2 Consideration should be given to the wear and the slip resistance properties of the tile surface.

NOTE 3 Design advice may be needed regarding the use of separating layers for categories 4 and 5.

NOTE 4 Performance level categories 1 to 5 will be equivalent to passing at least 3, 6, 10, 12 and 14 cycles, respectively, of testing in accordance with ASTM C627.

3.2.3 Installation selection criteria

Installation systems shall be selected in accordance with [Table 3.2.3](#).

NOTE [Table 3.2.3](#) provides bond coat selection criteria on the basis of adhesion strength. Other factors such as deformability also need to be considered. Manufacturers' recommendations for the selection of an installation system should be sought.

Table 3.2.3 — Installation system selection criteria

Performance level category	Adhesive fixing		Screeds	Wet mortar bed fixing			
	Tiles with < 3 % water absorption	Other tiles		Tiles with < 3 % water absorption	Other tiles		
1	Minimum of C2 cementitious, or R1 reaction resin	Minimum of C1 cementitious, or R1 reaction resin	Proprietary or non-proprietary	Proprietary bond coat material	Proprietary or non-proprietary bond coat material		
2							
3							
4	Minimum of C2 cementitious, or R1 reaction resin		Proprietary specified by manufacturers	Proprietary installation systems specified by manufacturers			
5							

3.2.4 Concrete floors

3.2.4.1 Bonded screed

A floor tiling installation over a bonded screed on a concrete slab is shown in [Figure 3.2.4.1](#).

A bonded screed application may be used for all performance level categories (see [Table 3.2.2](#)). For the installation of non-proprietary screeds, see [Appendix A](#).

For a bonded screed, the bond coat shall be applied to the surface (concrete or membrane) immediately prior to application of the screed.

For on-ground installations, a drainage layer or moisture vapour barrier may be needed to protect the tiling system.

Where a waterproof membrane is required in accordance with AS 3740 or AS 4654.2 and the wet bed method of installation is used, the waterproof membrane shall be placed on the concrete.

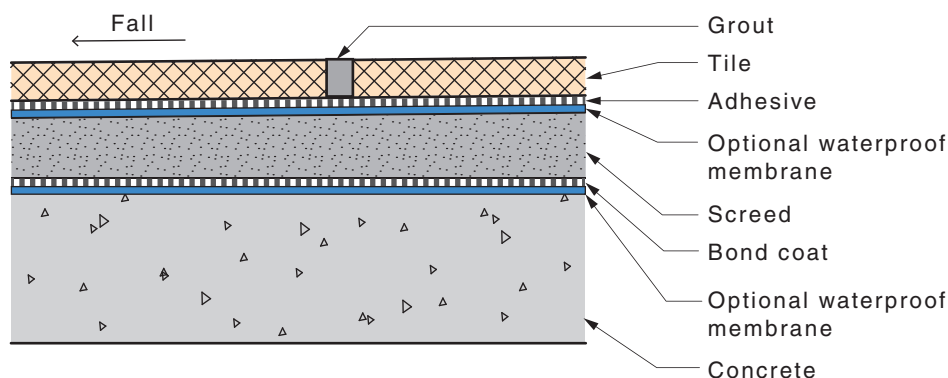


Figure 3.2.4.1 — Bonded screed on a concrete slab

3.2.4.2 Direct adhesive method

Floor tiling installed directly onto a concrete slab is shown in [Figure 3.2.4.2](#).

A direct adhesive method may be used for all performance level categories (see [Table 3.2.2](#)).

For on-ground installations, a drainage layer or moisture vapour barrier may be needed to protect the tiling system.

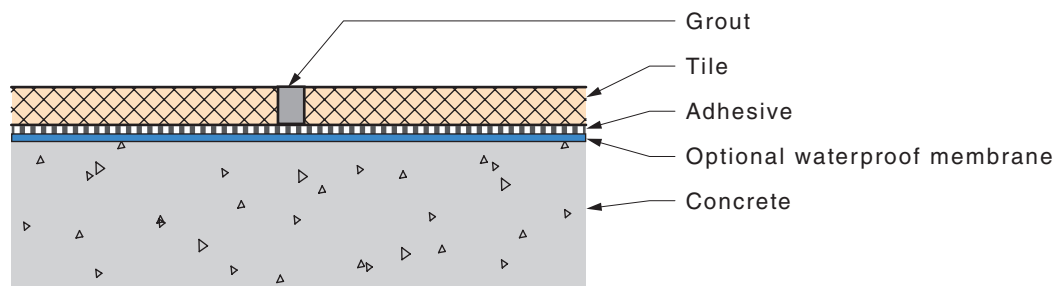


Figure 3.2.4.2 — Direct adhesive method

3.2.4.3 Unbonded screed over separating layer

Floor tiling installed over an unbonded screed on a concrete slab is shown in [Figure 3.2.4.3](#).

An unbonded screed application may be used for all performance level categories (see [Table 3.2.2](#)). See [Appendix A](#) regarding the installation of non-proprietary screeds.

For on-ground installations, a drainage layer or moisture vapour barrier may be needed to protect the tiling system.

Where a waterproof membrane is required in accordance with AS 3740 or AS 4654.2 and the wet bed method of installation is used, the waterproof membrane shall be placed on the concrete.

This method is also suitable for unbonded waterproof membranes.

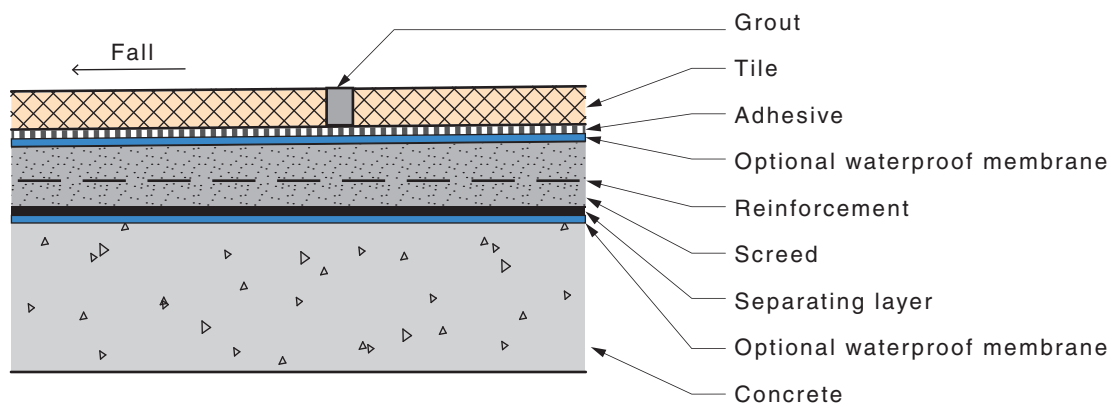


Figure 3.2.4.3 — Unbonded screed over separating layer

3.2.4.4 Screed with in-floor heating element

Floor tiling installed onto a concrete slab with in-floor heating with a screed is shown in [Figure 3.2.4.4\(A\)](#) and with a proprietary underlayment in [Figure 3.2.4.4\(B\)](#).

NOTE An adhesive may be substituted for a proprietary underlayment.

Floor tiling installed onto a concrete slab with an in-floor heating element application may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)). See [Appendix A](#) regarding the installation of non-proprietary screeds.

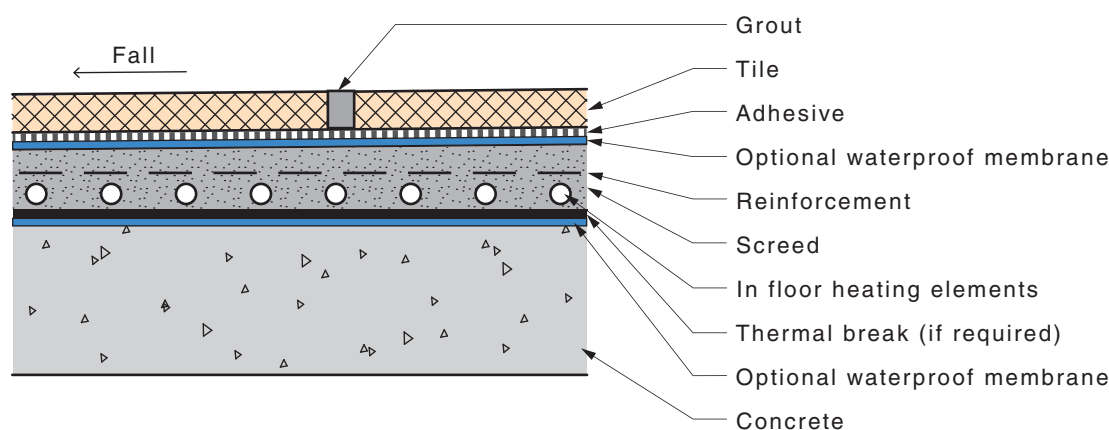


Figure 3.2.4.4(A) — Screed with in-floor heating element

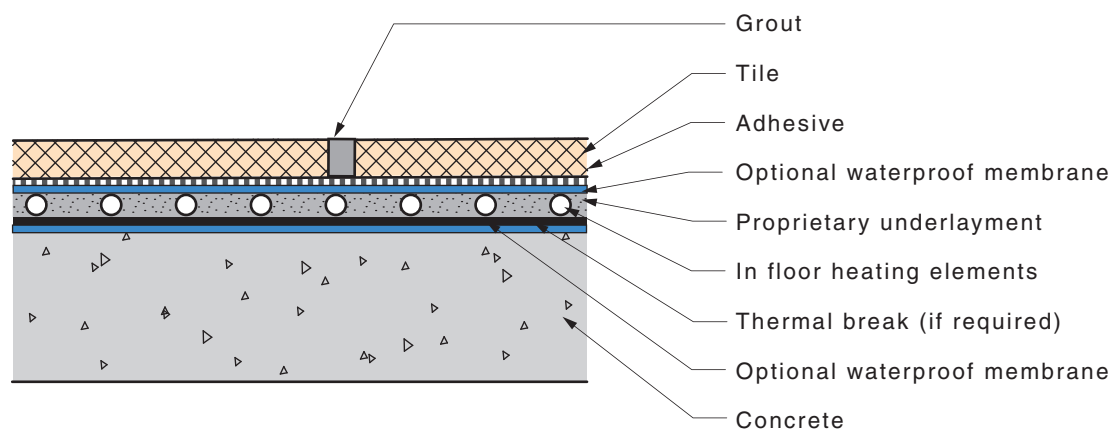


Figure 3.2.4.4(B) — Proprietary underlayment with in-floor heating element

3.2.4.5 Functional underlayment

A floor tiling installation incorporating an underlayment to a concrete floor is shown in [Figures 3.2.4.5\(A\)](#) and [3.2.4.5\(B\)](#).

An underlayment system, as shown in [Figure 3.2.4.5\(A\)](#), may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)). Where specified by manufacturers' instructions, an underlayment system as shown in [Figure 3.2.4.5\(B\)](#) may be used for performance level categories 4 and 5.

For on-ground installations, a drainage layer or moisture vapour barrier may be needed to protect the tiling system.

Where a waterproof membrane is required in accordance with AS 3740 or AS 4654.2 and the wet bed method of installation is used, the waterproof membrane shall be placed on the underlayment.

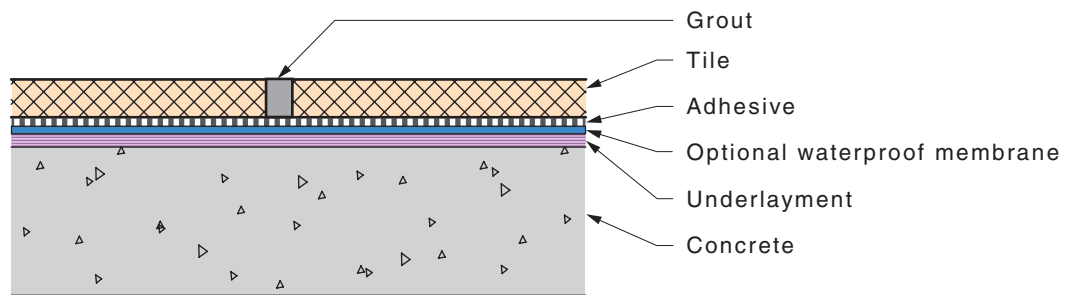


Figure 3.2.4.5(A) — Direct adhesive method to underlayment

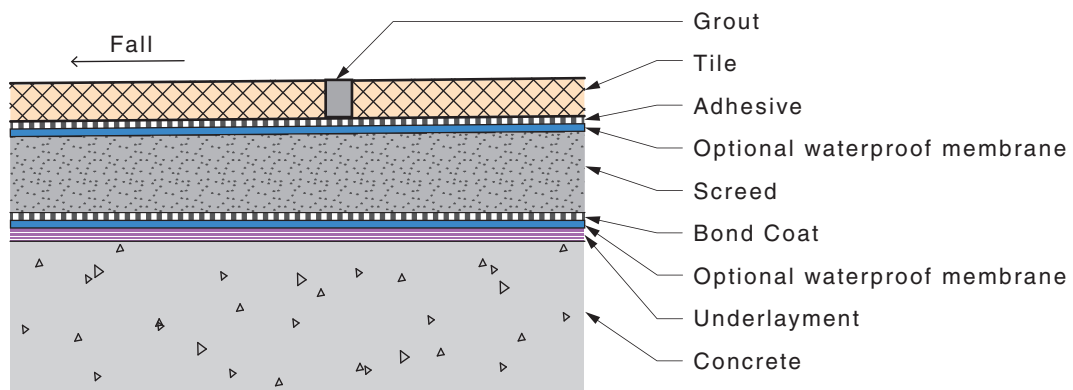


Figure 3.2.4.5(B) — Screed to underlayment

3.2.4.6 Roof deck or balcony with drainage mat

A roof deck or balcony with a drainage mat is shown in [Figures 3.2.4.6\(A\)](#) and [3.2.4.6\(B\)](#). Where a waterproof membrane is required, see [Clause 4.2.1](#).

A roof deck or balcony with direct adhered tiles over a drainage mat, as shown in [Figure 3.2.4.6\(A\)](#), may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)). Where specified by manufacturers' instructions, a roof deck or balcony with screed over a drainage mat, as shown in [Figure 3.2.4.6\(B\)](#), may be used for all performance level categories (see [Table 3.2.2](#)).

Where the concrete slab does not have a gradient of a minimum of 1:100 to the drainage outlet, this gradient shall be achieved by applying a screed or a proprietary underlay.

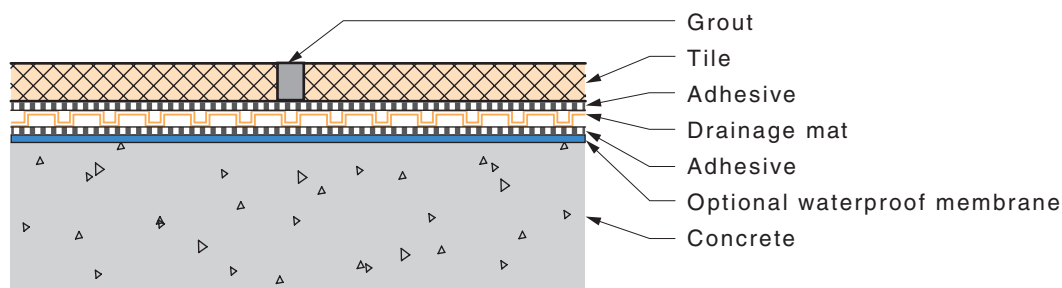


Figure 3.2.4.6(A) — Roof deck or balcony with direct adhered tiles over drainage mat

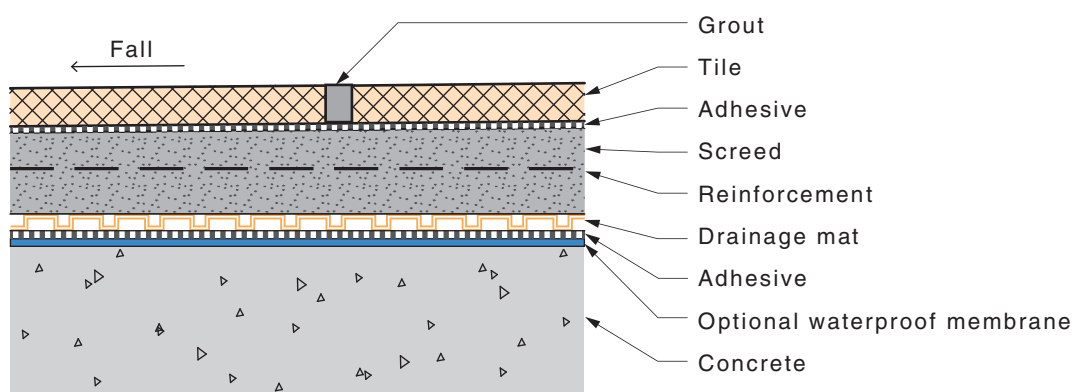


Figure 3.2.4.6(B) — Roof deck or balcony with screed over drainage mat

3.2.4.7 Roof deck or balcony drainage

A roof deck or balcony with drainage to an outfall is shown in [Figures 3.2.4.7\(A\), 3.2.4.7\(B\) and 3.2.4.7\(C\)](#) and may be used for performance level categories 1 to 4 (see [Table 3.2.2](#)). Where a waterproof membrane is required, see [Clause 4.2.1](#). Where the concrete substrate has the requisite fall, the waterproof membrane may be applied directly over the substrate as shown in [Figure 3.2.4.7\(A\)](#).

NOTE Where a non-proprietary screed is placed over a membrane, there may be an increased risk of efflorescence.

Where the concrete substrate does not have the requisite fall, the fall shall be created before applying the membrane. An example to accommodate this is shown in [Figure 3.2.4.7\(B\)](#).

Where the concrete slab does not have a gradient of a minimum of 1:100 to the drainage outlet, this gradient shall be achieved by applying a screed or a proprietary underlay.

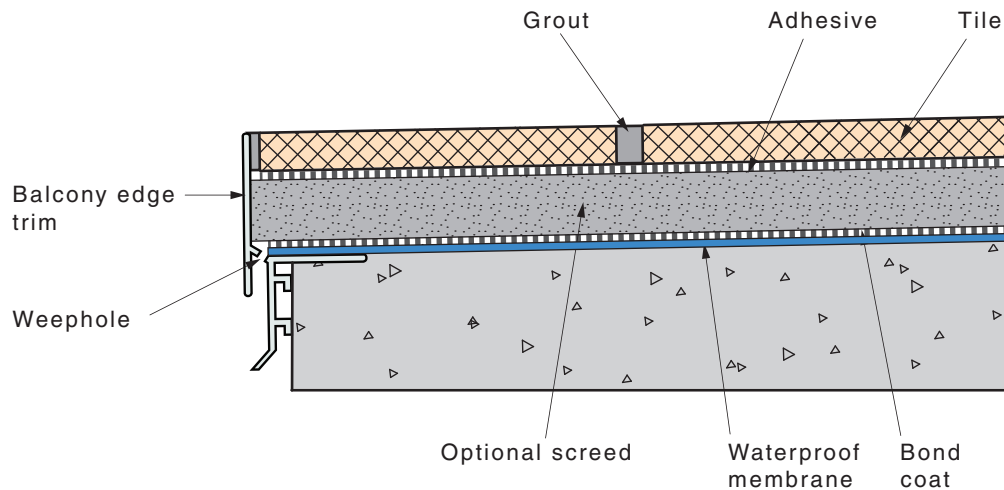


Figure 3.2.4.7(A) — Edge drainage with waterproof membrane under screed

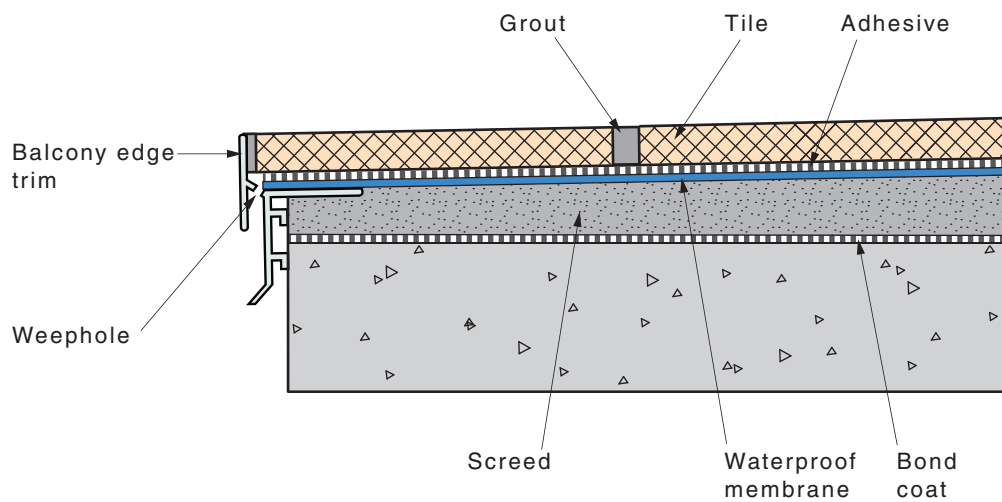


Figure 3.2.4.7(B) — Edge drainage with waterproof membrane over screed

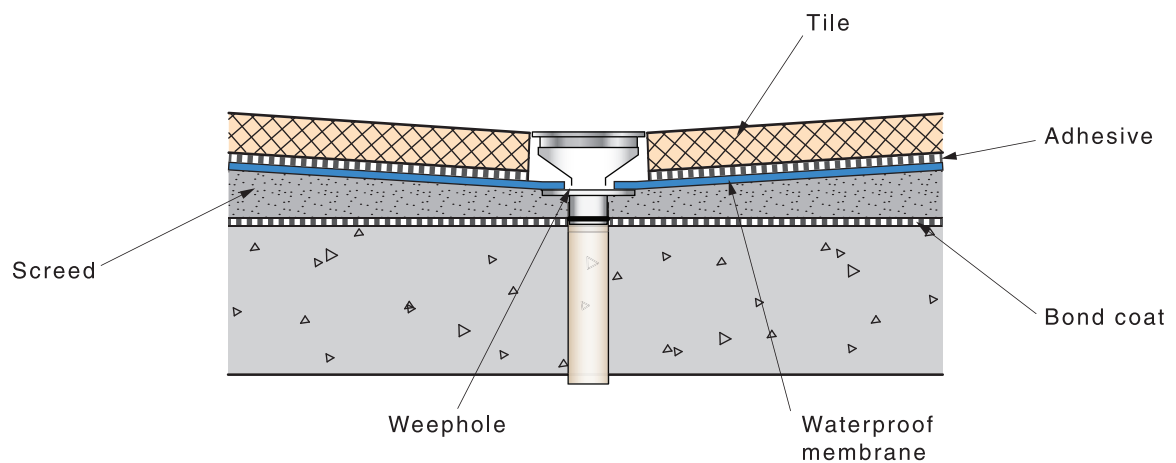


Figure 3.2.4.7(C) — Roof deck or balcony central drainage

3.2.5 Framed floors

3.2.5.1 Fibre-cement sheet flooring installations on joists

Floor tiling installed directly onto a fibre-cement sheet on joists is shown in [Figure 3.2.5.1](#).

A fibre-cement sheet flooring installation on joists may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)).

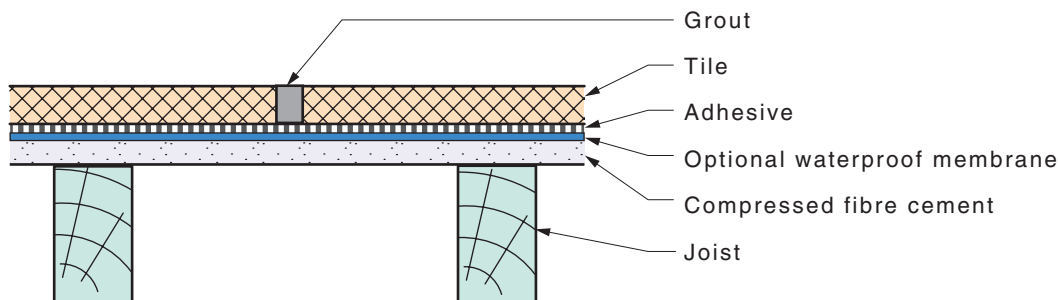


Figure 3.2.5.1 — Fibre-cement sheet flooring installation on timber joists

3.2.5.2 Timber substrates overlaid with fibre-cement sheet

Floor tiling installed directly onto a timber substrate overlaid with fibre-cement sheet is shown in [Figure 3.2.5.2](#).

A timber substrate overlaid with fibre-cement sheet may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)).

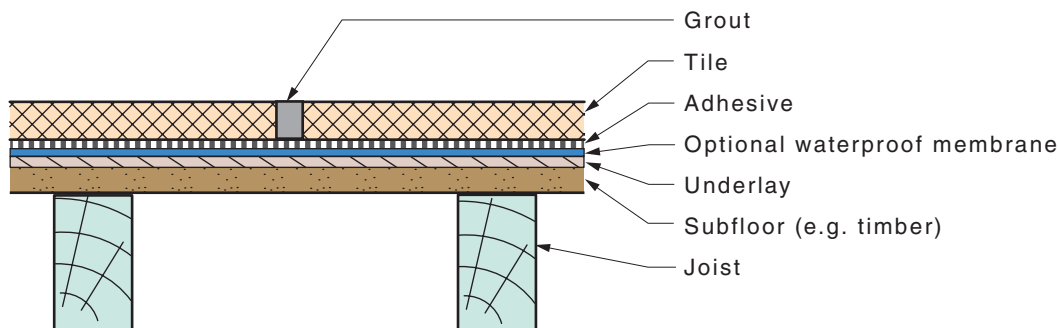


Figure 3.2.5.2 — Timber substrates overlaid with fibre-cement sheet

3.2.5.3 Framed substrates with an unbonded screed and separating layer

Floor tiling installed over an unbonded screed on a framed substrate is shown in [Figure 3.2.5.3](#).

An unbonded screed application may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)). See [Appendix A](#) regarding the installation of non-proprietary screeds.

Where a waterproof membrane is required in accordance with AS 3740 or AS 4654.2 and the wet bed method of installation is used, the waterproof membrane shall be placed on the subfloor.

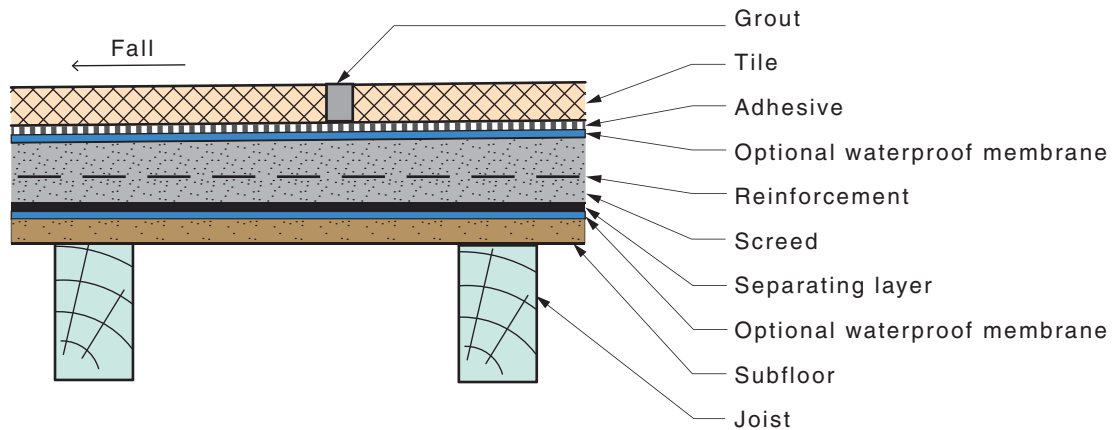


Figure 3.2.5.3 — Timber substrates with a cement mortar separating layer

3.2.5.4 Framed substrates with screed and in-floor heating

A floor tiling installation with in-floor heating on a framed substrate with a screed is shown in [Figure 3.2.5.4\(A\)](#) and with a proprietary underlayment in [Figure 3.2.5.4\(B\)](#).

NOTE An adhesive may be substituted for a proprietary underlayment.

A floor tiling installation with in-floor heating on a framed substrate application may be used for performance level categories 1 to 3 (see [Table 3.2.2](#)). See [Appendix A](#) regarding the installation of non-proprietary screeds.

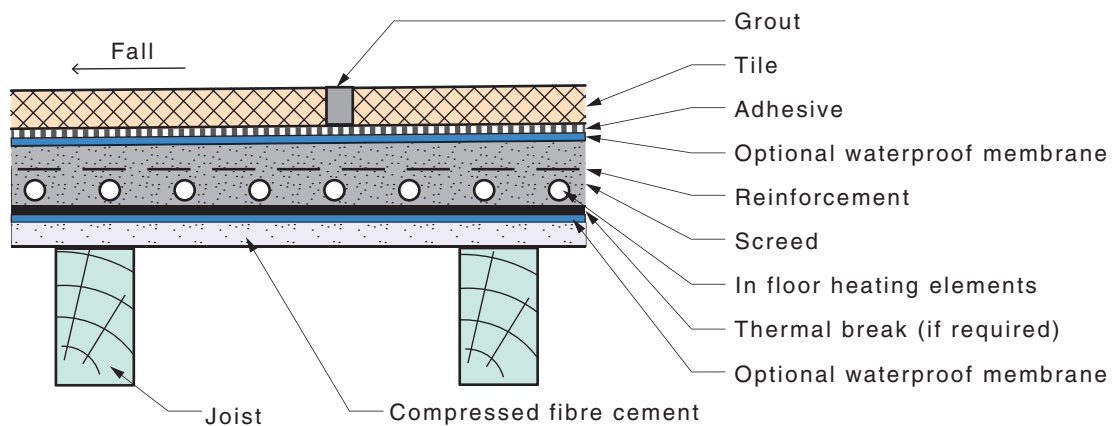


Figure 3.2.5.4(A) — Framed substrates with screed and in-floor heating

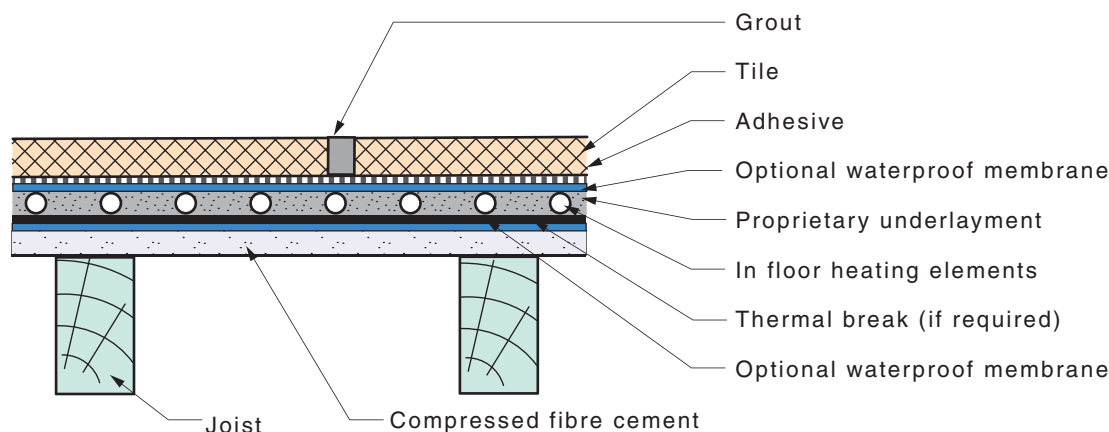


Figure 3.2.5.4(B) — Framed substrates with proprietary underlayment and in-floor heating

3.3 Walls

3.3.1 General

For wall tiles with < 3 % water absorption, a minimum C2 cementitious or R1 reaction resin adhesive shall be used.

NOTE Other factors such as deformability also need to be considered and manufacturers' recommendations for the selection of an installation system should be sought.

3.3.2 Masonry or concrete construction

3.3.2.1 Bonded render

Wall tiling installed over a bonded render on a concrete or masonry wall is shown in [Figure 3.3.2.1](#).

See [Appendix B](#) regarding the installation of non-proprietary renders.

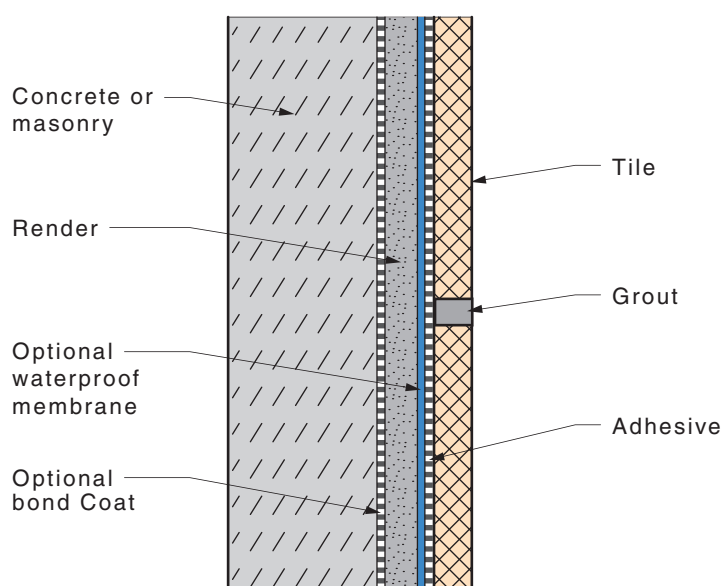


Figure 3.3.2.1 — Wall tiling on bonded render

3.3.2.2 Direct adhesive method

A wall tiling installation using a direct adhesive method on a concrete or masonry wall is shown in [Figure 3.3.2.2](#).

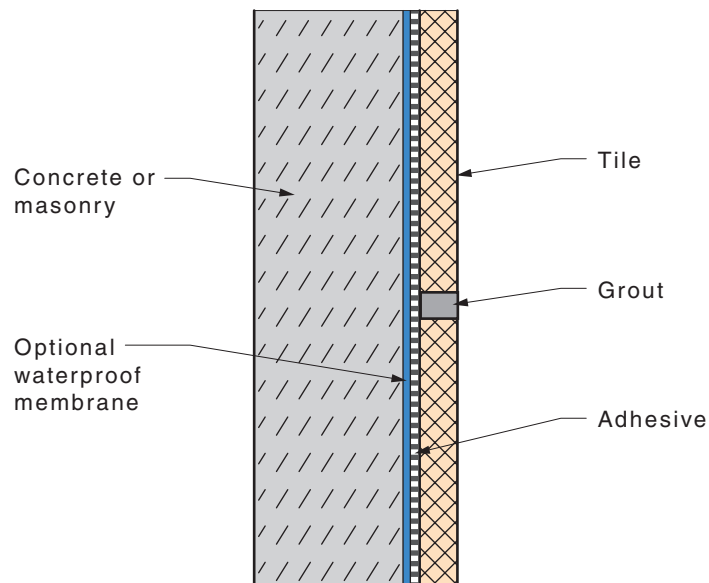


Figure 3.3.2.2 — Wall tiling using direct adhesive method

3.3.2.3 Render over a separating layer

A wall tiling installation using a render on a concrete or masonry wall over a separating layer is shown in [Figure 3.3.2.3](#). Where this method is used over brick or block masonry, perpend and joints should be made flush with the wall face prior to application of the separating layer.

See [Appendix B](#) regarding the installation of non-proprietary renders.

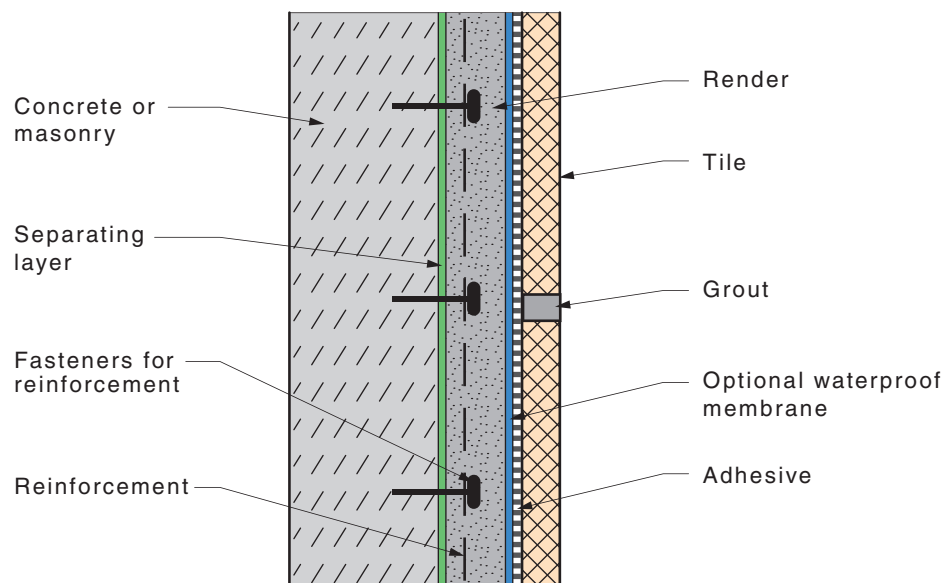


Figure 3.3.2.3 — Wall tiling using a render over a separating layer on concrete or masonry

3.3.3 Framed construction

3.3.3.1 Direct adhesive to wall lining board

A wall tiling installation using direct adhesive applied to the wall lining board is shown in [Figure 3.3.3.1](#).

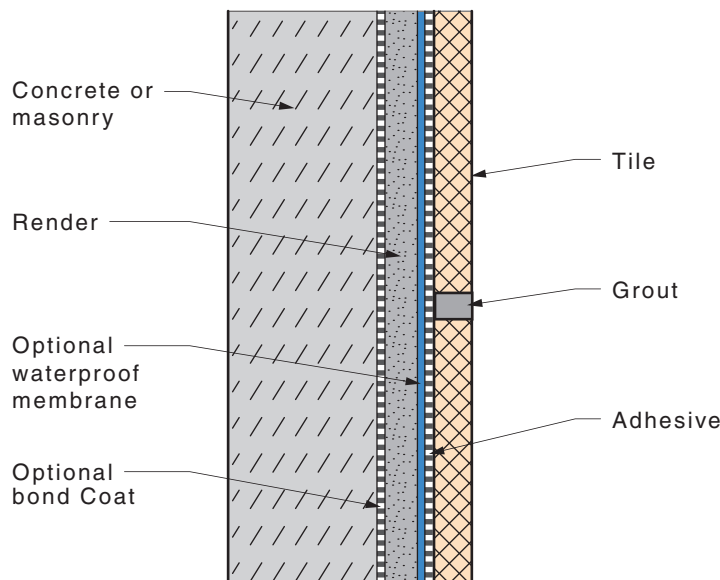


Figure 3.3.3.1 — Direct adhesive to wall lining board on framed construction

3.3.3.2 Direct adhesive to wall lining board with support angles

A wall tiling installation using direct adhesive applied to the wall lining board with support angles, is shown in [Figure 3.3.3.2](#). Fasteners for the support angles shall be securely fixed to the timber or metal stud in accordance with the applicable design load requirements for the construction.

NOTE Support angles are used to provide additional support for heavy deadloads on lightweight construction.

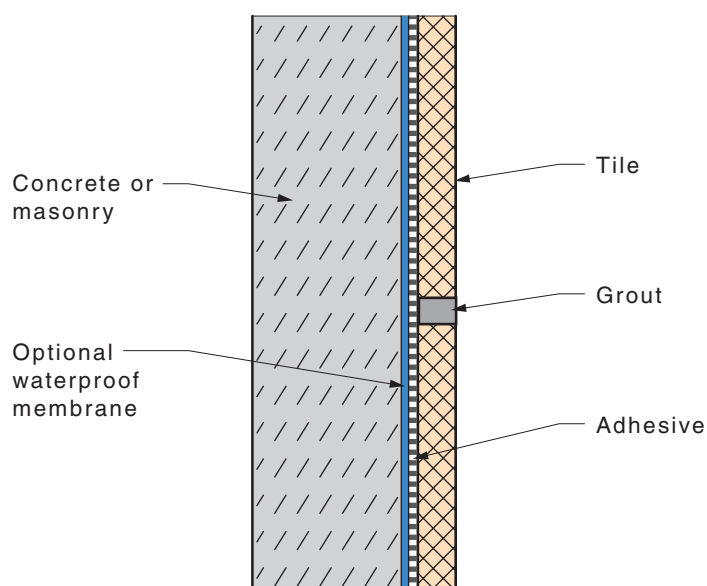


Figure 3.3.3.2 — Direct adhesive to wall lining board with support angles

3.3.4 Permanent formwork

3.3.4.1 Unbonded render over separating layer

Where direct bonding to the wall surface is not practicable, for example to permanent formwork, an unbonded render over a separating layer may be used. A wall tiling installation using unbonded render over a separating layer is shown in [Figure 3.3.4.1](#).

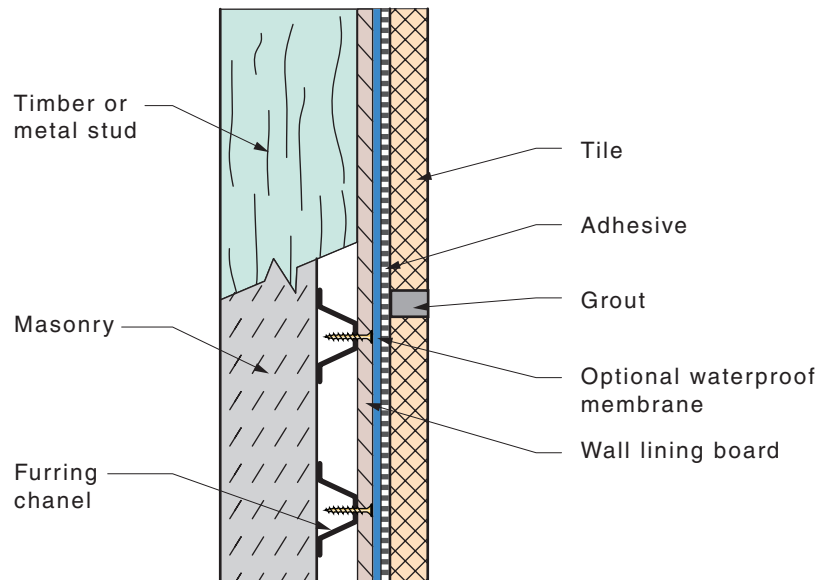


Figure 3.3.4.1 — Unbonded render over separating layer

3.3.5 Metal

3.3.5.1 Direct adhesive method

A wall tiling installation using direct adhesive applied to a metal-clad wall is shown in [Figure 3.3.5.1](#). The adhesive may require a primer to be applied to the metal surface in accordance with manufacturer's requirements.

NOTE 1 Generally, a reaction resin adhesive is used for bonding to metals.

NOTE 2 Corrosion protection may be required when tiling to metal.

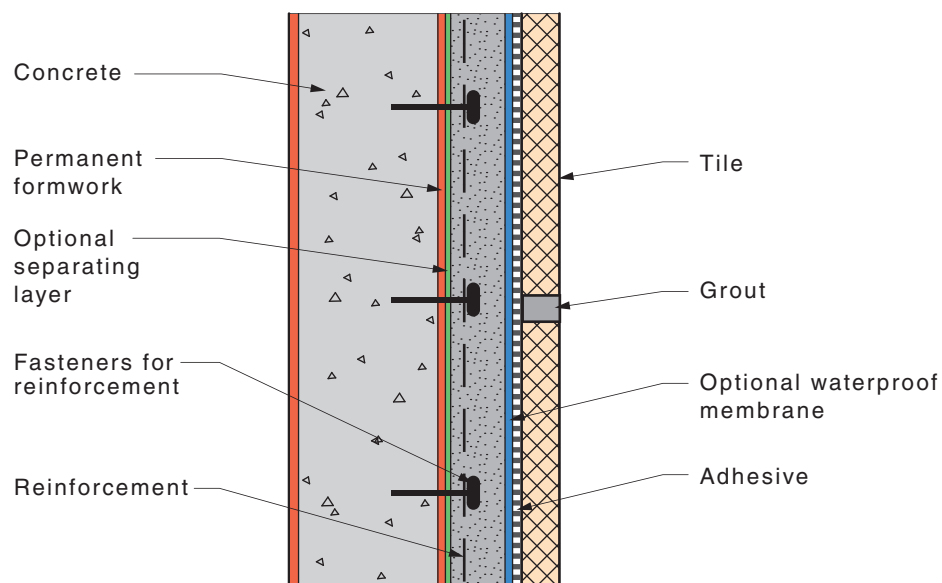


Figure 3.3.5.1 — Direct adhesive to metal sheet

Section 4 Preparation of substrate for tiling

4.1 Determination of suitability

4.1.1 General

Prior to the installation of tiles, the substrate needs to be prepared.

The substrate shall be prepared by undertaking the following steps in the following order:

- (a) The substrate shall be inspected in order to determine whether it is sound and suitable for the intended tiling application. This includes taking into account the following:
 - (i) Deflection.
 - (ii) Flatness.
 - (iii) Surface profile.
 - (iv) Levels and falls, as well as plumbness.
 - (v) Porosity.
 - (vi) Unsuitable and problematic substrates.
 - (vii) Moisture content.
 - (viii) Maximum dead loads.
- (b) Where the substrate is deemed unsuitable, a determination shall be made whether the surface requires repairs or whether it can be corrected as part of the tiling process. Methods for correction include the use of underlays, underlayments, screeds, wall patch mortars, etc. See [Appendix H](#) where an underfloor heating underlayment system is to be used.
- (c) Tiling shall be delayed pending drying and allowance for shrinkage of fresh concrete or mortars.

The tiling installation is then performed when the substrate has been deemed acceptable and when site conditions are appropriate.

NOTE Care should be taken where the systems used will be hidden by this preparatory work, e.g. flashings and waterproofing of shower compartments.

4.1.2 Deflection

The structural background shall be structurally sound, stable and rigid enough to support ceramic and stone tiles, as well as similar finishes. Substrate deflection under all live, dead and impact actions, including concentrated loads, shall not exceed the values specified in [Table 4.1.2](#), where L = span length.

Table 4.1.2 — Substrate maximum deflection by tile type

Tile installation system	Maximum deflection
Ceramic tile	$L/360$
Porcelain panels	$L/360$
Natural stone tiles	$L/720$
Reconstituted stone tiles	$L/720$
NOTE The deflection values given in this table are the maximum allowable deflection. Site-specific requirements should be considered when selecting a tile type or system.	

4.1.3 Flatness, surface profile, levels and falls, and plumbness

Substrates shall be true to the required plane in order to enable the tiling system to meet the deviations specified in [Clause 5.4.8.1](#). The flatness tolerances for the substrate are identified in [Table 4.1.3\(a\)](#). To achieve the deviations in trueness and the tolerances for flatness, a levelling compound underlayment may be required. Framed walls that are out of plumb or alignment may need to be replaced. Masonry walls that are out of plumb or alignment may need to be rendered or treated with a repair mortar.

Greater accuracy to datum is generally required when fixing large tiles, panels and slabs. In such cases, the use of levelling compound underlayment is recommended (see [Clause 4.2.6](#)).

Greater accuracy to datum may be needed in small rooms, along the line of partition walls, in the vicinity of door openings and where specialized equipment is to be installed directly on the floor.

For concrete substrates, the surface profile shall be in accordance with [Table 4.1.3\(b\)](#).

Table 4.1.3(a) — Substrate surface flatness tolerances

Fixing method	Flatness
Wet mortar bed fixing	20 mm in 3 m
Adhesive (tile length < = 380mm)	6 mm in 3 m and 1.5 mm in 0.3 m
Adhesive (tile length > 380mm)	3 mm in 3 m and 1.5 mm in 0.6 m

Table 4.1.3(b) — Concrete surface profile tolerances

Fixing method	CSP No.
Wet mortar bed fixing	1–10
Adhesive (tile length < = 380mm)	1–4
Adhesive (tile length > 380mm)	1–5
NOTE For concrete surface profile (CSP) details, see Appendix J .	

4.1.4 Porosity

The porosity of the surface of the substrate should be tested in accordance with ASTM F3191, in order to be able to select an appropriate adhesive and, if required, a primer.

A porous substrate is one that will absorb surface water, whereas a non-porous substrate is one where water will bead on the surface. Both may require priming, as instructed by the manufacturer of the adhesive/bond coat.

4.1.5 Unsuitable and problematic substrates

4.1.5.1 General

Many substrates are unsuitable and not recommended for direct bonding of tiles due to dimensional instability, structural inadequacy or because the bond is difficult to achieve to them. Problematic substrates are those that, when properly prepared, can receive direct bonding. Many unsuitable and problematic substrates are able to support tile installations after further preparation, treatment with suitable underlays or underlayments, or if the tiles are installed with specialized adhesive systems.

4.1.5.2 Unsuitable substrates

The following are some examples of substrates that, due to either adhesion or structural issues, should not be directly bonded to:

- (a) *Some wood-based materials* — Masonite, particle board, MDF, strip timber floors, coated and resin impregnated boards, dimensionally unstable boards, and timber surfaces that are not sufficiently supported and rigid enough to support the loads.
- (b) *Contaminated concrete* — With laitance, oil, waxes, grease and the like; treated with curing compounds, densifiers, crystalline additives and the like; and highly burnished steel trowel, friable broom, or loose wood float finishes; or concrete with vertical moving cracks.
- (c) *Some underlays* — Mats with low compressive strength, cement sheets or boards with bond inhibiting coatings, and polystyrene insulation boards.
- (d) *Some waterproof membranes* — Moisture cured polyurethane membranes, bitumen membranes, membranes that inhibit bond, and membranes that are not structurally sound enough to withstand a tiling load.
- (e) *Existing finishes* — Vinyl asbestos tiles and cutback adhesives, cushioned back sheet vinyl, unsound ceramic or stone tiles, sealed or waxed terrazzo or stone finishes.

NOTE Expert advice should be sought where suspected asbestos-containing materials are present.

4.1.5.3 Problematic substrates

The following are some examples of substrates that may be made ready with surface preparation and the use of compatible adhesives:

- (a) *Metallic surfaces* — Steel, aluminium, and stainless steel, including oxidized or corroded metal surfaces.
- (b) *Painted surfaces* — Otherwise suitable substrates that are coated with paints.
- (c) *Epoxy and polyester coatings* — Epoxy waterproof membranes, epoxy flooring, and polyester composite pool shells.
- (d) *Vinyl tile* — Well bonded solid vinyl tile or sheet.
- (e) *Access floors* — Metal or gypsum based modular systems.
- (f) *Cracked and chemically treated concrete* — Concrete with shrinkage cracking of a non-structural nature, and chemically hardened concrete.
- (g) *Post-tensioned concrete* — Large areas of tiling where the movement potential is unknown.

4.1.6 Management of substrates unsuitable for direct bonding

4.1.6.1 General

Unsuitable or problematic substrates may be prepared for a tile installation where their structural rigidity meets the requirements of [Clause 4.1.2](#) and the moisture content does not exceed manufacturers' specifications.

Unbonded screeds or renders may be used over rigid, unsuitable or problematic substrates as an alternative to direct bonding in many instances. This would include the use of screeds over cleavage membranes on floors or renders over cleavage membrane and lath systems on walls.

Cracks in concrete should be assessed in order to determine the likelihood of further movement. Where there is thought to be a low risk of further movement, proprietary adhesives may be used. Otherwise,

an underlay may be required. Any loose materials or dust, from either building debris or residue from mechanical preparation, shall be removed by vacuum cleaning and wet wiping.

4.1.6.2 Treated concrete surfaces

Burnished concrete surfaces, waterproofing additives, curing compounds and other types of treatments or coatings adversely affect the adhesion of tile installation systems and shall be removed by mechanical treatment methods. Physical defects on concrete surfaces, which compromise the adhesion of the tiling systems shall be removed by mechanical preparation methods. This includes laitance or rain damage.

NOTE Mechanical preparation methods, such as diamond grinding or captive shotblasting, create a suitable surface for the subsequent steps in the tile installation process. The quality of the surface profiling after surface preparation can be compared against concrete surface profile (CSP), as shown in [Appendix J](#).

4.1.6.3 Metallic substrates

Some tiles may be installed on metal substrates following adhesive manufacturer's instructions. Typical applications include internal metal stairs and floors, internal ship decks, and cool room panel walls. Refer to tile and adhesives manufacturers' specifications for product instructions. Where tiles are to be installed on metal substrates, the following should be taken into account:

- (a) The flexibility of the surface intended to be tiled may limit the size and thickness of the tiles to be installed.
- (b) Whether there is a requirement for a protective anti-corrosion surface coating to be applied on the metal surface prior to the bond coat and primer. Alkaline C class adhesives can corrode bare metallic surfaces.
- (c) Checker plate type metal floors may require an underlayment to be installed in order to smooth the surface prior to tiling.
- (d) Maritime applications on commercial vessels and installations (i.e. offshore oil platforms) are subject to safety of life at sea (SOLAS) regulations and certified systems may be required.
- (e) Painted metal surfaces typically require a small degree of surface preparation, such as sanding prior to tiling.
- (f) Polyester powder coated surfaces, such as cool room panels, are notoriously difficult to bond to and manufacturer's advice should be sought.
- (g) Bonding tiles directly to external metal substrates is not recommended due to the potential for excessive thermal movement.

Bare metal surfaces shall be cleaned to a bright surface by mechanical abrasion and then wiped down with solvent prior to the application of the adhesive.

4.1.6.4 Resilient flooring

Vinyl tile and sheet shall be firmly bonded to the substrate. Vinyl tile or sheet surfaces shall be prepared by abrasion or a proprietary polish stripping agent to remove coatings and waxes prior to the application of tile installation systems.

NOTE Expert advice should be sought where asbestos-containing materials are suspected to be present.

4.1.6.5 Non-structural cracks

Shrinkage or induced cracks in concrete, concrete masonry, mortar beds and the like can transfer into the tile and appear on the face of the tile due to dynamic lateral movement in substrate cracks where tiles are rigidly bonded over them. Anti-fracture membranes or underlayment systems may be incorporated into the installation in order to reduce or eliminate cracks from being reflected into the

tile. Anti-fracture membrane or underlayment system manufacturers should be consulted regarding the appropriate system.

4.1.6.6 Structural cracks

Where structural cracks are present, a structural engineer needs to assess the extent of the issue. This assessment shall be completed before any further work is carried out.

4.1.6.7 Treatment of cracks

An anti-fracture membrane or underlay shall be selected based on its ability to function as designed with the given expected potential crack movement and proposed service loads.

The anti-fracture product shall be installed in accordance with the manufacturer's instructions.

Non-structural substrate cracks shall be cleaned and prepared to present with structurally sound flanks. Where the anti-fracture product manufacturer requires cracks to be filled, they shall be filled with flexible sealants, adhesives or other fillers prior to treatment.

Unless permitted by the anti-fracture product manufacturer, an individual tile shall not be placed over an area that is only partially covered by the anti-fracture membrane.

NOTE Sealants may be used in place of normal grout in joints that are in close proximity to treated cracks.

Liquid applied anti-fracture systems should be limited to cracks less than 3 mm wide. Class 3 waterproof membranes may be used for this purpose where specified by the manufacturer.

4.1.7 Moisture content

Excessive moisture in the substrate can —

- (a) damage some installation materials;
- (b) affect the bonding of tiles;
- (c) cause warping of moisture sensitive tiles; and/or
- (d) cause migration of moisture soluble materials that affect the surface appearance of the tiles.

Where excess moisture is likely to have an adverse affect on bonding, appearance, or structural integrity, particularly of moisture-sensitive stone, a moisture testing process should be performed.

The suitability of the installation materials for damp conditions, both at installation and in service, should be confirmed. Materials that are not moisture sensitive should be selected for areas subject to dampness.

Moisture testing applies to internal concrete floor substrates and is not usually recommended on external floors or internal walls.

[Appendix I](#) provides guidance regarding moisture testing.

4.1.8 Maximum dead loads

The maximum dead loads for tile placement specified by the sheet manufacturer shall not be exceeded.

NOTE Maximum dead load includes the weight of the tile, adhesive, grout, and any other tiling system components.

4.2 Substrate rectification and preparation

4.2.1 Internal and external wet areas

The waterproofing system shall be compatible with the tiling system (see [Clause 2.14](#)).

4.2.2 Screeds and renders

A screed or render is used as an intermediate layer between the structural background and the tile bed in order to provide a flat and even surface on which to apply the tiles [see [Table 4.1.3\(a\)](#)]. Instructions for the design and laying of screeds and renders are provided in [Appendices A](#) and [B](#).

Where proprietary screed or render mixes are used, they shall be used in accordance with the manufacturer's instructions. Proprietary screeds and renders typically provide shorter drying and curing times.

4.2.3 Separating layer

A separating layer is used to separate the tiling system from the background. This may be necessary where the background is contaminated, cracked or otherwise unsuitable for direct bonding. When a separating layer is to be used, the surface shall be free of ridges or projections that may form a key and impair the sliding action between the two elements. Slip sheets shall be free of creases. Overlaps shall be correctly detailed.

4.2.4 Liquid and flexible *in situ* underlays

When a liquid or flexible *in situ* underlay is used, the surface of the concrete shall be clean, dry, and free from bond inhibitors. The surface of the concrete shall be prepared in accordance with the manufacturer's instructions.

4.2.5 Rigid underlays

The timber or wood composite floor surface shall be free from any protrusions, such as fastener heads. All floor coverings shall be removed. Any loose boards or panels shall be re-fastened firmly. If any boards or panels are badly cupped or deformed, the surface shall be rough sanded to a uniform finish. Where floors are not in a sound enough condition (see [Clause 4.1.1](#)), they should be replaced.

Only underlay sheets specified for tiling shall be used. Underlay sheets shall be fixed to strip timber, structural particleboard, or plywood flooring in accordance with the underlay manufacturer's instructions.

The following should be taken into account:

- (a) Patterns the sheets are to be laid out in.
- (b) Minimum fastener centres and edge clearances.
- (c) Specified gaps between sheets.
- (d) Sheets not fastened in proximity to subfloor joints or gaps between boards.

4.2.6 Underlayments

When a liquid or trowellable, *in situ* underlayment is to be used, the product shall be used in accordance with the manufacturer's instructions for installation and suitability for the application.

NOTE Most underlayments are only suitable for dry, internal applications. Care should be taken to select the appropriate product for external and wet area usage.

4.3 Structural considerations for backgrounds

4.3.1 Concrete floors

4.3.1.1 General

Concrete floors to be used as the background for tiling on residential slabs shall be constructed in accordance with AS 2870, particularly with regard to shrinkage cracking control. More complex concrete structures shall be designed in accordance with AS 3600, particularly with regard to shrinkage, creep, deflections and crack control.

The maximum variation in the surface should conform to [Table 4.1.3\(a\)](#). Construction in wet areas should conform to [Clause 4.2.1](#).

4.3.1.2 New concrete floors

New concrete floors intended for tiling should be provided with a finish to suit the method of fixing to be used. The surface porosity of the concrete finish may dictate selection of the adhesive system.

Structural concrete should be subject to continuous air-drying after it has been allowed to cure. Drying of structural concrete should be, at a minimum, the time shown in [Figure 4.3.1.2](#) before either screed or a directly bedded finishing product is applied.

The minimum drying times specified may not be long enough to allow for sufficient shrinkage of the concrete. This may occur where only one side of the concrete is exposed or because concrete elements of different sizes have different shrinkage rates. Exposure to rain and other adverse weather and site conditions will also affect drying times.

Where insufficient drying time occurs, all potential differential movements should be reassessed. Wider movement joints may need to be installed at closer spacings.

Where a non-proprietary slurry bond coat is proposed for low or non-absorptive concrete, such as densely power trowelled concrete surfaces or mature and well hydrated concrete, the following shall be required —

- (a) surface scarification; and/or
- (b) a change to more suitable proprietary bond coat products.

An initial method for determining the acceptability of a finished concrete surface for a direct fixing method may be carried out using ASTM F3191. The adhesive manufacturer should be consulted regarding suitable, modified slurry bond coats and adhesives for use on dense concrete surfaces.

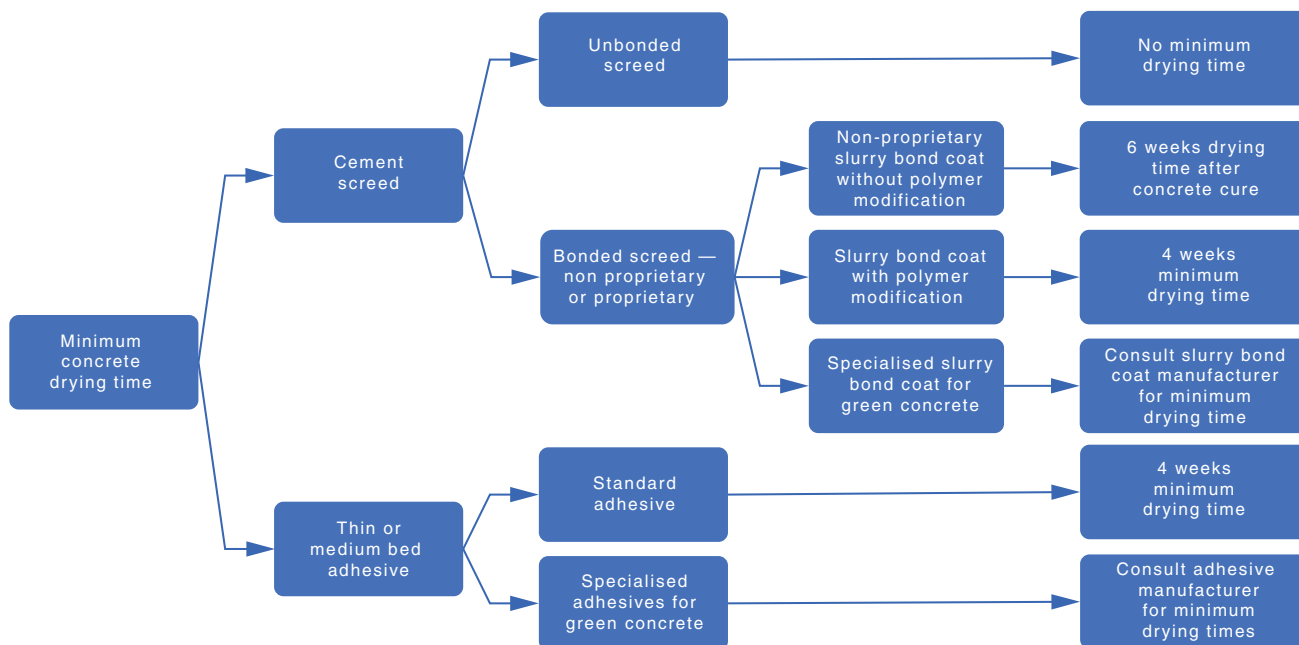
Overly absorptive surfaces may be structurally unsound for direct bonding or require priming of the concrete prior to direct bonding.

Some tiling failures have been linked to the failure to adequately remove formwork release agents from concrete surfaces. It is essential that these contaminants, some of which are extremely difficult to detect, be either chemically or mechanically removed prior to the commencement of tiling.

Where adhesive is to be used to fix the tile, the manufacturer's instructions on surface preparation shall be followed.

NOTE Guidance on the removal of contaminants is typically available from the adhesive manufacturer.

When a wet mortar bedding method is used, it may be bonded to the substrate or installed over a separating layer (see [Clause 4.2.3](#)).



NOTE 1 The installation commencement time may be governed by the water sensitivity of the intended tile (see [Appendices K, L, M and N](#)). Water sensitive tiles may require a determination of the residual moisture content of the concrete and or screed rather than relying on a nominated drying time.

NOTE 2 For polymer modification of slurry bond coats, see [Clause 2.8](#).

NOTE 3 Installations using the wet bed method have the same minimum drying time requirements as cement screed.

Figure 4.3.1.2 — Minimum drying time for new concrete floors

4.3.1.3 Existing concrete floors

Existing concrete floors intended for tiling shall be prepared to achieve an appropriate finish to suit the method of fixing that will be used (see [Clause 4.1.3](#)). The surface porosity of the concrete finish may dictate the adhesive system selection.

Where the surface has an unsuitable finish, mechanical equipment should be used to scabble the surface of the slab to expose the coarse aggregate. All loose debris and dirt should be removed by thorough sweeping or, preferably, by vacuum equipment. Alternatively, a screed (see [Clause 4.2.2](#)) or a separating layer may be used (see [Clause 4.2.3](#)).

Where the slab is sound and true with a suitable trowel or float finish but is contaminated by grease, oil, paint, curing compounds, etc., either of the following should be carried out prior to the application of the adhesive:

- (a) Mechanical removal.
- (b) Cleaning of the surface of the slab with a suitable wash, and then drying.

4.3.1.4 Concrete floors with existing finish

Where possible, all existing finishes should be removed. Where this is not possible, a separating layer should be used. Where the existing finish is sound and where a suitable adhesive is available for bonding to the surface, removal of the existing finish may not be necessary.

NOTE Localized patching may be necessary.