





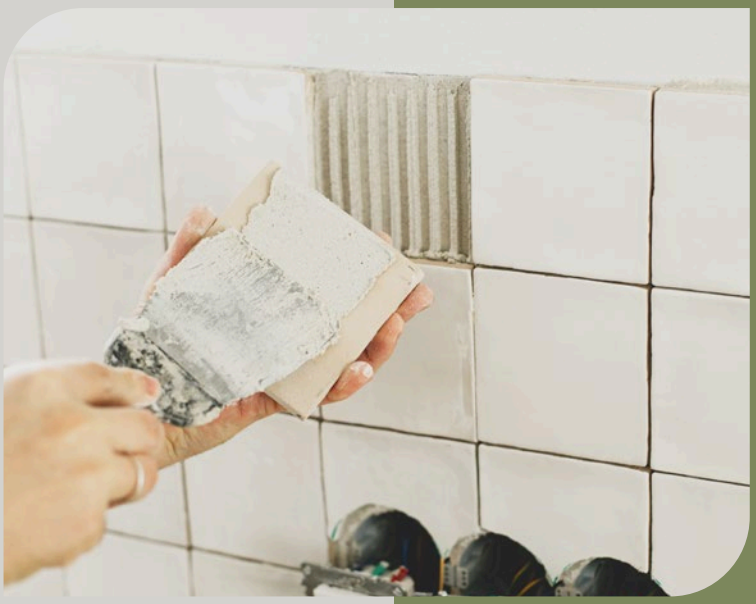

CIDB MALAYSIA

## GOOD INDUSTRY PRACTICES

# *for* CERAMIC TILING

CIDB Technical Publication No. : 2602

# GOOD INDUSTRY PRACTICES FOR CERAMIC TILING

CIDB MALAYSIA

**Good Industry Practices for Ceramic Tiling**
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# FOREWORD

The “Good Industry Practices (GIP) on Ceramic Tiling” guide shares some of the good practices adopted by practitioners and contractors on how good workmanship for ceramic tiling can be achieved on site. Common issues associated with ceramic tiling, their causes and possible solutions to address them are also highlighted.

This guide is not meant to be a definitive dictation on how ceramic tiles must be designed and installed. It only serves to illustrate good practices in the design, pre-installation, installation and post installation of ceramic tiles. We gratefully acknowledge the contributions of practitioners in the production of this guide and trust that the industry will find this publication useful. We welcome any contributions from readers to further improve any subsequent editions of this guide.

This guide is intended to provide general good practice recommendations on ceramic tiling. While every effort has been made to ensure accuracy and reliability, CIDB Malaysia accepts no responsibility or liability for any errors, omissions, or consequences arising from the use of this publication. Responsibility for the design, specification, and execution of ceramic tiling rests exclusively with the appointed project professionals and contractors, who must ensure compliance with applicable codes, manufacturer guidelines, and project-specific requirements.

This guide is not intended to be used as specification or compliance requirement unless the parties to a construction contract agree to do so, in which case it shall be binding only upon those parties. The qualified person shall not use this guide to decide if the building or parts of the building project in accordance with the relevant by-laws. It is still the responsibility of the qualified person to ensure that the quality of the construction works conforms to approved standards, practice, specifications and drawings, as specified in the contract.

It should be noted that the use of this guidance and compliance with this "Good Industry Practice(GIP) for Ceramic Tiling" does not itself confer immunity from legal obligations.

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# ACKNOWLEDGEMENT

The development of this Good Industry Practices (GIP) on Ceramic Tiling was made possible through the dedication and collaboration of a committed panel of industry stakeholders.

CIDB Malaysia wishes to express its deepest appreciation to the technical committee, which comprises representatives from construction industry associations, professional bodies, consulting firms, tile manufacturers and suppliers, specialist contractors, and experienced practitioners. Their collective expertise, drawn from diverse roles across the construction value chain, ensured that this guide reflects practical realities and best practices applicable to the Malaysian context.

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CIDB also acknowledges the time, commitment, and collaborative spirit demonstrated by members of the working committee who contributed throughout the development process:

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Their input has been essential in producing a guide that is not only technically sound but also practical and accessible to industry users. We hope this guide will serve as a valuable tool for improving tiling practices and workmanship, and we look forward to continued collaboration in future quality-driven initiatives.

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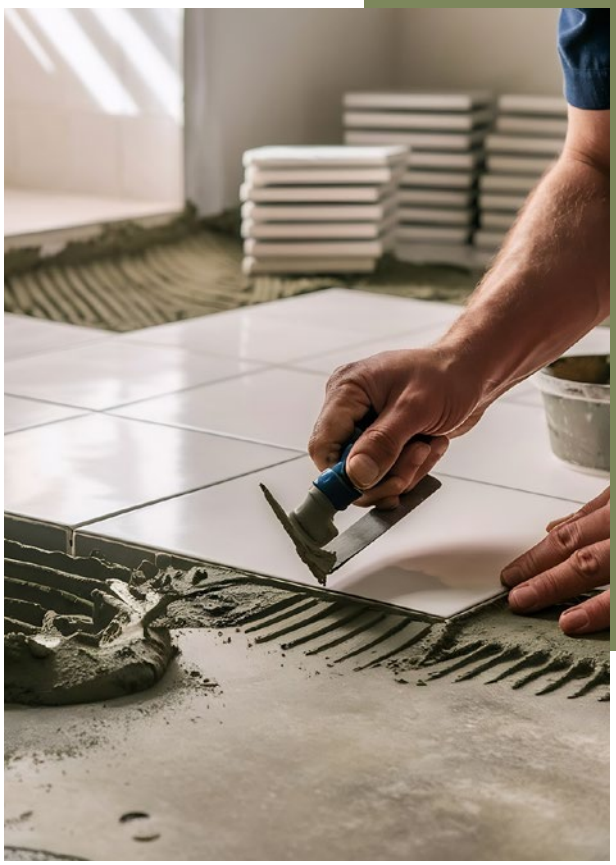
# 1 INTRODUCTION

This Good Industry Practices (GIP) guide aims to provide a comprehensive guidance on the proper material selection, methods, and standards for ceramic tiling in the Malaysian construction industry. The guide seeks to address recurring quality issues, improve workmanship standards, and align with relevant local and international codes. By addressing the needs of various stakeholders, this guide aims to raise industry-wide competency and ensure that ceramic tiling works meet the desired standards of quality, durability, and performance. Key objectives include:

- Enhancing awareness of proper tile installation techniques.
- Reducing common defects associated with poor tiling practices.
- Promoting compliance with CIDB and Malaysian standards.
- Encouraging a culture of quality, safety, and sustainability in tiling works.



# 2 PRE-INSTALLATION

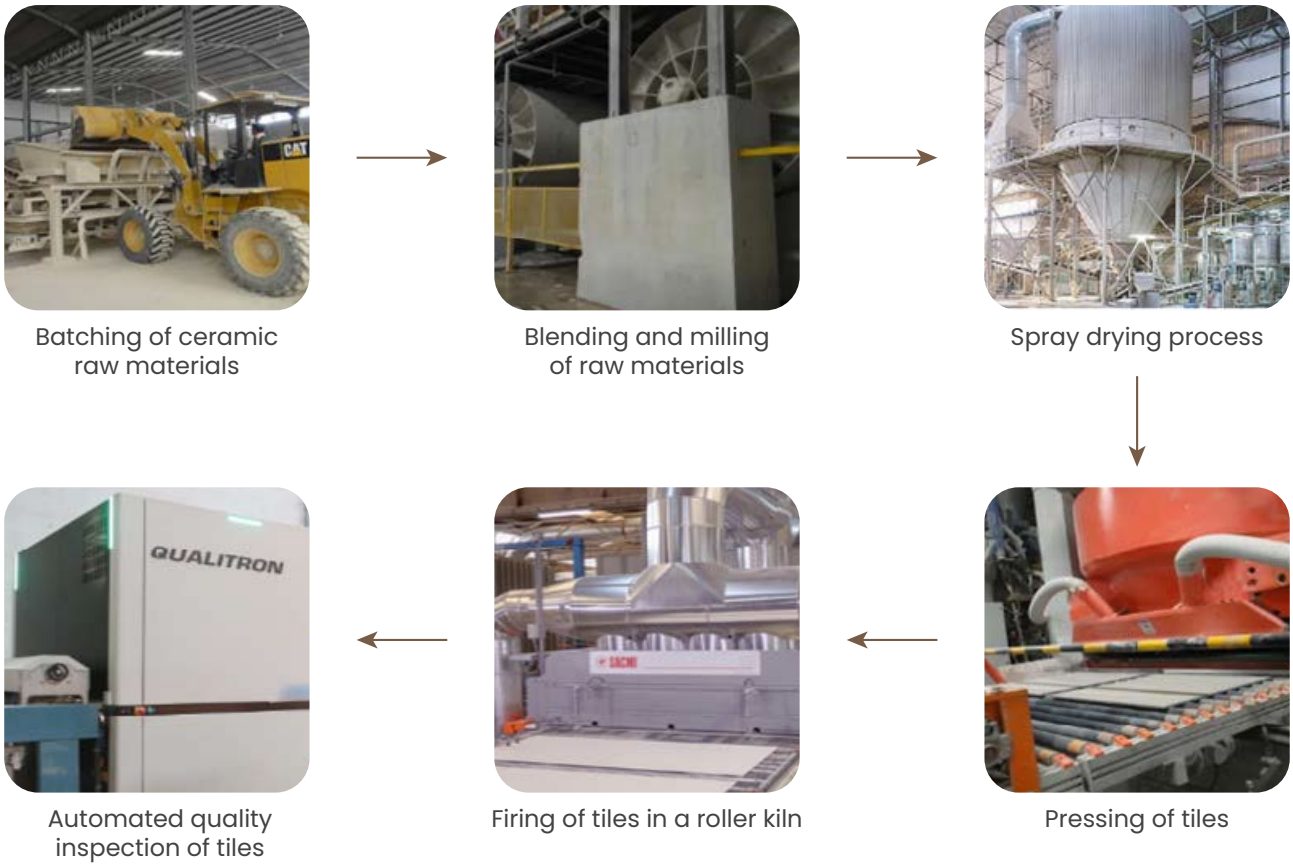
Good tiling work relies on three equally important factors: good planning & design, the right materials, and quality installation. These are key to a long-lasting, functional, and aesthetically pleasing ceramic tile installation.

## 2.1 Selection of Tiles

Ceramic tiles are produced from a mixture of inorganic raw materials such as clay, feldspar, quartz, sand and water. All ceramic tiles used in Malaysia shall comply with MS ISO 13006 - Ceramic Tiles: Definitions, Classification, Characteristics and Marking.

Its durability and superior properties are derived from its manufacturing process, where the tiles are shaped and pressed under high pressure and fired to a high temperature above 1200°C. There are two forms of ceramic tiles, glazed and unglazed. Glazed tiles have a glass-like surface layer that provides the desired colour, design and finish, while unglazed tiles offer a consistent colour and design throughout the tile.

The following photos illustrate the manufacturing process in a schematic diagram.




Batching of ceramic raw materials

Blending and milling of raw materials

Spray drying process

Pressing of tiles

Firing of tiles in a roller kiln

Automated quality inspection of tiles

Schematic diagram for manufacturing process of ceramic tiles

## 2.1.1 Types of Tiles

Ceramic tiles are classified by water absorption per MS ISO 13006. Porcelain tiles (a type of ceramic tile) have very low absorption ≤0.5% (high strength and durability).

Ceramic tiles possess higher water absorption typically above 3%. Various sizes of tiles and size tolerance are available:

- Large format tiles typically refer to the tiles with at least one edge dimension of 600 mm or greater. Due to their size, these tiles possess low flexibility and high surface area, requiring precise substrate preparation and full adhesive coverage to prevent voids and ensure long-term performance.
- Slabs refer to sizes ≥ 1 m². Due to the size and weight, slabs require careful handling, substrate preparation and installation techniques.



- Rectified tiles are mechanically cut to achieve more precise and uniform edges and size tolerance to provide consistent tile joints after installation.
- Non-rectified tiles are supplied without a trimming process, resulting in a higher dimensional variation that requires allocation of wider grout joints.



## 2.1.2 Selection Criteria

When selecting ceramic tiles, the key is to match the tile's properties to the specific area where it will be installed:

- Interior dry areas like living rooms, focus on aesthetics and moderate durability;
- Kitchens or laboratories, opt for tiles with high stain and chemical resistance.
- Wet areas like bathrooms, outdoor area and pool deck, prioritise high slip resistance and low water absorption;
- High-traffic commercial spaces, choose tiles with high abrasion and breaking strength;
- Outdoor locations, opt for porcelain tiles which have low water absorption, high breaking strength and high slip resistance

Choosing the right tile for the right application is the foundation of a durable and aesthetically pleasing installation. The following criteria should be evaluated before tiling work begins:

| Selection Criteria | Considerations & Requirements |
|---|---|
| **Water Absorption** | Water absorption is the key indicator of porosity and strength. A low water absorption indicates high strength and durability, which are suitable for areas that are frequently exposed to water or moisture, outdoor areas, high traffic and commercial applications. |
| **Breaking Strength & Modulus of Rupture** | Measures the strength and load-bearing requirements.<br>Tiles with high breaking strength and Modulus of Rupture (MOR) are essential for areas that must withstand heavy loads, impacts, or high-density traffic. This primarily includes:<br>• Commercial & Public Floors<br>• Industrial Facilities<br>• High-traffic Workplaces<br>• Outdoor Driveways and areas that may be subjected to point loads from heavy furniture or equipment.<br>For external and heavy loading areas, thicker 20mm tiles are recommended. |
| **Abrasive Resistance** | The abrasive resistance is classified by the P.E.I. class (0 to 5) for glazed tiles and the volume loss (max. 175mm$^3$) for unglazed tiles.<br>Higher ratings, like 4 or 5, are recommended for high-traffic areas like entrances, external or commercial spaces. |
| **Slip Resistance** | Choose the correct slip resistance based on Annex J MS1294 with either Shod Ramp Test (R rating: R9 to R13) or Pendulum Test (P rating: P0 to P5) where higher rating provides better slip resistance. |

| Selection Criteria | Considerations & Requirements |
|---|---|
| **Colour & Shade variation** | The colour/shade consistency is graded by the V rating (V1 to V4) while marble and natural stone designs may exhibit higher variations. |
| **Environmental Considerations** | Local Environmental Certifications – SIRIM Eco-label, MyHIJAU Mark<br>▪ EPD (Environmental Product Declaration)<br>▪ Sustainable Manufacturing - includes the use of energy-efficient equipment, good water management with low water intensity, recycling of production waste materials, recycling of fired reject tiles to reduce landfill waste |

## 2.2 Layout Planning

A well-planned tile layout shall enhance visual quality and ensure mechanical integrity by accommodating movement. Good practices include:

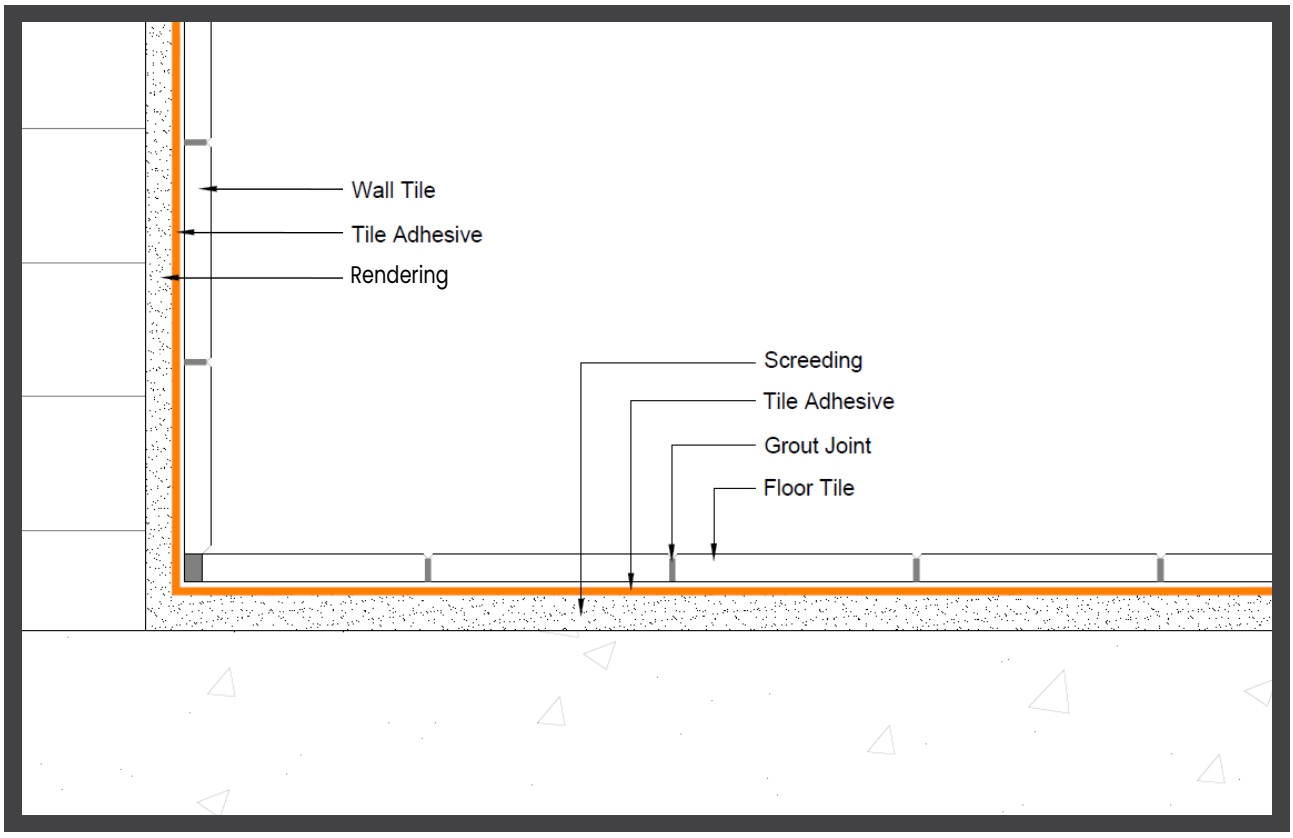
- Detailed layout drawings shall be prepared to confirm tile placement, joint alignment, transitions, and coordination with fixtures and adjacent elements. This allows the architect or client to visually assess tile pattern and alignment, colour consistency and shade matching, which enables design adjustments before full installation.
- Plan from the centre or a designated focal point for tile orientation and symmetry. Avoid small tile slivers at edges and align tiles with structural joints where possible.



## 2.3 Selection of Adhesive and Grout

Correct selection of adhesive and grout is essential to ensure compatibility with the tile type, substrate conditions, and environmental exposure. Good practices include:

- Cement-based, polymer-modified, or epoxy type of adhesive shall conform to MS ISO 13007-1. Use improved-performance adhesives in demanding conditions (e.g. porcelain tiles, submerged areas or high stress environments).
- Working time and pot life of the adhesive must suit the size and duration of the project to prevent premature skinning or reduced bond strength.
- Grouts shall comply with MS ISO 13007-3 and can be cementitious, epoxy or polymer-modified grout, selected based on exposure to chemicals, water, or stains. Ensure grout joints are sealed where necessary to prevent staining or moisture ingress.
- Flexibility is important for substrates prone to movement or temperature variations.
- Follow manufacturer's recommendations to ensure full system compatibility and performance.




Adhesive bedding detail

# 3 INSTALLATION

Successful tile installations require more than just good products. Adherence to good practices during the installation process can assist in reducing the risk of common issues like cracking, debonding, and staining. Below are good practices grouped by critical stages of installation:

## 3.1 Surface Preparation

Proper surface preparation is foundational as its suitability directly affects performance, durability, and long-term adhesion of the tiles. Even the best adhesive cannot compensate for a poor substrate. Inadequate surface preparation is a common cause of debonding and hollow tiles. Good practices include:

- Before installation, inspect the substrate for soundness, stability and capability to support the tile load without excessive deflection or movement. Tap the surface to detect any hollow or weak areas that could compromise adhesion.
- The substrate shall be flat and even. The surface evenness shall comply with MS 1294 — tolerance should generally be within ±3 mm over 1.2 meters. Irregularities can lead to tile lippage or debonding and where necessary, use self-levelling compounds to achieve the required tolerances.
- The surface shall be clean, dry, and free from dust, oil, laitance, paints, curing compounds, or contaminants that may impair adhesion. Priming shall be carried out where required to improve bond strength or manage substrate porosity.
- Conduct moisture testing for substrates prone to dampness (e.g. new concrete or screed) to avoid tiling over uncured substrates. Surface moisture content should be less than 6% or as specified by the Architect/Designer/Specifier.
- The receiving surface shall be lightly wetted (i.e. surface dampening to control suction and prevent loss of water from the substrate, which could cause hollowness) prior to tiling.
- Apply primers where needed, especially on porous or smooth surfaces (e.g. anhydrite screeds, gypsum boards).
- Repair any defects by filling cracks or holes with patching compounds. Repair should be carried out using non-shrink cementitious filler compliant with MS 1294.



Removing concrete protrusion



Damping the surface with water



Cleaning the surface with a broom



Checking the substrate for hollowness

## 3.2 Adhesive Preparation and Application

Adhesive preparation and application affect bonding strength and tile alignment. Improper application can lead to poor adhesion and lippage. Good practices include:

- Adhesives should be stored in a cool environment with a relative humidity of ≤70%, stacking with a pad of more than 10cm to isolate ground moisture.
- Adhesive bedding should be mixed with consistent proportions using clean water to prevent poor performance and failure. When proprietary products are used, the manufacturer's instructions should be followed, especially for the mixing proportions, procedure and slaking time, where applicable.
- For large-format tiles and slabs, the adhesive should be applied to both the substrate and the back of the tile (back-buttering) to achieve a minimum of 90% coverage beneath the tile.
- Use a notched trowel appropriate for tile size and surface. Larger tiles require larger notches.
- Adhesive coverage shall comply with MS 1294 and ensure that the adhesive wets the back of the tile and achieves a minimum contact area of at least 90% coverage in general, with full coverage (≈ 100%, no voids) at tile edges and in wet or exterior locations as required by MS 1294.
- Apply adhesive in manageable sections to ensure tiles are laid before the adhesive begins to skin over (typically within 20–30 minutes).
- Prevent voids by ensuring no air pockets remain beneath the tiles, especially in exterior or submerged areas.



Proper storage of adhesives on site



Pour the required quantity of water in a clean mixing bucket or liquid latex according to manufacturer's specifications



Slowly add the powder into the container according to manufacturer's specifications



Mix with low-speed mechanical mixer, moving in a circular motion until a uniform paste consistency is obtained without any trace of powder or lumps



Allow the mix to slake for 5 minutes then remix



Finally, the adhesives is ready for use

## 3.3 Tile Installation

Correct installation techniques ensure level surfaces, consistent joints, and proper alignment.

- Before commencing tiling works, tiles should be visually inspected for defects, damage, stains and shade variation.
- Ensure all services are incorporated and coordinated with the approved drawings before starting tiling work.
- Ensure adequate lighting during installation, as even minor misalignments can become visible under certain light conditions.
- A mock-up shall be constructed to demonstrate design intent, including tile pattern, alignment, colour consistency, and shade matching. It shall also be used to assess and approve workmanship quality prior to full-scale installation. Once approved, the mock-up shall serve as the project's benchmark (reference panel) for quality comparison throughout the works.
- Start from a reference line by using a chalk line or laser level to guide tile alignment.
- Allow a minimum joint width of 3mm for internal installation. For external areas, especially in areas exposed to direct sunlight, a minimum 5 mm joint width is recommended.
- Maintain consistent joint widths using tile spacers, which help with both appearance and grout performance.
- When placing tiles, lightly press and slide them into the adhesive to ensure good contact.
- Cut tiles shall be minimised for a better visual effect. Where unavoidable, cuts shall be located in less visible areas and shall not be less than half a tile in width.
- Immediately remove excess adhesive that oozes into joints which can interfere with grouting.
- For tiles with any edge ≥ 600 mm, use a suitable tile levelling system to minimise lippage. Position levelling kits at all joints and at intervals of 300 mm or less.
- When installing large slabs, use an aluminium frame with suction pads to lift and position the tiles. This reduces the risk of breakage and improves installation safety and accuracy. The suction cup cover is used to prevent direct contact between the suction cup or the vibrator and the tile surface. This helps minimise the risk of staining or marking, especially on polished or dark-coloured tiles, where the rubber or plastic of the suction cup may leave residue or discolouration that is difficult to clean.
- Mechanical fixings must always be provided in addition to adhesive where tiles have a facial area greater than 0.1 $m^2$, or are 300 × 300 mm or larger, or weigh more than 40 $kg/m^2$, and are installed above 3 m from finished floor level or as specified by the specifiers. The type and quantity of fixings should be based on the fixture specifications and site conditions.

The laying process for floor tiles:



Clean the back surface of the ceramic tile with a damp sponge to remove dirt and dust before back-buttering



Spread a thin coat of the adhesive mix onto the substrate to cover it completely



Immediately apply the adhesive to the back of the tile using the notched part of the trowel. Apply and comb more adhesive to achieve required thickness in a single direction. Spread within "open time"



Use spirit level to ensure a flat, even, and properly sloped surface



Utilise plastic spacer for consistent joint



Use tile levelling system during installation to prevent lippage

The laying process for wall tiles:



Applying adhesive with notched trowel on wall



Applying adhesive on back surface of wall tile



Applying double buttering technique



Ensure full adherence to the surface



Using rubber mallet to tap on the wall tiles after laying for uniformity



Controlling adhesive thickness



The correct way to apply the adhesive for slabs is by trowelling parallel to the short side of the slab

## 3.4 Grouting

Grouting completes the installation and contributes to tile stability, hygiene, and aesthetics. Good practices include:

- Grout only after the adhesive has set (usually 24 to 48 hours unless rapid-setting). Grout curing time shall comply with MS 1294 - a minimum 24 hours before cleaning or loading.
- Follow the manufacturer's instructions on the proper mixing of grouts, especially on water ratios and mixing time.
- Work in small areas and apply grout with a rubber float diagonally across joints.
- Immediately wipe off excess grout with a damp sponge before it dries on the tile surface.
- Seal grout lines wherever required, especially in wet or stain-prone areas, unless using epoxy grout.



Waiting to apply tile grout after 24 hours



Clean the joints until free of dust, debris, or any loose particles. Ensure the joints are dry before grouting



Ensure sufficient joint depth to grout, at least 2/3 of the joint depth



Fill the joint completely with the grout paste using a hard rubber trowel

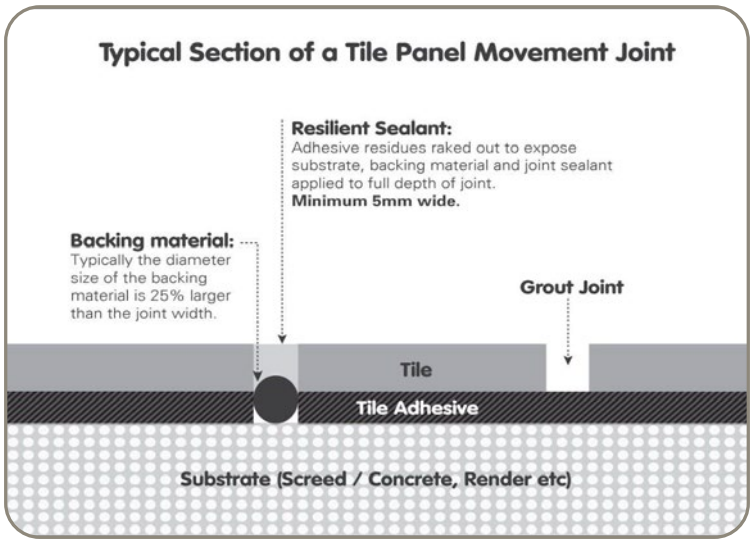


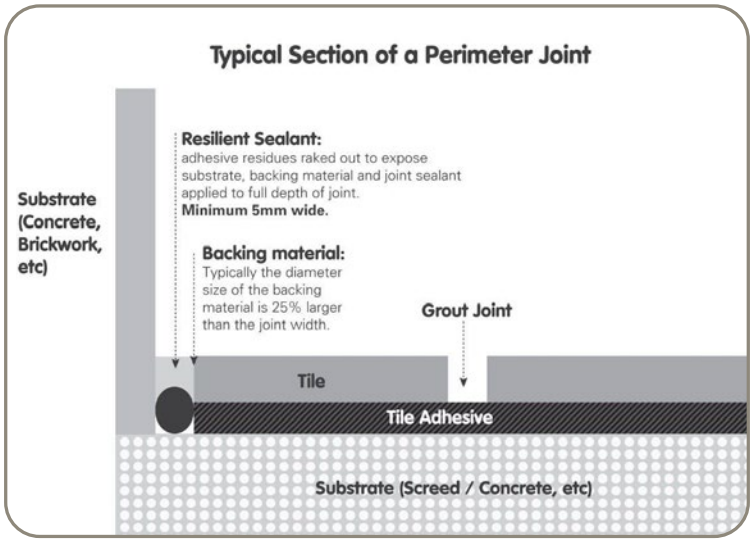
Remove excess grout mortar on tile surfaces

## 3.5 Tile Movement Joints

Movement joints accommodate expansion, contraction, and substrate shifts, preventing cracking and tile debonding. Good practices include:

- Install movement joints at these locations:
  - ✓ Around room perimeters
  - ✓ At changes in substrate, materials or plane
  - ✓ Every 6–9 metres in interior floors
  - ✓ Every 3–4.5 metres in exterior or sun-exposed areas
- Use flexible sealants (e.g. polyurethane or silicone) in joints, not rigid grout. Sealants shall comply with MS 1294 where the minimum depth of the sealant should be 6 mm or the thickness of the tile (whichever is smaller).
- Never fill movement joints with cementitious grout.




## 3.6 Tiling Product Compatibility

Product compatibility in tiling is critically important and directly affects the performance, durability, safety, and aesthetics of the finished installation. Ensuring that all materials used such as tiles, adhesives, grouts, primers, waterproofing membranes, and substrates are chemically and mechanically compatible helps prevent failures such as cracking, debonding, staining, and water ingress.

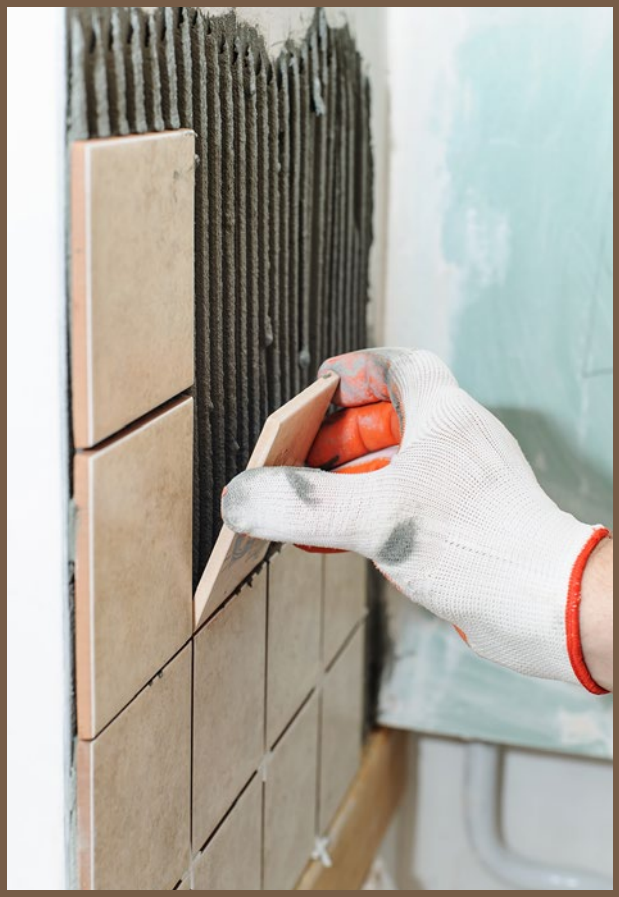
The following table shows why compatibility matters and its impact on the tiling.



| No | Aspect | Impact On Tiling | Why Compatibility Matters |
|---|---|---|---|
| 1. | Adhesion | Poor bond strength leading to debonding or hollow tiles | Not all adhesives bond well with every tile or substrate (e.g. porcelain requires adhesives with higher strength) |
| 2. | Flexibility | Cracks in grout or tile due to differential movement | Substrates that flex (e.g. plywood) and large slabs which are rigid require flexible adhesives and grout |
| 3. | Water Resistance | Moisture penetration, dirt stains, and efflorescence | Incompatible or non-waterproof adhesives/ grouts can absorb water and degrade |
| 4. | Chemical Reactions | Staining and surface deterioration | Incorrect use of cleaning agents will etch and damage the tile surface |
| 5. | Thermal Expansion | Cracking due to differing rates of expansion/ contraction | Materials must accommodate thermal movement, especially in outdoor or heated floor areas |
| 6. | Curing Behaviour | Grout cracking or adhesive failure | Different curing times can affect when other materials should be applied or trafficked |

## 3.6.1 Common Compatibility Checks

- Use improved-performance adhesives (e.g. C2-rated) for dense tiles like porcelain.
- Cement-based adhesives may not bond well to non-porous or flexible substrates without priming. Use primer if tiling over existing tiles, gypsum boards, or waterproofing membranes.
- Epoxy grouts are better in chemical or wet areas, but may not suit all tiles (e.g. textured surfaces can stain). Use flexible grout for areas with movement or thermal variation.
- The waterproofing membrane (sheet or liquid) must allow proper bonding with the tile adhesive. Always follow the manufacturer's system recommendations, where some may offer warranties only when using a complete, compatible system.



## 3.6.2 Good Practices on Compatibility

- Compatibility between components shall comply with requirements set out in MS 1294 and follow manufacturer data sheets for each product (especially regarding substrate preparation, drying times, and usage limitations).
- Conduct adhesion or compatibility tests when unsure, particularly on-site mock-ups.
- Consult technical support for unusual conditions (e.g. tiling over metal, wood, heated floors, or swimming pools).

---

## 3.7 Common Issues and Recommendations

The performance and durability of tiled surfaces depend on the correct choice of materials, proper workmanship, and adequate supervision. The failure of any one element can lead to the most common defects inherent in the industry. These defects are not inevitable; they are preventable through knowledge, planning, and rigorous quality control.

These issues are also exacerbated by the Malaysian tropical climate, where high moisture levels and thermal expansion can quickly compromise improperly installed tiles, often leading to costly rectification works, user dissatisfaction, and shortened service life of the tiled surfaces. A robust tiling system must therefore account for movement, moisture, and long-term performance under cyclic environmental stress.

## 3.7.1 Tile Hollowness and Debonding

Tile hollowness refers to the hollow sound produced when installed tiles are tapped with a tapping rod which could indicate inadequate adhesion between the tile and the tile bed. Debonding refers to the detachment of tiles from the tile bed.



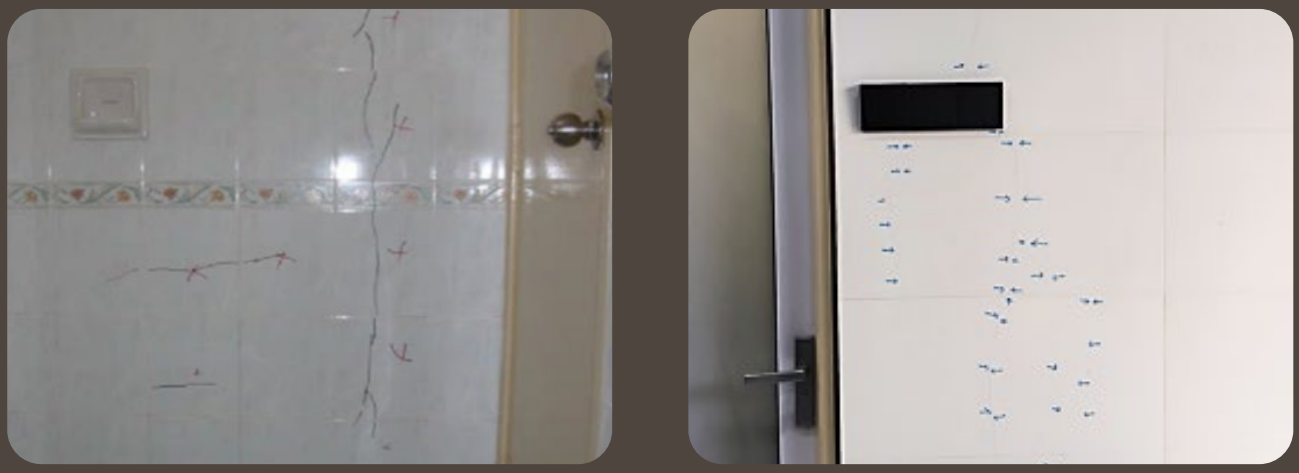


Debonding of the tiles showing evidence of insufficient adhesive contact

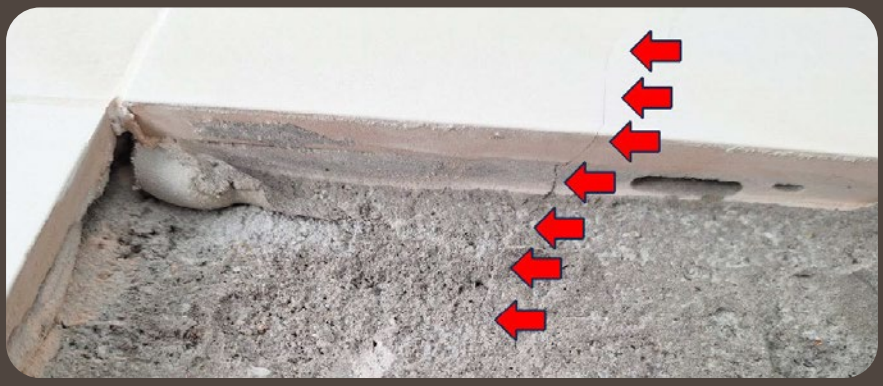
| Common Causes | Recommended Solutions |
|---|---|
| Inadequate adhesive coverage | Ensure a minimum coverage 90% |
| Incorrect adhesive type | Use appropriate adhesive type for tile type, substrate condition and area. Do not mix Ordinary Portland Cement with the adhesive for installation of porcelain tiles |
| Early installation on uncured screed | Ensure screed is sufficiently cured for at least 21 days |
| Installation after the adhesive has skin over | Ensure complete installation within the open time of adhesive |
| Dirty or contaminated substrate | Ensure clean and proper substrate preparation before tiling |
| No allocation of perimeter or intermediate movement/control joints | Perimeter and intermediate joints should be allocated as per MS 1294; BS 5385 may be used as supplementary guidance |

## 3.7.2 Cracking on Tiles

Visible crack line appearing on tiles which can extend across adjacent tiles



Continuous crack lines extending through adjoining tiles resulting from substrate stress



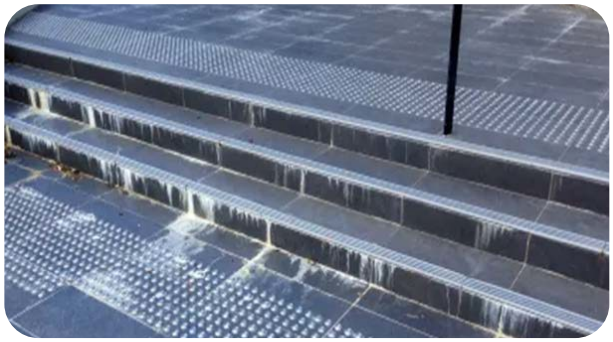
Evidence of a structural crack which propagated onto the tile

| Common Causes | Recommended Solutions |
|---|---|
| Excessive shrinkage of cement render or screed layer | Ensure stable and properly cured substrate before tiling as cement mortar are susceptible to high drying shrinkage |
| Inadequate expansion or perimeter joints | Ensure to incorporate movement and perimeter joints |

## 3.7.3 Efflorescence

Deposits of whitish powder on the tile or grout surface resulting from soluble salts in the substrate migrating to the surface during evaporation.





Efflorescence on external floor and staircase



Efflorescence on external wall

| Common Causes | Recommended Solutions |
|---|---|
| Excessively wet substrate | Ensure the substrate is fully cured before tiling. Put up a temporary tent in outdoor installation areas. |
| Inferior or porous grout in wet, outdoor area | Use epoxy grout, as it is water resistant and chemical resistant.<br>High performance polymer-modified grout is a good mid-range option if epoxy is too costly. |
| Lack of a proper moisture barrier or drainage | Apply suitable vapour or moisture control barrier beneath the tile system to reduce moisture transmission.<br>Adequate drainage and surface run-off should also be provided to avoid standing water, which can lead to long-term damage.<br>Block any water path to avoid any contact with the soluble salts in the cement mortars. |
| Poor structural detailing like cracks or porous zones in slabs/walls | Ensure proper drainage and waterproofing membranes. Seal expansion joints or penetrations and provide ventilation to reduce trapped moisture. |
| High water–cement ratio concrete leading to porous concrete or usage of aggregates or sand with high soluble salt content | Use low water–cement ratio mixes to reduce porosity. Select aggregates and sand with low soluble salt content. Incorporate pozzolanic materials (e.g. fly ash, silica fume) to bind free lime. |
| Cement with high alkali content or tiles and bricks with natural salts | Choose low-alkali cement and efflorescence-resistant mortars or use tiles/bricks tested for salt content. |
| Newly installed tiling systems exposed to rain or water before curing | Protect the newly installed tiling system from rain for at least 72 hours.<br>Ensure adequate curing time before exposure to moisture. |

## 3.7.4 Tile Lippage

Lippage is the vertical displacement between adjacent tiles, creating uneven edges that can cause safety hazards, chipped tiles, or aesthetic issues.



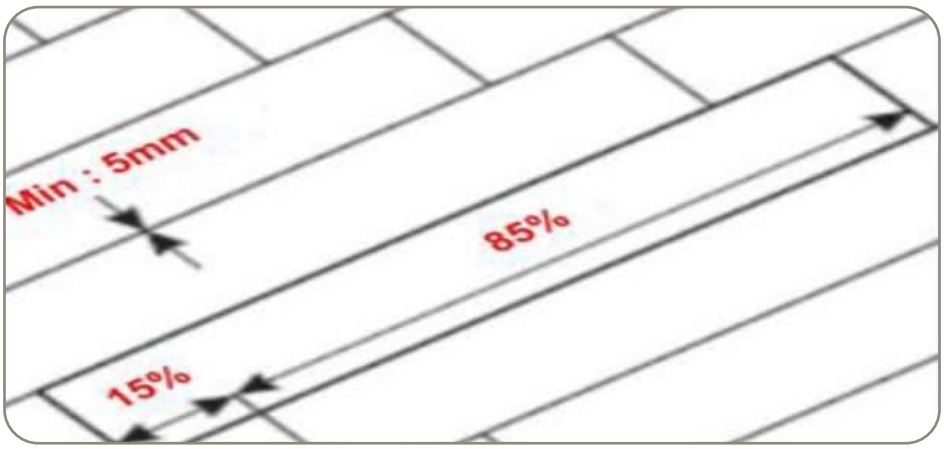


Lippage detected at a pointing



Severe lippage from 50:50 offset laying pattern

| Common Causes | Recommended Solutions |
|---|---|
| Uneven substrate or inconsistent adhesive thickness | Ensure good substrate preparation and apply adhesive evenly before tiling. Follow lippage tolerance standards.<br>Use self-levelling screed for installation of porcelain slabs. |
| Poor tile levelling during installation | Ensure the use of tile levelling tools especially for large format tiles. |
| 50:50 offset laying pattern for rectangular tiles | Adopt a 30:70 offset laying pattern |
| Higher visible curvature for large format tiles or long plank tiles | Adopt an 85:15 offset laying pattern and a minimum 5mm tile joint for large format rectangular tiles to reduce the vertical difference between adjacent tiles. |




An 85:15 offset laying pattern

## 3.7.5 Misalignment and Joint Inconsistency

Refers to tiles deviating from the intended layout lines and irregular grout joint widths





Inconsistent tile joints



Misaligned tile pointing

| Common Causes | Recommended Solutions |
|---|---|
| Poor layout planning | Plan the layout with gridlines and commence from a control line in accordance with the Setting Out Point (SOP) established by the Architect/Designer. Ensure consistent jointing as per MS 1294 |
| Inconsistent tile joint widths | Ensure the use of rectified tiles and tile spacers |
| Misalignment of tile joints in wall or floor | Establish datum lines, correct uneven surfaces, and maintain straight joints using spacers and continuous laser verification. |

## 3.7.6 Stained Grout Joints

Refers to the darkened, stained grout joints which may have been caused by penetration of moisture beneath the tiles.



Badly stained grout

| Common Causes | Recommended Solutions |
|---|---|
| Poor-quality porous grout | Use a water-resistant, polymer-modified grout. |
| Lack of moisture barrier, or cementitious moisture control primer. | Apply a suitable moisture barrier beneath tiles. |
| Inadequate cleaning and maintenance | Ensure regular cleaning using neutral pH cleaners |
| Persistent moisture or poor ventilation | Ensure drying after regular cleaning to reduce humidity build-up. |

## 3.7.7 Shade Variation

Variation in tile shade and texture is normal and commonly acceptable when within the manufacturer's declared variation range, such as the V-rating system (V1 – V4), where variation is part of the tile design. This should be clearly communicated among the Architect/designer, developer, and user. Assessment of the finished work should refer to the manufacturer's stated variation and the Architect's reviewed and approved design intent.

Typical causes of tile shade variation, including differences in production batches and variation as part of tile design characteristics are demonstrated below.



Mixing of tiles from different lots/batches



V3 – Moderate variation



V4 – substantial variation

Variation as part of the tile design

| Common Causes | Recommended Solutions |
|---|---|
| Mixing of tiles from different lots/batches during installation | Ensure the lot/batch numbers match prior to tiling. |
| Shade variation in tiles after rectification/replacement works. | Keep adequate spare tiles from the same batch to ensure consistent colour and size during installation. |
| Sorting or dry laying omitted prior to installation. | Dry lay prior to installation. |

## 3.7.8 Haze Marks Along Edges of Polished Tiles

Refers to dull, hazy or smudged marks along tile edges especially visible under low-angle light. It is often detected on polished surfaces after the removal of protective sheets.





Haze marks along the edges of polished tiles

| Common Causes | Recommended Solutions |
|---|---|
| Installed tiles exposed to moisture over a period of time during floor protection period | Ensure no residual moisture e.g. rainwater comes in contact with the tile surface during the floor protection period.<br>Ensure the grout is sufficiently dry before protection. |

# 4 POST-INSTALLATION

Post-installation practices are essential to safeguard the visual quality, durability, and long-term performance of ceramic tiling works. This chapter outlines general guidance on protection, inspection and maintenance measures following installation. The recommendations are developed based on relevant national standards, established industry practices, and manufacturer guidelines, with certain methods reflecting the industry consensus reached during the preparation of this document. Proper implementation of these practices helps prevent early deterioration, ensures functional performance, and supports the overall quality of completed tiling works.



## 4.1 Protection During and After Installation

Tiles are often subjected to potential damage during ongoing construction or renovation works. They must be adequately protected until handover. Improper protection can lead to cracking, chipping, grout staining, or dislodged tiles—requiring costly repairs before handover. Good practices include:

- Foot traffic should be restricted on newly tiled areas for at least 24–48 hours after installation, in accordance with MS 1294 (or as per tile/adhesive/grout manufacturer's recommendation).
- Cover tiled surfaces with protective sheets (e.g. corrugated boards, non-staining drop cloths, or foam underlay) especially in high-traffic areas.
- Avoid using adhesive tape on tiles as some tapes can leave residues or damage tile finishes. Use pressure sensitive tape or high temperature tapes
- Do not place equipment or heavy materials/loads on freshly laid tiles until fully cured.



Protective covering applied on the floor to safeguard new tiles from dust, scratches, staining and damage.

## 4.2 Initial Cleaning Procedures

Proper cleaning removes construction residues like grout haze, adhesive traces, and dust, leaving the tiled surface looking its best. Good practices include:

- Clean tiles 24–72 hours after grouting, once grout has sufficiently cured. Cleaning shall follow MS 1294.
- Use a pH-neutral or slightly acidic cleaner specifically designed for the removal of grout haze.
- Avoid using stain removers that contain hydrofluoric acid or hydrochloric acid.
- Use soft sponges or cloths to clean and avoid metal scrapers or abrasive pads that could scratch glazed or polished tiles.
- Rinse thoroughly with clean water to remove all residues.



Use soft sponges to clean and rinse the sponge frequently using two separate containers of water: one to rinse the excess grout from the sponge and a second container with clean water to rinse the sponge.



## 4.3 Tiling Quality Check

A thorough post-installation check ensures that the tilework meets aesthetic,functional, and safety standards before final acceptance. Detecting issues early allows for rectification before handover, avoiding disputes and costly call-backs.

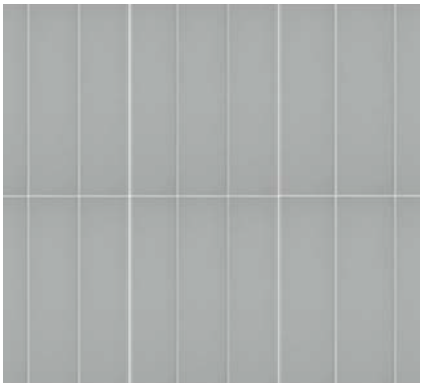
### 4.3.1 General Requirements

- All tiling works shall conform to MS 1294: Part 1, 2, 3, and 4 - Code of Practice for the Design and Installation of Ceramic Wall and Floor Tiling and Mosaics.
- All ceramic tiles used shall comply with MS ISO 13006 or approved equivalent, and shall be suitable for the intended application based on their classification.

## 4.3.2 Visual Quality Check

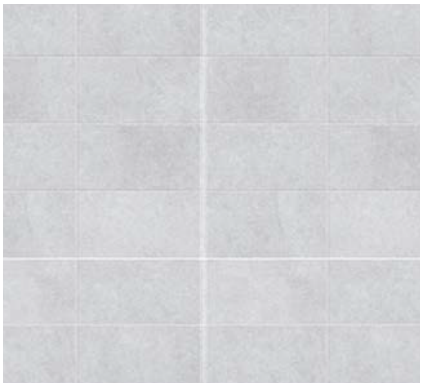
For surface quality evaluation, visual check shall be conducted under normal ambient lighting from a normal standing position, viewed at a distance of approximately 1 to 1.5 metres, in line with common industry practice for assessing installed finishes.

Common surface quality checks include inspecting for chips, cracks, scratches, or glaze defects, ensuring the colour and tonality are consistent, verifying that the tiles are clean and free from stains or grout haze, etc.



**V1-UNIFORM SHADE**

Minimal differences in tonality and/or pattern



**V2-SLIGHT VARIATION**

Slight distinguishable differences in tonality and/or pattern



**V3- MODERATE VARIATION**

More significant tonality and/or pattern variation



**V4-RANDOM VARIATION**

Unique and random colour and pattern variation

### a) Tonality and Shading Check

- Tiles shall match the approved sample or as specified by the Architect
- Shade/tonal variation shall fall within the manufacturer's declared range depending on the inherent variation in the V rating

### b) Joint Width Check

- Joint widths checks should be carried out visually from the appropriate standard viewing distance.
- The minimum gap for tiling is 3mm for indoors and 5mm for outdoors respectively.
- Tile joint consistency depends on the size tolerance of the tiles. Rectified tiles allow for more consistent joint widths. Consistent joints imply visually uniform and aligned, not perfectly identical measurements across every joint.

### c) Tile Lippage Check

- Tile lippage can be caused by the high curvature of the tiles and/or by improper levelling and installation techniques.
- MS 1294 sets the allowable lippage between adjacent tiles at not more than 1.0mm. Use a straight edge and a taper gauge for measurement.

### d) Surface Evenness Check

- For tiles with profiled, textured, or patterned finishes, the evenness requirement shall apply to the tile's underlying body plane and not the decorative surface relief.

### e) Wet Area Requirements

- Floor gradients in wet areas shall comply with MS 1294 and be laid to fall towards the drain outlet.

### f) Hollowness Check

- Conduct swiping and tapping after 28 days on completion of tiling work. Hold the tapping rod perpendicular to the surface and apply consistent force. Record findings on the inspection sheet, marking tile ID, location, and remarks.
- Each tile shall be swiped and tapped at five (5) points, four (4) near the corners and one (1) at the centre using a tapping rod.
- Corner tapping points shall be located 25 mm ± 5 mm from each adjacent tile edge. Avoid tapping directly on grout joints or at perimeter edges. For tiles 600mm or larger, additional tapping points shall be taken at the mid-edge positions or as directed by the Qualified Person (QP). (as per References)
- There are different types of hollowness, between tile and adhesive, adhesive and substrate, and within the substrate. A high pitch indicates tile bond failure, whereas a low one indicates substrate failure. For hollowness between tile and adhesive layer, there is often a distinct "echo" when tapping across the affected area. Inspectors should familiarise themselves with the “solid” sound by tapping several well-bonded tiles before testing. Use light, even tapping and repeat if uncertain. Final determination shall be made by the Qualified Person (QP).
- A tile shall be deemed defective if hollow sounds are detected at three (3) or more of the five (5) test points.





Checking tile hollowness using a tapping rod

## 4.4 Maintenance

Proper tile usage and maintenance are essential to ensure long-term performance of tiled surfaces. Good practices include:

- Clean regularly using suitable mild detergents to maintain the surface condition.
- Avoid harsh or abrasive cleaners that may damage glazed, polished, or natural stone tiles.
- Maintain slip resistance by keeping floors clean, dry, and free from contaminants.
- Inspect joints and sealants periodically and rectify cracks early to prevent water penetration.

| REFERENCES | |
|---|---|
| MS ISO 13006 | Ceramic tiles — Definitions, classification, characteristics and marking |
| MS ISO 13007-1 | Ceramic tiles – Grouts and adhesives – Part 1: Terms, definitions and specifications for adhesives (First revision) (ISO 13007-1:2014, IDT) |
| MS ISO 13007-2 | Ceramic tiles – Grouts and adhesives – Part 2: Test methods for adhesives |
| MS ISO 13007-3 | Ceramic tiles – Grouts and adhesives – Part 3: Terms, definitions and specifications for grouts (First revision) (ISO 13007-3:2010, IDT) |
| MS ISO 13007-4 | Ceramic tiles – Grouts and adhesives – Part 4: Test methods for grouts |
| MS 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 |
| MS ISO 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 |
| MS 1294-1 | Wall and floor tiling - Part 1: Design and installation of ceramic, natural stone and mosaic wall tiling in normal internal conditions - Code of practice (First revision) |
| MS 1294-2 | Wall and floor tiling - part 2: Code of practice for the design and installation of external ceramic wall tiling and mosaics |
| MS 1294-3 | Wall and floor tiling - part 3 : Code of practice for the design and installation of ceramic floor and mosaics |
| MS 1294-4 | Wall and floor tiling - part 4 : Code of practice for tiling and mosaics in specific conditions |
| Uniform Building By-Laws (Amendment) 2021 | "Qualified Person" means Architect, Engineer or Building Draughtsman. |

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