BRANZ

ISSUE 646 BULLETIN

FLOOR LEVELLING COMPOUNDS

February 2020

- Floor levelling compounds are used to correct minor imperfections and variations in strip and sheet flooring and concrete floors.
- This bulletin outlines the generic types of floor levelling compounds available, the substrates they can be applied to and guidance on preparing and applying them.
- This bulletin updates and replaces BRANZ Bulletin 360 of the same name.

1 INTRODUCTION

1.0.1 Floor levelling compounds (FLCs) correct both minor and major (up to 200 mm) imperfections and variations in floors to give a flat, level, defect-free surface for the application of floor finishes. They are most often required with resilient sheet flooring to avoid unevenness in the substrate being transferred through to the finished floor surface and in wet area floors receiving a waterproof membrane (such as under tiled floors) to eliminate low spots.

1.0.2 While FLCs are widely available and easy to use, floors themselves should still be constructed to be level and free of obvious defects. Floors should meet the tolerances in NZS 3114:1987 *Specification for concrete surface finishes* for concrete floors, AS/NZS 2455.1:2007 *Textile floor coverings – Installation practice – General*, NZS 3604:2011 *Timber-framed buildings* for timber floors, NZS 4229:2013 *Concrete masonry buildings not requiring specific engineering design* or FloorNZ best practice guidelines *Resilient floor coverings planning and installation*. FLCs are also referred to in NZS AS 1884:2013 *Floor coverings – Resilient sheet and tiles – Installation practices*.

1.0.3 For all products, obtain, read and follow the manufacturer's instructions.

1.0.4 This bulletin updates and replaces BRANZ Bulletin 360 of the same name.

2 SPECIFYING FLOOR LEVELLING COMPOUNDS

2.0.1 A wide range of compounds are used for levelling floors, but not all are suitable for all situations. Even within product types, formulations typically have different limitations in application. A product should be carefully selected to suit each specific application.

2.0.2 When specifying an FLC, consider the following:

- Compatibility with the substrate material – concrete, timber or reconstituted wood boards (particleboard, strand boards), existing sound ceramic tiles, existing fully adhered linoleum or PVC, terrazzo or steel.
- Condition and moisture content of the substrate – many FLCs are not suitable for use over damp concrete (no DPM).
- Extent and type of substrate surface preparation required.
- If an FLC is to be applied over a wet concrete floor slab (relative humidity above the slab of 75% or greater), a moisture barrier should be applied to the substrate to negate the negative pressure of the dampness rising from beneath. If the floor is then subjected to positive water pressure, such as a bathroom shower, a second moisture barrier should be applied over the FLC layer and beneath the floor covering to prevent degradation of the FLC.
- Required thickness of floor levelling compound to attain a level floor.
- Area to be covered – some latex-modified cement compounds are suitable only for localised repairs in areas of light foot traffic.
- Likely ambient temperatures during application.
- Floor finishes being applied over the compound (such as resilient sheet flooring, ceramic tiles, carpet, parquet etc) and flooring adhesives used. FLCs must be compatible.
- Whether the floor is heated – not all cement-based FLC compounds are suitable for use under ceramic tiles with heated floors.
- Use of the space – foot or wheeled traffic. A thickness of 4.5–6 mm is generally sufficient for foot traffic. Some manufacturers say that FLCs as thin as 6 mm (depending on product formulation) may be satisfactory for use under wheeled traffic. However, a minimum thickness of 12 mm is generally considered desirable.
- Timing – how much time is available to carry out floor levelling? How quickly will the flooring be installed and walked on after application of the FLC? Rapid curing compounds may be used if time is tight.
- Compatibility with waterproofing membranes in wet areas.
- Compatibility with flooring (vinyl, ceramic tile etc) adhesives.
- Shrinkage – for concrete, FLCs must be non-shrinkage.
- Requirements for a feathered edge.
- Location of movement/control joints and saw cuts in the substrate.
- Likely temperature changes in the location. FLC compounds are available that resist large temperature changes, freezing and thawing, and some can be used outside.

2.0.3 White floor fill, similar to plaster of Paris, is generally not suitable for use as an FLC as it provides a poor surface for adhesives and will crack and shatter under foot traffic. Some high-performance gypsum-based self-levelling compounds have been developed, but they are very expensive and most are currently not being marketed or sold in New Zealand.

2.1 HAZARDS AND SAFETY

2.1.1 Some FLC ingredients may irritate eyes and skin or make breathing difficult. Before application, read the manufacturer's safety data sheets. During mixing and application, wear appropriate safety protection – overalls, dust mask, safety glasses and gloves.

2.1.2 Recycle surplus or waste materials if possible or dispose of it safely and as recommended by the manufacturer.

2.2 DESIGN PARAMETERS

2.2.1 Specific design requirements to consider are:

- adding further layers over the structural floor increases the risk of failure of adhesion between the layers – fibre-reinforced FLC compounds help minimise the risk of failure
- using only in non-structural situations (although some epoxies may be used to enhance the condition of existing concrete surfaces)
- not bridging movement control joints in the underlying structure
- ensuring substrate deflection is less than 1/360th of the span for the expected loads

- not using FLCs (except some epoxies) under coatings or as an exposed surface
- allowing sufficient curing time for new concrete substrates so that concrete shrinkage and moisture levels will not affect the FLC.

3 PRODUCT TYPES

3.1 PRIMERS

3.1.1 Primers enhance the bond with non-porous substrates in particular, but are generally recommended in many situations. The primer should be selected for the specific location – for example, a primer for a house may be different from one for a warehouse where floors will be subjected to greater dynamic and point loads.

3.1.2 Manufacturers offer different primers for a variety of substrates, conditions (porosity, smoothness, required bond strength, solvent free) and drying times.

3.1.3 Some FLC compounds can be mixed to a slurry with water for brushing or rolling to the floor as a primer or bond coat.

3.2 CEMENT-BASED COMPOUNDS

3.2.1 Cement-based levelling compounds are a dry sand/cement-based powder that water is added to. These products are typically fast-hardening, fully bonded compounds applied in thicknesses of 10–25 mm. They can be used over many substrates (including suspended timber board floors and reconstituted wood board (RWB) sheet floors) that are strong enough to meet the deflection criteria and accommodate the dead and live loads applied. Some lightweight levelling compounds are available to minimise additional dead loadings.

3.2.2 They can be trowelled, poured or pump applied.

3.2.3 Formulations are available to give:
- thickness from feather edge to 100 mm maximum – many products specify a maximum thickness of 12–30 mm
- rapid hardening – walk-on times from 30 minutes to 48 hours
- rapid overlay – from 45 minutes to 2 days under favourable conditions.

3.2.4 Some compounds may:
- be self-levelling (designed to find their own flat surface) in thicknesses of more than 5 mm
- provide compressive strengths of up to 43 MPa for high dead loads
- be suitable for use under most types of floor finishes
- achieve a high-quality finish to tight tolerances.

3.2.5 Specific requirements for cement-based FLCs are:
- careful surface preparation
- generally require a dry substrate, although at least one high-tech product is available that can be applied to wet (not fully cured) concrete slab substrate
- primed surfaces – with the correct primer for the substrate
- skilled and experienced or licensed/approved applicators.

3.3 MODIFIED CEMENT-BASED COMPOUNDS

3.3.1 Modified cement-based compounds are a two-part formulation mixed on site – a cement-based powder and an emulsion of acrylic or synthetic rubber (SBR).

3.3.2 FLCs using an SBR emulsion are generally more water resistant, but those with acrylic emulsions have better handling properties.

3.3.3 Formulations are available to give:
- thicknesses from feather edge to 100 mm – some products have a specified maximum thickness

- quick drying, with walk-on times of 2–48 hours
- rapid overlay (from 45 minutes to 2 days under favourable conditions) with application by trowelling or pouring and, in some cases, pumping
- self-levelling or self-smoothing (typically a highly polymer-modified, two-part system designed for problematic substrates)
- compressive strengths of up to 40 MPa for high dynamic load applications
- low shrinkage
- low tension
- resistance to freeze/thaw cycles
- suitability for use under most floor finishes
- suitability for use over substrates that are subject to a limited degree of flexing and/or thermal expansion and contraction (manufacturers' guidelines must be followed)
- good bonding over a variety of substrates such as concrete, sound ceramic or vitrified tiles, steel, wood or terrazzo.

3.3.4 Specific requirements for modified cement-based FLCs are:
- component parts must be mixed in correct proportions – some products may be available in ready-to-mix pre-proportioned units
- substrates may require wet priming with emulsion – some modified cement FLCs may be self-priming
- substrates must be dry.

3.4 GYPSUM CEMENT-BASED COMPOUNDS

3.4.1 Gypsum cement-based FLCs consist of gypsum cement and plaster sand mixed with water. They can be pumped or poured and screeded into place over a range of substrates including timber strip flooring and reconstituted wood board sheet flooring.

3.4.2 The characteristics of gypsum cement-based FLCs are:
- generally low cost
- low shrinkage
- application thickness from feather edge to 75 mm
- compressive strengths are typically 11–17 MPa, but up to 42 MPa is possible
- quick application and quick initial set.

3.4.3 Gypsum cement-based FLCs are not suitable for use:
- where there is any likelihood of moisture from above or below
- over green concrete – an expansive reaction can occur in gypsum (calcium sulphate) when in contact with concrete and dampness from the substrate or a water-mixed adhesive
- under tiles subject to medium or heavy wear, wheeled traffic or high impacts
- under resilient flooring surfaces (which require compressive strength of 20 MPa or greater)
- under cement-based adhesives
- where subjected to surface wear before tiling
- where the FLC may become wet.

3.4.4 When specifying or using a gypsum cement-based FLC, check:
- whether the surface needs to be primed
- that there will be sufficient ventilation during the drying period – complete drying of 18 mm thick applications takes 5–7 days under favourable conditions
- the level of surface hardness provided – this can vary between formulations.

3.4.5 Gypsum cement-based FLCs should not be installed until the building is weathertight and, for some formulations, until all wet trades (stopping, plastering) have completed their work.

3.5 EPOXIES

3.5.1 Epoxy/polyurethane FLCs are two-part or three-part compositions often consisting of 75–100% solids. They are formulated to be a pour-on thin coat (0.5–1 mm) self-levelling finish or a high-strength chemical-resistant patching compound. They can be used externally (but not left exposed to UV) and over all substrates to give a tough, non-shrinking, waterproof, abrasion-resistant surface.

3.5.2 Epoxy:
- is often stronger than the floor substrate it is attached to
- must not be applied to concrete with a moisture content over 75% relative humidity
- has negligible shrinkage
- fills small undulations and indents
- is particularly suitable for application over concrete, existing tiles or terrazzo
- provides an abrasion-resistant and chemical-resistant surface
- is typically more costly than cement-based FLCs
- is not considered suitable for strengthening or stabilising existing concrete floors – it is almost impossible to sufficiently wet the degraded concrete to provide adequate surface bond strength, and the epoxy usually delaminates below the epoxy-bound surface layer and comes up in large sheets.

3.5.3 Self-levelling flooring epoxies that fill small indentations while providing a seamless floor finish are also available. They can be applied to concrete and to timber and particleboard floors in good condition.

3.5.4 Some two-part modified polymer FLCs are suitable for use with underfloor heating systems.

4 PREPARATION

4.1 GENERALLY

4.1.1 Always follow the manufacturer's instructions.

4.1.2 The FLC will only be as strong as the material it is bonded to, so good preparation before laying the FLC is critical. The FLC will also reflect any fine cracks and saw cuts in the substrate.

4.1.3 Problems with FLCs usually result from:
- inadequate substrate preparation and/or poor substrate condition
- specifying or using the wrong product
- incorrect mixing

- over watering
- poor application, including application that is too thick
- application during ambient temperatures beyond the manufacturer's recommendations
- poor bond to the substrate
- insufficient curing time allowed
- reflection of cracks through the FLC
- damp substrates.

4.1.4 The key to success when installing an FLC is the bond between the FLC and substrate surface. Before applying the FLC, ensure that floor surfaces are:

- sound and solid, free of any weak concrete, loose material or cement laitance
- rigid and free of excessive deflection – as a general guide, the maximum deflection of the floor structure (or the flooring for timber) should not exceed 1/360th of the span under design load conditions
- clean and free of any material that may affect the bond – dust, oil, wax, grease, asphalt, sealing and concrete curing compounds
- dry.

4.1.5 Repair/fill cracks, voids and blowholes and apply primer as recommended.

4.2 PREPARING CONCRETE FLOORS

4.2.1 Contamination can be removed from concrete floors with:

- abrasive blasting using the captive shot-blasting method
- use of a diamond grinding machine
- scabbling or scarifying to give a suitably textured surface
- high-pressure waterblasting (considered the least desirable method).

4.2.2 Acid etching of concrete is corrosive and dangerous and not recommended. It may also leave residues that can reduce the performance of cement-based compounds.

4.2.3 Where a resilient floor covering is to be adhered, unless the concrete floor slab is substantially free from grooves, ridges, gaps or holes (exceeding 1 mm), trowel arcs or broom finish, an underlayment shall be used. The underlayment shall:

- comply with the requirements of NZS/AS 1884:2013, specifically clause1.4.3(b)
- have a service life not shorter than the resilient floor covering being used and be compatible with the floor covering and adhesives to be used
- be non-shrinking so no cracks are visible when the floor covering is installed
- be non-staining, non-exuding and capable of withstanding the traffic load on the floor without indenting or deforming
- be capable of being bonded to the concrete subfloor so that the bonding is not affected by the expected traffic loading or static or point loads applied to the floor.

4.2.4 Remove all dust and debris, preferably by vacuuming, immediately before applying the compound.

4.2.5 Another option is to lay an unbonded topping slab over the contamination separated by a slip layer (see section 6).

4.3 PREPARING TIMBER FLOORS

4.3.1 Timber flooring and floor structure must be rigid enough so that the FLC is not subject to stress from deflection in the floor. The amount of deflection that specific FLCs can handle will vary depending on the product being used but must be no greater than 1/360th of the span.

4.3.2 Where a floor deflects more than the specific FLC can comfortably handle, the FLC will crack along joints in the flooring or in areas subject to movement and flexing and may potentially disintegrate. Where slate, tiles or sheet vinyl is to be installed, consider using an underlayment (a proprietary thin fibre-cement sheet underlay), which helps protect from surface inconsistencies and movement in timber substrate floors, in conjunction with an FLC.

4.3.3 Where structural floor deflection is not the governing issue, generally the underlayment shall:

- comply with the requirements of NZS/AS 1884:2013, specifically clause 1.4.3(a).
- be capable of being bonded to the subfloor so it is not affected by normal traffic or point loading
- be standard hardboard of type RD, high-performance MDF, plywood, fibre-cement sheet or self-levelling underlayment specifically designed for timber floors.

4.3.4 Sheet and timber strip floors should preferably be glued and screwed, with loose boards fixed and open joints (any gaps exceeding 1 mm) filled. Sand with a drum sander and vacuum the floor before applying the FLC.

4.4 OTHER SURFACES

4.4.1 Ensure that existing floor finishes such as ceramic tiles, linoleum, vinyl and PVC are well bonded to the substrate before applying the FLC.

4.5 PRIMING

4.5.1 Prime absorbent or porous substrates with the manufacturer's recommended primer to seal the surface and prevent:

- water being drawn from the levelling compound – where water is removed too quickly, the surface will be weak and prone to disintegration because it has not hydrated or cured properly
- air bubbles rising through the FLC causing blemishes that can weaken the FLC surface and be visible through the floor covering.

4.5.2 Priming non-absorbent or non-porous materials such as terrazzo and tiles is also often required to provide a satisfactory bond between the FLC and the substrate.

5 COMPOUND APPLICATION

5.0.1 Mix, lay and cure the compound following the manufacturer's instructions. It is crucial to get the proportions right for component parts of FLCs and additives or admixtures, especially with epoxies.

5.0.2 Some FLCs, particularly cement-based compounds, require skilled and experienced applicators.

5.0.3 The mixing process for cement-based FLCs is typically:

- pouring the correct amount of clean potable water into a suitably sized mixing pail – the amount of liquid is critical to successful mixing
- slowly adding compound powder while mixing continuously with an electric drill mixing paddle at a slow speed of 300–500 rpm
- thoroughly mixing for several minutes to get a smooth uniform consistency.

5.0.4 General principles for application:

- Ensure the primer has been properly applied to achieve maximum adhesion and is completely dry.
- Lay to the specified thickness and within the accepted floor finish tolerances for the type of flooring being laid over the compound.
- At feathered edges, glue to the substrate where recommended by the manufacturer.
- Ensure ambient room temperatures are within the recommended range.
- Do not re-temper materials after the initial set has occurred.
- For timber floors, incorporate any reinforcing according to the manufacturer's instructions, ensuring that it is correctly embedded in the FLC.
- Maintain a wet edge when laying by working progressively across a floor – do not place the edges first then work towards the centre.

5.0.5 After application:

- Cure according to the manufacturer's instructions, keeping the ambient air temperature within the required limits.
- Protect the FLC from heavy and/or point loads until it is fully cured.
- Allow the FLC to dry before installing flooring material (refer to the manufacturer's specific requirements of product used, which can be as little as 4 hours) – a maximum relative humidity reading of 75% is required before resilient sheet flooring is installed.
- Floor coverings should be installed to protect the FLC as soon as practical. Where there is a delay, lay temporary protection (softboard sheets, old carpet) over the FLC.

6 TOPPING SLABS

6.0.1 An unbonded topping slab can be laid where the substrate is not suitable or cannot be made suitable for an FLC. Check that the floor to ceiling height will accommodate the slab thickness and that the floor structure will take the additional weight.

6.0.2 To provide satisfactory performance, an unbonded topping slab must:

- be separated from the substrate by a continuous separating (slip) layer of polythene or flexible wall underlay that is free from damage when the topping slab is laid
- be laid over a substrate that is free from loose material or sharp projections or indents that may damage the separating layer – indents should be filled or ridges removed so that drying shrinkage is not restrained
- have a minimum concrete strength of 17.5 MPa with a maximum coarse aggregate size of 12 mm
- be at least 70 mm thick (measured at the thinnest point of the slab) to prevent the slab curling as it cures and shrinks
- be reinforced with expanded metal lath, 0.9 mm wire mesh located centrally in the topping slab or chopped polypropylene fibre

- have movement joints in the underlying structure carried through the topping slab (and be saw cut where the topping slab area exceeds 10 m^2)
- be moist cured for 7 days minimum
- have a minimum drying period of 3 months under good drying conditions for a 70 mm thick topping slab when protected from subsequent wetting
- not be loaded for at least 7 days to allow strength development
- meet the surface tolerance limits required of the applied floor finish.

6.0.3 Proprietary bulk-fill levelling compounds may be used in place of traditional concrete topping slabs. Bulk-fill products can be applied in thicknesses of 6 mm to any thickness based on the manufacturer's specifications for the individual product.

6.0.4 Bonded slabs are typically thinner (minimum thickness 15 mm) than unbonded slabs (minimum thickness 45 mm/no maximum thickness) and must be fully adhered to the substrate. Generally, if a concrete slab is not suitable for an FLC, it will not be suitable for a bonded concrete slab.

7 FURTHER INFORMATION

STANDARDS

AS/NZS 2455.1:2007 *Textile floor coverings – Installation practice – General*

NZS 3114:1987 *Specification for concrete surface finishes*

NZS 3604:2011 *Timber-framed buildings*

NZS 4229:2013 *Concrete masonry buildings not requiring specific engineering design*

NZS AS 1884:2013 *Floor coverings – Resilient sheet and tiles – Installation practices*

PUBLICATIONS

BRANZ Bulletin 641 *Concrete toppings*

BRANZ Good Practice Guide *Tiling* (3rd edition)

FloorNZ best practice guidelines *Resilient floor coverings planning and installation*

BRANZ

INSPIRING THE INDUSTRY TO PROVIDE BETTER BUILDINGS FOR NEW ZEALANDERS

BRANZ ADVISORY HELP LINES

FOR THE BUILDING INDUSTRY
0800 80 80 85

FOR THE HOME OWNER AND PUBLIC ENQUIRIES
0900 5 90 90

Calls cost $1.99 per minute plus GST. Children please ask your parents first.

BRANZ Find www.branzfind.co.nz

HEAD OFFICE AND RESEARCH STATION
1222 Moonshine Road, Judgeford, Porirua, New Zealand
Private Bag 50 908, Porirua 5240, New Zealand
Telephone 04 237 1170 - Fax 04 237 1171
www.branz.nz

Standards referred to in this publication can be purchased from Standards New Zealand by phone 0800 782 632 or by visiting the website: www.standards.co.nz.

Please note, BRANZ books or bulletins mentioned in this publication may be withdrawn at any time. For more information and an up-to-date list, visit BRANZ Shop online: www.branz.nz or phone BRANZ 0800 80 80 85, press 2.

ISSN 1178-4725 (Print) 2537-7310 (Online)