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BRANZ REPORT

AR0030

Durability Opinion of Quik'nTuff™

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DURABILITY OPINION OF QUIK'nTUFF™

1. CLIENT

EIFS International Trust
PO Box 2106
Wellington
New Zealand

2. SUMMARY

It is BRANZ opinion that the Quik'nTuff™ Wall System will meet the durability provisions of NZBC B2.3.1 (b) of 15 years, the hazardous materials provisions of NZBC F2.3.1 and the moisture provisions of NZBC E2.3.2, E2.3.6 and E3.3.1, providing it is installed in accordance with the manufacturer's instructions, and the conditions of use in this opinion.

If the wall cladding system is properly maintained, with panels, fixings and render remaining dry while in service, the Quik'nTuff™ Wall System is expected to provide a serviceable life of at least 30 years in most New Zealand weather extremes.

Quik'nTuff™ Wall Systems panels used in Australia will have an aluminium foil adhered to the inner surface. While the BCA has no durability requirements, it suffices to say that addition of the foil for the Australian market should not adversely affect the physical performance of the panel; more so, it should improve some performance features. The durability of the aluminium foils emissivity [lustre] over the serviceable life cannot be assured, therefore its use as a reflective insulation material cannot be certified. This opinion is based on testing of the product as specified to meet NZBC requirements; however it is transferable to BCA certification processes.

3. NZBC REQUIREMENTS

The performance requirement for building elements that are moderately difficult to access or replace should be 15-year durability, as specified in clause B2.3.1 (b) of NZBC. When used as a building element and subject to normal maintenance, which allows continued compliance to the performance requirements of the NZBC, external-cladding systems must also meet the performance provisions of NZBC E2.3.2 and E2.3.6, and E3.3.1. Components of the cladding system must meet the performance provisions of NZBC F2.3.1

4. SCOPE

The scope of application for this product includes external wall cladding [EIFS] on residential buildings, internal partition walls and flooring over concrete slab on 2nd floor levels, replacing particleboard. This opinion only refers to the application as an EIFS.

5. PRODUCT

The Quik'nTuff™ Wall System is a unique face-Sealed (drained & ventilated) cavity wall EIFS. The system is a thermal insulating wall cladding EIFS system for new and existing timber or steel frame, masonry and reinforced concrete walls. The system is based on a reinforced blend of acrylic-modified cement-based binder and expanded polystyrene [EPS] beads, forming the wall panel [Conpolcrete™]. The panels are mechanically fixed to timber framing, masonry or

concrete using proprietary 'Lock brackets' fixed in a horizontal striated pattern that holds the panel away from the substrate. In the Australian market the wall panel is lined with aluminium foil, but un-lined for the New Zealand market. The gap between panel and framing forms a 'drainage cavity' and ventilation pathway, which assist with water management, but reduce the systems insulation performance. It is therefore likely that the system would need to use additional insulating material to provide the required wall insulation properties to meet Code requirements.

The fasteners used depend on the substrate and include specified nails, screws, washers and masonry anchors. Proprietary weep hole components are used to form drainage points along the base of the wall system.

The panels are jointed, edge angled or sealed with fibreglass mesh tape [JointMesh] or corner angled fibreglass mesh [Black Mesh Angle], and finished with polymer-modified cement jointing render. Recess joints are set with render and render additive, reinforced with fibreglass mesh. Two coats of render are applied over the wall area, then primed and painted. Ancillary items include corbels made from the Conpolcrete™ panel material, damp proof membrane, gap sealant and panel boot. The panel boot provides a controlled drip line for the finishing of the coating system.

The coating system could be either a polymer modified cement-based mineral texture, or a 100% acrylic-based aggregated texture. An over coat can also be used, consisting of a 100% acrylic, heavy duty paint membrane [Superflex membrane] with elastomeric properties. The superflex membrane is also intended to provide weather tight protection for external masonry surfaces. An acrylic resin-based masonry primer is used for render and masonry surfaces. Therefore these materials identified in this assembly are those summarised and evaluated in Section 6.

6. BASIS OF OPINION

6.1 History of Use

EIFS were first used in Europe during the early 1950's, in the USA in 1969 and in New Zealand from the early 1980's. The Quik'nTuff™ Wall Systems however are proprietary EIFS systems based on a similar technology that produces lightweight concrete panels with EPS beads, and as yet, do not have a history in the New Zealand or Australian building environment. EIFS system in general however has been used successfully in New Zealand for approximately 11 years. The early European systems are still in service, conferring a serviceable life of up to 30 years. The additional strength afforded by the binder additive should enhance this serviceable life, providing the system is kept dry.

The fibreglass mesh, galvanised steel fasteners, EPS, PVC, trims and flashings, polyethylene DPC, polypropylene weep holes and acrylic-modified render and additive are all standard building materials that have proven their durability, as required by clause B2.3.1 of the NZBC.

6.2 Materials of the EIFS and Associated Materials

The materials of the Quik'nTuff™ system include:

- Conpolcrete wall panels
- Corbels made from Conpolcrete™ bands 120 mm x 37 mm x 2230 mm.

- Fasteners -Panel fixing screws
- Fasteners- Corbel fixing screws
- Damp proof course
- Gap sealant
- Joint Mesh, reinforcing mesh and angle mesh
- Galvanised Lock Brackets
- Masonry primer
- Mineral texture coat and acrylic texture coat
- Superflex membrane
- Two-in-one coat
- Weep holes
- Panel boot
- Render and render additive

6.3 Conpolcrete wall panels and corbels

The Conpolcrete™ panel and Corbels are constructed from a blend of EPS beads and Portland cement with an acrylic-modified binder. The binder modification is a proprietary component of the system, to which it is BRANZ opinion that it constitutes no health hazard to end-users in its fixed state within the panels, and when exposed to environmental conditions expected in either the New Zealand or Australian built environment. The panels are 2230 mm long with nominal thickness of 37 mm and 51 mm, and density of 420 kg/m^3.

BRANZ test report AR0029 has verified the durability of the Conpolcrete™ panels with no Al foil backing with that a variety of panel formulations. The durability test regime includes accelerated aging by Freeze-Thaw cycling and temperature-humidity cycling. Conpolcrete™ panels passed all performance requirements when tested for bending strength, internal bond strength, water penetration resistance and water vapour transmission resistance

The only concern is the high porosity of the panels that allows them to fail the water penetration resistance test. If water penetrates into a wall system via coating or jointing damage or failure, the trapped water will form increased water vapour pressure beneath the coating and render system, causing 'bubbling' and delamination as the sun heats the outer surface. It is therefore imperative that water does not penetrate the coating system and, does not enter from the wall cavity side. The aluminium foil backed panels should protect the panel core from internal water vapour or liquid. In the New Zealand market, it is recommended that the rear surface be treated with a waterproofing material [eg: silicone], possibly sprayed on at the production line.

The polystyrene components in this system are Class H expanded polystyrene [EPS] beads that comply with AS 1366 Part 3. Polystyrene has good mechanical properties, is resistant to moisture in the short term, and however should not be exposed to moisture on a long-term basis. Therefore all waterproofing systems must be adequately maintained to keep it dry. However polystyrene is damaged [dissolved] by interaction with phthalate-based plasticisers in PVC sheathing around electrical cables, which leach out of the cables over time. Therefore it is advised that when cables penetrate the polystyrene board for exterior electrical connections, the cable must be supported away from, or sheathed from [inside a conduit] the polystyrene in an appropriate manner. In the Quik'nTuff™ system all wiring is carried by plastic conduit when passing through the panels. The polystyrene component of the panels and Corbels are also subject to UV photo degradation, therefore care must be taken to ensure they are not exposed to

direct sunlight for longer than 30 days during storage and installation. Any powdery oxidation products that form on the panels must be sanded off prior to rendering. EPS are also combustible and should not be exposed to flame or other ignition sources. The EPS foam is protected from long-term direct exposure to UV by the render-coat finishing system; therefore degradation by UV is unlikely to affect the exposed EPS beads.

Care must be taken with the choice of colours for the finishing system, as dark colours absorb significantly more IR heat, and heat distortion in polystyrene starts at about 65°C. The serviceable temperature is lower under stress, because of creep. EPS is a thermoplastic and therefore subject to creep [flows away from the direction of any applied mechanical stress], and because it is a foamed plastic, the ability to withstand localised stress is significantly diminished. Therefore it is not suitable for attaching fasteners that will apply localised loads. The minimum service temperature is well below –20°C, which is only ever never experienced in New Zealand at high altitudes.

Dry polystyrene will not support growth of micro-organisms such as fungi or bacteria, and does not attract ants, termites or rodents, since it has no nutritional value. However, there are reports of termite infestation and damage [Hardy, 1996] within EPS panels of EIFS in the USA. The root cause is trapped moisture attracting the termites. While New Zealand may be regarded as being 'termite-free', this problem must be considered for the Australian market.

It is therefore BRANZ opinion that the Conpolcrete™ wall panels and Corbels will meet the 15-year durability provision of NZBC B2.3.1(b).

6.4 Fasteners

The panel fixing screws are ZF100 hot-dipped galvanised steel, 12g, 25 mm long self-drilling, hexagonal head screws with Climaseal 3 to comply with AS 3566. Corbel fixing screws are ZF100 hot-dipped galvanised, 8g x 60 mm, self-drilling, countersunk, Phillips head screws. It is BRANZ opinion that the fasteners will meet the 15-year durability provision of NZBC B2.3.1, providing the timber is kept dry. If the moisture content of the timber is higher than 18% water content for extended period of time, the fastener may not meet the 15 year durability requirement.

6.5 Damp proof course [DPC]

The DPC is made from embossed polyethylene, with a 0.5 mm base thickness and 0.75 mm embossed thickness, complying with AS 2904-1995. Polyethylene has a Rockwell hardness of D41-D46 (Shore), when tested to ASTM D785, impact strength of 1.02- 8.15 J/12.7 mm when tested to ASTM D256, tensile strength of 21-38 MN/m^2 when tested to ASTM D638, water absorption < 0.01%$^{w}/_{w}$ over 24 hours when tested on 3 mm thick sheet to ASTM D570 and water vapour permeability of 60×10^{-5} $ml/cm^2.s/mil/cmHg$ at 25°C, making it a durable and functional water resistant material. It is BRANZ opinion that the DPC will meet the 15-year durability provision of NZBC B2.3.1

6.6 Gap sealant and adhesive

The gap sealant is general purpose, water-based sealant. This Everflex sealant has main components of acrylic polymer, fumed silica, White oil, ammonia, biocide, methyl silane, sodium decylbenzene sulphonate and water. The adhesive is 'Floorbond WB' containing styrene-acrylic and butyl-acrylate-styrene copolymers, calcite, sodium polyacrylate, petroleum hydrocarbon, 1,2 Benzisothiazol, 3-one and dibutyl phthalate. The durability of the adhesive matrix itself should meet the 15 year provision, however plasticiser migration from the adhesive

could attack any PVC material or polystyrene [PS] if they come in contact with each other. Possible dis-bonding within the PS-based panels could occur if any migrating plasticiser dissolves the interfacing PS material. If this adhesive is used to bind the PVC panel boot to the timber or to the panel, then possible failure could provide a situation of excess movement and subsequent fracturing, leading to possible water ingress. However, it is BRANZ opinion that these components of the system will meet the 15-year durability provision of NZBC B2.3.1 providing they are not damaged by UV exposure or their adhesive bond to substrate is not compromised by structural movement or impact damage.

6.7 Joint mesh, reinforcing mesh and angle mesh

The Black Mesh Angle is 431 g/m^2, pre-creased, alkali resistant fibreglass mesh, with tensile strength of 400 daN/50 mm warp resistance and 690 daN/50 mm weft resistance and temperature tolerance range of 0-40°C, used to form corner angles. The joint mesh is 92 g/m^2 alkali resistant woven yarn fibreglass mesh, with tensile strength of 112 daN/ 50 mm warp resistance and 128 daN/50 mm weft resistance, used fit into rebated panel joints. The reinforcing mesh is 100 g/m^2 alkali resistant fibreglass mesh skimmed into the base coat of render to reinforce impact areas. The fibreglass mesh is added to improve the tensile strength, crack resistance and impact resistance of the render.

The alkali resistance treatment provides a 50% retained tensile strength after 28 days submersion in sodium hydroxide. Consequently, while concerns for water absorption into alkaline cement based render promoting alkali attack on the fibreglass must be considered, any ingress of water sufficient to catalyse this form of attack would be more detrimental to the render and failure to the NZBC E2 provision. In the case of long-term exposure to water or the weather [BRE, 1988], fibreglass has been shown to suffer an approximate 50% reduction in strength over 10 years. In a dry environment, however, the fibres will have a serviceable and durable life of at least 30 years.

Although the function of the fibreglass may also be to prevent shrinkage cracking due to the curing and drying processes, any significant damage to the reinforcing is unlikely to have a significant impact on the system durability. Nevertheless, a coating, sealing and priming system as recommended by the manufacturer should prevent such damage. It is therefore BRANZ opinion that these components of the system will meet the 15-year durability provision of NZBC B2.3.1(b).

6.8 Galvanised Lock Brackets

The lock brackets that tie the wall panel to the framing, providing an extended wall cavity, are ZF galvanised, pre-drilled, 'L' formed profile brackets. It is therefore BRANZ opinion that this component of the system will meet the 15-year durability provision of NZBC B2.3.1(b).

6.9 Masonry Primer, mineral texture coat, render additive, acrylic texture coat, Superflex membrane and Two-in-one coat

These components of the Quik'nTuff™ system contain a common ingredient of water-based acrylic resin [100% in primer, two-in-one coat, render additive and superflex membrane], where the acrylic texture includes 1 mm & 2 mm diameter aggregates, and the mineral texture includes Portland cement with 1 mm & 2 mm diameter aggregates. The acrylic resin component has a proven history of performance. The inclusion of 2 mm sized aggregate reduces the dry film thickness of acrylic on top of the particles, therefore if the aggregate is porous [eg: calcite], then water ingress to the substrate is possible if the thin dry film build on the particles should form micro cracks. Therefore vigilant maintenance is required.

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While the minimum recommended finish system [Bulletin #342] is two acrylic paint coats or a polymer-aggregate texture coat, the preference is to have another elastomeric sealer top coat or glaze coat over any texture-coat layer, or a waterproof primer applied to the render surface prior to application of the textured finish. This is because textured coats are susceptible to micro cracking after exposure throughout its serviceable life, thus becoming permeable to water. When Hi-build coatings or specialist products with low water vapour permeability are used, the render must be allowed to dry thoroughly before coating application. Dark colours are best avoided as they absorb higher levels of solar IR heat and can introduce thermal cracking.

The surface coating must be maintained at typically 8-10 year intervals, and sealed joints and flashings must be inspected regularly and repaired where necessary. It is therefore BRANZ opinion that these components of the system will meet the 15-year durability provision of NZBC B2.3.1(b) and the Quik'nTuff™ Wall System warranty, which is claimed to be extended to 25 years under a 'Peace-of-Mind' Care program that depends on annual cleaning of the system. This program should include annual spot maintenance repair and re-coating, with regular re-painting in 2-3 year intervals if this 25 year claim is to be achievable.

6.10 Weep holes and Panel boot

The weep holes are made from impact copolymer PMA6100 polypropylene from Montell Polyolefins and the panel boot is made from high impact resistant UV-stabilised poly vinyl chloride [PVC] with an 82 Shore D hardness, as determined by ASTM D2240, suitable for interior and exterior applications. These polymers and their respective areas of application, will not be exposed to any chemical or physical environment that will compromise their performance and durability. Therefore it is BRANZ opinion that these components of the system will meet the 15-year durability provision of NZBC B2.3.1(b).

6.11 Render

The render is acrylic resin-based polymer modified Portland cement. Factors that can affect the durability performance of the render are moisture in the form of rain causing erosion and entrapped moisture, causing failure [micro-fractures] through freeze-thaw conditions. BRANZ is unaware of any freeze-thaw problems associated with EIFS, possibly due to the use of polymer modifiers that reduce the occurrence of natural shrinkage of cement-based renders. Therefore the render must be protected from rain, sun and drying winds for at least 24 hours after application, and must not be applied to frozen surfaces or when ambient temperature is below 5°C or over 30°C. The render must be continuously protected from the weather with a well-maintained compatible acrylic-based coating system. The coating system must allow the passage of water vapour and have a durability period of at least 5 years. The installation should include a protective coating over any aluminium joinery that may come in contact with the render to prevent the possibility of alkali-initiated corrosion. If properly installed, maintained and free from impact damage and water ingress, the render should meet the 15-year durability provision of NZBC B2.3.1(b).

6.12 EIFS Reports

Although the use of EIFS worldwide has been substantial over the past 30 years, many reports [Nisson. 1995] have indicated problems with water tightness in some systems, albeit due to poor workmanship or possible failures as discussed below. This emphasises the need for detailed and professional installation of this system, as workmanship cannot be considered within a materials durability opinion.

Many reports suggest that the conventional 'barrier' EIFS which rely on a watertight skin to prevent water penetration, do not work, and that the only way to prevent moisture damage is to install a drainage plane behind the panel. While the Quik'nTuff™ Wall System provides a drainage cavity, and a drainage plane on its back surface, the material is too porous that it will not exclude capillary-driven [wicked] water from this drainage. Therefore the back of these panels should be treated with a water-proof coating if fitted in New Zealand buildings.

The aluminium foil on panels used in the Australian market will function as such a drainage plane, but this function will also advance the degradation of its emissivity. While a drainage plane allows water to drain out of the system [Tonyan. 1996; Brown *et al.* 1997; Gallant. 1997], it is not the 'answer' to moisture problems.

6.13 E2 External Moisture

Provided that this cladding system is installed and maintained in accordance with the manufacturer's technical literature and recommendations of this opinion, it should meet the performance provisions of NZBC E2.3.2 and E2.3.6. This is provided that all junctions between the cladding and external joinery, at control joints and around penetrations are detailed and sealed to ensure the cladding system is watertight, and that the coating remains functional as a waterproofing agent. The ground clearances to the cladding as set out in NZS 3604: 1999 and NZBC E2/AS1 must be maintained at all times, and backfilling against the cladding system should not be permitted.

6.14 E3 Internal Moisture

If insulating wall-cladding systems are used as part of a total insulation system, which includes adequate heating and ventilation, they should meet the NZBC E3.3.1 provisions for internal moisture. Insulating wall cladding systems are not barriers to the passage of water vapour, but if correctly installed, primed, coated and sealed, they will not create, or increase the risk of damage resulting from condensation.

6.15 F2 Hazardous Building Materials

It is BRANZ opinion that no component of the Quik'nTuff™ cladding system emits any significant quantity of hazardous material that may be hazardous to people, during installation or use of the building. This is provided that the exposed areas are well ventilated, and appropriate personal protection [gloves, goggles] are used, as with sealant and adhesive use in particular. Therefore the system should meet the provisions of NZBC F2.3.1.

6.16 Conditions of Use

Thorough inspections of the system, including sealant and other joints, must be made on a regular basis to ensure durability of the components, especially considering adverse affects on the fibreglass reinforcing from water ingress, which may also lead to damage of the building structure and linings. Inspections should be made at least annually. If water penetrates the cladding system, then repairs must be undertaken to render the system weathertight once again. Sealant joints and gap fills must be repaired or replaced when necessary.

Care must be taken to prevent damage to all surfaces and edges through loading or impact. Any damage to the cladding must be repaired using new render-work and all materials and accessories as necessary, followed by application of a weatherproof acrylic coating system.

Cracking of outer protective coats can occur if they are in contact with materials with different rates of expansion or contraction, such as dark-coloured aluminium joinery. As the components of the EIFS exhibit different rates of thermal and moisture movement, the likelihood of micro-fractures or micro-fissures forming on the outer protective coating is possible. Therefore a final elastomeric sealer coat should be added, especially over texture-coated finishing with aggregate.

The complex construction of the EIFS makes it more susceptible to breaches in water tightness, possibly at joints, breaks [windows, doors] or within the body of the system [failure of coatings], as a result of poor workmanship and/or poor understanding of the system. The installation of these systems must be in accordance with the manufacturer's specification and by fully trained workmen.

7. REFERENCES

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