BRANZ OPINION

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Durability Of Eterpan 430 for Progressive Building Systems

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DURABILITY OF ETERPAN 430 FOR PROGRESSIVE BUILDING SYSTEMS LTD

1. Summary

When used in accordance with the Conditions of Use listed below, Eterpan 430 meets or exceeds the performance criteria of the NZBC for:

- 50 years in structural bracing and non-structural applications when sealed, stopped and coated with proprietary coating system. The serviceable life of the coated product will be 50 years provided the coating system is properly maintained to prevent water entry.
- 15 years when used internally. The serviceable life for internally used product will in practice be at least 50 years in dry areas (not in bathrooms, laundries etc) of a building.
- 15 years when used externally if uncoated.

These statements are based on satisfactory results of testing the product to AS 2908.2 (BRANZ Test Report MTR 1083), extensive testing of carbonated material (BRANZ Test Report MTR 1101), fungal cellared material (BRANZ Test Report 1114) and material exposed to the atmosphere for 1 year (BRANZ Test Report 1125).

2. NZBC requirement

As a non-structural part of the building envelope, the NZBC durability requirement of Eterpan 430 is 15 years according to clause B2.3.1 (b) i).

When used as structural bracing, the NZBC requirement of fibre cement cladding materials is 50 years according to clause B2.3.1 (a) i).

3. Product

Eterpan 430 is a fibre cement sheet manufactured in China from a mixture of sand, cement, cellulose fibre and water. The cellulose fibre is sourced from NZ pinus radiata wood pulp. Steam autoclaving cures the product. It is used in a variety of applications in buildings as a sheet material, most commonly as an external cladding. Cellulose-fibre cement sheet has been manufactured since the 1970's and has replaced asbestos cement sheet in the cladding market. As such, the generic product group has a history of use of around 20 years. The generic product group is essentially durable in nature as long as delamination and moisture movement of the sheet do not cause excessive problems. Significant loss of strength can occur in fibre cement boards when exposed to a fungal decay hazard because the cellulose fibres are consumed by the fungus.

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4. Basis Of Opinion

4.1 History of Performance

Cellulose cement sheet materials have been manufactured and sold in New Zealand since 1982.

Some types of fibre cement board caused problems early on in the history of the product. Specifically, sheet material experienced very large moisture movement figures after carbonation of the cement matrix had taken place. This problem has largely been overcome around the world now, as formulations have been altered to eliminate the problem.

Eterpan 430 has been used extensively for the last 6 years throughout Asia in temperatures ranging from below freezing to the mid thirties Celsius. No failures attributable to the composition or manufacture of the board have been brought to the attention of BRANZ in that time. Similar boards produced by Eternit have been used in other parts of the world for over 20 years (Eterspan, Promina and Eternit siding), with no failures attributable to composition or manufacture (Rene Vermeir, Eternit Asia Pacific).

4.2 Testing

Recent tests on Eterpan 430 to AS 2908.2 have confirmed the product's fitness for purpose. These tests included heat/rain cycling, freeze/thaw cycling, watertightness testing and modulus of rupture before and after hot water soaking (BRANZ Test Report MTR 1083). Extensive testing on carbonated product have indicated no significant change in bending strength, internal bond strength and impact resistance from the initial values. Moisture movement increased from 0.11% to 0.55% upon full carbonation, but this level of moisture movement upon carbonation is not excessive compared with an increase of 0.35% to 0.38% obtained in past BRANZ research for earlier cellulose fibre cement sheet products (Sharman and Vautier, 1986). The figures are not excessive compared with certain other building materials, for example 0.25-0.35% moisture movement in length or width for particleboard (BRANZ Bulletin 285). Furthermore, these moisture movement values represent the maximum movement possible between saturated material and material with 0 % moisture content. These extremes would not occur in real life, and the actual movement would be further reduced by coating Eterpan 430 with a good quality paint system.

Fungal cellar testing has shown a significant loss of bending and impact strength in Eterpan 430 (consistent with the expected behaviour of the generic product group), which is alleviated somewhat if the product is precarbonated (BRANZ Test Report 1114). This embrittlement suggests a loss of the fibres by fungal attack. A similar strength in either sheet direction after fungal cellaring strengthens this view as cellulose fibre usually adds a larger degree of strength in the machine direction compared to the cross direction. Moisture movement is not as high in the fungal cellared product (whether precarbonated or not) as in carbonated material not exposed to fungal cellaring. This testing was very severe and it should be remembered that the results are only relevant when conditions occur that encourage fungal growth. These conditions include ground contact or prolonged dampness. Therefore, conditions of use should avoid these situations.

The durability of 7.5 mm fibre cement board when exposed to the atmosphere at three locations for a period of one year was assessed (BRANZ Test Report 1125). The three locations were BRANZ (Wellington, New Zealand), Allunga (Queensland, Australia) and CSIRO (Melbourne, Australia). Provided fungal growth can be avoided, the main factor affecting the physical properties of the material is the effect of carbonation due to atmospheric carbon dioxide. Carbonation levels in the uncoated fibre cement sheets after one year averaged 55% (Melbourne), 62% (BRANZ) and 71% (Allunga). The carbonation level in the control sample was 9.6%. Little change was observed for modulus of rupture, internal bond strength and impact resistance for the atmospherically exposed samples, compared to the control samples. Moisture movement of the uncoated sheets increased from 0.11% for the control samples to 0.21-0.34% for the uncoated samples exposed for one year. This change is not considered excessive as described above. Given the physical property results at carbonation levels ranging from 55% to 71%, it is unlikely further significant changes in the physical properties of the uncoated sheets will occur up to complete carbonation. Carbonation levels in the coated sheets remained less than the control sample after one year exposure to the atmosphere at all three locations. Little change in the modulus of rupture, internal bond strength, impact resistance and moisture movement of the coated boards was observed after one year. Given that little change in physical properties occurred at carbonation levels ranging from 55% to 71% for the uncoated samples (with the exception of moisture movement), it is unlikely further carbonation of the coated samples will change the physical properties of the sheets over the expected life time. Carbonation of the coated product will be slow provided the integrity of the coating system is maintained over the expected lifetime.

In order that the product system achieve the 15 or 50 year durability given in this opinion, care must be taken to ensure that the associated fixings attaching the sheet material to framing do not degrade. Coastal (and occasionally geothermal) environments can be particularly corrosive to galvanised fasteners. Materials appropriate to the required life should be chosen, and attention given to coating systems and any other requirements that may be necessary to ensure that the fasteners do not fail.

5. Conditions of Use

Where the product is used in New Zealand for structural bracing applications, and it is coated with a continuous waterproof coating system, it will be durable for 50 years under the following conditions:

- The coating system on the product is maintained over the service lifetime so that it remains impervious to liquid water
- Fungal growth on the sheet is not allowed to occur in structural bracing applications. Fungal growth causes decay of the cellulose fibres in the product and loss of sheet strength. The product should not be exposed to conditions where it will remain almost permanently damp such as below ground or in contact with heavy lush foliage. For example, this may occur along the bottom plate of a wall. The loss of strength due to fungal growth under these conditions is not specific to Eterpan 430 but applies to the generic fibre cement product group as a whole.
- To eliminate the risk of fungal growth, the product must be used with the appropriate ground clearances detailed below. Appropriate edge overhang along the bottom plate must be used to

prevent capillary action forcing water behind the sheet material. Appropriate coating of sheet edges must be maintained to ensure wetting of the edges is avoided.

- The fastener system does not degrade or suffer from corrosion

Where the product is used in New Zealand for non-structural cladding applications, and it is coated with a continuous waterproof coating system, it will be durable for 50 years provided the coating system is maintained so that it remains impervious to liquid water.

In cladding applications where the product remains uncoated, it will be durable for at least 15 years.

For all applications, the product should not be exposed to conditions where it will remain almost permanently damp such as below ground or in contact with heavy lush foliage. Under these conditions fungal growth can occur leading to decay of the cellulose fibres in the product and loss of sheet strength as previously described for structural bracing use.

For external applications, Eterpan 430 must be kept clear of the ground by a minimum of 100 mm in paved areas and 175 mm in unpaved areas. The ground clearances detailed in NZS 3604:1990 Appendix E should be followed at all times.

Type 316 stainless steel fasteners should be used rather than hot dip galvanised steel in the following parts of the country:

- Areas within 500 metres of the high tide mark where there are regular strong onshore winds. (Includes most Wellington coastal regions, and all Western coasts).
- Areas within 200 metres of the high tide mark where there are occasional strong onshore winds, or regular weaker onshore winds.
- All areas within 100 m of the high tide mark.

Note, tidal river estuaries are not part of the coast. Sea harbours are part of the coast.

Fibre cement products of appropriate thickness should be used for high impact zones such as school corridors or loading areas.

6. References

BRANZ Bulletin 285. Thermal and moisture movement in building materials.

BRANZ Test Report MTR 1083. Testing of Eterpan 430 Fibre-Cement Board to AS 2908.2.

BRANZ Test Report MTR 1101. Testing of Eterpan 430 After Carbonation.

BRANZ Test Report MTR 1114. Testing of Eterpan 430 After Fungal Cellaring.

BRANZ Test Report MTR 1125. Testing of Eterpan 430 Fibre Cement Board After Atmospheric Exposure for 1 Year.

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Rene Vermeir, Eternit Asia Pacific, fax communication, 20 September 1996.

Sharman, W. R. and Vautier, B. P. 1986a. Accelerated durability testing of autoclaved wood-fibre-reinforced cement-sheet composites. BRANZ Reprint No. 43. Judgeford.

Sharman, W. R. and Vautier, B. P. 1986b. Durability studies on wood-fibre-reinforced cement-sheet. BRANZ Reprint No. 50. Judgeford.

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