

Tekton Consulting

Tekton Group Ltd, PO Box 45045, Lower Hutt 5042, ph: +64 27 2300120

MATACRYL MEMBRANE SYSTEM

NZ Building Code Compliance Technical Report

Executive Summary

This report presents an analysis of the properties of the Matacryl Membrane system and its compliance with the New Zealand Building Code when used as an external membrane for waterproofing decks, concrete roof areas, walkways, bridge decks, podiums and carparks, including above a habitable space.

Background

Matacryl is supplied to the NZ construction market for use as a waterproofing membrane. The analysis in this report reviews information provided by the manufacturer and presents it to support the manufacturer's evidence of compliance with the New Zealand Building Code.

It is intended to facilitate decision-making by a BCA when considering a building consent application.

What is the Matacryl Membrane system

The Matacryl Membrane system is a waterproofing membrane, applied over new or existing roof and deck substrates, such as concrete, in residential and commercial buildings, where a trafficable surface such as tiles and the like are installed over the top of the membrane. It can also be used directly as a trafficable surface by pedestrians and vehicles.

It consists of the following components.....

- Duracon 108 primer (porous surfaces) or Duracon 107 primer (non-porous surfaces)
- Matacryl LM
- Matacryl Thix
- Matacryl Manual
- Duracon 307 or Duracon 319 Topcoats (when required)
- Duracon 2K FG Clear Topcoat (when required)
- Walton-Park 18/36 aggregate
- Duracon 215 bodycoat (when required)
- Matacryl STC Topcoat (when required)

Matacryl® products (Matacryl® Manual, Matacryl® Thix and Matacryl® LM) are urethane-modified pre-reacted 100% solid membrane systems based on acrylic monomers, formulated with a range of viscosities. Curing is initiated by the addition of Matacryl® Catalyst.

Duracon products are low viscosity multi-component reactive resins based on methyl methacrylate (MMA), used as primers and sealers on porous substrates.

Duracon 2K FG Clear Topcoat is a UV-stable two component aliphatic polyurethane overglaze for application over mineral aggregate floor surfaces.

Other components may be used as required to prepare the substrate or to provide for subsequent covering:

- Equus Ready Rep (repair mortar)
- ASO®-EZ6 Rapid Screed
- Textile AFM (a decoupling mat)
- Graded calcined Bauxite
- Coloured Quartz aggregate

Analysis

What are the applicable Building Code clauses?

The following code clauses are applicable to the use of the Matacryn Membrane system used as described above (see Appendix 1 for details of how these clauses are applicable):

B2 Durability – B2.3.1 (a)*, B2.3.1 (b), B2.3.2*

D1 Access Routes – D1.3.3(e)

E2 External Moisture – E2.3.1 (contributes to), E2.3.2, E2.3.6, E2.3.7

F2 Hazardous building materials – F2.3.1

(* where difficult to access or replace e.g. where protected by tiles or screed)

How does the Matacryn Membrane system comply with the performance requirements of the NZ Building Code?

B2 Durability

B2.3.1 (a), B2.3.1 (b), B2.3.2

The Matacryn Membrane system is outside the scope of Acceptable Solution B2/AS1. Verification Method B2/AS1 provides for the verification of durability by proof of performance, taking into account the expected service conditions by one or more of the following:

- a) In-service history,
- b) Laboratory testing,
- c) Comparable performance of similar building elements.

The expected service conditions are dominated by resistance to immersion in water (if used in a directly trafficable application without protection) or exposure to UV and mechanical damage (if not protected).

The Matacryn (One Coat) Bridge Deck waterproofing system has been reviewed and a certificate issued by the BBA Agrément Board¹. A bridge deck is particularly demanding for durability, as water contaminated by de-icing salts must be prevented from penetrating the bridge deck (where it would lead to corrosion of reinforcing steel). The design life of a bridge structure is typically in excess of 100 years. The BBA HAPAS certificate concluded that “provided the installed system is not damaged during subsequent resurfacing, it will provide an effective waterproof layer to the concrete bridge deck”.

Tests conducted in support of the BBA Agrément certification included:

- tensile adhesion at –10°C, 23°C and 40°C
- resistance to chloride ion penetration
- resistance to freeze/thaw
- resistance heat ageing
- resistance to chisel impact
- resistance to aggregate indentation at 40°C, 80°C and 125°C
- resistance to thermal shock, heat ageing and crack cycling

- tensile adhesion to 7-day-old concrete substrate
- tensile adhesion of overlaps after 6 months
- shear adhesion of HRA surfacing to waterproofing system interface
- tensile bond strength of HRA surfacing to waterproofing surfacing system interface.
- tensile adhesion on tamped and timber formed surface finish of concrete substrate
- tensile adhesion of system installation at –5°C on concrete substrate.

Resistance to immersion in water is evidenced by the resistance to chloride ion penetration reported by the BBA HAPAS certification and by EXOVA².

Resistance to UV has been tested^{10, 11} by assessment of colour change, hardness and tensile properties following accelerated exposure to UV radiation, with only negligible variations after UV exposure.

Enhanced resistance to UV when the membrane is exposed to sunlight is provided by Duracon 307. Silica sand added to the Matacryn and/or Duracon 307 to provide slip and wear resistance provide further protection from UV.

D1 Access Routes

The Matacryn Membrane system may be used in applications where it provides a trafficable surface for pedestrian access. Wet slip resistance of Matacryn with the addition of silica sand to the priming coat and wear resisting layer has been tested⁹ by pendulum testing in accordance with BS 812. This exceeds the wet slip resistance required by Acceptable Solution D1/AS1.

Duracon has been tested in-situ by Opus¹² to AS/NZS 3661.1:1993 and found to have a mean wet coefficient of friction of 0.69, compared with a minimum required of 0.4.

E2 External Moisture

The Matacryn Membrane system is outside the scope of materials included in Acceptable Solution E2/AS1. A first principles approach, and comparison of relevant attributes with other products accepted in practice is taken below.

E2.3.1

MBIE Determination 2016/016³ found that a nominally flat, or zero pitched roof, can provide for precipitated water to be shed, and comply with E2.3.1. It noted that the scope of E2/AS1 is limited to particular materials, not applicable to the Matacryn Membrane system. It noted also that the Code of Practice for Torch-on Membrane Systems for Roofs and Decks⁴ provides for dialogue between the designer and supplier. In other words, the limits of fall are not absolute.

It noted that is possible, and realistic to expect, that a notionally flat roof structure could in practice have low points in which water would pond, but took the view that this is appropriately considered as a matter for compliance with E2.3.7(b), because such low points reflect construction tolerances, and are not a deliberate design to accumulate water.

The Matacryn Membrane system does not present any barrier to the shedding of precipitated water from the roof, even at nominally zero pitch, and therefore contributes to compliance with E2.3.1.

E2.3.2

The dominant considerations for E2.3.2 are resistance to water, and water vapour transmission.

The water vapour transmission, or permeability, has been tested and reported. For Matacryn Manual: $1.11 \times 10^{-11} \text{ kg}/(\text{m}^2 \cdot \text{s} \cdot \text{Pa})^5$. For comparison, this is similar to, or better than, other roof and deck membrane waterproofing products ($2 \times 10^{-10} \text{ kg}/(\text{m}^2 \cdot \text{s} \cdot \text{Pa})$), or tanking materials ($10^{-11} \text{ kg}/(\text{m}^2 \cdot \text{s} \cdot \text{Pa})$).

Resistance to water pressure has been tested⁵, with the membrane subjected to an applied pressure of 5 bars (500 kPa) for 72 hours, with zero water penetration through membrane.

The mechanical properties have been tested and reported⁷.

The membrane has excellent adhesion to concrete (rupture within the concrete), good hardness (85 IRHD), ability to bridge cracks and excellent elongation at breaking (145%). The elongation at breaking can be compared with other well accepted roofing membrane products (elastomeric sheet approx. 400%, or torch-on bituminous membrane approx. 40%).

The membrane also has excellent crack bridging properties. Testing by Kiwa⁸ with the following results: “after testing no cracks were detected in the waterproofing membrane”.

E2.3.7

The waterproof membrane being fully adherent to the underlying concrete or timber roof substrate minimises the passage of moisture should the membrane itself fail to resist penetration by moisture, which provides for E2.3.7(a) being met.

In considering E2.3.7(b) there is a possibility of unintended ponding of water at low points on a nominally flat deck as a consequence of normal construction tolerances.

When this is considered in the context of the functional requirement (clause E2.2) to provide adequate resistance to penetration and the accumulation of moisture from the outside, then provided the water resistance integrity of the membrane is not compromised then the functional requirement does not depend absolutely on precipitated water being shed.

The Matacryn Membrane system has been shown to resist the passage of water when tested at pressures up to 5 bar (500 kPa) for 72 hours. It is also used as for a range of applications where it could be subjected to long term or permanent hydrostatic water pressure e.g. sub-grade waterproofing of Buildings and Civil Engineering Structures, and protection and waterproofing of Tunnels, Channels and Dam structures. It follows that the membrane would provide sufficient resistance to water that might pond in localised low points, and therefore would satisfy E2.3.7(b).

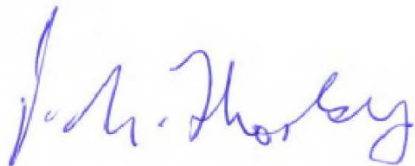
Tensile bond strength of the system applied to wet concrete tested after XX days⁹ resulted in cohesive failure in the concrete. It can be concluded that the system is tolerant of application to concrete when it is not completely dry.

F2 Hazardous building Materials

The Matacryn Membrane system has no components¹³ giving rise to harmful concentrations at the surface of the material where the material is exposed (notwithstanding the material is not exposed) nor in the atmosphere of any space. The resins are two-component resins which cure by a polymerisation reaction to produce an inert thermoset plastic with negligible residual reactivity.

Conclusions

The Matacryn Membrane system used as described and installed in accordance with the manufacturer's installation instructions complies with the applicable performance requirements of the NZ Building Code.



P N Thorby

References

1. BBA HAPAS Certificate 10/H161 Product Sheet 1, *MATACRYL (One Coat) Bridge Deck Waterproofing System*, 1 July 2019
2. EXOVA Report No. 10-05-2837-1 *Testing of a Polymeric Membrane Material* 16 February 2011
3. Ministry of Business, Innovation and Employment Determination 2016/016 *Regarding the code-compliance of a zero pitch roof system using a protected liquid applied membrane Determination*, 29 April 2016
4. Membrane Group New Zealand Inc., *Code of practice for torch-on membrane systems for roofs and decks: for the selection, design and installation of reinforced modified, bituminous materials*, (Oct. 2008)
5. Bureaux Veritas Report 1423855/1A *Water vapour transmission of Matacryl Manual and Matacryl STC Coatings*, 4 March 2005
6. Croatian Architecture Institute, Ltd, Zagreb, Report Number 2740-049/04, 17 March 2004
7. CETE Mediterranee, File No 17125 01, *Summary of Tests Carried out on Matacryl Systems*, January 2002
8. Kiwa Polymer Institut GmbH, Test Report P8217-1 *Crack Bridging Properties of Matacryl Park Deck System*: 7 May 2013
9. Kiwa Polymer Institut GmbH, Test Report P6663-1a *Matacryl Park Deck System*: 29 June 2012
10. Kiwa Polymer Institut GmbH, Test Report P10307-4-E *Matacryl Manual Resistance to UV radiation*: 17 August 2017
11. Kiwa Polymer Institut GmbH, Test Report P10307-1a-E *Matacryl Manual with Matacryl STC Resistance to UV radiation*: 17 August 2017
12. Opus Central Laboratories Report 10-527919.85 *Pedestrian Slip Resistance testing to AS/NZS 3661.1:1993*, September 2010
13. Product Safety Datasheets
 - Duracon 107
 - Duracon 108
 - Duracon Ready Rep
 - Duracon 205
 - Duracon 215
 - Duracon 307
 - Duracon 319
 - Duracon 2K FG Clear Topcoat
 - Duracon Catalyst
 - Matacryl Manual
 - Matacryl LM
 - Matacryl STC

Appendix 1 Code Clause Analysis

This appendix sets out the analysis of which code clauses are applicable to the use of the Matacryn Membrane system as an external waterproofing membrane.

B1 Structure -

Consideration has been given to B1.3.1, B1.3.2, the applicable physical conditions of B1.3.4, and B1.3.4.

Careful reading of B1.3.2 and B1.3.1 would lead to the conclusion that these are not applicable, because the structural failure of the membrane is not likely to cause injury, nor is the structural behaviour likely to cause loss of amenity. Clauses B1.3.3 and B1.3.4 then become not applicable.

Having said that, and taking a “fitness for purpose” view, the membrane would be unaffected by wind loads and applied loads in service such as those resulting from pedestrian traffic on the membrane, dead loads of say tiles or pavers laid on top etc.

B2 Durability –

If the membrane is uncovered and not difficult to replace the code requirement is B2.3.1(b), fifteen years. If the membrane is covered and difficult to replace the code requirement is 50 years.

There are two typical environments that that lead to degradation of a membrane such as this. The first is exposure to UV radiation (sunlight). The second is failure of the product by hydrolysis when continuously immersed in water.

The Matacryn membrane is designed to tolerate both of these environments, and there are correspondingly different code obligations depending on the accessibility of the membrane.

If the membrane is exposed to UV, then typically the membrane would not be difficult to access or replace, and the requirement would be B2.3.1 (b) and the predominant failure would be UV degradation. The possibility of ponding would also need to be considered.

If the membrane is protected from UV, by say tiles or pavers, or having been overlaid by a plaster screed to form falls, then exposure to UV is not applicable, the effect of immersion in water is applicable, and the requirement is B2.3.1 (a).

Where the membrane is difficult to access or replace (such as under tiles or under a screed) then B2.3.2 is also applicable.

D1 Access Routes –

The Matacryn Membrane system can be used to provide a trafficable surface for pedestrians (e.g. decks and walkways) and vehicles (e.g. car parks). An access route (for pedestrians) in buildings is required to have adequate slip-resistant walking surfaces under all conditions of normal use. Specifically. Clause D1.3.3(e) is applicable.

E2 External Moisture -

The primary purpose of the Matacryn Membrane system is to “provide adequate resistance to penetration by, and the accumulation of, moisture from the outside” as required by the functional requirement E2.2.

Looking at each of the E2 clauses:

E2.3.1 Roofs must shed precipitated moisture. In locations subject to snowfalls, roofs must also shed melted snow.

This is a requirement of a roof. It is reasonable to consider a deck in the same context, but in neither case does it explicitly apply to the membrane. Compliance with the clause is achieved by having appropriate roof pitch, which is determined by the substrate and not the membrane.

Notwithstanding this, it is reasonable to consider whether the membrane compromises compliance with this clause, and it is now conventional to ascribe a “contributes to” compliance where the product is obviously associated with a user expectation.

E2.3.2 Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to *building elements*, or both.

This clause is functionally directly relevant.

E2.3.3 Walls, floors, and structural elements in contact with, or in close proximity to, the ground must not absorb or transmit moisture in quantities that could cause undue dampness, damage to *building elements*, or both.

This clause is not applicable – the membrane is not a “wall, floor, or structural element in contact with, or in close proximity to, the ground”, nor is it a part of any of those building elements.

E2.3.4 *Building elements* susceptible to damage must be protected from the adverse effects of moisture entering the space below suspended floors.

This clause is not applicable.

E2.3.5 *Concealed spaces* and cavities in *buildings* must be constructed in a way that prevents external moisture being accumulated or transferred and causing condensation, fungal growth, or the degradation of *building elements*.

This clause is not applicable.

E2.3.6 Excess moisture present at the completion of *construction* must be capable of being dissipated without permanent damage to *building elements*.

This clause is not applicable. The membranes do not contain moisture.

E2.3.7 *Building elements* must be constructed in a way that makes due allowance for the following:

- (a) the consequences of failure:
- (b) the effects of uncertainties resulting from *construction* or from the sequence in which different aspects of *construction* occur:
- (c) variation in the properties of materials and in the characteristics of the site.

This clause is applicable. It is effectively a “robustness test” for the product, and tests that the product is robust and can be effectively installed in practice.

Appendix 2 Application to Princes Wharf Remediation

The system specified for the Princes Wharf remediation consists of:

- Matacryn Membrane system applied to prepared concrete deck substrate
- Concrete screed to falls
- Matacryn Membrane system applied to fully cured screed
- Decoupling mat
- Tiles set in full bed waterproof adhesive.

Analysis

The system described is a “belts and braces” approach to ensuring the long-term performance with respect to External Moisture. It is a robust system with multiple layers of defence.

Effectively it provides a double membrane layer, both protected from UV. The top layer could potentially be subject to long term water immersion due to water penetration between tile joints and subsequent migration through the decoupling mat. The Matacryn Membrane system is not affected by water immersion and would continue to provide a barrier to water movement. In the unlikely event that the top layer of Matacryn Membrane system was imperfect, water would then need to migrate through the screed, (which is itself resistant to water migration), and then also penetrate through a second Matacryn Membrane system.

The Matacryn Membrane system has a high degree of extension before failure and is capable of accommodating crack movement in the concrete substrate.

Matacryn Membrane system has a high bond with concrete (even if applied to damp concrete) and is not affected by any applied loads that might occur. Evidence of this is provided by its use (with aggregates) as a trafficable surface for carparking buildings, and as waterproofing for road bridge decks.

The decoupling mat provides for the tiles to be mechanically separated from the weatherproofing membrane and substrate.

The body of this report sets out how the Matacryn Membrane system complies with the relevant performance requirements of the New Zealand Building Code.

Conclusion

The system specified for the Princes Wharf remediation using the Matacryn Membrane system, and installed in accordance with the manufacturer’s instructions, is robust and meets the performance requirements of the New Zealand Building Code