



## Determination 2019/058

# Regarding the durability of steel sub-floor bearers installed in four houses that have been built in respect of building consents issued on the basis of national multiple-use approvals

### Summary

This determination considers whether galvanised steel bearers used in subfloor framing to four houses meet the required minimum 50-year durability period described in Building Code Clause B2.3.1(a). The building consents for the houses were in respect of work described in national multiple-use approvals issued under section 30F of the Act. The houses have been built and the authority has refused to issue the code compliance certificates for the as-built work because it is of the view the bearers do not comply with Clause B2 Durability.

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## 1. The matter to be determined

- 1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004<sup>1</sup> (“the Act”) made under due authorisation by me, Katie Gordon, Manager Determinations, Ministry of Business, Innovation and Employment (“the Ministry”), for and on behalf of the Chief Executive of the Ministry.
- 1.2 The parties to the determination are:
- Rangitikei District Council (“the authority”), carrying out its duties as a territorial authority or building consent authority, which applied for the determination.
  - Hometime Ltd, the owner of 157 High Street, Bulls, and 5 Guthrie Court, Marton. Hometime Ltd is trading as ‘QuickBuild Homes’ (“QuickBuild”) and represented by its shareholder, N Coliver

<sup>1</sup> The Building Act and Building Code are available at [www.legislation.govt.nz](http://www.legislation.govt.nz). The Building Code is contained in Schedule 1 of the Building Regulations 1992. Information about the Building Act and Building Code is available at [www.building.govt.nz](http://www.building.govt.nz), as well as past determinations, compliance documents and guidance issued by the Ministry..

- N Colliver who is the licenced building practitioner (“LBP”)<sup>2</sup> for at least one of the four<sup>3</sup> buildings. Mr Colliver is acting as the agent for QuickBuild.
- T & L Brandon, the owners of 43B Armagh Terrace, Marton.
- S Kalla, the owner of 14 Ahuru Street, Bulls.

1.3 This determination arises from a dispute about the durability of steel sub-floor bearers (“the steel bearers”) installed in four prefabricated buildings (“the houses”) which have been issued with national multiple-use approvals. The national multiple-use approvals are issued to Mr Colliver.

1.4 I have also sent relevant information, including the draft determination and the expert’s report and responses, to the group within the Ministry responsible for issuing the national multiple-use approvals (refer paragraph 1.8.4, final bullet point). The group made no comment on the draft determination other than to note that the decision focused on the compliance of the steel bearers and not the issue of the multiple-use approvals.

1.5 The matter to be determined under section 177(1)(a) is therefore whether the bearers comply with Clause B2 Durability of the Building Code<sup>4</sup>.

1.6 This determination does not consider other elements of the houses or other clauses<sup>5</sup> of the Building Code, nor does the determination consider the solution options presented by QuickBuild in response to the determination’s findings.

1.7 In making my decision, I have considered relevant parts of submissions from the parties, the report of the corrosion expert commissioned by the Ministry to advise on this dispute (“the expert”) and the other evidence in this matter.

## 1.8 Standards, documents and key terms

1.8.1 Standards, documents and key terms discussed in this determination are described below.

1.8.2 The QuickBuild specifications used to establish the compliance of the steel bearers are based on the following standards and documents:

- AS/NZS<sup>6</sup> 2312:2002 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. Incorporating Amendment No.1:2004 (this standard is now superseded by AS/NZS 2312:2014, refer paragraph 1.8.3)
- HERA<sup>7</sup> Structural Systems Technical Report SSTR-001: Extending the Durability Performance of Galvsteel using a Protective Coating System - first issued December 2008, reissued June 2010 (“the HERA report”)
- NZS<sup>8</sup> 3404.1:2009 Steel Structures Standard Part 1: Materials, fabrication and construction (this standard was a secondary reference and is now superseded by SNZ TS 3404, refer paragraph 1.8.3)

<sup>2</sup> LBP No. BP121530, Licence classes: Site, Carpentry and Design

<sup>3</sup> Mr Colliver is named as the designer on the building consent

<sup>4</sup> First Schedule, Building Regulations 1992

<sup>5</sup> In this determination, unless otherwise stated, references to sections are to sections of the Act and references to clauses are to clauses of the Building Code

<sup>6</sup> Joint Australia New Zealand Standard

<sup>7</sup> Heavy Engineering Research Association

<sup>8</sup> New Zealand Standard

- The Durability Statement 2010 (“the Durability Statement”) produced for a named manufacturer (refer Appendix B2 for Tables 1 and 2 from this statement)
- NZS 3604:2011 Timber Framed Buildings (this standard is current and is a reference standard<sup>9</sup>)

#### 1.8.3 Current versions of relevant standards are:

- AS/NZS 2312.2: 2014 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings (and is a secondary reference standard)
  - Part 1: Paint coatings
  - Part 2: Hot dip galvanizing
- Technical specification SNZ TS 3404:2018 Durability requirements for steel structures and components (Currently referenced in Acceptable Solution B2/AS1 for Building Code Clause B2 Durability).

#### 1.8.4 Key terms used in this determination which relate to galvanised steel products include:

- **Corrosion zones:** NZS 3404 classification of geographic locations according to their environmental ability to cause corrosion (Sea spray, Zone 1 to Zone 4)
- **Corrosivity categories:** Classification of atmospheric conditions according to their ability to cause corrosion (C1 to C5, CX). These corrosivity categories are discussed in Section 6.2 of AS/NZS 2312.2: 2014; while indoor and outdoor examples are described in Table 6.1 of AS/NZS 2312.2.
- **DFT:** Dry film thickness of an applied coating system
- **Exposure zones:** NZS 3604 classification of geographic locations depending on the severity of exposure to wind-driven sea salt (Zone B, C or D)
- **Life to first maintenance:** the time interval that can elapse after initial coating before coating deterioration reaches the point when maintenance is necessary to restore protection to the base metal
- **Microclimate:** local environmental effects, including those produced by the erection of a structure.
- **MultiProof Certificate:** Also referred to herein as a ‘national multiple-use approval’. A certificate issued under section 30F of the Act being “a statement by ... [the Ministry] that a set of plans and specifications for a building complies with the Building Code<sup>10</sup>.”

#### 1.8.5 Appended to this determination are the following:

- Appendix A: the relevant provisions of the Act, the Building Code and the Acceptable Solutions
- Appendix B: Parts of relevant standards and the Durability Statement.

<sup>9</sup> A reference standard is standard that is referenced in either an Acceptable Solution or a Verification Method; the standard may be referenced in full or in part, and may be subject to modification.

<sup>10</sup> Refer <https://www.building.govt.nz/building-code-compliance/product-assurance-and-multiproof/multiproof/>

## 2. The building work and background

### 2.1 General

- 2.1.1 QuickBuild provides a range of prefabricated houses marketed as capable of assembly using limited building skills by following an ‘assembly manual’. Limited variations are available when ordering the kitset.
- 2.1.2 The houses have simple rectangular plans, with 15° pitch gable roofs. Floors, walls and roofs are formed using 150mm thick structurally insulated panels (“SIPs”) which comprise colour-coated metal bonded to both faces of an expanded polystyrene foam (EPS). Floors are supported on H5<sup>11</sup> treated timber piles and galvanised steel bearers, which are the subject of this determination; the subfloor construction is shown in Figures 2 and 3.
- 2.1.3 The Ministry has issued QuickBuild with 9 MultiProof Certificates in total for a range of houses, which were approved under the national multiple-use provisions of the Act from September 2011 to June 2018 (see Appendix A1.1).



**Figure 1: A QuickBuild house**

- 2.1.4 I have been provided with the full specification and drawings for two of the subject buildings and partial information for the remaining two. On the basis of the information received it is assumed all four building consents meet the conditions of the two MultiProof Certificates (Nos A10125 and A10134), namely:

This National Multiple-Use Approval is subject to the following conditions:

...

5. This National Multiple-Use Approval can only be used where the following conditions apply:

...

- f. Exposure zone: Up to and including Zone D as defined in 3604:2011, except where adverse microclimatic factors (e.g. geothermal).

- 2.1.5 All components for a house are delivered to site and stored in containers in preparation for construction.

<sup>11</sup> Timber treatment class to New Zealand Standard NZS 3602: Part 1: 2003 Timber and wood-based products for use in building

## 2.2 The QuickBuild houses

2.2.1 Houses described in MultiProof Certificates issued to QuickBuild use the same construction methodology and range in size from one-bedroom cabins at about 35m<sup>2</sup> up to four or five-bedroom houses at more than 150m<sup>2</sup>. The houses considered in this determination are:

- ‘Bigbach’ at 95m<sup>2</sup> – described in a MultiProof Certificate issued on 5 November 2016 (Certificate Number A10125)
- ‘KSM - 4 Bed’ at 138m<sup>2</sup> - described in a MultiProof Certificate issued on 9 September 2017 (Certificate Number A10134).

2.2.2 The authority has listed the houses covered by its application as follows:

- |               |                    |        |                       |
|---------------|--------------------|--------|-----------------------|
| • Building 1: | 157 High Street    | Bulls  | unknown <sup>12</sup> |
| • Building 2: | 14 Ahuru Street    | Marion | unknown               |
| • Building 3: | 43B Armagh Terrace | Marion | ‘Big Bach’            |
| • Building 4: | 5 Guthrie Court    | Bulls  | ‘KSM 4 Bed’           |

## 2.3 The sub-floor construction

2.3.1 The following photograph shows the piles and the galvanised steel bearers during construction of a prefabricated house on a level site.



**Figure 2: Typical sub-floor construction for all four buildings**

2.3.2 Clearance from the underside of the SIPs floor structure to the ground is typically 450mm, with 300mm clearance below the galvanised steel bearers. The sub-floor crawl space is enclosed with corrugated steel cladding, with a minimum 40mm gap provided at the bottom for ventilation of the sub-floor as shown in Figure 3.

2.3.3 The consented specification describes the steel bearers as:

Bearers to be [named manufacturer] or other 150x65x1.5mm or 1.2mm as per bearer plan galvanised steel purlins.  
Galvanised to Z275<sup>13</sup>. Treated in accord with Durability table in [specification] section 4.02.  
All in accord with engineers requirements.

<sup>12</sup> It is known the house has been consented on the basis of a MultiProof Certificate using the steel subfloor bearers but it is not known which specific certificate was used.

<sup>13</sup> Refer note to Table 1 for nomenclature.

### 2.3.4 Specification section 4.0.2 says:

Bearers for decks to be treated in accord with the [two tables from the Durability Statement, refer Appendix B2.1 and B2.2]

Treatments table for purlins. Purlins manufactured with Z275 by default.

Purlins in sub floor space - to be read in column 8 [from the table in Appendix B2.1] - Internal & High humidity

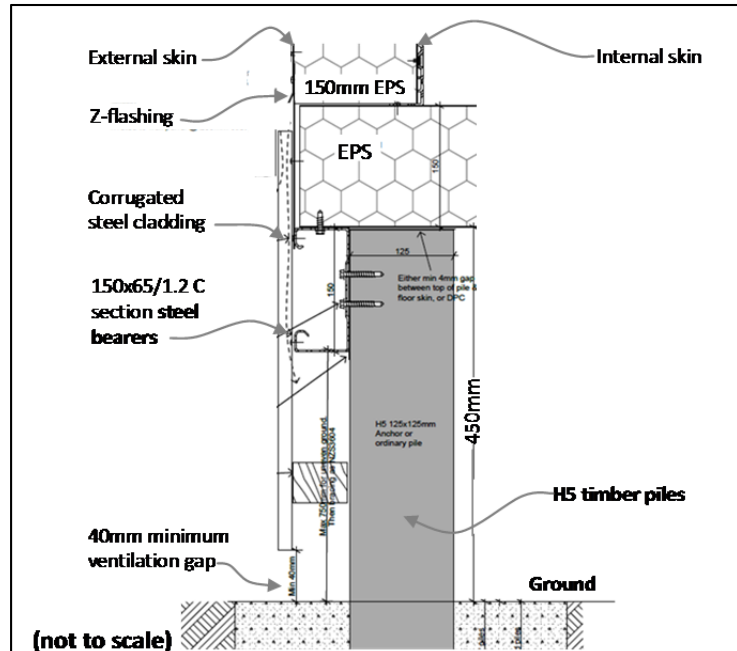


Figure 3: The sub-floor construction

## 2.4 The Durability Statement

2.4.1 Specification section 4.0.2 in paragraph 2.3.4 refers to the treatment table in Appendix B2.2, which provides the following categories of coatings to be used for different geographical and microclimatic environments to achieve a 50-year durability:

Table 1: Key to the Table 2 of the specification (refer Appendix B2.2)

Treatment System	Galvanizing coating class	Requirements for additional applied coating systems
1	Z275	<ul style="list-style-type: none"> <li>no paint coating required</li> </ul>
2	Z275 or Z450	<ul style="list-style-type: none"> <li>one of the paint systems P1 – P5 applied when new, <u>or</u></li> <li>P1 or P2 applied when new and recoated every 15 years</li> </ul>
3	Z275	<ul style="list-style-type: none"> <li>one of the paint systems P1 – P5 applied when new, <u>or</u></li> <li>P1 or P2 applied when new and recoated every 15 years</li> </ul>
4	Z275	<ul style="list-style-type: none"> <li>one of the paint systems P3, P4 or P5 applied when new and recoated every 15 years, <u>or</u></li> <li>P1 or P2 applied when new and recoated every 8 years</li> </ul>
<p><b>Note:</b>            Z275 = 19 micron<sup>14</sup> nominal thickness of zinc coating per side            Z450 = 32 micron nominal thickness of zinc coating per side</p>		

<sup>14</sup> One micron (or  $\mu\text{m}$ ) is equal to  $1 \times 10^{-6}$  m

- 2.4.2 The subject house sites are in Marton and Bulls; located close to the border between exposure zones B and C according to NZS 3604:2011<sup>15</sup> (see Appendix B1.1). That location is equivalent to the border between Zones 1 and 2 shown in NZS 3404.1:2009<sup>16</sup> (see Appendix B1.2).
- 2.4.3 The Durability Statement says that steel in sub-floor spaces is in the same microclimatic environment as steelwork in an internal environment with high humidity. The Durability Statement also includes a note that ‘all environments may be extended inland by prevailing winds and local conditions’, which needs to be taken into account when choosing an appropriate classification for these sub-floors.
- 2.4.4 The following table summarises the five coating system classifications referred to in Table 1 (refer to the table Appendix B2.2):

**Table 2: The applied coating systems from Table 1 of the specification (Appendix B2.2)**

System	First coat	Second coat	Third coat
P1	Acrylic paint	Acrylic paint <sup>17</sup>	-
P2	Galv. iron acrylic primer	Acrylic paint <sup>18</sup>	-
P3	Etch primer	Acrylic elastomeric	-
P4	Epoxy primer	High build epoxy	Acrylic 2-pack
P5	Epoxy primer	High build epoxy	Polyurethane gloss

## 2.5 The building consents

- 2.5.1 The authority issued building consents for the four houses during 2018. I have seen copies of two of these consents and I expect that the two remaining consents would have been similar in their general content and conditions.
- 2.5.2 On 22 August 2018, the authority issued the following two building consents to QuickBuild for prefabricated houses based on the applicable ‘MultiProof Certificate’:
- No.180248: 3 bedroom (Marton): ‘The Bigbach’ (Certificate A10125)
  - No.180244: 4 bedroom (Bulls): ‘The KSM 4 Bed’ (Certificate A10134)
- 2.5.3 It appears that the authority carried out inspections and the houses were substantially completed by early 2019 but failed to pass inspections due to the authority’s concerns about the durability of the steel bearers.

## 2.6 The earlier applications for determination

- 2.6.1 Continuing correspondence failed to resolve the issue and the Ministry received four separate applications for determinations in early 2019 from the agent for QuickBuild (for the same four buildings listed in paragraph 2.2.2). Those applications concerned the durability of the steel bearers and two other matters related to the bearers but not related to their durability. (One of the four separate applications is in progress at time of writing; the remaining three applications have been withdrawn.)

<sup>15</sup> New Zealand Standard NZS 3604:2011 Timber Framed Buildings

<sup>16</sup> New Zealand Standard NZS 3404.1:2009 Steel Structures Standard Part 1: Materials, fabrication and construction (now withdrawn)

<sup>17</sup> Note 4 to the table for this entry says “Contact the coating supplier for feedback on the appropriate acrylic paint for its intended use. For example, for internal high humidity locations it is recommended to use acrylic enamel at the specified nominal DFT.”

<sup>18</sup> Ibid

- 2.6.2 The Ministry engaged the expert to provide an opinion about the durability of the steel bearers installed in two of the four houses. Following receipt of the expert's report, and before three of the four applications were withdrawn, the agent amended the scope of the applications to remove an examination of the durability of the steel bearers. However, the Ministry received the current application from the authority on 26 June 2019 to continue this consideration; the application was accepted on 9 July 2019; the application was supported by the expert's report.
- 2.6.3 Submissions used in the current case therefore consider the relevant material received for the four earlier applications, detailed submissions made by the parties for two of the four buildings (43B Armagh Terrace and 5 Guthrie Court) plus the responses to the expert's report.

### **3. The expert's report**

#### **3.1 General**

- 3.1.1 As mentioned in paragraph 1.7, I engaged an independent corrosion expert to assist me. The expert is a Chartered Professional Engineer and an acknowledged authority in New Zealand on corrosion engineering<sup>19</sup>.
- 3.1.2 The expert provided a report dated 10 May 2019 on the durability of galvanized steel purlins used as bearers in residential subfloor construction in the subject houses. The corrosion expert was asked to provide opinions as to what protective coating system should be required for the steel bearers to meet the minimum 50-year durability requirements of Clause B2.
- 3.1.3 The expert's report was based on a review of:
- evidence provided with the determination application
  - the technical documentation supporting the MultiProof Certificates
  - relevant Standards and industry guidelines
  - relevant maps and photos
  - atmospheric corrosivity test data published by BRANZ<sup>20</sup>.

#### **3.2 Standards and guidance documents**

- 3.2.1 The expert explained the background to and basis of the Durability Statement that supported the MultiProof Certificates, noting the following (in summary):
- "In 2008, [a named manufacturer] commissioned HERA<sup>21</sup> to advise on extending the life to first maintenance of ... galvanized products such as ... Z275 and Z450 C-sections which are commonly used for roof purlins in large open-ended buildings like aircraft hangars, where durability and future maintenance can be problematic."
  - The resulting 2008 HERA report provided a methodology for determining the performance of uncoated and coated galvanized sections based on the corrosion

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<sup>19</sup> The expert specialises in the specification of engineering materials and protective coatings. He is a Fellow of Engineers NZ, an Australasian Corrosion Association Life Member, and a NACE (National Association of Corrosion Engineers) International Corrosion Specialist and CIP (Coating Inspector Program) Instructor. The expert has also contributed to the production of several coating standards including AS/NZS 2312 and SNZ TS 3404, and also industry guidelines such as 'Protective coatings for steel bridges' published by the NZ Transport Agency.

<sup>20</sup> The Building Research Association of New Zealand

<sup>21</sup> Heavy Engineering Research Association



rate of zinc and steel for different atmospheric corrosion categories with microclimate modification (refer paragraph 1.8.2).

- Using the above report, the named manufacturer issued the Durability Statement (which was updated as the relevant standards were updated) and the 2010 version of the statement was included in the specification for the two MultiProof Certificates. The Durability Statement was used to describe the protection required for the steel bearers used in the subject houses.

### 3.3 Exposure zone classification

3.3.1 In regard to the Durability Statement, the expert noted (in summary):

- The houses are about 16km and 19km from west coast surf beaches, so would have a macroclimate of category C3 in the treatments table of the Durability Statement (refer Appendix B2.2).
- Subfloors are assumed to have microclimate of ‘Internal/High humidity’, so the C3 coating options for steel in that situation are:
  - System P3, P4 or P5 applied when new to achieve 50-year durability, or
  - System P1 or P2 applied when new and recoated every 15 years.

3.3.2 If requirements were based on the current technical specification SNZ TS 3404, the expert noted that the sub-floor would be designated as C2 according to Table 2 of SNZ TS 3404, with the ‘surface-specific atmospheric corrosivity’ for an internal damp environment of C3.

3.3.3 In addition, and according to AS/NZS 2312.2, the ‘life to first maintenance’ of:

- Z275 galvanising is 10 to 29 years
- a coating system similar to P1 will add 5 to 10 years, providing a combined life of 15 to 39 years
- a coating system similar to P5 will give a combined life of 50 years.

### 3.4 Durability issues

3.4.1 The expert noted that the 15-year life of acrylic dispersion and acrylic enamel coating systems is based on the assumption that corrosion of both zinc and steel occurs before repainting. However:

- this requires a level of surface preparation that would be difficult but might be possible on purlins when a roof was replaced after 15 years
- this would be impractical to carry out in the crawl space of a sub-floor where there is a minimum clearance of only 300mm under the steel bearers
- estimated ‘life to first maintenance’ given in AS/NZS 2312 are based on factory-applied coatings applied to properly prepared surfaces installed in locations that minimize times of wetness from rain, condensation, etc
- when a purlin C-section is used as a bearer, its durability is compromised as its bottom flange can collect debris and condensed moisture, with the inspection photographs showing both building debris and speckle rust on installed steel bearers
- evidence of rusting so early in the life of the building suggests that sections were not adequately cleaned of non-visible salt contaminants before priming

- any dust and debris trapped above bottom flange will slow drying and accelerate corrosion
- where ponding may be anticipated acrylic coatings are not recommended and immersion-grade coatings like epoxy should be used.

3.4.2 In regard to re-coating C-section members, the expert noted (in summary):

- the folded edge to the flange creates an obscured re-entrant corner that is difficult to coat with wet paint
- an application of a protective powder coat system using a dip or electrostatic spray process is preferred to ensure full coverage of the surface
- it is very difficult to achieve required coating thickness on edges using a wet paint system on lightweight steel sections due to drying shrinkage
- any wet coating system should ideally be applied before rolling the profile (as is applied for colour-coated profiled metal cladding)
- for a 50-year life, a wet coating system should be equivalent to System P3, P4 or P5 as a minimum, or by applying a thermoplastic ethylene copolymer powder coat system.

3.4.3 The expert considered that the:

Use of hot-dip galvanized steel ... channel sections (or conventional treated timber) for bearers could reduce the number of piles required and would eliminate many of the problems associated with the thin wall C-section profile that was initially developed for, and widely used as, a roof purlin or girt with profiled metal cladding.

### 3.5 Comments on the submissions

3.5.1 The expert also commented on some assertions made within submissions and included the following comments (in summary):

- In regard to paint thickness measurements<sup>22</sup>:
  - values listed for the completed paint system (ranging between 75 to 148<sup>23</sup> microns) for the bearers do not confirm that the applied paint protection is “a minimum of 80 [microns] DFT”
  - the 20 micron thickness of the galvanizing needs to be deducted from the DFT readings as the gauge measures the combined thickness of paint and galvanising on the steel surface and not just the applied paint
  - the minimum value is therefore 100 microns, but there are five readings out of the 55 taken where the total DFT is less than 100 microns
  - At 28 locations the primer thickness was below the specified thickness of 40 microns. (The primer thickness ranged between at 20 to 59<sup>24</sup>.)
- In regard to paint type:
  - the topcoat applied is a conventional exterior grade semi-gloss waterborne acrylic dispersion paint, not an acrylic enamel type of topcoat

<sup>22</sup> DFT measurements of both the paint primer and the completed paint system were provided by QuickBuild to support the earlier application for 5 Guthrie Court, see paragraph 2.6.3.

<sup>23</sup> Excluding the thickness of the galvanizing

<sup>24</sup> Ibid

- the paint manufacturer does not supply this as an acrylic enamel type, with other products recommended such as acrylic enamel for use in humid environments like kitchens and bathrooms.
- In regard to the deck detail:
  - the outer perimeter steel bearer is exposed to moisture below the deck from rainwater, resulting in partial ponding on its bottom flange
  - the bearer will therefore not “remain dry in service”.
- In regard to floor fixings:
  - fixings of bearers to floor panels are specified as “[galvanized proprietary] screws or 4.8mm rivets”
  - it is arguable that these should have equivalent durability to bearers as they are unlikely to be replaced during the life of the building
  - unless fixings meet durability requirements of AS 3566.2 Class 4<sup>25</sup>, or are given the same or equivalent protective coating as used on bearers, these should be specified as 304 stainless steel.
- In regard to maintenance in service:
  - QuickBuild claims that bearers only need to have a 15-year durability as they can be maintained by the homeowner like roof cladding. The expert said:
 

In my professional opinion this is impractical in a sub-floor space and is not what was envisaged when the ... Durability Statement was prepared. Repainting rusty steel C-section in situ in the sub-floor space is a far more difficult and complex maintenance procedure than accessing or replacing exposed plumbing which may have a 15-year design life under Clause B2.
  - if galvanized steel C-section purlins are used as bearers, then they should be coated for a 50-year design life because they have surfaces that are difficult to access, and their failure could go undetected during normal use and maintenance of the building.

### 3.6 Response to the Ministry’s questions

3.6.1 The expert responded to specific questions from the Ministry’s as follows:

***Has the ‘environment’ from Table 2 (of the Durability Statement) been applied correctly to sub-floor situations?***

- The ‘environment’ has been applied correctly because Internal/High humidity is the best fit for sub-floor situations built over bare soil.

***Subfloors can range from dry to very damp – how should this be taken into account?***

- ‘High humidity’ is a more corrosive environment than ‘Damp’ so this will be conservative for most subfloors built over unsealed foundations.
- A dry sub-floor would be designated as C1 where uncoated Z275 sections could meet the 50-year minimum requirement.

<sup>25</sup> Australian Standard AS/3566.2: 2002 Self-drilling screws for the building and construction industries – Part 2: Corrosion resistance requirements

***How should the salt spray corrosion zones in NZS 3404 be applied to what is an enclosed sub-floor space?***

- The micro-environment for an enclosed sub-floor space would be rated as Internal/Damp which is now designated C3 for all macro-corrosion zones except for C5.

***Are the intended levels of protection correct [P2 & Z275]. What would the expected life of these systems be?***

- The protection is not sufficient to satisfy Clause B2.
- The expected life to first maintenance of correctly prepared and applied coatings would be some 15 to 40 years for P2 and 10 to 30 years for Z275.
- In a high humidity environment, perforation of a 1.2 or 1.5 mm thick C-section and loss of structural capacity is expected to occur within the following 10 years unless full restoration of the protective coating is carried out.
- The expected life to failure of bearers could therefore be less than 50 years.

***What is the effect of not cleaning off any swarf<sup>26</sup>?***

- Swarf retains moisture and locally accelerates corrosion.
- Steel swarf and timber drillings from H5 timber piles also accelerates loss of zinc due to galvanic effects.
- The Durability statement requires removal of debris and swarf prior to enclosing.

### **3.7 The expert's conclusions**

#### **3.7.1 The expert concluded that:**

It is my professional opinion that a Z275 ... galvanized rolled profile section should not be used as a bearer in a typical non-coastal and sheltered sub-floor environment, unless it is factory-coated with a protective coating system that will achieve 50 years durability in a C3 environment.

It is also my professional opinion that the bearers installed in the Bulls and Marton buildings that are referenced in the above applications do not currently comply with Clause B2 Durability of the NZ Building Code.

## **4. The submissions and the draft determination**

### **4.1 The authority's initial submissions**

#### **4.1.1 The authority's initial submissions for 'Building 3' in Marton and 'Building 4' in Bulls (see paragraph 2.2.2) were dated 3 April 2019 and 24 April 2019 respectively, and were made in respect of the earlier applications for determination on this matter (refer paragraph 2.6). These submissions included the following comments about durability (in summary):**

- The material supporting the MultiProof certificates clearly state 'that durability has to meet [the named manufacturer's] 50 year durability requirements' and the Durability Statement uses NZS 3404 zones 'seaspray, Zone 1, Zone 2, Zone 1.'

<sup>26</sup> Swarf is fine debris or waste material resulting from, in this case, cutting or drilling the steel bearers.

- The houses are both located within Zone 1 (1 to 20km from the west coast), with the sub-floor classed as ‘Internal-High Humidity’.
- The map of corrosivity zone maps in NZS 3404 ‘cannot be considered an accurate reflection in places being in or out of a Zone where they are close to a Zone border separation as the map is not detailed enough’.
- The Durability Statement classifies the bearers as C3, which requires specific paint coatings to be applied when new and recoated every 15 years.
- In regard to the crawl space:
  - the height provides access to parts of the bearers, but not to the top and parts of the back of the bearers without being removed – it is not acceptable to just repaint those steel areas that are able to be accessed
  - QuickBuild contended that removing bearers ‘would mean dismantling the house’, but at the same time maintained that the bearers can be repainted as part of normal maintenance
  - the bearers must be ‘sufficiently durable’ without ‘reconstruction or major renovation’
  - the bearers provide ‘structural stability’, are ‘difficult to access or replace’ and failure could go undetected during normal use and maintenance
  - the only way a bearer can satisfy Clause B2 ‘is that when it is installed it would need to meet its 50-year design life.’
- Photographs of painted bearers in Bulls show:
  - bottom of C-sections with rust, timber swarf and debris
  - other areas with surface rust, which was later painted over
  - bearers had been touched up ‘by spraying over the rust that could be reached via the limitation of the crawl space and limited accessibility to the entire beam.’
- Photographs of unpainted bearer in Marton showed surface rust due to swarf after only a few days, which raised the authority’s concern, although the swarf was subsequently cleaned off.

#### 4.1.2 The authority considered that the steel bearers in the houses:

...cannot satisfy the performance requirement of [Clause] B2.3.1 because:

- a) The bearers must perform to a life of 50 years, as the bearers provide structural stability, are difficult to access or replace (refer to drawing 401<sup>27</sup>), and failure to comply with the [Building Code] would go undetected during normal use and maintenance of the building;
- b) The specifications identified in [tables in the Durability Statement]<sup>28</sup> are given in respect of purlins, not bearers, and do not perform to a life of 50 years;
- c) Even applying the most restrictive durability specification contained in the Table [2] (for Zones 3 and 4) bearers would require re-coating every 15 years to a level of P1 and P2 in accordance with specifications at Table 1<sup>29</sup> on pg. 12 (A10125);
- d) The reasons given in [paragraph 3.4 of this determination in respect of the expert’s report] ...

<sup>27</sup> See Figure 3

<sup>28</sup> See Appendix B2.1 for source

<sup>29</sup> See Appendix B2.2 for source

## 4.2 QuickBuild's submission

4.2.1 QuickBuild's submissions dated 15 July 2019 responded to the application and also to the expert's report; adding further comments in support of the steel bearers as installed in the subject houses.

4.2.2 In response to the authority's reasons as outlined in paragraph 4.1.2, QuickBuild included the following comments (in summary, and referencing paragraph 4.1.2 above):

- Item (a): Difficulty of access and replacement of bearers:
  - Access to the sub-floor is easy through access panel, with 450mm clear space under the floor panels and 300mm under the steel bearers to the ground.
  - Steel bearers in QuickBuild homes are 'very easy to replace' compared to a light timber framed house, with no extra fixings required except for some extra rivets.
- Item (a): Lack of detection of failure:
  - Any sub-floor inspection would reveal any issues.
  - Electrical and plumbing also needs 15-year durability and sub-floor components are in the same crawl-space as the steel bearers.
- Item (b): Use of steel purlins as bearers:
  - The steel performs the same in either situation – the steel and the atmosphere are the same.
  - The performance of a structural member does not change just because it has a different name.
- Item (c): Need for re-coating:
  - Applying the Durability Statement, the Marton houses in Zone 2 do not need any coating, and the Bulls houses in Zone 1 can have P1 or P2 applied coatings if recoated every 15 years.
- Item (d): The corrosion expert's opinion:
  - The current Durability Statement is based on SNZ TS 3404, and both say that the zone requiring coatings 'is "typically" up to 20kms.'
  - BRANZ mapping tool shows the Marton's houses at 18.6 and 19.5km from high water mark, which is outside zone needing coatings on galv. Steel.
  - The above indicates that Marton the steel bearers will meet 50-year durability without additional coating.

4.2.3 QuickBuild concluded:

As the bearers can be inspected easily, and replaced easily, the consented [Ministry] approved plans are correct...

4.2.4 QuickBuild also addressed the expert's opinion that 'we need to address sub-floor corrosion issues', stating that there were:

...three possible routes to achieve compliance.

1. The bearers are easily replaceable. Therefore they need 15 year durability.
2. Put a DPM<sup>30</sup> over the ground, reduce ventilation to the sub-floor and turn it into an "Internal – Dry" space.
3. Upgrade bearers when they are replaced, to 1.75mm thick for C3, or new builds to 2.25mm thick.

4.2.5 An opinion was sought by QuickBuild from a corrosion consultant on the expected life of for 2.25mm thick Z450 bearers as a possible replacement of the Z275 bearers (refer proposal 3 above). The corrosion consultant replied to QuickBuild on 25 June 2019 which:

- included a table based on data in AS/NZS 2312.1:2014 giving expected life for corrosivity categories C1 to C5 (see Appendix B2.5)
- noted the assumption that 'the "Z450" is 450g/m<sup>2</sup> of zinc deposition which equates to about 64 microns' thickness of zinc
- concluded that 'even in a C3 environment the "life" of the galvanizing would be around 46 years, then there would be 25-50 microns of steel loss per year, so over a 4-year period expect 100-200 microns steel loss or less than 10%.'

4.2.6 QuickBuild concluded:

The homes in Marton are clearly in Zone C2 in [NZS 3404.1:2009 and SNZ TS 3404:2018].

- There are no references to the relevant structural steel, other metals and protective coatings related durability standards within B2.
- There are no Acceptable Solutions for structure steel structures, the use of protective coatings and /or recommended detailing.

### 4.3 The corrosion expert's response to the parties' submissions

4.3.1 The Ministry asked the corrosion expert to review QuickBuild's submissions and proposals. The expert responded in a letter to the Ministry dated 12 August 2019, confirming that:

- Steel bearers are required to have a minimum life of 50 years (as opposed to 15 or 5 years):
  - as structural members under Clause B2.3.1 (a)(i), and also because
  - failure is likely to go undetected during 'normal use and maintenance' under Clause B2.3.1(a)(iii)

4.3.2 In response to QuickBuild's 'three possible routes to achieve compliance' (see paragraph 0), the expert noted that (in summary):

- QuickBuild's proposal 1 to replace or repaint bearers at 15-year intervals is an alternative solution proposal which:
  - would need to be demonstrated to the authority as being compliant
  - would need to be recorded in such a way as to alert subsequent owners.

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<sup>30</sup> Damp proof membrane

- QuickBuild’s proposal 2 to seal sub-floor from ground moisture to reduce humidity is an alternative solution proposal. However:
  - sealing is unlikely to provide protection for 50 years
  - sealing brings a risk that any leak into unventilated space would not be detected and could make the environment more corrosive, especially given the locations near the Zone 1/Zone 2 boundary.

4.3.3 In regard to QuickBuild’s corrosion consultant’s conclusion on the expected life for Z450 galvanised bearers (see paragraph 4.2.5 and Appendix B2.5), the expert noted:

- the assumption that the thickness of zinc is about 64 microns (giving 46 years life in C3) is incorrectly based on a deposition of 450g/m<sup>2</sup>, which refers to total weight of zinc on a sheet including both sides (see note to Table 1)
- Table 6.2 of AS/NZS 2312.2 gives 25 microns thickness of zinc to use in durability calculations for Z450 galvanising
- across the C3 range (i.e. between C2 and C4) uncoated Z450 has a calculated life to first maintenance of between 36 and 12 years (see also Appendix B2.3).

#### **4.4 The draft determination and submissions received**

4.4.1 The draft determination was issued to the parties for comment on 20 September 2019.

4.4.2 QuickBuild responded to the draft determination in an email dated 4 October 2019, and noted (in summary) that:

- The Durability Statement had been relied on; both the Statement and NZS 3604 rely on NZS 3404. The maps in both standards show “Marton as NOT being in an area requiring coating to steel structure”.
- While the determination says the steel bearers are not complaint, at the time the MultiProof Certificate was issued this was not known “or else the certificate would not have been issued”.
- The expert assisted in producing a ‘white paper’ on durability published in July 2018 which noted that “the guidance for using structural steel and other metals is limited” and “there were no Acceptable Solutions for structural steel structures [and] the use of protective coatings...”.
- As there was no Acceptable Solution, reliance was placed on the Durability Statement and NZS 3404 as would have been done by any designer.
- A proposal to treat the subfloor area as an internal space was outlined.

4.4.3 The authority responded to the draft determination on 4 October 2019. The authority accepted the draft but noted that (in summary):

- the Act does not provide for MultiProof Certificates to be cancelled or suspended and the Ministry may wish to consider this in the determination
- the authority was obliged to accept a MultiProof Certificates as establishing compliance under the Act; it considered the draft determination did not adequately address the procedural difficulties for building consent authorities arising from the use of the MultiProof Certificates



- the determination should consider a number of related matters including; the suspension of the MultiProof Certificates, the next steps by the Ministry and QuickBuild; and how the parties, and those affected but outside the determination process, were to be informed of the situation and its resolution.
- 4.4.4 Following receipt of this submission I responded in writing to the Chief Executive of the authority noting the matters that were within my jurisdiction to determine under the Act, and how the Ministry intended to respond to those matters that were outside my jurisdiction. I consider this correspondence was separate to the determination process, but irrespective of this, the letter was copied to the parties to the determination.
- 4.4.5 The owner of 14 Ahuru Street, Bulls accepted the draft without comment on 10 October 2019.
- 4.4.6 The owners for No 43B Armagh Terrace, Marton responded to the draft determination on 12 October 2019. They noted that they opted for the house “to achieve a low maintenance, warm and easy care retirement home”; and that any problems had not been anticipated.
- 4.4.7 The expert responded to QuickBuild’s 4 October 2019 submission on 11 October 2019 saying, in summary, that:
- “NZS 3604 ... does not rely on ... NZS 3404 and includes no references to it. Also, the exposure and corrosivity zones are defined differently in each Standard and their maps, while similar, are also different”. The QuickBuild documentation only references NZS 3604 with respect to the durability of steel fastenings to timber piles.
  - “While Marton is located in macroclimate corrosion category ‘B’ as defined by AS/NZS 2312 [2002], Table 14<sup>31</sup> of NZS 3404 [2009] categorises steelwork in Zone 2 (i.e. 5 – 50km from salt water on west coast of the North Island) that is an internal high humidity environment (defined in Table 15<sup>32</sup> as Steel in subfloor spaces) to have a surface specific corrosion category of ‘C’ and an appropriate protective coating. AS/NZS 2312.2 [2014] predicts uncoated Z275 in this environment to have a life to first maintenance of 7 to 22 years, and 75 microns of acrylic paint over galvanizing to require maintenance after 5 to 10 years.”
  - The ‘white paper’ was written before the publication of SNZ TS 3404 which is now referenced in the Acceptable solution for Clause B2. Before this there were secondary references to durability standards for steel structures.
- 4.4.8 With respect to the Durability Statement the expert noted:
- the Durability Statement is based on NZS 3404 but this “also requires fixing, handling and maintenance of the [galvanised steel elements] to be in accordance with the “NASH<sup>33</sup> Handbook Best Practice for Design and Construction of Residential and Low-Rise Steel Framing”.

<sup>31</sup> Table 14 – “Surface specific corrosion categories”

<sup>32</sup> Table 15 – “Exposure conditions not covered by Table 14”

<sup>33</sup> National Association of Steelframed Housing

- The NASH Handbook has been withdrawn, but the latest variant of this document, dated 2019, is now referenced in Acceptable Solutions B1/AS1 and B2/AS1<sup>34</sup>.
- “The scope of the current NASH Standard (Clause 1.1.1) requires the subfloor to comply with NZS 3604 or NZS 4229 that cover timber framing or concrete masonry, i.e. not steel framing. Also, in clause 3.1 it requires any uncoated Z275 steel framing to “be within a closed building envelope.”

4.4.9 QuickBuild provided a further detailed submission received on 25 November 2019. The submission noted that the houses in Marton complied with the building consent issued by the authority were as described in the MultiProof Certificates, that the houses in Bulls “can either have the bearers replaced after 15 years, or have a DPM added” and this position was supported by the following:

- “The bearers only require a durability of 15 years.”
- Bearers can, and have been, “replaced quickly and easily with minimal skill. ... they are not integrated into the structure in the same way that traditional timber frame bearers are” and “[d]ifferent techniques are required, but these are basic and quickly learnt.” “The 300mm [subfloor crawlspace] is sufficient space to replace bearers”.
- With a DPM in place the subfloor changes from a “High Humidity” environment to a “Damp” environment “with the only moisture entering that space, coming in through the limited ventilation around the external pile flashings”. The subfloor space being non-ventilated and having a DPM means the galvanised steel bearers “will last 50 years with no maintenance”.
- Table 1 in B2/AS1<sup>35</sup> shows a DPM being used in situations that only requires a 15-year life<sup>36</sup>.
- Reference was made to a BRANZ appraisal for preformed galvanised and hot dipped plate fixings for portal frames (the appraisal says the plates will meet a 50-year life “if used in a closed building”), so the steel bearers will be sufficiently durable if the same level of dryness is attained as the plate’s intended end use in steel sheds.
- Reference was made to an Engineering New Zealand report<sup>37</sup> dated September 2019 that said steel can be protected either by a “weathertight building envelope” or by an appropriate coating.

4.4.10 The submission included a map of the North Island with 9 sites noted on what appears to be a corrosion map<sup>38</sup>, but the submission did not describe the map’s relevance; and a detail of a subfloor perimeter which noted the use of a 300 micron DPM on the ground with “laps taped” and “taped to piles” - the perimeter detail was otherwise as shown in Figure 3.

<sup>34</sup> NASH Standard Part 2: May 2019 Light Steel Framed Buildings

<sup>35</sup> The Acceptable Solution for B2 Durability, B2/AS1, Table 1 “Durability Requirements of Nominated Building Elements”

<sup>36</sup> Namely – “DPMs applied to the top of concrete slabs”, “DPMs behind retaining walls used for landscaping”, and for “DPMs designed for ready access and replacement”.

<sup>37</sup> Engineering New Zealand report entitled “Demonstrating Durability” 3 September 2019

<sup>38</sup> Neither the map nor its source is identified.

## 5. Discussion

### 5.1 General

- 5.1.1 The authority maintains that the steel sub-floor bearers installed in houses in Bulls and Marton are required to perform adequately for at least 50 years, but the coatings applied to the steel members would require recoating every 15 years in order to remain durable and meet the requirements of Clause B2 of the Building Code.
- 5.1.2 However, QuickBuild maintains that the sub-floor is easily accessible for inspection and steel bearers are very easy to replace if necessary. QuickBuild also maintains that bearers in the Marton houses do not require any paint coating because their sites are within a zone where bare galvanised steel is acceptable.

### 5.2 Compliance with Clause B2 Durability

#### *The required durability period under Clause B2.3.1*

- 5.2.1 The relevant performance requirement for Clause B2 says:

**B2.3.1** Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:

- (a) the life of the building, being not less than 50 years, if:
  - (i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or
  - (ii) those building elements are difficult to access or replace, or
  - (iii) failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.
- (b) 15 years if:
  - (i) those building elements (including the building envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or
  - (ii) failure of those building elements to comply with the building code would go undetected during normal use of the building, but would be easily detected during normal maintenance.

- 5.2.2 There is a difference in views regarding the durability period of the steel bearers. The authority is of the view the durability period is 50-years and QuickBuild is of the view it is a 15-year period because the steel bearers are easy to access and replace.

- 5.2.3 A building element only needs to satisfy one of the criteria within Clause B2.3.1(a) for the 50-year durability period to apply. In this case, the steel bearers provide structural stability to the building and therefore are required to satisfy the performance requirements of the Building Code for a minimum period of 50 years.

- 5.2.4 In respect of QuickBuild's comments that the steel bearers have a durability period of 15 years, I note the following in regard to the subject buildings:

- Accessing the steel bearers requires disassembly of parts of the building to gain access to some faces of the steel bearers – typically the removal of the perimeter subfloor cladding to gain access the outward-facing surfaces of the steel bearers; these surfaces cannot be accessed otherwise. At least two of the houses have large timber desks adjacent the perimeter wall and it is not known how the perimeter steel bearers are to be accessed at the junction of the deck and the building.

- While QuickBuild considers the steel bearers can be easily replaced, the company is very familiar with this construction and has the resources and knowledge necessary to undertake this work. I do not consider it is reasonable that an owner can be expected to carry out work of this nature to maintain their house. I also do not believe that the disassembly and replacement of structural elements can be considered ‘normal maintenance’. I do not consider it is reasonable that the bearers, as a key structural element to the subject buildings, can be considered to have a 15-year life as is contended in QuickBuild’s submission dated 25 November 2019.
- The failure of the bearers could easily go undetected during the building’s normal use and maintenance. Subfloor spaces are areas not normally accessed in order to carry out maintenance. An owner’s reasonable expectation is that subfloor spaces are not accessed unless a specific need arises. In addition, parts of the bearers are hidden from view (particularly the outer faces of the perimeter bearers) and would not been seen during an inspection unless some disassembly was undertaken.

### ***Durability performance***

5.2.5 I accept the expert’s opinion with respect to the likely durability of the steel bearers when used in the subject houses. In considering whether the steel bearers will comply with the Building Code for the 50-year period required by Clause B2.3.1(a) I note the following:

- The expert’s assessment shows that the Durability Statement was intended for a very different end use; it is therefore not appropriate to apply this statement to support the use of the steel bearers in the subject buildings.
- The expert considered the correctly prepared and applied P2 paint coating would provide an expected durability for the steel bearers of between 15 to 40 years. The expert considered the uncoated bearers would have an expected durability of 10 to 30 years.
- Maintenance of the coating system to achieve a 50-year life requires either temporary removal of the bearers, or working horizontally in a very confined space, preparing, and then applying the paint system. It is not possible to easily prepare and paint the return faces of the steel bearers, or to paint those surfaces that are covered by a pile or panel. The expert has noted the difficulty in applying an adequate and uniform wet paint film to the bearers.
- Even if the steel bearers could be properly prepared and an adequate paint system applied at regular intervals to achieve the required 50-year life, I am of the opinion this work would still not be considered ‘normal maintenance’.
- The evidence suggests the bearers for at least one house was not well prepared and adequately painted when the bearers were fully exposed and easily accessible. The same preparation and painting will be that much more challenging when access is limited to working in the subfloor space. The expert considers in service maintenance impractical in a sub-floor with clearance in the order of 300mm under the steel bearers.

## **Conclusions**

5.2.6 Taking account of the above together with the other evidence, I am therefore of the opinion that the steel bearers installed in the subject houses will not achieve a minimum 50-year durability period required by Clause B2.3.1(a).

### **5.3 The MultiProof certificates**

5.3.1 Section 19 requires a building consent authority to accept “a current national multiple-use approval... as establishing compliance with the Building Code”. The issue of a MultiProof certificate meant at that time the Ministry was satisfied on reasonable grounds, as section 30F(1)(e) of the Act states:

(1) The chief executive must issue a national multiple-use approval if he or she is satisfied, on reasonable grounds, that—

...

(e) if the building work were properly completed in accordance with the plans and specifications that accompanied the application, that the building work would comply with the building code.

5.3.2 The specifications, included as part of the MultiProof certificates, states that the steel bearers will comply with the 50-year durability period. However, I have found the treatment of the steel bearers as proposed will not satisfy Clause B2.3.1(a).

5.3.3 For clarity, as the matter to be determined is whether the bearers comply with Clause B2 Durability, I have not considered the correctness or otherwise of the decision to issue the MultiProof certificates themselves. That matter sits outside the scope of the matters I can consider under section 177 of the Act.

5.3.4 While I do not have to accept the MultiProof certificates as establishing the compliance of the steel bearers with the Building Code, a building consent authority would be required to do so under section 19 of the Act. However, as I have established that the steel bearers as specified in the MultiProof certificates are non-compliant, a building consent authority should have regard to this decision, and refuse to grant the building consent. The building consent authority should then seek a determination on the refusal.

5.3.5 I note QuickBuild is working with the Ministry to amend the MultiProof certificates concerned to result in the steel bearers complying with Clause B2.3.1(a).

5.3.6 In this case, QuickBuild should outline a proposal to bring the steel bearers into compliance with Clause B2.3.1(a) to be considered as an amendment to the building consents.

## **6. The decision**

6.1 In accordance with section 188 of the Building Act 2004, I hereby determine that the steel sub-floor bearers installed to these houses do not comply with Clause B2 of the Building Code.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 27 November 2019.

Katie Gordon  
**Manager Determinations**

## Appendix A: The relevant provisions of the Act, the Building Code and the Acceptable Solutions

### A.1 Relevant provisions of the Act

A1.1 The national multiple-use provisions include:

#### **30A National multiple-use approval establishes compliance with building code**

- (1) A national multiple-use approval establishes that the plans and specifications to which it relates comply with the building code.
- (2) To avoid doubt, a national multiple-use approval does not confer the right to carry out building work that requires a building consent

#### **30F Issue of national multiple-use approval**

- (1) The chief executive must issue a national multiple-use approval if he or she is satisfied, on reasonable grounds, that—
  - (a) the application meets the requirements of section 30B; and...
  - (e) if building work were properly completed in accordance with the plans and specifications that accompanied the application, that building work would comply with the building code.
- (2) A national multiple-use approval may be issued subject to—
  - (a) a waiver or modification of the building code; and
  - (b) 1 or more conditions, including, but not limited to, conditions that the approval applies only—
    - (i) in specified regions; or
    - (ii) in specified climates or conditions; or
    - (iii) to specified aspects of the building work; or
    - (iv) if the building work complies with specified requirements.

A1.2 Provisions relating to building consents include:

#### **45 How to apply for building consent**

- (1) An application for a building consent must—
  - (a) be in the prescribed form; and
  - (b) ...
  - (ba) if a national multiple-use approval has been issued in relation to some or all of the plans and specifications required under paragraph (b), be accompanied by—
    - (i) a copy of that national multiple-use approval; and
    - (ii) details of any proposed minor customisations; and

A1.3 Provisions relating to code compliance certificates include:

#### **94 Matters for consideration by building consent authority in deciding issue of code compliance certificate**

- (1) A building consent authority must issue a code compliance certificate if it is satisfied, on reasonable grounds,—
  - (a) that the building work complies with the building consent; and...

## A.2 Relevant requirements of the Building Code

A2.1 The relevant requirements of Clause B2 are:

### Clause B2—Durability

#### Objective

**B2.1** The objective of this provision is to ensure that a building will throughout its life continue to satisfy the other objectives of this code

#### Functional requirement

**B2.2** Building materials, components and construction methods shall be sufficiently durable to ensure that the building, without reconstruction or major renovation, satisfies the other functional requirements of this code throughout the life of the building.

#### Performance

**B2.3.1** Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:

- (a) the life of the building, being not less than 50 years, if:
  - (i) those building elements (including floors, walls, and fixings) provide structural stability to the building, or
  - (ii) those building elements are difficult to access or replace, or
  - (iii) failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.
- (b) 15 years if:

...

## A.3 The Acceptable Solution B2/AS1

A3.1 Relevant parts of the Acceptable Solution B2/AS1 include:

### 1.2 Assessing required durability

**1.2.1** Evaluation of building elements shall be based on the following concepts:

- a) **Difficult to access or replace** – applies to building elements where access or replacement involves significant removal or alteration of other building elements. Examples are works involving the removal of masonry or concrete construction, or structural elements or repair of buried tanking membranes. A 50 year durability is required.
- b) **Moderately difficult to access or replace** – applies to building elements where access or replacement involves the removal or alteration of other building elements. Examples are the replacement of services reticulation in wall cavities and skillion roofs, or of plant and hotwater cylinders built into roof spaces without adequately sized access openings....
- d) **Failure to comply with the NZBC would go undetected during both normal use and maintenance of the building** – applies where the building elements are hidden from view with no provision for inspection access, and failure would not be apparent until significant damage had occurred to other building elements. Examples are building paper behind a masonry veneer cladding, and insulation in a skillion roof. A 50 year durability is required.
- e) **Failure to comply with the NZBC would go undetected during normal use of the building but would be easily detected during normal maintenance** – applies where normal maintenance will identify faults unlikely to be observed by building occupants until significant damage has occurred. Examples are degradation of

exterior claddings on roofs and walls, sealant filled joints, flashings, services with specific provision for inspection access, chimneys and flues. A 15 year durability is required.

- f) **Failure to comply with the NZBC would go undetected during both normal use and maintenance of the building**– applies where the building elements are hidden from view with no provision for inspection access, and failure would not be apparent until significant damage had occurred to other building elements. Examples are building paper behind a masonry veneer cladding, and insulation in a skillion roof. A 50 year durability is required
- d) **Failure to comply with the NZBC would go undetected during both normal use and maintenance of the building**– applies where the building elements are hidden from view with no provision for inspection access, and failure would not be apparent until significant damage had occurred to other building elements. Examples are building paper behind a masonry veneer cladding, and insulation in a skillion roof. A 50 year durability is required.



## Appendix B: Parts of relevant standards and the Durability Statement

### B1 Relevant parts of Standards

B1.1 The relevant exposure zones are shown in Figure 4.2 of NZS 3604, and defined in paragraph 4.2.3 of that standard:



#### 4.2.3 Exposure zone descriptions

##### 4.2.3.1 Zone B: Low

Inland areas with little risk from wind blown sea-spray salt deposits.

##### 4.2.3.2 Zone C: Medium

Inland coastal areas with medium risk from wind blown sea-spray salt deposits. This zone covers mainly coastal areas with relatively low salinity. The extent of the affected area varies significantly with factors such as winds, topography and vegetation.

**4.2.3.3 Zone D: High**

Coastal areas with high risk of wind blown sea-spray salt deposits. This is defined as within 500 m of the sea including harbours, or 100 m from tidal estuaries and sheltered inlets, and otherwise as shown in figure 4.2. The coastal area also includes all offshore islands including Waiheke Island, Great Barrier Island, Stewart Island, the Chatham Islands, and the areas shown in white in figure 4.2.

B1.2 Relevant corrosion zones in NZS 3404.1:2009 are shown in Figure 20:

NZS 3404.1:2009

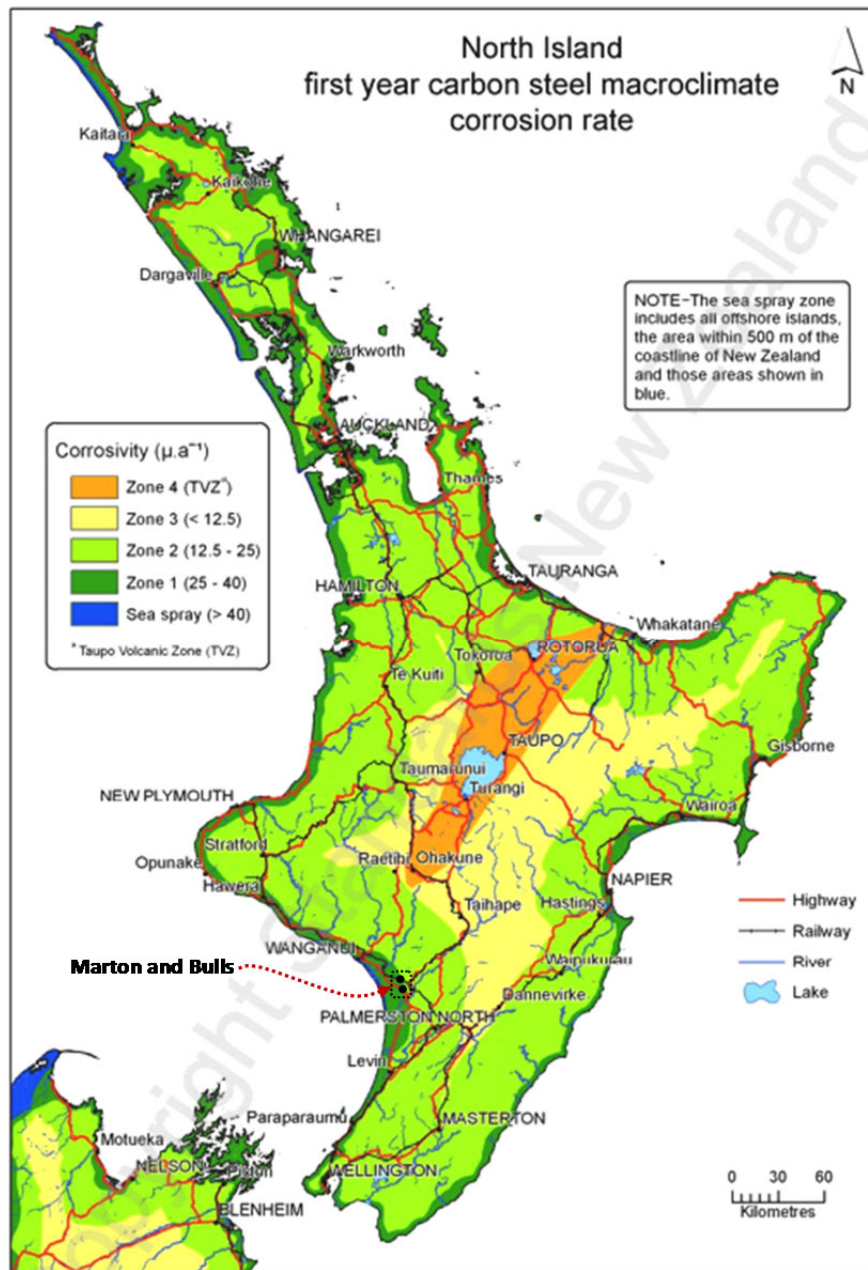


Figure 20 – North Island corrosivity zone map

## B2 Other relevant guidance information

B2.1 The ‘Treatments tables for purlins’ in the specification are based on Table 1 and Table 2 of the Durability Statement by the named manufacturer (August 2010). The Durability Statement includes the following matrix (referred to as Table 2) for determining corrosivity categories, which are used to select an appropriate coating system.

Corrosion map to NZS3404.1	ISO 9223	Typically	Location	Characterised by	Residential /Dry	Internal		Open front		Awning
						Damp	High humidity	Protected	Open	
Seaspray	C5	Within 200m of breaking surf	West coast, South Island	Heavy salt deposits, constant smell of salt spray in the air.	1	3	4	4	4	4
		Within 100m of breaking surf	West coast, North Island		1	3	4	4	4	4
		Within 50m of breaking surf	Other coasts		1	3	4	4	4	4
Zone 1	C4	200m up to 500m or more inland from breaking surf, in the immediate vicinity of calm salt water such as harbour foreshores.	West coast, South Island	Medium salt deposits, frequent smell of salt in the air.	1	3	4	4	4	4
		50m up to 500m or more inland from breaking surf, in the immediate vicinity of calm salt water such as harbour foreshores.	All other coasts		1	1	3	4	4	4
		500m to 1km from breaking surf, in the immediate vicinity of calm salt water such as estuaries.	West coast of both islands and South coast of South Island.		1	1	3	4	4	4
Zone 2	C3	500m to 1km from breaking surf, in the immediate vicinity of calm salt water such as estuaries.	East coast of both islands, South coast of North Island and all harbours	Little salt deposits, occasional smell of salt in the air.	1	1	3	3	4	4
		1km to 20km from salt water	West coast of both islands and South coast of South Island		1	1	3	4	4	4
		1km to 5km from salt water	East coast of both islands, South coast of North Island and all harbours		1	1	2	3	4	4
Zone 3	C2	20km to 50km from salt water.	West coast of both islands and South coast of South Island	Minor salt deposits, no smell of salt in the air.	1	1	1	2	3	3
		5km to 50km from salt water	East coast of both islands, South coast of North Island and all harbours		1	1	1	2	3	3
		Inland more than 50km from salt water.	Both islands	No marine influence	1	1	1	1	1	1

Note: all environments may be extended inland by prevailing winds and local conditions.

Key	
1	Z275
2	Z450 or Z275 and one of the paint systems P1 – P5 applied when new.
3	Z275 and one of (P3, P4 or P5) applied when new, or P1 or P2 applied when new and recoated every 15 years.
4	Z275 and one of (P3, P4 or P5) applied when new and then recoated every 15 years

B2.2 The Durability Statement includes the following (referred to as Table 1) for determining an appropriate coating system (P1 to P4).

Table 1

System	Surface Preparation	1 <sup>st</sup> Coat			2 <sup>nd</sup> Coat			3 <sup>rd</sup> Coat			Total nominal DFT <sup>3</sup> (µm)
		Type	PRN <sup>1</sup>	Nominal DFT <sup>2</sup> (µm)	Type	PRN <sup>1</sup>	Nominal DFT <sup>2</sup> (µm)	Type	PRN <sup>1</sup>	Nominal DFT <sup>2</sup> (µm)	
P1	Degrease, wash and dry	Acrylic dispersion paint		40	Acrylic dispersion paint <sup>4</sup>		40				80
P2		Galvanised iron acrylic primer		40	Acrylic dispersion paint <sup>4</sup>		40				80
P3 <sup>5</sup>		Etch primer		12	Acrylic elastomeric		350				362
P4 <sup>5</sup>	Sweep abrasive blast	Polyamide cured epoxy primer	C10	75	High build epoxy	13	200	Acrylic 2-pack	C33	50	325
P5 <sup>5</sup>								Polyurethane gloss	C26	50	325

## Notes on Table 1

<sup>1</sup>PRN: Paint reference number as given in appendix C of reference [c].

<sup>2</sup>DFT; coating dry film thickness.

<sup>3</sup>The total nominal DFT does not include the galvanised coating thickness.

<sup>4</sup>Contact the coating supplier for feedback on the appropriate acrylic paint for its intended use. For example, for internal high humidity locations it is recommended to use acrylic enamel at the specified nominal DFT.

<sup>5</sup>P3, P4 and P5 coatings must be applied by a professional coating applicator to achieve the required durability performance.

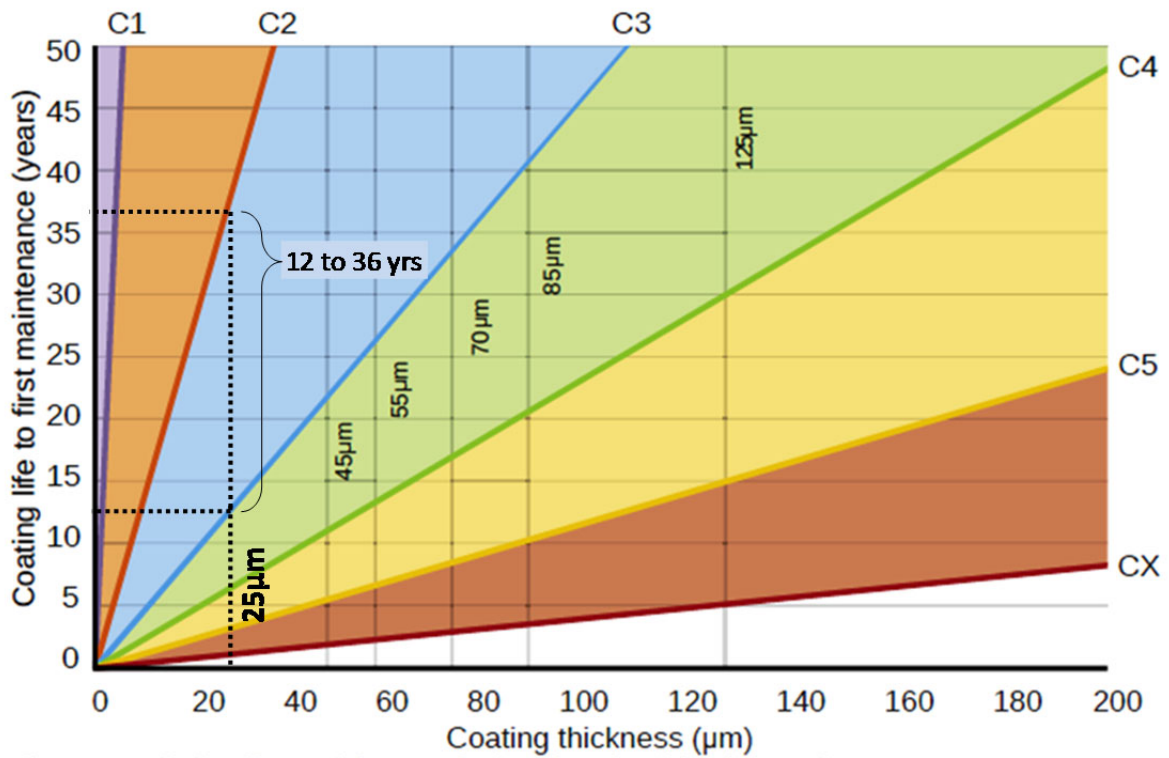
B2.3 Table 6.2 in AS/NZS 2312.2 referred to by the corrosion expert is shown in part:

**AS/NZS 2312.2 Table 6.2: Life to first maintenance (part)**

System	Reference Standard	Minimum thickness		Selected corrosivity category & Calculated life (minimum-maximum, years)					
		g/m <sup>2</sup>	µm	C2	C3	C4	C5	CX	
Batch HDG	AS/NZS 4680	HDG390	390	55	78->100	26-78	13-26	6-13	2-6
		HDG500	500	70	>100	33-100	16-33	8-16	2-8
		HDG600	600	85		40->100	20-40	10-20	3-10
HDG sheet	AS 1397	Z350	140	20	29->100	10-29	5-10	2-5	1-2
		Z450	180	25	36->100	12-36	6-12	3-6	1-3
HDG tube	AS/NZS 4792	ZB140/140	140	20	29->100	10-29	5-10	2-5	1-2
		HDG300	300	42	60->100	20-60	10-20	5-10	1-5
	AS 4750	ZE50	50	7	10-70	3-10	2-3	1-2	0-1

(Source: Galvanizers Association of Australia)

B2.4 The following graph shows calculated corrosivity rates from AS/NZS 2312.2 restated in a graphical format – extracted from ‘An introduction to AS/NZS 2312.2:2014’ issued by the Galvanizing Association of New Zealand:



(Source: Galvanizing Association of New Zealand)

B2.5 The following table is based on the data in AS/NZS 2312.1:2012 (and was referred to by QuickBuild’s corrosion consultant):

**Corrosion rates for 2.25mm thick Z450 bearers**  
(Based on data in AS/NZS 2312.1:2014)

Corrosivity Category	Corrosion Rate Zn µm/year low	Corrosion Rate Zn µm/year high	Corrosion Rate Zn µm/year Average	2.25mm bearers with Z450 @ 64µm Life -Years
C1	<0.1	<0.1	0.1	640
C2	0.1	0.7	0.4	160
C3	0.7	2.1	1.4	46
C4	2.1	4.2	3.15	20
C5	4.2	8.4	6.3	10