engineering new zealand

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association of consulting and engineering

B2 Practice Advisory

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INTRODUCTION

The issue of how to appropriately deal with New Zealand Building Code Clause B2 – Durability, is a subject of some debate within the building industry. This practice advisory attempts to outline the issues, current practices, what is practicable and reasonable, and suggests areas where industry guidance and/or change is needed.

The objective of Clause B2 – Durability is to ensure that a building will throughout its life continue to satisfy the other objectives of this code. While B2 applies to such diverse things as building wrap, thermal insulation, electrical wiring and uPVC pipes, this paper principally concerns itself with those building elements that rely on durability to sustain structural stability (under vertical and lateral loading) to the building. This is because the structural members are the elements subject to debate. These building elements typically have a required life of at least 50 years.

At the heart of the debate is the allocation of potential liability relating to the failure of durability and whether Producer Statements can or should be used to confirm compliance with the Building Code (PS1s and PS2s) or with a Building Consent (PS4s).

Professional bodies that represent engineering designers[1] typically advise designers not to sign Producer Statements in this context. The rationale for this advice is discussed later in this advisory. On the other hand, BCAs can reasonably require designers to demonstrate how their design complies with the durability requirements of the Building Code – we suggest ways this can be achieved.

Acknowledgement

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[1] Including Engineering New Zealand, ACE New Zealand, and SESOC

THE NATURE OF DURABILITY

Durability is a parameter relating to a material in a particular environment. It is not related to a building system or to creating an environment in the way that E2 is. For example, a vertical load bearing element might start off as a pile below the water table. At the ground floor it may be exposed to the atmosphere as an architectural feature and above the ground floor it might be enclosed within the building envelope/vapour barrier. Let's assume it's steel; below ground it may be encased in concrete to provide a minimum of 50 years durability. Exposed at the ground floor it may have an applied, protective paint system (easily visible for inspection) and once interior it may rely on effective E2 protection provided by the building façade (made up of sheet cladding, cavity, flashings, RAB and wall framing – a system). At each location it has a different environment and the means of demonstrating code compliance will vary.

This example is important because it illustrates that a designer needs to consider the durability of each material individually, in the exposure/environment that it will be exposed to during its in-service life. That's not to say that a designer may ignore what each element is adjacent to or fixed to, eg effects of dissimilar metals or galvanized fixings into treated timber. However, that adjacent material forms part of the environment for the material that the designer is considering.

In a typical building design team different designers take responsibility for different element materials; an architect will select the cladding and interior materials, a structural engineer will determine the material for the columns, walls, beams and floors, and building services engineers will select materials for pipes, ducts, cables and the like. This allocation of responsibilities also flows over into construction observation/monitoring, as discussed further on.

For the design of structure for durability it is important to recognise that the nature and process of the 'design' is quite different to design for stability, B1, in several ways:

a. Typically, the durability design is empirical rather than specific engineering design ie equivalent to Acceptable Solution rather than Verification Method design.

b. Many durability solutions are proprietary in nature meaning that the designer has to rely on a third party's intellectual property.

c. Similarly, many durability solutions rely on specialist applications which also, in effect, rely on third-party design.

d. Often the specified durability solution is time-dependent and does not align with B1 life durations as there may be some form of ongoing maintenance.

The result is that often, the real design responsibility does not lie fully with the design engineer but rather with a proprietary or third-party designer. This responsibility offset continues into construction monitoring where there are many proprietary or specialist applications and processes, for which the design engineer is not able to directly carry out construction monitoring, but must instead rely on quality assurance and non-destructive testing (NDT) performed by others.

BCA EXPECTATIONS

Before issuing a building consent a BCA is required to satisfy itself, on reasonable grounds, that the application meets the requirements of all Building Code clauses, including B2. Legislation does not permit a BCA to insist on the provision of Producer Statement. However, they are reasonably entitled to require the designer to demonstrate how they have addressed the requirements of B2. It is fair to say that, except for specialist façade design, designers historically have not been explicit as to how compliance is achieved for B2. When designing for aggressive environments, designers may record key matters affecting durability in their calculations, but it is less common that the design process is explained in a design statement.

The great majority of primary structure (and much secondary structure) is fabricated from three materials; reinforced concrete, mild steel and treated timber. Design for durability is quite different for each material, as are the code compliance pathways. Good practice would suggest that as a minimum, each of these three materials (when used) are specifically addressed in a design statement for structural durability.

DESIGN FOR B2 – STRUCTURAL DURABILITY

Durability relates to materials, their environment and for some, natural aging. The durability requirements for different materials vary and are covered by various codes and compliance documents. Engineering New Zealand and ACE New Zealand strongly recommend that for B2 each relevant material is addressed separately.

Reinforced concrete

Design of reinforced concrete for durability is specifically addressed within the Building Code, clause B2. NZS3101: Part 1 Section 3 is cited within B2 as being an Acceptable Solution. Designers are required to:

- Section 3.3: Choose a design life (typically not less than 50 years).
- Section 3.4: Choose a general exposure classification, governed typically by wind direction and distance from a coastline.
- Section 3.5: Check for aggressive soil and groundwater classification (this may require input from a specialist environmental/geotechnical engineer).
- Section 3.7: Select appropriate minimum concrete covers in combination with concrete strength and binder. When environment conditions are beyond the scope of NZS 3101, seek specialist advice.

Engineering New Zealand and ACE New Zealand recommend that the selections made are recorded in a design statement (refer to template for examples) in addition to a Design Features Report (DFR).

Timber

Design of timber for durability is specifically addressed within the Building Code, clause B2. Section 3.2 of B2/AS1 (Acceptable Solution) lists required treatment for solid radiata pine and Douglas Fir members and cites the following standards: NZS3602, NZS3640 and NZS3604. Engineering New Zealand and ACE New Zealand recommend that the selections made from B2/AS1.3.2 are recorded in a design statement (refer to template for examples) in addition to a DFR.

Mild steel

Design of mild steel for durability is addressed within the Building Code, clause B2 in two ways. Firstly, it may be considered under the Verification Method B2/VM1 when in-service history gives confidence that specific durability measures may be relied on. This is only practicable for mild steel that is reliably enclosed within a vapour barrier within a structure that is intended for uses that don't involve or generate significant interior moisture. Typical structures in this category would include most office buildings and multi-unit residential. [Note that many designers believe that a specific Acceptable Solution for this common case should be included within B2.] Caution needs to be taken with roof or façade elements where the failure of E2 systems may result in damp[2] conditions.

Secondly, since November 2018, Acceptable Solution B2/AS1, paragraph 3.6.1 has listed NZS TS 3404 (Technical Specification for Durability Requirements for Steel Structures and Components) as "an Acceptable Solution for meeting the durability requirements of steel building elements within its scope". NZS TS 3404 refers in turn to AS/NZS 2312. This is helpful to designers as it provides a compliance pathway for many steel components, particularly those that that can be readily inspected. Strictly speaking, however, it does not provide a compliant design pathway for members that are hidden from view and which are either exposed to external atmospheric conditions or damp conditions. This is because clause B2.3.1 requires certain elements to perform for 50 years, if they provide stability to the building and/or would go undetected if they suffered durability deterioration.

Engineering New Zealand and ACE New Zealand recommend that the selections made from B2/AS1.3.6.1 are recorded in a design statement (refer to template for examples) in addition to a DFR. As with concrete, when steel is exposed to an extreme environment, specialist advice should be sought.

[2] Refer to NZS TS 3404 for definition of damp

CONSTRUCTION MONITORING FOR STRUCTURAL DURABILITY

The manufacturing, fabrication, supply and installation pathways for each of the three primary structural materials are quite different. There are also differences according to construction sector ie residential, small commercial, large commercial. Similarly, there are differing construction monitoring methodologies for each of the three primary structural materials. This is discussed in the following sections.

Reinforced concrete

Durability within reinforced concrete is achieved essentially by protecting the reinforcing from oxidation/rusting by sufficient thickness (cover) and quality (strength and porosity) of the concrete.

Quality control of concrete manufacture and supply is achieved by certification of concrete batching plants that supply all sectors of the industry. Construction monitoring activities are effectively limited to review of test results and review of supply dockets that have been collected by the contractor.

Quality control of the reinforcing cover, pre-pour clean-out and vibration is managed by the main contractor. Typically, construction monitoring activities by the structural engineer, across all sectors, include selective observation of reinforcing placement, clean-out and covers.

These B2 quality objectives (concrete quality and reinforcement placement) are also key to compliance with B1 objectives and so it may be argued that a PS4 for B1 in effect, also covers B2, for reinforced concrete.

Treated timber

Durability of structural timber is essentially about protecting the timber from decay and insect attack by way of timber treatment. The supply and treatment process is long and mostly not visible to the construction monitoring entity. It includes:

- Selection and conditioning of the timber
- Quality of the preservation chemicals
- The treatment (vacuum injection) process
- Supply chain/racking quality (particularly in residential projects)
- Onsite timber selection control and post-cutting treatment (eg touching-up cut ends)

Quality assurance protocols may be practicable in some cases, particularly on large commercial projects. However, for the most part, timber does not play a primary role in structural stability. Where it is used as primary structure, eg with large capacity LVL frames and walls, there are usually highly detailed quality assurance requirements including mill and third-party certification and procurement tracking control.

In the residential sector, timber often constitutes the primary structure of a building but, by comparison, there is typically very little quality assurance that is readily apparent to the design professional who is carrying out observation or monitoring. This lack of quality assurance is partly because there is a reliance on BCAs to undertake inspections for buildings designed in accordance with NZS 3604.

For both commercial and residential sectors, monitoring professionals and BCAs are reliant on specialist and off-site processes relating to the durability of timber. On-site observation could include random checking of timber quality and treatment markings, backed up with requests for supply dockets that show treatment and traceability.

Mild steel

Like timber treatment, the protective treatment of mild steel involves specialist and proprietary processes and products that are often applied off-site and which require testing techniques that are beyond the expertise of the typical design professional. The processes typically include:

- Degreasing and removal of burrs, sharp edges and the like
- Abrasive blasting to expose 'white metal'
- Strict climatic and time control between blasting and coating
- Specialist chemistry and production of protective treatment products
- Specialist application involving variables including:
  - Climatic control
  - Control of wet film thickness
  - Rate of application
  - Timing between coats
  - Compatibility between coats

Monitoring professionals and BCAs are all reliant on specialist and off-site processes relating to the durability of mild steel.

RESPONSIBILITIES FOR CONSTRUCTION ACTIVITIES

Some BCAs have begun requesting Construction Review Producer Statements [PS4s] for durability – B2. This is not in keeping with current building industry practice and Engineering New Zealand and ACE New Zealand recommend that engineers carrying out construction monitoring do not issue B2 PS4s . As explained above, engineers have no practical means of monitoring the effective durability of many materials eg timber treatment and mild steel protective coatings. Instead they must rely on quality assurance from suppliers, applicators and independent testing organisations.

Engineering New Zealand and ACE New Zealand believe that it is appropriate that building owners and BCAs also rely directly on quality assurance statements (PS3s and the like) for durability of common materials rather than on a PS4. This is particularly the case for material treatments that occur off site or for which the durability is achieved by specialist application. It should be noted that it is appropriate for designers to specify appropriate levels of contractor quality assurance, specialist third-party (independent) inspections and NDT. Note that for mild steel this is included in AS/NZS5131.

Engineering New Zealand and ACE New Zealand acknowledge that this is an area where the building industry needs to provide more transparent evidence of quality assurance and are committed to working with BCAs and MBIE to achieve a process that provides meaningful PS3s and warranties where appropriate.

It is a fundamental principle of the Building Act that all those involved in the sector shall take responsibility for their own work. Designers should take responsibility for design. Similarly, manufacturers, suppliers, fabricators, applicators, installers and contractors must also take direct responsibility for their own work.

THE USE OF TEMPLATE LETTERS IN LIEU OF PRODUCER STATEMENTS

Engineering New Zealand and ACE New Zealand recommend the use of standard letters to demonstrate B2 compliance, instead of Producer Statements. This is for the reasons outlined in this advisory, summarised as follows:

- Durability applies to many building elements. An individual designer or design firm will only be responsible for specific design of a limited number of building elements. It is not reasonable or equitable to expect one designer to take overall responsibility for durability.
- Durability applies to a number of different materials each with their own compliance pathways. The existing Engineering New Zealand, ACE New Zealand and NZIA Producer Statement forms are not suitable for demonstrating compliance with B2 because they do not allow different means of compliance to be stipulated for different materials.
- Durability is predominantly empirical with reliance on Acceptable Solutions and proprietary design. In this situation a Producer Statement confuses real design responsibilities.
- Durability application relies predominantly on off-site specialist processes which makes typical Construction Monitoring processes impracticable.
- Construction Monitoring for durability relies on contractor QA together with third-party testing and specialist NDT. It is appropriate for BCAs to rely directly on those who carry out the work.

Engineering New Zealand and ACE New Zealand have prepared template letters that can be used instead of a Producer Statement, to demonstrate compliance with B2. These templates are appended to this advisory and are available for download in the members' area of the Engineering New Zealand website. Engineering New Zealand and ACE New Zealand recommend that the template letters, modified only as necessary, are submitted together with the usual Producer Statements for B1 – Stability.

KEY RECOMMENDATIONS

Design

- ✗ Don't use standard Producer Statement forms PS1 and PS2 for demonstrating compliance with Building Code Clause B2 – Durability.
- ✓ Do use the template letters for design and design review instead, modified only as appropriate.
- ✓ Do provide clear demonstration, by way of a specific design report, of how compliance with B2 is being achieved.
- ✓ Do issue a draft structural maintenance schedule at building consent application.

Construction Monitoring

- ✗ Don't use standard Producer Statement form PS4 for demonstrating compliance with Building Code Clause B2 – Durability.
- ✓ Do use the template letter for construction monitoring instead, modified only as appropriate.
- ✓ Do provide clear demonstration by way of a specific report, of what construction monitoring relating to B2 has been carried out (with reference to site reports when relevant) together with a schedule of what contractor QA has been relied upon.
- ✓ Do issue a structural maintenance schedule at application for CCC (and copy to building owner/manager).

APPENDICES

The following templates are included as appendices. Editable Word versions are available for download in the members' area of the Engineering New Zealand website.

Letters in lieu

- Design (.dotx)
- Design Review (.dotx)
- Construction Monitoring (.dotx)

Report templates

- Maintenance Schedule
- Design Report (still to come)
- Construction Monitoring Report (still to come)

Letter in lieu – Design

This letter template may be used in lieu of a **PS1 for clause B2 – Durability.**

To the Building Official,

[BCA]

[Building Project] at **[Address]**

Compliance with Building Code Clause B2 – Durability

The purpose of this letter is to demonstrate how compliance with Clause B2 (Durability) of the Building Code will be achieved for the above project. We can confirm that for specifically designed structural elements that are included within our design documentation:

Material	Means of compliance	Details
Reinforced concrete	B2/AS1	Concrete cover to reinforcing has been selected in accordance with NZS3101, Part 1, Section 3
Structural timber	B2/AS1	Timber treatment has been selected in accordance with Table 1A of B2/AS1
Mild steel structure	Alternative Solution	Protection for mild steel has been specified in accordance with SNZ TS 3404 – Durability requirements for steel structures and components and AS/NZS2312 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. This guide works on a time to first maintenance basis and assumes on-going maintenance. Refer to the attached maintenance plan (optional but recommended).
Other		

Yours faithfully,

[Design Engineer]

For and on behalf of

[Design Firm]

Letter in lieu – Design Review

This letter template may be used in lieu of a **PS2 for clause B2 – Durability.**

To the Building Official,

[BCA]

[Building Project] at **[Address]**

Compliance with Building Code Clause B2 – Durability

The purpose of this letter is to confirm that that we have reviewed how compliance with Clause B2 (Durability) of the Building Code will be achieved for the above project. We can confirm that as a result of our review we are satisfied on reasonable grounds that for specifically designed structural elements that are included in the design documentation:

Material	Means of Compliance	Details
Reinforced concrete	B2/AS1	Concrete cover to reinforcing has been selected in accordance with NZS3101, Part 1, Section 3
Structural timber	B2/AS1	Timber treatment has been selected in accordance with Table 1A of B2/AS1
Mild steel structure	Alternative Solution	Protection for mild steel has been specified in accordance with SNZ TS 3404 – Durability requirements for steel structures and components and AS/NZS2312 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. This guide works on a time to first maintenance basis and assumes on-going maintenance. – Refer to the attached maintenance plan (if provided).
Other		

Yours faithfully,

[Design Review Engineer]

For and on behalf of

[Design Review Firm]

To the Building Official,

[BCA]

Letter in lieu – Construction Monitoring

This letter template may be used in lieu of a **PS4 for clause B2 – Durability.**

Building Project at **[Address]** DP/Lot number: **[DP/Lot number]**

Building Consent Number: **[Building Consent Number]**. In respect of **[Description of Building Work]**

Construction Monitoring in relation to Building Code Clause B2 – Durability

The purpose of this letter is to confirm that direct construction monitoring by **[Construction Monitoring Firm]** in relation to Clause B2 (Durability) of the Building Code, for the above project, has been limited. This is because material protection is typically carried out by specialist applicators and requires specific quality assurance by the suppliers and/or third-party independent inspectors. Subject to all proprietary products meeting their performance specification requirements we can confirm that in relation to specifically designed structural elements included in the design documentation prepared by the **[Design Firm]**, the following relates to B2/Durability applicable to the materials listed below:

Material	Means of Compliance	Details
Reinforced concrete	B2/AS1	Compliance with cover and concrete quality requirements for B1 will also imply compliance with B2. Refer to the PS4 for B1.
Structural timber	B2/AS1	The quality of timber treatment is dependent on the QA systems of manufacturers/suppliers. Refer to the contractor's PS3 and QA records.
Mild steel structure	Alternative Solution	The quality of mild steel protective coatings is dependent on: • Steel preparation • Quality and production consistency of the coating products • QA of the application and curing • QA of the handling, protection and repair Refer to: • Contractor's and sub-contractor's PS3s and QA records • Third party inspection and rest results • On-going maintenance plan (attached)
Other		

Yours faithfully,

[Construction Monitoring Engineer]

For and on behalf of

[Construction Monitoring Firm]

The letter may accompany Engineering New Zealand/ACE New Zealand Producer Statement PS4(B1) – Construction Review in relation to the Building Work.

Note: This letter shall only be relied on by the Building Consent Authority named in Engineering New Zealand/ACE New Zealand Producer Statement PS4(B1) – Construction Review in relation to the Building Work. Liability under this letter accrues to the Construction Monitoring Firm only. The total maximum amount of damages payable arising from this letter and all other statements provided to the Building Consent Authority in relation to this Building Work whether in contract, tort or otherwise (including negligence), is limited to the sum of $200,000.

Typical template for structural maintenance schedule

For submission with both **letter in lieu of PS1 for clause B2 – Durability** and **Application for CCC,** possibly with **letter in lieu of PS4(B2).**

[Project name]
Structural maintenance schedule

This schedule of ongoing inspection and maintenance of structural elements shall be included with the Operations and Maintenance manuals and provided to the Owner/Body Corporate and building managers.

Inspection/maintenance timeframe and item	
Half-yearly	Wash down all exposed steelwork that is not in a fully interior environment including: • Veranda steelwork • Steel Carpark structure (beams, columns, braces etc) • Deck and balcony steelwork • Exposed façade steelwork, both primary and secondary structure • Plantrooms and plenums with fresh-air intakes • External structural components such as Buckling Restrained Braces, Viscous Dampers, Eccentrically Braced Frames and the like • Sub-ground floor mild-steel structures such as beams, isolation bearings etc.
(b) 5 yearly	Inspect and repair sealant that encloses structural mild-steel components and/or timber with mild-steel fixings
(c) 10 yearly	Check exposed timber fixings for corrosion, repair as required.
	Inspect/replace sealant that encloses structural mild-steel components and/or timber with mild-steel fixings. This will typically include sealants around the perimeter of precast panels. Note that 10 years is the expected useful life for many sealants
	Check exposed structural steel within plantrooms and plenums for corrosion. Repair protective coatings as required.
	Check all exposed steelwork that is not in a fully interior environment for signs of corrosion. Repair protective coatings as required.
	Audit of damage to exposed intumescent coatings. Repair as required.
(d) 25 yearly	Inspect samples of structural steel that is hidden from view but not enclosed within a vapour barrier, and repair protective coatings as necessary. A typical example is a veranda with built-in steelwork. (Such steelwork should typically have duplex protective coatings). Inspection may typically require removal of claddings and/or the drilling of holes for borescope access. Repair as required.
	Inspect all exposed, external timber. Repair as required.
	Inspect all exposed, external reinforced concrete for signs of spalling or cracking. Repair as required.
	Audit of damage to enclosed intumescent coatings. Repair as required.
Following fit-out or alterations	Audit of damage to intumescent coatings. Repair as required.
Following seismic shaking > SLS1 event	Inspections and repair as per b), c) and d) above

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