Department of Building and Housing
Te Tari Kaupapa Whare

Determination 2011/045

The durability of support brackets installed in the concrete floor slab to an aircraft hangar at 1627 Manapouri-Te Anau Highway, Southland

1. The matter to be determined

1.1 This is a Determination under Part 3 Subpart 1 of the Building Act 2004[1] ("the Act") made under due authorisation by me, John Gardiner, Manager Determinations, Department of Building and Housing ("the Department"), for and on behalf of the Chief Executive of that Department.

1.2 The parties to this determination are:

- the building owner, Mr J Paton ("the applicant"), acting through the builder as his agent ("the builder")
- Southland District Council carrying out its duties and functions as a territorial authority or a building consent authority ("the authority").

1.3 The authority issued a notice to fix because it believed galvanised steel brackets used as formwork in a concrete floor slab to support a door channel would compromise the required durability of the slab. The matter was not addressed, and the authority subsequently refused to issue a code compliance certificate. The matters for determination[2] are whether the decisions of the authority to issue the notice to fix and to refuse to issue a code compliance certificate were correct.

1.4 In making my decision, I have considered the submissions received from the parties and the other evidence in this matter.

2. Background

2.1 The building work to which the determination relates was the construction of a small, 14m by 9m, aircraft hangar for which the authority issued Building Consent No. BLD/2010/45642/1 on 28 July 2010 under the Building Act 2004.

2.2 The building comprises a proprietary metal framed steel clad structure sitting on a concrete slab, and includes a 9m long by 3m high door in one wall. The details of

[1] The Building Act, Building Code, Compliance documents, past determinations and guidance documents issued by the Department are all available at ww.dbh.govt.nz or by contacting the Department on 0800 242 243.
[2] Under sections 177(1)(b), 177(2)(d) and 177(2)(f) of the Act. In this determination, unless stated otherwise, references to sections are to sections of the Act, and references to clauses are to clauses of the Building Code.

the door have not been provided to me, but the design included the provision of a metal angle ("the door track"), which I assess as nominally 40mm x 40mm in dimension, being cast into the floor directly under the door as shown in Figure 1. This provides a triangular cross section above the floor slab to serve as a guide or support for door runners.

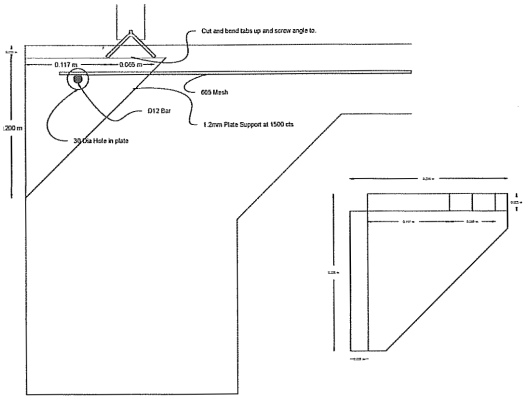

Figure 1

2.3 The builder concluded, while preparing for the pouring of the concrete floor, that this door track required to be supported on brackets fixed to the edge boxing of the perimeter concrete foundation beam. I presume this was necessary in order to ensure the location of the track, in both plan and elevation, could be fixed accurately prior to the pour, and would not suffer movement from concreting operations. No bracket was detailed on the plans submitted with the application for a building consent. Brackets were folded from 1.2mm thick galvanised steel sheet. A 30mm hole was provided to allow for the 12mm diameter perimeter reinforcing bar to be laid in the desired location. It appears from photographs provided with the applicant's submission that there are 8 brackets.

2.4 The authority inspected the works on 4 August 2010. The concrete pour was scheduled for the following morning. The authority identified the following issues with the bracket detail, documented in a Failed Inspection Notice dated 4 August 2010 issued to the builder following the inspection:

- Foundation beam compromised by the 200mm x 200mm brackets and will not resist tensile pull.
- The 12mm diameter rod not adequately protected from moisture, due to the moisture track from the side of the foundation beam provided by the brackets.
- The 30mm diameter hole in the bracket provided poor protection for the reinforcing rod.
- The reduction in the cross section of the beam due to the brackets.

2.5 The notice stated that the pour was not to proceed without an Engineer's report. The builder procured a certificate ("the engineer's certificate") from the owner's engineer, in accord with the authority's request, on the same day. The certificate included a detail of the bracket, with provision for 'an epoxy coating or similar minimum 120mm wide' to seal the outside of the beam where the bracket was fixed. The certificate stated:

> This is to certify that the folded plate support detail for the door track guide as detailed above does not detract from the strength of the footing and does not effect [sic] its structural integrity.

2.6 The builder proceeded with the concrete pour on 5 August 2010 as scheduled. The authority issued a notice to fix on 6 August 2010 which included the following statements:

> The brackets supporting the door track have been installed as a 'non-consented' amendment by the builder and were subsequently rejected by Council.
>
> Considering the location of the brackets at the top outer edge of the foundation, Structural and Durability issues have arisen:
>
> 1. That the structural integrity of the foundation beam had been compromised by culling into the effective cross sectional area of the designed beam and restricting the tensile effectiveness of the [reinforcing] in the top outer edge. [The reinforcing] has very little concrete around its perimeter with the bracket intersecting the beam eight times in the opening length of the door.
> 2 The Building clause … requires that structural elements require a 50 year durability…. To give a satisfactory durability with reinforcement, a 50mm cover is required from steel reinforcement to the outer edge of the foundation wall.
>
> With a detail like the bracket installation, there is a clear moisture track created down the side of the brackets to the reinforcement leaving only 9mm of protective cover with the concrete, 41mm short of the Code requirement.
>
> While [the authority] acknowledges that the Engineer has taken responsibility for the structure, it is not satisfied with the epoxy resin cover as a durability precaution. Epoxy substances are generally a non-flexible material and will not allow for the expansion and contraction expected of a beam of this nature. Also the 30mm cover requirement above the slab is well outside the weather line where it meets the bracket and creates a weak section where no protection is provided. Cracking is very likely in this area.

2.7 The work of constructing the hangar continued without any remedial works to the brackets, although a protective coating was applied to the surface of the concrete beam adjacent to the brackets.

2.8 On 27 October 2010 the authority wrote to the applicant, stating:

> [the authority] is satisfied that the construction of the building is compliant from the floor up.
>
> There remains however the issue of the Notice to Fix which identifies the brackets installed in the footing which were not part of the consent process.
>
> The Engineer's suggestion of an epoxy resin as a 50 year durability was not acceptable to [the authority], and similarly the [liquid applied bitumen waterproofing] product installed gives little protection from moisture.
>
> It should be noted the brackets are flush with the outside building line and only 30mm below the surface of the floor which is outside the weather line. There are two moisture tracks created, one where the [door track] meets the concrete on the outer edge and the exposed surface on the foundation wall.
>
> It is our view that over 50 years this would deteriorate and allow moisture to attack the reinforcing.

2.9 The builder replied by letter dated 1 November 2010, stating that in his opinion the work was compliant with Clause B2; stating that the structural engineer had indicated his view and that the brackets had been painted with a two pot epoxy waterproofing product. The builder noted that:

> The brackets and track are within the building line as the track is positioned behind the doors as shown on drawing 1 and 7. The outside face of the doors also overhangs the foundation by approximately 25mm.
>
> … the floor slab has had 25mm control joints cut in it. There appears to be no problem with these and there [sic] induced cracks, that are normal building practice, and pose more of a possible problem than that caused by the track support brackets.

2.10 On 4 November 2010 the authority carried out a further site visit and wrote to the applicant on 5 November to advise that the authority's view had not changed. The authority noted that:

> The photos [taken on the 4th November site visit] clearly show that the application of the coating to the brackets is hardly effective as a 50 year durability for the resistance of moisture and that cracks are visible to the side of the bracket. The coating appears to be a [proprietary] type product very thinly applied.
>
> We are also unconvinced that the join between the floor and the cast in angle iron door track is satisfactorily protected from the driving rain as the door is 30mm above the floor.

2.11 The Department received an application for a determination on 9 December 2010.

3. The submissions

3.1 The application for determination submitted by the builder on behalf of the applicants, dated 6 December 2010, included a three-page submission entitled "Explanation of Works" which provided background information to the dispute and included photographs of the brackets, supporting track, and coatings applied to the concrete face to the outside of the brackets.

3.2 The submission included copies of:

- a product data sheet for the epoxy waterproofing product
- the Failed Inspection Notice
- the engineer's certificate
- correspondence between the authority and the builder
- a PS1 Producer Statement from the engineer dated 3 July 2010,
- various design documents including fire report, calculations, and drawings.

3.3 The submission made the following points in relation to the matter to be determined:

- Similar brackets have been installed by the builder on previous jobs.
- That authority's concern in relation to the brackets, identified following the site inspection on 4 August 2010, included:
  - that these would seriously weaken the structural strength of the footings
  - that the footings would fail in short order, or that the slab and footing would crack at those locations, letting water into the slab which would lead to corrosion of the reinforcing steel, meaning the 50 year durability would not be met.
- The builder advised the engineer of these concerns, and the engineer issued the certificate that evening (refer paragraph 2.5).

- The certificate included a detail as to the epoxy coating to be applied to the exterior face of the foundation beam, and the epoxy coating was applied as per the detail.
- Both the builder and the engineer consider the work complies with the Building Code.

3.4 The authority acknowledged the application for a determination but made no submission in response.

3.5 The Department requested further information from the engineer, by email dated 27 January 2010. The information sought included advice about the concrete cover to the edge reinforcing steel, the slab's reliance on the edge reinforcing, the effect of any cracking to the top of the slab allowing water ingress, and the probable corrosion of the edge reinforcing in this particular situation. The engineer had not responded to that request at the time the draft determination was issued to the parties.

3.6 A draft determination was issued to the parties for comment on 16 March 2011. The draft concluded that the building work did not comply with Building Code Clause B2 Durability at the time the notice to fix was issued and therefore the authority was correct to issue the notice to fix and to refuse to issue a code compliance certificate.

3.7 The authority accepted the draft without comment in a response received on 21 March2011. The applicant did not accept the draft and provided a submission from the engineer which stated that;

- There is little or no risk of the thin galvanised plate causing corrosion to the top trimmer bar
- The structural integrity of the foundation does not rely on the strength of the D12 top reinforcing bar in question; the reinforcing bar is there for temperature and shrinkage requirements only,
- The thin galvanised plate is unlikely to cause a crack to be induced to the concrete foundation beam as the foundation beam has sufficient reinforcing to resist such possible cracking. To-date the light folded galvanised plate brackets have not induced any obvious cracking in the foundations and ingress of water has not occurred.
- Where the plates of the brackets are exposed on the side of the foundation beams two coats of an adequate waterproofing epoxy coating has been applied to protect the exposed galvanised plates.

3.8 A second draft determination was submitted to the parties on 3 May 2011 taking into account the submissions received. The second draft determination concluded that at the time the notice to fix was issued it was not unreasonable for the authority to be concerned that the building work might not comply with Clause B2 Durability and therefore the authority was correct in its decision to issue the notice to fix. The draft also found that, based on the information provided, there was now reasonable grounds to consider that the building work complies.

3.9 In an email dated 6 May 2011, the authority did not accept the second draft and reiterated its view that moisture would track from the door rail via the support brackets, and the concrete could crack and spall as a result of the corrosion of the top

reinforcing bar. The authority considered that the corrosion to the bar would occur prior to it achieving a durability period of 15 years.

3.10 In a letter received on 12 May 2001 the applicant accepted the draft and the builder responded to the authority's submission. The builder noted that the support brackets are galvanised steel, the remained of the reinforcing steel has a 50mm cover, and that the support brackets are within the door opening area and therefore easily accessible if remedial work was required in the future. The builder also noted that weather seals, though not shown on the drawings, will be installed to the door.

3.11 I have taken account of the submissions and amended the determination as I consider appropriate.

4. Discussion

4.1 The durability period required by the Building Code

4.1.1 The notice to fix raised issues of durability insofar as it relates to the structural integrity of the slab (refer paragraph 2.6). The relevant provisions of Clause B2 of the Building Code, and Acceptable Solution B2/AS1, are set out in Appendix A. The provisions require that if the element in question provides structural stability, or if the element is difficult to access or replace, or failure of the element would be undetected during normal use or maintenance of the building, then the durability requirement is 50 years.

4.1.2 The authority considered that the presence of the bracket resulted in a moisture path into the beam, and allowed such moisture to be as close as 9mm to the reinforcing bar. In my view, based on the information available at the time that conclusion was reasonable. I note here that NZS3101[3] defines the cover to reinforcing exposed to ground which would apply to the side of the foundation beam and will depend on concrete strength and corrosiveness of the soil.

4.1.3 The authority considered that an epoxy material may be too rigid to accommodate movement in the foundation, and therefore would fail to provide the necessary protection over the required life of the structure. In the absence of any relevant evidence of the performance of the selected material being provided, that concern was justified in my view.

4.1.4 The authority considered that the proximity of the bracket to the exposed top surface of the slab raised a further and separate concern as to the potential for cracking and subsequent reduction in durability of the foundation. I note that NZS3101 defines the minimum cover to embedded steel items exposed to weather which would apply to the top of the slab and will be primarily dependant on concrete strength.

4.1.5 The top surface of the slab edge over the length of the door is exposed to weather when the door is open. I note from the photos provided by the applicant that the edge of the slab is visible beyond the line of the door when it is closed, and I am therefore satisfied that the slab is exposed to weather even when the door is closed. In my view the concern identified by the authority was not unreasonable irrespective of whether the edge of the foundation was sealed.

[3] New Zealand Standard NZS 3101:Part 1:2006 Concrete Structures Standard

4.1.6 For the purpose of clarity I note that I do not consider corrosion of the bracket itself a material issue. The bracket is assumed to be required only as a support to the door track during construction.

4.1.7 However, I must also take into account of the submission received from the engineer (see paragraph 3.7). From the additional information provided in the engineer's submission I draw the following conclusions.

- The element in question (the top D12 bar) is to some degree redundant and does not provide structural integrity to the foundation or stability to the building.
- Corrosion and failure of the bar would be detectable during normal use or maintenance of the building
- In the event of corrosion causing the door track to fail, which would be easily detected , the track could be replaced "with moderate difficulty" to the same or other design depending on the condition of the edge of the floor slab. Or, it might not need to be replaced at all depending of the type of door installed at the time.

4.2 Refusal to Issue the Code Compliance Certificate

4.2.1 While it may appear unnecessary to separately address whether or not the authority was correct to refuse to issue the code compliance certificate, given that this refusal followed directly from, and was specifically limited to, the failure of the builder to rectify the issues identified in the Notice to Fix, I have also considered this refusal separately.

4.2.2 In my view the issue is whether or not the authority had reasonable grounds, at the time the letters dated 27 October 2010 and 5 November 2010 were issued, to consider that details of the construction relating to the non-consented bracket incorporated within the foundation would reduce the likely durability below the 50 years required by the Building Code as was the authority's view, meaning the works did not at that time meet the requirements of the Act, irrespective of any consenting technicality.

4.2.3 The grounds relied upon by the authority in refusing to issue a code compliance certificate are those contained within the letters dated 27 October 2010 and 5 November 2010. In relation to these grounds I have the following comments:

- The authority has photographs demonstrating that the protection then applied to the edge of the foundation beam, noted in their view to be a liquid applied bitumen type product rather than an epoxy, that was not providing an effective moisture barrier. The concern this raises as to likelihood of future corrosion is justified in my view.
- The authority had at this time identified a further concern in relation to the detail, namely that the door track sitting on the bracket introduced a separate potential moisture path liable to lead to corrosion of the perimeter reinforcing bar. As noted above my expectation is that the door track will be exposed to water, both when the door is open and when it is closed. This concern of the authority in this regard is reasonable in my view.

4.3 Response to the submissions made by the builder

4.3.1 I note the response from the builder by letter dated 1 November 2010, and I address the relevant points raised therein as follows. The builder states that:

- The statement that the brackets have been painted with a two coat epoxy waterproofing product – which I interpret as meaning the coating applied to the outside face of the concrete rather than to the brackets themselves - is one I am unable to verify: I note the authority describes this as a liquid applied bitumen type product. However the photograph produced by the authority showing a crack to the side of the bracket is sufficient evidence to justifiably question its effectiveness, irrespective of the specific product used.
- The letter implies that the door track is effectively protected from direct exposure to weather. As noted above, I am, not persuaded this is so when the door is closed, and it is clearly not the case when the door is open.
- The builder states that exposed control joints provide a similar level of risk of corrosion to reinforcing. I don't accept that provides any justification for accepting the specified non-compliance. As an aside, I note that my expectation would be that reinforcing passing through control joints where there is potential exposure to moisture, should be galvanised or otherwise protected, e.g. by a joint sealant.

4.4 Conclusions

4.4.1 The engineer has submitted that the D12 bar is in effect redundant as part of the structure of the building and serves primarily as support to the hangar doors. As the hangar is not required to comply with Clause E2 of the Building Code the hangar would comply with the Building Code without doors. Therefore if the track failed the hangar would remain code compliant and replacement of the track not necessary. Consequently I consider durability requirement of the door track supports at most, no more than 15 years.

4.4.2 For the reasons detailed in paragraph 4.2.3, I conclude the grounds relied upon by the authority, at the time of the refusal to issue a code compliance certificate, were reasonable and justified concerns as to the ability of the building works specified by the owner to satisfy the requirement for durability as defined in the Building Code. Although the engineer had provided a justification statement at short notice, I consider it not unreasonable for the authority to request further information.

4.4.3 The authority would have been better informed in terms of the significance of the reinforcing bars to the structural integrity of the building had their questions of the engineer been responded to in a timely manner.

5. The decision

5.1 In accordance with section 188 of the Act, I hereby determine that the authority did not have reasonable grounds to consider the building work would comply with Building Code Clause B2 Durability at the time the notice to fix was issued; and accordingly I confirm the authority's decision to issue the notice to fix.

5.2 In accordance with section 188 of the Act, I also determine that there are now reasonable grounds to consider the building work does comply with Clause B2 Durability of the Building Code, and accordingly I reverse the authority's decision to refuse to issue a code compliance certificate.

Signed for and on behalf of the Chief Executive of the Department of Building and Housing on 16 May 2011.

John Gardiner
Manager Determinations

Appendix A The Building Code and the Acceptable Solution

A1. The relevant provisions of Building Code Clause B2 Durability include:

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.

(c) 5 years if:

(i) The building elements (including services, linings, renewable protective coatings, and fixtures) are easy to access and replace, and

(ii) Failure of those building elements to comply with the building code would be easily detected during normal use of the building.

A1. The relevant provisions of the Acceptable Solution B2/AS1 include:

Paragraph 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.

Figure 1 from B2/AS1: