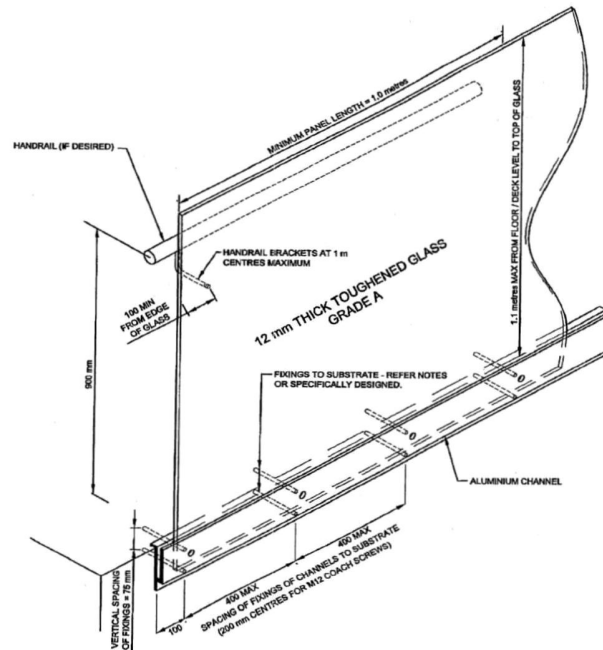




Determination 2012/066

Regarding the refusal to issue a code compliance certificate for a house with a glass balustrade at 102 Oceanbeach Road, Tauranga



1. The matter to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004¹ (“the Act”) made under due authorisation by me, John Gardiner, Manager Determinations, Ministry of Business, Innovation and Employment (“the Ministry”²), for and on behalf of the Chief Executive of the Ministry.

1.2 The parties to this determination are:

- the applicant, Tauranga City Council, carrying out its duties and functions as a territorial authority or building consent authority (“the authority”)
- the owners of the building, CG Forster and JA Hume (“the owners”).

1.3 I have also included the supplier of the glass panel balustrade system, Glass Relate Limited (“the supplier”), and the installer, Euroglass Systems Ltd (“the installer”) as persons with an interest in the determination

¹ The Building Act, Building Code, Compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.dbh.govt.nz or by contacting the Ministry on 0800 242 243.

² After the application was made, and before the determination was completed, the Department of Building and Housing was transitioned into the Ministry of Business, Innovation and Employment. The term “the Ministry” is used for both.

- 1.4 The matter for determination is whether the authority was correct in its decision to refuse to issue a code compliance certificate for the house because it is not satisfied that the glass panel balustrade complies with the Building Code³ (First Schedule, Building Regulations 1992).
- 1.5 I therefore take the view that the matter for determination⁴ is whether the authority was correct in its decision to refuse to issue a code compliance certificate. In making this decision I must consider whether the glass balustrade system complied with Clause B2 of the Building Code insofar as it relates to Clause B1 Structure and F4 Safety from falling.
- 1.6 In making my decision, I have considered the submissions of the parties, the report of the independent expert (“the expert”) commissioned by the Ministry to advise on this dispute, and the other evidence in this matter.

2. The building work

- 2.1 The building work consists of a proprietary cantilevered glass panel balustrade system installed to two decks on a two-storey house. The balustrade that has had failures is fitted around the upper storey deck which itself is cantilevered.
- 2.2 The 12mm thick frameless glass balustrade is contained in an aluminium support channel that is in turn attached to the face of the timber deck structure. The front edge of the deck consisted of 290 x 45 timber trimming joists bolted each side of a 150 x 100 steel RHS. The side edge consisted of 290 x 45 timber joists bolted each side of a 200 x 75 steel channel.
- 2.3 The aluminium channel is 13mm wide and is designed to hold toughened-glass panels that are 12mm thick. The aluminium channel was fixed through its bottom leg with a countersunk screw in the timber joist, and fixed through the joists and structural steel with a countersunk bolt through the back of the aluminium channel as the upper fixing.

3. The background

- 3.1 On 17 March 2009 the authority issued building consent No. 29822 for extensive remedial work and alterations to the existing building. A specific engineering design was supplied for the cantilevered glass balustrade to the upper deck by way of an amendment to the consent.
- 3.2 The aluminium channel was provided by the supplier and the glass supplied by the installer (a second deck immediately below the subject deck used an independent bolt type fixing system and the glass and fixing system for that deck was supplied by the installer).
- 3.3 In February 2010 one of the glass panels on the northwest side of the upper deck shattered. It was subsequently replaced by the installer.
- 3.4 In September 2010 an assessment was carried out by a firm of engineering consultants (“the engineering consultant”) and was subsequently supplied to the authority along with a Producer Statement PS1 Design from a Chartered Professional Engineer for the glass balustrades.

³ 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

⁴ Under sections 177(1)(b) and 177(2)(d) of the Act

- 3.5 In February 2011 a different glass panel on the same deck also shattered. The replacement panel was supplied and installed by the supplier; at which point the supplier replaced all of the grub screw fixings to all glass panels around the deck. The new grub screws were stainless steel with a nylon washer attached to the end.
- 3.6 The building work was completed by 27 April 2011 and the owner sought a code compliance certificate, though expressed concern regarding the glass balustrade system.
- 3.7 The authority became aware of other failures where the same channel system had been used to secure cantilevered glass balustrades, and the authority delayed the issuing of three other code compliance certificates where the same system has been used.
- 3.8 On 6 October 2011 the authority received further information from the supplier which included a letter from the engineering consultant that contained an opinion regarding a revised method of securing the glass with a modified screw that had a wider and thicker washer end. The engineering consultant stated that:
- The previous screws had sharp pointed end[s] which is understood to have cut through the nylon insert. This would have resulted in concentrated stress on the glass and the reason for the glass failure.
- ... It is our opinion that the new improved screws with correct fixing procedure would not result in any failure of [the] glass panels.
- 3.9 On 4 November 2011 the owner advised the authority of another glass panel failure, and that it was the same panel that had been replaced and installed by the supplier (refer paragraph 3.5).
- 3.10 The balustrade system was subsequently replaced with an alternative balustrade system from another supplier.
- 3.11 On 11 November 2011 the Ministry received the application for determination from the authority.

4. Submissions

- 4.1 The application for determination from the authority was received on 11 November 2011, and included background to the events and copies of:
- the producer statement – PS1 Design, from a Chartered Professional Engineer
 - test reports and assessment of testing carried out by the engineering consultant
 - correspondence from the engineering consultant dated 26 August 2011
 - relevant plans from the approved consent documents amended 19 February 2009
 - technical information, dated 18 February 2010, on spontaneous breakage of tempered glass from a north American flat glass manufacturer
 - a Wikipedia reference for ‘Spontaneous glass breakage’

- 4.2 The authority's submission included an outline of what it considers to be three potential causes of the series of failures, being:
- damage to the glass panels during transportation or installation, where subsequent expansion and contraction cause stress concentrations around the damage
 - spontaneous breakage attributable to nickel sulphide inclusions in the tempered glass (which the authority considered less likely due to the number of failures and supply of glass from at least two different sources)
 - binding in the frame, with expansion and contraction of the glass and the frame.

The authority is of the view that the third potential cause is the most likely as there is limited space available in the system for expansion and contraction, with no gaskets or resilient materials to isolate the glass from the metal channel.

- 4.3 The authority noted that other failures had occurred where the same channel system was in use, and the decks are located in high wind zones and therefore 'the glass is likely to move in the channel without the modifying influence of a resilient material to avoid glass/metal contact'.
- 4.4 The owner acknowledged the application but made no submission.
- 4.5 A draft determination was sent to the parties and persons with an interest for comment on 14 August 2012.
- 4.6 The authority and the owner accepted the draft without further comment in responses received on 4 and 14 September 2012 respectively.
- 4.7 On 7 September 2012 the installer contacted the Ministry in regards the determination; and on 11 September 2012 the installer was provided with copies of the expert's reports and the draft determination for comment.
- 4.8 The installer provided a submission in response to the draft in a letter to the Ministry dated 12 November 2012. The installer was of the view that the balustrade failure was due to a system failure rather than an 'installation problem', caused by glass-to-metal contact, or the point loads caused by the grub screws. The installer referred to other balustrade failures that he was aware of. The installer noted that:
- the multiple failures mean the supplier should reassess the system design, the installation instructions, and training supplied to the installers
 - the installer followed the installation instructions. Instructions on how to tighten the grub screws were vague, and there was no warning that over-tightening the grub screws could result in 'glass exploding'
 - the training for professional installers is for systems that rely on 'clamping pressure'. As far as the installer was aware, there are no other systems that subjected glass to concentrated point loads as was the case here.

5. The expert's report

- 5.1 As stated in paragraph 1.6, I engaged an independent expert who is a Chartered Professional Engineer to assist me. The expert provided two separate reports dated 26 March 2012; one on the balustrade installed to the subject house and a second taking into account failures of the same balustrade system at other locations around the Bay

of Plenty. A copy of the report was sent to the parties for comment on 28 March 2012.

5.2 The expert also reviewed a proposed installation methodology put forward by the supplier and provided further comment (refer paragraph 6.)

5.3 The subject house

5.3.1 The expert visited the house on 5 December 2011 to observe the deconstruction of the existing cantilevered glass balustrade.

5.3.2 The owner advised the expert that on all three occasions when the failures occurred there was no significant wind and the temperature was hot.

5.3.3 The expert provided information on the construction of the balustrade system (refer paragraph 2) and made the following observations:

- the bolt through the back of the aluminium channel to the joists and structural steel was loose and the balustrade channel could be moved by pushing the glass horizontally
- an additional set of fixing holes had been drilled along the channel
- the front section of channel support was in two pieces with a joint in the middle of the central glass panel
- on removal of the shattered glass from the front corner panel it was possible to see the crack pattern had originated from the grub screw
- the middle front glass panel had shards broken off the bottom edge and these were sitting in the channel
- the grub screws were fully tightened
- at one end of the shattered panel there was a thin packer between the glass and the aluminium channel
- the rear of the aluminium channel had been in contact with the bolts fixing the trim joists to the structural steel
- burrs were present on the inside of additional holes that had been drilled through the outer leg of the channel, and these holes were further apart and at a lower level than the factory drilled holes
- the head bolt in the countersunk fixing through the back of the channel was proud of the face of the aluminium in some locations.

5.3.4 The expert also noted that the glass used was safety glass in accordance with Part 3 of NZS 4223⁵.

5.3.5 The expert was of the opinion that the installation was not in accordance with the supplier's specification, in particular the re-drilling of channel fixing holes, the joint in the support channel being in the centre of the glass pane, the grub screw fixings at 460mm (rather than 250mm at which tests were undertaken), and the channel fixings to the building not being in accordance with the specifications.

⁵ New Zealand Standard NZS 4223 Glazing in buildings

- 5.3.6 The expert noted that at the time of initial construction there was no specific guidance on an appropriate mechanism to align the top of the glass and the maximum torsion acceptable on the grub screw fixings.
- 5.3.7 The expert's view was that the installation methodology, in particular adjusting the tightness of the grub screws in order to align the top edge of the glass panels, caused point loads on the glass that when combined with thermal stresses caused the glass panels to fail.

5.4 The balustrade system

- 5.4.1 The expert researched other failed glass panels of the same balustrade system in the Bay of Plenty area and became aware of at least 15 failures at seven other addresses. The expert inspected the balustrades installed on an apartment building that had had a number of failures. The inspection was conducted at the time that the balustrades were being deglazed, remediated, and reinstalled to a revised installation procedure (refer paragraph 5.4.4).
- 5.4.2 The expert was of the view that there was sufficient consistency in the failures of this balustrade as well as others using the same system that it was likely that the other failures would have a similar cause, being the installation procedures creating high point loads on the glass and subsequent thermally-induced additional loads.
- 5.4.3 The expert noted that in regards to Clause B1 the structural capacity had been demonstrated by calculations and testing to AS/NZS 1170.1⁶, and that the glass used was safety glass.
- 5.4.4 The expert described the changes the supplier has made to the grub screw fixings over recent years, noting that following investigation of failures at the apartment building a new procedure has been established for tightening the grub screws, adjusting the channel to align the top of the glass, and a continuous handrail is added to the top of the glass.
- 5.4.5 The expert noted that glass installed using the revised procedure described in paragraph 5.5.4 would still be prone to thermal expansion and contraction loads. The expert considered there was still a risk of failure, but the continuous handrail would at least provide a secondary barrier.
- 5.4.6 The expert considered that other installations of the balustrade system installed prior to January 2012 may experience failure.

5.5 The supplier's response

- 5.5.1 As a result of the expert's findings I sought a response from the supplier in respect of those findings and any redesign of the system and detailed installation information that could be provided to the determination.
- 5.5.2 The supplier submitted a response to the Ministry on 4 May 2012, noting that in their view the glass balustrade system was compliant with the Building Code and the failures that have occurred are the result of faulty installation. The supplier stated that the modifications made were to lessen the chances of installation faults. (I note here that one failed glass panel had been installed by the supplier; refer paragraph 3.9).

⁶ Australia/New Zealand Standard AS/NZS 1170.1:2002 Structural design actions – Permanent, imposed and other actions

- 5.5.3 The supplier submitted that any failure to install the system correctly, or other construction variations, did not mean that the system itself did not comply. The supplier considered the system would be compliant provided the grub screws were tensioned properly.
- 5.5.4 The supplier provided a letter dated 30 April 2012 from the engineering consultant that stated the consultant's opinion that the glass balustrade system as previously designed complies with the relevant requirements of the Building Code, and that failures are likely to be the result of incorrect insulation of the grub screws. The consultant did not consider thermal movement of the aluminium or fixing to be a likely cause in the failures. The consultant considered that the delay in failure of the panels following installation was likely due to damage caused through over-tightening of the grub screws and subsequent stress concentrations at those points of damage developing through external loads such as wind, people, and thermal movement of the glass.
- 5.5.5 The supplier commented that it had 'been of the view that professional installers should have well understood the dangers inherent in over-tensioning a point of impact on glass and the need to install according to specifications'.

5.6 The authority's response

- 5.6.1 The authority provided a further submission in an email to the Ministry on 15 May 2012. The authority said it appeared that incorrect installation practices has played 'a significant role' in the balustrade failures, and that balustrade failures reported in the region appear to be confined to this system. The authority observed that 'intricate' installation procedures were unlikely to be always followed on a building site.
- 5.6.2 The authority noted the features of the updated installation manual that were not in the earlier version, and commented that the manual did not give guidance as to the level of competence or experience required by an installer. The authority suggested that specialist training through the supplier would be 'the only sure way of removing [the installation] problem'.
- 5.6.3 The authority expressed concern that the system was distributed throughout the country and that due to the nature of the installation problems there may have been other failures outside of those identified during the determination. The authority considered that a warning under section 26 of the Act would be appropriate (refer paragraph 7.5).

6. The proposed installation methodology

- 6.1 The supplier provided details of a proposed installation methodology to the Ministry for comment. The supplier has submitted that it has altered its processes regarding provision of the product only to 'suitably competent installer(s)', and had updated its installation manual accordingly; a copy of the updated manual, dated 1 January 2012, was provided. The supplier also now requires that the installer provide a 'Producer Statement PS1 Design' confirming correct installation.
- 6.2 The supplier highlighted the following aspects of the proposed methodology:
- the addition of a rubber gasket between the glass and the rear of the aluminium channel, which prevents metal-on-glass contact at this location

- use of nylon-tipped fixing screws that were tensioned using a ‘torque screwdriver’.
- 6.3 The proposed installation methodology was discussed in detail at a meeting held in Tauranga on 29 May 2012. The meeting was attended by officers of the Ministry, authority staff, and representatives of the supplier. The meeting also discussed the supplier’s investigation and assessment of existing balustrade installations, and its response if defects were found.
- 6.4 On 7 May 2012 I requested the expert review the supplier’s updated manual in respect of the proposed installation methodology. The expert provided a report dated 6 June 2012 that was copied to the parties and the supplier on 13 June 2012.
- 6.5 The expert commented on the original installation instructions, noting that these were not adequate in that they did not address the matter of the tightness of the grub screws, and that this contributed to the incorrect installation of the product and its subsequent failure. The expert was of the view that if there is contact between the metal and the glass initiating any stresses then failures could still occur, and that longitudinal expansion and contraction on a tightly fixed system would still be problematical; and therefore the expert maintained that earlier installations of the product should be reviewed.
- 6.6 The expert noted that the installation instructions related to only a limited number of installation arrangements and that more fixing designs and details were required. The expert also noted that the reference to a PS1 Design should be a PS3 Construction.
- 6.7 In respect of the proposed installation methodology (refer paragraph 6.1) the expert made detailed comments on various aspects of the manual and noted (in summary):
- design issues should not be left up to the installer and details of the fixing centres for each type of fixing should be specified
 - the design needs to take account of timber shrinkage after installation and the inaccessibility for tightening of the bolts after installation; and accessible bolts would need to be tightened after six and twelve months
 - there are no instructions for what is to be done in regard to referring back to the designer if on-site construction details onto which the glass balustrade system is to be fixed do not comply with one of the options available.

7. Discussion

- 7.1 In terms of section 94(1)(a) of the Act, an authority can only issue a code compliance certificate if it is satisfied, on reasonable grounds, that the building work complies with the building consent. I note that in this instance no concerns have been raised as to compliance with the amended consent; however at the time of the authority considering the issue of the code compliance certificate there had been a failure of a significant building element. In Determination 2008/30⁷ I concluded that in addition to compliance with the building consent, confirmation of a building’s compliance with the Building Code was required before an authority could issue a code compliance certificate. I am still of that opinion,

⁷ Determination 2008/030: The issuing of a code compliance certificate for a multi-storey apartment building

- 7.2 Taking into account the evidence of failure of the glass panel in the balustrade system installed in the subject house, the findings of the expert and the submissions of the parties, I consider that the balustrade system as installed did not comply with Clause B2 of the Building Code insofar as it relates to Clause B1 Structure. At the point of failure the balustrade, as a barrier, no longer satisfied the requirements of Clause F4 Safety from falling.
- 7.3 I therefore consider the authority was correct to refuse to issue the code compliance certificate. I note that a new balustrade system has since been installed by a different supplier.
- 7.4 I note that adequacy of the proposed installation methodology (refer paragraph 6) is outside the matters to be considered in this determination. The assessment by the expert (refer paragraphs 6.4 to 6.7) has identified matters that need to be addressed by the supplier: it is suggested that these matters be addressed and the methodology be revised accordingly. If the methodology is to be presented to an authority as evidence that the system will meet the requirements of the building code, then it is the supplier's responsibility to provide sufficient evidence to demonstrate this to the satisfaction of the authority concerned.
- 7.5 With respect to the authority's view that a warning under section 26 of the Act would be appropriate (refer paragraph 5.6.3): I note that the supplier is reviewing a large sample of existing balustrade installations based on the expertise of the installer, and the nature of the installation. The review will inform the supplier of the nature and extent of possible remedial work. I have reviewed the proposed methodology and I consider that, subject to the review's findings a warning under section 26 of the Act is not required at this time. The supplier has given an explicit undertaking to keep the Ministry informed of the review's progress and its findings.

8. Decision

- 8.1 In accordance with section 188 of the Building Act 2004, I hereby determine that the glass balustrade system as installed did not comply with the Building Code and accordingly I confirm the authority's decision to refuse to issue a code compliance certificate.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 23 November 2012.

John Gardiner
Manager Determinations