



## Determination 2009/108

### Code compliance of plywood sheet and plywood weatherboard claddings on a house at 18 Shakespeare Road, Wanganui



#### 1. 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, 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 applicant is the Wanganui District Council (“the authority”), carrying out its functions as a territorial authority or building consent authority. The other party is S W Palmer (“the owner”), who practices as an architectural designer and who was also the designer and the builder of the house. The plywood manufacturer, Carter Holt Harvey Woodproducts, has been included as a person with an interest in the determination.

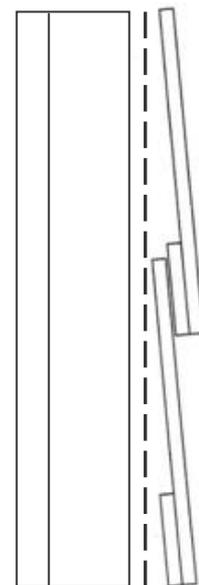
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<sup>1</sup> The Building Act, Building Code, Compliance documents, past determinations and guidance documents issued by the Department are all available at [www.dbh.govt.nz](http://www.dbh.govt.nz) or by contacting the Department on 0800 242 243

- 1.3 The matter for determination under section 177(a) of the Act<sup>2</sup> is whether the cladding as installed on the house complies with Clauses B2 “Durability” and E2 “External Moisture” of the Building Code (Schedule 1, Building Regulations 1992), taking into account the age of the building work. By “the cladding as installed” I mean the components of the systems (such as the backing materials, the flashings and the coatings), as well as the way the components have been installed and work together. In making my decision I have not considered any other aspects of the Building Code.
- 1.4 The matter arose because there was concern on the part of the authority that 7mm 3 ply cladding would not be durable.
- 1.5 In making my decision, I have considered the submissions of the parties, the reports of the experts commissioned by the Department to advise on this dispute (“the experts”), and the other evidence in this matter.

## 2. The Building

- 2.1 The building consists of a detached house which is two storeys in part with an additional attic space, and is situated in a very high wind zone for the purposes of NZS 3604<sup>3</sup>. The house is complex in plan and form with complex junctions and with a roof at varying levels. Construction is conventional light timber frame, with concrete floor slabs and foundations, aluminium windows, and corrugated steel roofing. Exterior finishing and cladding timbers were specified as treated H3. The cladding is a mix of plywood sheets in some places and of weatherboard that the owner made out of those sheets in two locations on the ground floor. There is an underlay of building wrap.
- 2.2 The plywood sheets are 7.5mm DD grade 3 ply H3 treated fixed vertically with the vertical joints filled with flexible sealant and covered with H3 treated battens. The plywood sheets are not relied on as bracing.
- 2.3 The weatherboards were made by cutting sheets of the plywood into 200mm strips to which 50mm strips (“ribs”) were glued, as shown in Fig. 1. The weatherboards are lapped 40mm or more and fixed through the laps to studs at not more than 500mm centres. Exposed bottom edges of the weatherboards were protected with a proprietary timber preservative coating. Butt joints were glued and covered with copper strips (“soakers”).



**Fig. 1.**

**Weatherboards fabricated from 7.5 mm plywood sheet.**

<sup>2</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>3</sup> New Zealand Standard NZS 3604:1999 Timber Framed Buildings

### 3. Legislation

3.1 The relevant provisions of the Building Code which applied at the time the consent was granted are:

**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
- (b) 15 years if:
  - (ii) 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
  - (iii) 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.

Limits on application

Performance B2.3.1 applies from the time of issue of the applicable code compliance certificate.

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

3.2 The relevant provision of B2/AS1, Paragraph 3.2.1, reads:

Part 1 of NZS 3602:2003 is an acceptable solution for meeting the durability requirements of timber building elements.

#### COMMENT

The use of timbers or timber treatments different to those referred to in NZS 3602 may still comply with the building code in particular applications. Where the use of a different timber or timber treatment is proposed, this would be an alternative solution and evidence must be provided to the territorial authority or building certifier that the intended use will meet the Building Code. For example, if imported hardwood is to be used to surface a deck, evidence that the timber was durable for a minimum of 15 years in the expected exposure conditions is required.

3.3 The relevant provisions of E2/AS1 are, Paragraph 9.4.2:

Timber weatherboard cladding shall include the following features:

- b) Timber selection and treatment of weatherboards in accordance with NZS 3602.

and Paragraph 9.8.2:

Plywood panels shall be:

- a) Manufactured to AS/NZS 2269, grade CD,
- b) A minimum of 5 ply,
- c) A minimum of 12mm in thickness, and
- d) Treated as required by NZS 3602.

- 3.4 AS/NZS 2296 specifies that grade CD plywood has quality C face veneer and quality D back (in this case, middle) veneer. Grade DD plywood has all quality D veneers.
- 3.5 The relevant differences in the permitted imperfections of quality C and D veneers are significant, for example: Quality C contains no unfilled holes whereas quality D may contain any number of unfilled holes not exceeding 75mm; quality C contains no knots other than sound knots not exceeding 50mm whereas there is no limitation on the knots present in quality D; and so on.
- 3.6 NZS 3602 requires H3.1 treatment for sheet cladding not providing bracing.

## 4. Background

- 4.1 The owner applied for a building consent in November 2001. The authority issued a building consent for the house (No. 20730) under the Building Act 1991. It is unclear at what stage the authority queried the use of the plywood sheets, however, those queries do not appear to have been resolved before the building was completed.
- 4.2 The house as built does not comply with the consent, particularly in respect of the plywood weatherboards which were specified as DG Radiata. The owner has not subsequently applied for a code compliance certificate.
- 4.3 Correspondence between the parties continued with the authority noting in its letter to the owner of 18 June 2003 that it had concerns regarding the use of the plywood weatherboards. The authority undertook a pre-line inspection and wrote to the owner on 4 August 2003 raising a number of matters including:
- Reliance on sealant at plywood sheet joints
  - Thickness of ply cladding
  - The use of ripped down plywood as weatherboards
  - Grade of plywood used.

The authority also required the owner to seek confirmation from the manufacturer that the plywood was 'acceptable to this situation'.

- 4.4 The manufacturer wrote to the owner on 22 August 2003, 19 September 2003, and again on 3 May 2004 saying:

Our recommendation for residential house cladding is an acrylic painted 5 ply cladding. ... The 5 ply solution with a maintained paint coat offers 50 year durability.

...it has been shown that a 3 ply 7mm cladding on girts spaced at 800mm will provide cladding with an adequate durability exceeding 15 years unpainted. The durability can be enhanced with a regularly maintained good quality stain or paint system.

We would recommend closer inspection and maintenance intervals in this event.

- 4.5 The authority wrote to the owner on 23 March 2004 informing the owner that it would not approve the use of the ply weatherboards as it could not be satisfied on reasonable grounds that they would have a durable life of at least 15 years based on:

- A lack of proven in-service performance
- Use of 3 ply plywood
- Grade of the ply being DD
- Lack of weather grooves.

The letter went on to note that the manufacturer had confirmed the durability of 15 years but made no mention of the grade of ply.

- 4.6 An application for a determination was received from the Council by the antecedent of the Department, the Building Industry Authority, on 9 July 2004.

## 5. Submissions

- 5.1 Included in the application, the authority forwarded copies of the following documents:

- Consented plans and specifications
- Correspondence between the owner and the authority
- Some inspection records, photographs and notes
- Correspondence with the manufacturer
- A summary outlining the concerns the authority had regarding compliance of the plywood sheet and cladding.

- 5.2 A number of submissions were received in response to the application and first two draft determinations, prior to the second expert's report being commissioned. I have summarised the content of those submissions in the table below.

Item	Description	Authority	Owner
<b>Plywood sheet cladding</b>			
1.	Thickness, number of ply, grade, and finish	DD grade with oil or stain finish not compliant	Complies
2.	Spacing supports	Requirements for supports not met	Requirements met
<b>Plywood weatherboards</b>			
3.	Durability of the cut joint	Treatment not adequate	
	Finish		Intending to use [a proprietary penetrating oil stain] in a light colour
4.	Dimensional stability	Prone to bowing	The boards have not bowed or cupped. The soakers indicate that significant movement has not taken place
5.	Weather grooves	Required	
6.	Direct fix to framing		E2/AS1 risk score of 5 therefore direct fixing acceptable

7.	Durability	Signs of decay present. Knots missing, ply delamination, and cupping locally.	In the top ply only and not a concern
8.	Durability	Delamination between the boards and the ribs	
<b>Condition of the weatherboards</b>			
9.	The parties agreed that the lap fixing had not resulted in any splitting		
	The butt joints showed no sign of opening up		
	There was no cupping or bowing of the weatherboards		
<b>General comment on cladding</b>			
			2 years' proven in-service performance
			Durability question resolved by the manufacturer

5.3 Submissions from both parties also included a number of comparisons with similar products and proprietary systems. These are described below:

#### **The authority's submissions**

- BRANZ recommends 5 ply 12mm ply for housing – thinner sheets are suitable for sheds.
- The manufacturer of the plywood concerned offers a proprietary brand of DD grade 12mm plywood as 'low cost rustic cladding for housing' or a proprietary brand of 7mm plywood used under paint or texture coating (the authority believed that this latter brand of plywood was used in this case).
- Another plywood manufacturer stated that 7mm plywood could be used but did not state the grade of the plywood.
- Certain proprietary plywood weatherboards were 11.5mm BB grade 5 ply with weather grooves.

#### **The owner's submissions**

- The boards are lapped more than the conventional weatherboards and have a larger volume of pressure equalisation cavity than conventional bevelled boards afford.

5.4 The owner also submitted a report from a testing laboratory stating that 'following a prolonged period of driving wet weather conditions' the plywood weatherboards had been measured as having moisture contents between 22% and 33%, and the internal framing between 5% and 24%.

## **6. Experts' reports and draft determinations**

### **6.1 The first expert's report**

6.1.1 On 29 June 2005 I referred the application and the parties' submissions, together with two samples of the weatherboards provided by the owner, to an expert in weathertightness. The resulting report, which was copied to the parties, discussed weatherboard profiles, experience with weathertightness of claddings, arguments for and against the need for weather grooves, material properties and dimensional stability.

6.1.2 The report concluded that:

The weatherboard system discussed here makes novel use of 7mm plywood as far as we can determine. Some aspects of its likely performance can be estimated by drawing parallels with other products and existing Standards. In our opinion, this establishes the following:

- The lap joints will not need a weather groove to keep capillary water from the framing and insulation.
- The body of the weatherboards will be acceptably weathertight and free from gravity leakage paths.
- The plywood treated to ... hazard class H3 meets current requirements for plywood used as a non-structural cladding.

Questions needing further exploration are:

- How stable are the weatherboards in relation to cupping and lateral distortion, and how does this depend on fixing and surface treatment?
- Are the butt joints durable and weathertight for the intended life of the cladding?
- Is the adhesive forming the edge thickening appropriate for its application?
- Have all cut edges been protected with preservative?

6.1.3 The report was inconclusive in regard to the product meeting the requirements of Clauses E2 and B2 of the Building Code.

### **6.2 The first draft determination**

6.2.1 In light of the submissions, the first expert's report, and the responses, I prepared a draft determination ("the first draft") dated 17 October 2005. The determination concluded that the plywood claddings did not comply and that an amendment to the building consent was required to show the claddings as installed. It also incorporated a waiver of Clauses B2 and E2 of the Building Code in respect of the plywood claddings on a number of conditions, including compliance with an agreed maintenance and repair regime.

6.2.2 In response to the first draft determination the owner said that he would prefer to 'negotiate the details' of the maintenance and repair regime with the authority before deciding whether to accept the first draft.

6.2.3 The authority did not accept the first draft determination, saying that it was not defined as they would have wished and that the issue remained unresolved. The authority also advised that agreement with the owner had not been reached as to the conditions of the waiver.

6.2.4 I accepted other comments and clarifications of a non-controversial nature and amended the determination accordingly.

### **6.3 The second draft determination**

6.3.1 I prepared a second draft determination, dated 29 March 2006, in light of the submissions to the first draft. The second draft included my reasons for accepting or rejecting other amendments requested by the parties.

6.3.2 A meeting was held on 10 July 2006 to discuss the determination, and correspondence between the parties and the Department continued. Agreement between the parties could not be reached on the conditions of the waiver, particularly the maintenance and reporting regime, and the determination was in effect placed on hold.

### **6.4 The second expert's report**

6.4.1 On 24 September 2009, a second expert was engaged to conduct an on-site inspection of the house and to report on the expected long term performance of the cladding. My brief to the second expert was based on the first expert's recommendations.

6.4.2 The resulting report, which was copied to the parties, discussed weatherboard overlapping and stability, including any signs of cupping or distortion, the effects of the fastening system and painting, joint durability, the soundness of the thickened edges, and signs of decay or deterioration on the cut edges.

6.4.3 The second expert noted that:

A close visual inspection of the interior found no internal signs of water entry (Point 2.9).

My inspections of the assembly found no indications of leaks or failures at these points [joinery junctions]. ... [T]he system which appears traditional in detail appeared significantly more durable and weathertight than most modern monolithic structures built during similar historical time period (Point 3.4).

[U]nable to find any of the usual visual indications of moisture or water stains on the inspected points of the lower base plate framing suggesting water has not affected the framing (Point 2.18).

6.4.4 Regarding the plywood cladding, the second expert observed that both the ply sheets and the ply weatherboards are made from relatively thin 7mm 3 ply DD "Eco-ply" which has treated CCA H3 on the outer two boards with the thin inner board having little or no penetration of treatment. According to the manufacturer, it is necessary to treat any cut edges with a suitable timber treatment.

- 6.4.5 The second expert further notes that the ply sheet DD grade has a rustic knot-inclusive surface on both sides, and is sometimes supplied with missing knots on the outer layer exposing the red glued surface of the inner sheet.
- 6.4.6 The second expert noted that ‘the thin boards are able to flex upon the placement of pressure but do not show signs of cupping of the board’.
- 6.4.7 Regarding the stability of the weatherboards, the second expert stated:
- Other than normal variations of thin ply the boards showed no or very little signs of cupping.
  - The ply had performed as the manufactures (sic) claim with good anti cupping ability.
- 6.4.8 The report concluded that:
- There was no evidence to suggest the weatherboard system was leaking water into the dwelling.
  - The detail was in place to drain water freely from the cladding should any water penetrate the cladding, and it was detailed at the window junctions.
  - The joints appeared durable with some minor exceptions.
- 6.4.9 The expert expressed concerns about the weathertightness of other aspects of the house as follows:
- The roof skylights in regard the detail to the lower section
  - The missing detail from above the bedroom window
  - The unprotected unfinished lounge canopy
  - The gutter discharge on the northern elevation
  - The decaying cladding below the bedroom deck – the result of specific concentrated water flow.
- 6.4.10 Regarding the question of whether the cladding will meet the durability requirements of 15 years, the second expert stated:
- I am not so confident about the deterioration rate to the cladding both the weatherboard and vertical direct fixed sheets where they are in direct contact to the prevailing elements (Point 5.1.16).
  - It is likely that the subject weatherboards will actually last longer than the vertical board and batten system (because of the positive effect of deflection given by the weatherboard) (Point 5.1.17).
  - The deteriorating effect of the thin vertical board is likely to mean future increased moisture is held against the framing, with the potential for typical monolithic clad framing failure (Point 5.1.18).
  - I am unable to predict the decay rate for the next 8-9 years. It is possible that in the exposed hard working areas, (the cladding locations which show the worst rates of deterioration), it may experience exponential increased deterioration rates from what was experienced over the current test period and accordingly will not meet the required standard (Point 5.1.19).
- 6.4.11 The second expert was of the opinion that:
- ... had the system being (sic) designed with a thicker 5 ply plywood, it would likely have the makings of a very innovative, alternative, durable and effective system

that would clearly be expected to satisfy the requirements of the building code (Point 5.1.21).

### **The authority's submissions**

6.4.12 The authority acknowledged receipt of the second expert's report and provided a response to this report on 23 October 2009.

6.4.13 Regarding the plywood cladding, the authority commented that:

One of our concerns which he [the second expert] has identified is that the central layer (of only 3 ply) is exposed with reduced treatment. This is a significant durability issue.

6.4.14 The authority has also indicated its concern regarding the use of wood protector and owner-applied glue, the tendency for exponential increase in deterioration over time, the breakdown in the outer surface of the cladding, and joints which are not sound.

### **6.5 The third draft determination**

6.5.1 Following receipt of the second expert's report, and in light of submissions to the draft determinations, a further draft determination, dated 4 November 2009 was prepared which considered the in-service performance of the cladding to date as evidence on which I can form a view as to whether the requirements of B2 of the Building Code will be achieved. The draft was issued for comment and for the parties to agree when the work contained in the first consent complied with clause B2 "Durability" of the building code.

6.5.2 Both parties accepted the draft subject to comment. I have considered the comments of the parties and made those amendments to the determination that I consider to be appropriate.

6.5.3 In response to the draft determination the authority submitted that it's 'best guess' of the date on which compliance with B2 was achieved would be mid 2003, being the date the exterior cladding was fitted. The authority also noted that the owner would potentially have a more accurate record of when the house was first occupied and that this was 'possibly around mid 2004'. The owner submitted that compliance with B2 was achieved on July 2004.

6.5.4 I have received limited information about the progress of the work, the dates of the site inspections, and when the building was substantially complete. However, a letter from the Authority to the owner dated 4 August 2003 refers to a 'pre-line inspection of the study area only' carried out on 29 July 2003. Other correspondence about and after this time also refers to the work completed on site including the installation of the plywood weatherboards.

6.5.5 I acknowledge the difference between the authority's view that compliance with B2 was achieved when the weatherboard cladding was installed in mid-2003, and the owner's view that compliance with B2 was achieved when the house was occupied in mid-2004. In my opinion the installation of the weatherboards has a greater significance in terms of the building's overall durability than the occupancy date. I am therefore of the view that the building complied with Clause B2 Durability on or

about the completion of the installation of the weatherboards, which I have taken to occurred on 1 August 2003.

## **7. Discussion and conclusion**

### **7.1 Compliance with Clause E2 of the Building Code**

- 7.1.1 The plywood sheet concerned is significantly different from that specified in E2/AS1 in that it is grade DD instead of CD, 3 ply instead of 5 ply, and 7.5mm thick instead of 12mm. The plywood claddings used are therefore an alternative solution.
- 7.1.2 In this case it is reasonable, considering the length of time this cladding has been in place, to consider the plywood cladding's in-service performance to date as the basis for forming a view as to its compliance. I consider the expert's report establishes that the current performance of the cladding is adequate because it is not allowing water penetration at present. Consequently, I am satisfied that the plywood cladding as installed complies with Clause E2 of the Building Code.
- 7.1.3 In addition, the building is also required to comply with the durability requirements of Clause B2. Clause B2 requires that a building continues to satisfy all the objectives of the Building Code throughout its effective life, and that includes the requirement for the house to remain weathertight.
- 7.1.4 Despite the technical reports by various experts there remains some doubt as to whether the ply claddings will be durable for the required minimum period of 15 years. There are signs that the ply cladding has begun to deteriorate and there are specific items that require attention. There are also signs that maintenance as recommended by the plywood manufacturer has so far been neglected.
- 7.1.5 Because the faults on the house may allow the ingress of moisture in the future, the building work does not comply with the durability requirements of Clause B2 insofar as it relates to Clause E2.
- 7.1.6 Because the faults identified with the cladding occur in discrete areas, I am able to conclude that investigation and satisfactory rectification of the areas outlined in paragraph 6.4.9 will result in the house being brought into compliance with Clause B2 insofar as it relates to Clause E2.
- 7.1.7 It is emphasised that each determination is conducted on a case-by-case basis. Accordingly, the fact that a particular cladding system has been established as being code compliant in relation to a particular building does not necessarily mean that the same cladding system will be code compliant in another situation.
- 7.1.8 I note in paragraph 4.4 the manufacturer's statement that durability (and, by implication, weathertightness) can be enhanced 'with a regularly maintained good quality stain or paint system'. Effective maintenance of claddings is important to ensure ongoing compliance with Clauses B2 and E2 of the Building Code and is the responsibility of the building owner.

## **7.2 Durability considerations**

- 7.2.1 I have concerns about the durability, and hence compliance with the Building Code, of certain elements of the building taking into consideration the completion of the building work during 2003.
- 7.2.2 The relevant provision of Clause B2 of the Building Code requires that building elements must, with only normal maintenance, continue to satisfy the performance requirements of the Building Code for certain periods (“durability periods”) ‘from the time of issue of the code compliance certificate’ (Clause B2.3.1).
- 7.2.3 In this case, the delay between the completion of the substantial portion of building work and the consideration of the issuing of a code compliance certificate raises concern that various elements of the building are now well through their required durability periods and would consequently no longer comply with Clause B2 if a code compliance certificate were to be issued effective from today’s date.
- 7.2.4 I am satisfied, that all the building elements complied with Clause B2 on 1 August 2003, refer paragraph 6.5.5.
- 7.2.5 In order to address these durability issues when they were raised in previous determinations, I sought and received clarification of general legal advice about waivers and modifications. That clarification, and the legal framework and procedures based on the clarification, is described in previous determinations (for example, Determination 2006/85). I have used that advice to evaluate the durability issues raised in this determination.
- 7.2.6 I continue to hold that view, and therefore conclude that:
- (a) The authority has the power to grant an appropriate modification of Clause B2 in respect of all the building elements.
  - (b) It is reasonable to grant such a modification, with appropriate notification, because in practical terms the building is no different from what it would have been if a code compliance certificate for the building work had been issued in 2003.
- 7.2.7 I strongly recommend that the authority record this determination and any modifications resulting from it, on the property file, and also on any LIM issued concerning this property.

## **8. What is to be done**

- 8.1 I note the variations between the consent drawings and the house as constructed that have been identified. I leave this matter to the authority to resolve with the owner as it considers appropriate.
- 8.2 A notice to fix should be issued that requires the owner to bring the building work into compliance with the Building Code, identifying the items listed in paragraph 6.4.9 and referring to any further defects that might be discovered in the course of investigation and rectification, but not specifying how those defects are to be fixed. It is not for the notice to fix to stipulate directly how those defects are to be remedied

and the building brought into compliance with the Building Code. That is a matter for the owner to propose and for the authority to accept or reject.

- 8.3 Accordingly I would suggest that the parties adopt the following process to meet the requirements of paragraph 8.2. Initially, the authority should issue the notice to fix. The owner should then produce a response to this in the form of a detailed proposal, based on further investigation as necessary and produced in conjunction with a competent and suitably qualified person, as to the rectification or otherwise of the specified issues. Any outstanding items of disagreement can then be referred to the Chief Executive for a further binding determination.
- 8.4 Once the matters set out in the notice to fix have been rectified to its satisfaction, on application by the owner the authority may issue a code compliance certificate.

## **9. Decision**

- 9.1 In accordance with section 188 of the Act, I hereby determine that the 7.5mm DD plywood in sheet form and cut into weatherboards used as cladding does not comply with the requirements of Clause B2 of the Building Code insofar as it relates to Clause E2.
- 9.2 I also determine that:
- (a) all the building elements, apart from the items that are to be rectified as described in Determination 2009/108, complied with Clause B2 on 1 August 2003.
  - (b) The building consent is hereby modified as follows:  
The building consent is subject to a modification to the Building Code to the effect that Clause B2.3.1 applies from 1 August 2003 instead of from the time of issue of the code compliance certificate for the building elements, except the items that are to be rectified, as set out in paragraph 6.4.9 of Determination 2009/108.

Signed for and on behalf of the Chief Executive of the Department of Building and Housing on 8 December 2009.

John Gardiner  
**Manager Determinations**