

Refusal of a code compliance certificate for a building with a “monolithic” cladding system: House 3

1 THE DISPUTE TO BE DETERMINED

- 1.1 This is a determination by the Building Industry Authority (“the Authority”) of a dispute referred to it under section 17 of the Building Act 1991 (“the Act”). The applicant is the owner, who has authorised the manufacturer of the cladding system to act as his agent in this matter. The other party is a territorial authority. The application arises from the refusal by the territorial authority to issue a code compliance certificate for a new house unless changes are made to its monolithic cladding system.
- 1.2 The Authority’s task in this determination is to consider whether it is satisfied on reasonable grounds that the external cladding as installed (“the cladding”) on this house complies with the building code (see sections 18 and 20 of the Act). By “external wall cladding as installed” we mean the components of the system (such as the backing material, the flashings, the joints, the plaster and/or the coatings) as well as the way the components have been installed and work together.

2 PROCEDURE

Sequence of events:

- 2.1 The owner applied for a building consent on 23 May 2003. The drawings submitted for the consent indicated that the cladding was to be “40 mm polystyrene, plaster finish to exterior, fixed over building paper”.
- 2.2 On 30 May 2003 the territorial authority wrote to the owner asking for “Ventilated cavity details required for polystyrene cladding”.
- 2.3 The consent was granted on 17 July 2003, but included no special conditions requiring a ventilated cavity detail.
- 2.4 It appears that the territorial authority believed that the consent had been issued on the basis of the use of 40 mm thick polystyrene sheets, fixed to the framing through 20 mm thick ventilated polystyrene battens. The owner states he made the decision to change the cladding manufacturer on 30 September 2003.

2.5 On 13 November 2003, the building inspector noted in the course of a site visit that the polystyrene on site, which was ready for installation, was from a supplier not specified in the consent drawings, and that it did not incorporate a 20 mm cavity off the framing. We are advised that he asked for more details on the cladding and said that the cladding should be approved before fixing. The builder provided the requested details and proceeded with fixing the cladding, completing the job by 21 November 2003. The territorial authority issued a Notice to Rectify No 52 dated 24 November 2003 saying:

The wall cladding system used is a system other than that specified on the approved plans and has been fixed in a manner that is contrary to [the territorial authority's] current policy.

It is also noted that this system does not carry a recognized appraisal certificate.

2.6 The Authority also notes that the Notice to Rectify No 52 (dated 24 November 2003, and received 25 November 2003) was accompanied by a covering letter dated 30 September 2003. No cladding had been installed by 30 September 2003. It was 95% complete by 25 November 2003, when the advice was finally received.

2.7 On 1 December 2003, the territorial authority issued an amended Notice to Rectify No 53, which superseded the previous issue. The Notice required the owner to rectify work on the project that was not in accordance with the Act, and also required that all work on the "entire wall cladding system" be ceased. The particulars of contravention quoted sections 32 and 33 of the Act, and also said:

It has not been satisfactorily demonstrated that the [cladding] will meet the requirements of NZ Building Code E2.1, E2.3.2, E2.3.5.

2.8 The owner was not directed to take any specific action other than to stop work on the wall cladding.

2.9 The owner applied for this determination on 19 December 2003.

3 THE SUBMISSIONS

3.1 The territorial authority provided copies of the following:

- A set of consent drawings and a general construction specification (which does not cover details either of the original cladding nor the cladding as installed);
- A copy of the building consent and inspection records;
- Relevant correspondence held by the territorial authority; and
- A chronology of events, which lead up to the issuing of the Notice to Rectify.

3.2 In addition, the owner made an extensive submission, which included:

- Relevant correspondence held by the owner;

- A detail on the moisture monitoring system built into the cladding and the moisture levels measured in this building;
- Specifications for the cladding, including flashings and control joint details;
- Test data on the drying behaviour of timber frames behind this type of cladding;
- A study on the water transport mechanisms behind this type of cladding;
- Test data on a comparative study comparing water absorption by fibre cement panels with this manufacturer's polystyrene panels;
- An individual producer statement for the hard fill placement;
- A warranty for the roofing and waterproofing system;
- A background paper from the Ontario Association of Architects entitled "OAA Rain Penetration Control Practice Guide" which outlines their views on effective rain control strategies;
- A BRANZ report on a weathertightness test to a modified AS/NZ4284 on this cladding system; and
- A selection of research bulletins from the manufacturer.

3.3 The Authority commissioned an independent expert to inspect and report on the cladding.

3.4 Copies of the submissions, the expert's report and other evidence were provided to each of the parties. Both the territorial authority and the owner made submissions on the expert's report.

3.5 The manufacturer (who is the owner's agent) made a number of comments on the report, some of which are summarised below:

- The assessor's moisture readings were inaccurate and should be discarded in favour of the manufacturer's figures.
- The gap under the sills had been sealed in places with paint and not sealant. The sill tray, therefore, was still capable of operating effectively.
- The manufacturer had deliberately left the thickness of the plaster unspecified. The inference was that the plaster should be thin so that it retains flexibility.
- The manufacturer stated that the cladding did not need vertical control joints.
- The unsealed penetrations through the cladding were acknowledged.
- The manufacturer stated that this cladding will dry out without requiring ventilated air to be able to move behind the cladding and out of ventilation holes at the top.

- The manufacturer included a further set of moisture readings from his built-in measurement units, which showed a slight drop in moisture levels since the last readings on 15 January 2004.
- The manufacturer also included a pro forma warranty that was offered with the cladding system, along with maintenance guidelines.

3.6 The territorial authority made the following comments:

- The report had highlighted some deficiencies in the cladding and there could be a weathertight problem where the cladding fits into the base rebate; and
- The deficiencies indicate that the quality of the workmanship could be an issue, especially as the territorial authority had not inspected the work of the applicator as it progressed.

4 THE RELEVANT PROVISIONS OF THE BUILDING CODE

4.1 The dispute for determination is whether the territorial authority's decision to refuse to issue a code compliance certificate because it was not satisfied that the cladding complied with clauses E2.3.2 of the building code (First Schedule, Building Regulations 1992), is correct. Those provisions of the building code provide:

Clause E2—EXTERNAL MOISTURE

OBJECTIVE

E2.1 The objective of this provision is to safeguard people from illness or injury, which could result from external moisture entering the building.

FUNCTIONAL REQUIREMENT

E2.2 Buildings shall be constructed to provide adequate resistance to penetration by, and the accumulation of, moisture from the outside.

PERFORMANCE

...

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

4.2 There are no Acceptable Solutions that have been approved under section 49 of the Act that cover this cladding. The cladding is not accredited under section 59 of the Act. The Authority is therefore of the opinion that the cladding system as installed can be considered to be an alternative solution.

4.3 In several previous determinations, the Authority has made the following general observations about Acceptable Solutions and alternative solutions:

- Some Acceptable Solutions cover the worst case, so that in less extreme cases they may be modified and the resulting alternative solution will still comply with the building code.
- Usually, however, when there is non-compliance with one provision of an acceptable solution, it will be necessary to add some other provision to compensate for that in order to comply with the building code.

5 THE AUTHORITY'S VIEW

5.1 The Authority has considered the submissions of the parties, the expert's report and the other evidence in this matter. The Authority's approach to determining whether building work complies with clauses E2.3.2 is to examine the design of the building, the surrounding environment, the design features that are intended to prevent the penetration of water, the cladding system, its installation, and the moisture tolerance of the external framing.

The house

5.2 The building is a single storey detached house with a concrete floor on a flat site. It has no balconies or wall/roof intersections. It is of conventional light timber frame construction and is of a relatively simple shape. Eaves overhangs vary between 450 mm and 900 mm. It is in a high wind zone in terms of NZS 3604: 1999 "Timber framed buildings".

5.3 All framing timbers are specified as H 1 Plus

5.4 The cladding is known as a monolithic cladding system. As specified in its manufacturer's data sheets ("the manufacturer's instructions"), it incorporates 50 mm thick polystyrene sheets fixed through the building wrap directly to the framing timbers. A polymer-based water resistant coating is applied to the polystyrene before installation and is overlain with a mesh reinforced polymer-based plaster and a decorative finish. The manufacturer's instructions include details for sill, jamb and window flashings at various junctions (but not all of the junctions actually present in the house). The manufacturer's instructions also provide the jointing details, but give no other information as to their composition or when they should be applied. The manufacturer does not supply the joint, flashing, plaster or coating systems.

5.5 The polystyrene is fixed directly to the framing timbers. The inside face of the polystyrene is indented by a diamond pattern of grooves at 50 mm centres. Each groove is approximately 10 mm deep by 14 mm wide.

5.6 Installation of this cladding is required to be by qualified applicators, although we have not been provided with any evidence as to whether this cladding was installed by a qualified applicator.

5.7 The final decorative finish coat of the plaster is a waterproofing membrane. We have not been provided with the specification of the waterproofing membrane.

- 5.8 The house has been fitted with a moisture detection system proprietary to the manufacturer. It involves the fitting of permanent moisture probes at 14 different sites on the bottom plate of external walls. The manufacturer has recorded moisture levels from these units 4 times since the internal plasterboard was installed. They indicate a gradually reducing moisture content at or below the threshold for the onset of decay.
- 5.9 The expert's report made the following comments on the as-built cladding details:
- There was no evidence of vertical control joints being fitted. He noted, however, that although the manufacturer's instructions were silent on vertical joint spacing, good trade practice would not normally require them in this case because the length of individual walls was below the maximum.
 - The termination of the cladding over the concrete slab was not totally according to the manufacturer's instructions. Those instructions required that the cladding overhangs the edge of the slab. In many cases the cladding is set into a rebate in the slab and does not overhang the slab edge. He noted that it could be possible for the gap between the cladding and the base of the rebate to become obstructed with time.
 - The sill flashings appear to be constructed with no gap between the bottom of the joinery flange and the inclined polystyrene sill. The lack of drainage in this situation can redirect moisture back inside the wall cavity. The presence of a head flashing was confirmed, but the jamb flashing was concealed.
 - There is no evidence of either the specified thickness of the plaster or the as-built thickness.
 - There are a number of minor service penetrations through the cladding that have been inadequately sealed.
 - Both the plaster and the final coating have been applied to a good standard, although the relative flexibility of the cladding to a horizontal load indicated that the plaster coat was thin.
- 5.10 Moisture readings taken with a portable meter through internal wall linings were around 10% and indicated that there was no undue moisture in the external walls. Moisture levels above 18% recorded after cladding is in place generally indicate that external moisture is entering the structure and that there is a consequent risk of decay in the structural timbers. While a moisture reading of less than 18% does not of itself indicate that the cladding is code compliant, it is indicative of the efficiency of the cladding in preventing moisture ingress to date.

Weathertightness risk

- 5.11 Recent New Zealand data and experience indicates that the impact of weathertightness problems in monolithic clad houses can be minimised if good design and construction practices are followed.
- 5.12 The installation to manufacturers' specifications and to accepted good trade practice is a fundamental requirement to ensure good weathertightness performance.

5.13 The next priority is to reduce the ability of moisture to get through the cladding by utilising design measures that minimise the effects of the rain impacting on the walls:

The main areas of concern are:

- Data shows a strong relationship between the width of the eaves and the incidence of wall leaks. An effective deflection mechanism, such as eaves greater than 600 mm wide, has been shown by Canadian data to manage more than 90% of rain incidents;
- While most reported leaks are substantially caused by defects in the cladding that require little or no wind pressure differential, the Authority believes that homes in high and very high wind zones (as defined by NZS 3604) are likely to experience wind pressure differentials and thus a higher risk of water ingress;
- Taller buildings result in an effective increase in the catchment area of the wall. Available data suggests a clear correlation between higher number of storeys and an increased incidence of leaking;
- Complex roofs and overall envelope shapes where the roofs frequently intersect with the walls on upper floors create opportunities for leaks to directly penetrate into the wall; and
- Recent data also shows that decks and balconies that are exposed in plan and/or cantilevered out from the external walls are the most frequent location for water leaks;

5.14 The inevitable penetration of moisture through the cladding can then be addressed by a combination of effective drainage, ventilation of the drainage cavity and moisture tolerance in the external wall framing timber. These factors being:

- The structure should allow water that has penetrated the cladding to drain out as quickly as possible. The Authority believes that generally a drainage cavity should be provided behind the outer cladding barrier in monolithic construction;
- The design of the outer walls should allow walls to dry to the outside once moisture penetrates the cladding and the moisture barrier. If walls do not dry, decay fungi can become established in as little as 3 months. Until scientific data on the optimum depth and configuration of the ventilation mechanism in New Zealand conditions is available, the Authority believes that the drainage cavity should be not less than 20 mm deep; and
- The external walls should have some degree of decay resistance, or moisture tolerance to allow for situations when moisture circumvents the cladding and moisture barriers and moisture levels in the timber rise to more than 18%.

5.15 In relation to these characteristics, the Authority finds that this house:

- Is in a high wind zone;
- Is constructed to one level;

- Incorporates no complex wall/roof intersections and has an overall envelope that is simple in shape;
- Has eaves that vary between 400 mm and 900 mm wide;
- Does not involve any decks or balconies;
- Has face-fixed cladding with grooved drainage channels on its inside face; and
- Has external walls constructed from H1.Plus treated timber, a treatment level that the Authority believes equates to the current H1.2 treated timber, which is considered to be effective in delaying the onset of decay.

Weathertightness performance

- 5.16 Generally, the cladding appears to have been installed according to good trade practice and to manufacturer's instructions. It can be considered to be reasonably effective in preventing the penetration of water. There are some minor defects in the way the plaster is sealed at window sills and services penetrations, and these need to be addressed to ensure ongoing weathertightness. The Authority notes that the rebated base termination detail is different from the overlapping detail that is included in the manufacturer's instructions, but finds that change would not materially reduce the ability of moisture to drain out from behind the cladding. It notes the importance of ensuring that the drainage gap between the cladding and the floor slab is clear at all times.
- 5.17 The Authority finds that the plaster coating should be weathertight, despite its lack of depth. It is concerned, however, that the cladding be regularly inspected and repaired as required to maintain its weathertightness if damaged by impact.
- 5.18 The Authority acknowledges the efforts by this manufacturer to properly specify the cladding installation, to understand and measure its weathertightness performance, and, in particular, the use of built-in moisture monitoring systems. Submissions from the manufacturer include a publication by the Ontario Association of Architects entitled "Rain Penetration Control Practice Guide". The Authority agrees with the general principles of water deflection, drainage, drying and decay resistance on which this guide is based.
- 5.19 The Authority believes that more extensive research is required before a full understanding of the behaviour, in a New Zealand context, of polystyrene-based monolithic cladding systems is available. In particular, the water transport, internal drainage and drying mechanisms are still not adequately understood. Until that level of understanding is reached, a conservative approach is required when assessing adequate drainage and ventilation mechanisms.
- 5.20 The Authority believes that the grooves cut into the back of these panels could be able to drain away moisture that has come through the external cladding. The Authority, however, has not seen sufficient justification within the research material provided to conclude that the grooves provide adequate ventilation to allow the framing to dry out in all situations.

5.21 Notwithstanding the Authority's conclusions on the ventilation mechanisms behind this cladding, the Authority finds that there are compensating provisions that assist the performance of the cladding in this particular case. These are:

- Apart from some minor details, the cladding appears to have been carefully installed according to good trade practice and to manufacturer's specifications;
- The building does not display to any significant extent any of the weathertightness risk factors;
- The waterproofing membrane coating system, which appears to have been installed to manufacturer's specification, affords an additional degree of protection to the cladding system;
- The external wall framing is H1.Plus treated, affording an increased resistance to the effects of any moisture that may penetrate the cladding; and
- The moisture level readings do not indicate any undue moisture ingress behind the cladding at this time.

5.22 The Authority considers that these additional provisions adequately compensate for the lack of a drainage cavity and allow the house to comply with the weathertightness provisions of the building code.

6 CONCLUSION

6.1 The Authority accepts that the expert's report establishes that the cladding on this particular building complies in most respects with the manufacturer's instructions. The Authority finds that the termination of the cladding in a rebate in the concrete ground floor slab in lieu of the manufacturers detail (where the cladding overlaps the concrete slab), will not materially increase weathertightness risks, provided the gap under the cladding is kept clear at all times. Accordingly the Authority is satisfied that once the other items of non-compliance that are listed in the expert's report are rectified, the cladding on this particular building will comply with clause E2.

6.2 The Authority emphasises 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.

6.3 The Authority declines to incorporate any waiver or modification of the building code in its determination.

7 WHAT IS TO BE DONE?

7.1 It is not for the Authority to decide how the cladding is to be brought to compliance with the building code. That is a matter for the owner to propose and for the territorial authority to accept or reject, with either of the parties entitled to submit doubts or disputes to the Authority for another determination.

8 THE AUTHORITY'S DECISION

- 8.1 In accordance with section 20 of the Building Act, the Authority determines that the cladding, which is not installed to all the manufacturer's instructions and may be unable to adequately prevent the ingress of moisture, does not comply with the building code. Accordingly, it confirms the territorial authority's decision to refuse to issue the code compliance certificate.
- 8.2 The Authority finds that because of the compensating factors in this case, the lack of a ventilated cavity behind the polystyrene panels is not, on its own, sufficient grounds to withhold a code compliance certificate.
- 8.3 The Authority, therefore, finds that once the following items of non-compliance and any other sources of moisture ingress that may be identified are rectified to the approval of the territorial authority, the cladding as installed on the house will comply with the building code, notwithstanding the lack of a drainage cavity. The items of non-compliance are:
- The gap between the joinery flange and the inclined sill of the windows should be properly established; and
 - All penetrations through the cladding should be properly sealed.
- 8.4 The Authority considers that the cladding will require on-going maintenance to ensure its continuing code compliance, and this maintenance programme should be undertaken after consultation with the territorial authority.

Signed for and on behalf of the **Building Industry Authority**
on this day of 2004

John Ryan
Chief Executive