

# ***Refusal of a code compliance certificate for a building with a “monolithic” cladding system: House 28***

## **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 of the building, represented by a building consultant and the other party is the territorial authority. The application arises from the refusal by the territorial authority to issue a code compliance certificate for one unit of a duplex (“the unit”) 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 monolithic cladding as installed (“the cladding”) on the unit complies with the building code (see sections 18 and 20 of the Act). By “wall cladding as installed” we mean the components of the system (such as the backing sheets, the flashings, the joints and the plaster and/or the coatings) as well as the way the components have been installed and work together.
- 1.3 The house itself is described in paragraphs 2.1 to 2.3, and paragraph 9 sets out the Authority’s final decision.

## **2 PROCEDURE**

### **The building.**

- 2.1 The building is one unit of a duplex constructed on a level excavated site that is in a low wind zone in terms of NZS 3604: 1999 “Timber framed buildings”. The duplex is three storeys high and the unit shares a common concrete block party wall with the adjoining unit. The unit is of conventional light timber frame construction, is of a relatively simple shape and has three main balconies and two smaller ones. Of the main balconies, two are situated at the intermediate level. One of these is partly enclosed and constructed over a garage space and the other is open and constructed over a living space. The third main balcony is open and is situated at the upper level over the partly enclosed lower level balcony. All these balconies have a 20 mm fibre-cement deck covered by a proprietary waterproof sheet membrane, and the lower open balcony is also overlaid with tiles. The two smaller 300 wide balconies cantilever out under the east elevation windows, are constructed in the same way, but have a timber-lined soffit. A narrow flat roof, which is plywood sarked and membrane lined, is constructed over part of the Family Room and returns over the rear of the unit as far as the Kitchen extension. A similar roof is constructed over the pergola beams to the main entrance. There are wall/roof intersections where the cladding adjoins either the balcony decks or the flat roof roofing beneath it. There are small parapet walls but no eaves projections to the main roof areas and the flat

roofs have eaves varying from 100 to 750 mm in width. Over some of the widow heads there is a 175 wide "eyebrow" projection that protrudes from the main roofline and has a membrane cover turned down into the spouting. A wide full-length membrane lined internal gutter drains the roofs of the adjoining units at the line of the party wall. This gutter discharges through the parapet wall at one end only into an external metal rainwater head served by a single downpipe.

- 2.2 The Authority has not been able to find evidence that the external framing is treated.
- 2.3 The external walls of the building are clad with what is described as monolithic cladding. In this instance it incorporates fibre-cement backing sheets fixed through the building wrap directly to the framing timbers and finished with a mesh reinforced stucco sand and cement plaster. The plaster in turn is finished with an acrylic paint system. The Authority has no evidence on the thickness of the plaster.

#### Sequence of events:

- 2.4 The territorial authority issued a building consent in May 2000
- 2.5 The territorial authority made various inspections in the course of construction and a "Final Checklist" filled in on 10 November 2001 had the comment "[r]echeck interim for...[the unit], 2x items still to do. Subsequently, an "Interim Code Compliance Certificate Memorandum", relating to a final inspection of 16 November 2001, was issued. On 19 November 2001, the territorial authority issued an interim code compliance certificate, but only for the adjoining unit.
- 2.6 On 12 December 2003, the territorial authority carried out a final inspection of the unit and made the following comments as regards the cladding:
- Cracks in plaster on sides, balustrade rail fixing.
  - No cavity to monolithic plaster system.
- 2.7 Following a further site inspection, the territorial authority issued a Notice to Rectify dated 16 January 2004, which included the statements:
- A site inspection of the above property {the unit} carried out on 9 January 2004 has revealed that the exterior cladding of the new building being constructed at the above address is a monolithic cladding system, which is showing signs of failure.
- The exterior cladding has not been installed in accordance with the NZ Building Code, Manufacturers specifications or accepted trade practice as detailed below.

The territorial authority then listed concerns relating to the three areas described in the last paragraph, and which can be summarised as:

- An insufficient number of control joints;
- A number of cracks were visible in the surface of the main cladding areas and particularly around window openings;
- Slopes had not been formed on horizontal surfaces, such as balcony ledges;
- Insufficient ground clearance provided at the base of the cladding to some areas;
- Minimal clearance between the cladding and the mid-floor roofing;
- No gap had been formed between the blockwork foundation wall and the base of the cladding;

- Flashings had not been installed between the deck and column junctions nor over the garage door opening;
- Two raking roof flashings were not continuous;
- The lack of proper flashings to the exterior joinery;
- No rubber flanges or silicon had been installed at the handrail penetrations at the balcony balustrades;
- The upper deck stormwater disposal system could not cope with the uncontrolled stormwater that was being discharged onto the deck from the main roof; and
- Fascia boards were imbedded into the cladding

The territorial authority also stated:

The Council has recently received information which shows that monolithic cladding systems without a 20mm cavity, provision for adequate ventilation, drainage, and vapour dissipation will, in the likelihood of leakage and/or the effects of residual moisture, cause irrevocable damage to the structural elements of the building.

The Council cannot be satisfied that the cladding system as installed on the above building meets the Functional Requirements of Clause E2 External Moisture of the Building Code... Accordingly, the works do not comply with the requirements of Clause E2.3.5 and E2.3.6 of the New Zealand Building Code 1992 (the "Code")

And that the owner was required to:

1. Provide adequate ventilation to the monolithic cladding and into the wall frame space by means of either a ventilated cavity or alternative approved system, and ensuring all issues related to the above are resolved.
2. Lodge with the council an application, within 28 days from the date of this notice, for an amended building consent, and provide all necessary information that may be requested to allow this consent application to be processed, alternatively.
3. Confirm to council, within 28 days from the date of this notice, your intention to apply to the Building Industry Authority for a determination in accordance with the Building Act 1991

2.8 The owner applied for this determination on 2 March 2004.

### 3 THE SUBMISSIONS

3.1 The territorial authority forwarded a lengthy submission. The bulk of the submission was a general comment on monolithic cladding, although some of the material related to this particular extension, such as:

- Face fixed monolithic cladding has no ability to dry out in the absence of a cavity and therefore decay can occur in conditions of sustained high humidity even when there is no moisture ingress from outside;
- Adding moisture to timber may have a negative effect on timber strength and durability and nails will have less gripping power. The territorial authority concluded that the timber used in this house was therefore unsuitable;
- Fibre cement sheets and timber bottom plates can reach high moisture levels in the absence of any external leaks, and thus have a reduced effectiveness as bracing elements when the design calls for that function;
- Paint systems over stucco plaster are inadequate because of the plaster's higher alkalinity while it is drying and the consequent effect on the integrity of the finished coat; and

- Building papers differ in the way that they allow moisture to pass through them, and that differing performance may affect the ability of monolithic walls to dry out.
- 3.2 The specific comment on this house related to inadequacies in the window and roofing membrane flashings, and to the fact that the stucco plaster was not continuous behind the fascia boards. The specific comments reiterated some of the comments made by the territorial authority in the Notice to Rectify but were not nearly as extensive
  - 3.3 The submission also included a set of photographs showing the areas of concern outlined in the Notice to Rectify as well as detailing some of the remedial work currently being undertaken on the adjoining unit.
  - 3.4 The territorial authority felt that it must refuse to issue a code compliance certificate on the grounds that there was insufficient scientific evidence on the performance of these building elements.
  - 3.5 The territorial authority in a letter to the Authority dated 10 June 2004, elaborated on their original submission, which was not fully specific as to this particular house. In this letter the territorial authority stated that their areas of concern were those itemised in the Notice to Rectify and then listed them in detail.
  - 3.6 The copies of the submissions and other evidence were provided to each of the parties. In a letter to the Authority, the owner, through its agent, outlined the history of the moisture testing carried out on behalf of the owner, gave an outline of a proposal to obtain code compliance and commented on the territorial authority's supporting evidence. The letter specifically noted that "[n]o locations of raised moisture content were found" and that repairs were necessary because a nail had punctured the membrane decking "with consequential water damage to timber framing". The letter concluded:
 

The thrust of Council's submission seem (*sic*) to be that a stucco system designed and constructed to present standards is fundamentally flawed, will fail and therefore be in contravention of the Building Act.

Council appear to base their submission, to a large degree, on study information from a company that produces a competing cladding system. This gives us concern.
  - 3.7 The territorial authority did not make a further submission in response to the submissions of the other party.

#### 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 clause 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

- E2.1 The objective of this provision is to safeguard people from illness or injury, which could result from external moisture entering the building.
- E2.2 Buildings shall be constructed to provide adequate resistance to penetration by, and the accumulation of, moisture from the outside.

**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 current Acceptable Solution, E2/AS1, allows for solid plaster systems with fibre cement backing sheets, but requires that they be fixed on battens to create a 20mm cavity between the sheet and the framing. The previous acceptable solution E2/AS1, which was in force when this consent was issued, allowed for mesh reinforced solid plaster to be applied to fibre cement backing sheets that were face fixed to the framing. The cladding is not currently accredited under section 59 of the Act. The Authority is therefore of the opinion that the cladding system as installed must now 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 EXPERT'S REPORT

- 5.1 The Authority commissioned an independent expert to inspect and report on the cladding. The expert inspected the building on two occasions and furnished a report, complete with relevant photographs, which reached the following conclusion:

I formed the view that there is a failure to meet the code requirements with regards to both the exclusion of moisture from the building elements and meeting their durability requirements. Moisture has entered the timber frame elements and there was evidence that timber decay has taken place.

The expert also noted the following specific faults that had been identified during the inspection:

- There are cracks in the plaster at various locations, with a major crack evident in the isolated boundary wall and there are also areas where efflorescence has occurred;
- There is no plaster construction break where the cladding abuts the concrete block foundation wall;
- The base of the cladding is in contact with garden areas or paving in several areas;
- The edge of the plasterwork over the garage door lacks a drip edge and there is efflorescence occurring at this soffit;
- There is a separation gap where the rear main wall abuts the party garden wall;
- The tops of the balcony parapet walls are flat;
- Weatherboards to the rear elevation are embedded into the plaster;
- There is minimal clearance and an inappropriate reliance on sealants where the cladding abuts the flat roof over the front entry and this also applies to some of the cladding/deck intersections;

- The ends of the flat roof spouting are embedded in the plaster;
- There is inadequate sealing to handrails, fixings and service items that are fixed directly to, or pass through, the cladding.
- There are various problems associated with sill flashings, including unfinished and unusual details and the overuse of sealants; and
- One mitred window joint is poorly formed;

The expert also made reference to the remedial work that is taking place at the adjoining unit.

- 5.2 On the first visit, the expert used a non-invasive type moisture meter applied through the interior linings to detect areas of moisture ingress. These did not detect any moisture beneath the plasterboard surface in any area. On the second visit, the expert undertook further testing (involving inserting the probes through small holes drilled through the external cladding into the framing timber) at nine locations and obtained moisture readings of between 10.2% and 44%, with an average of 28% over all the locations. Moisture levels above 18% recorded after cladding is in place generally indicate that external moisture is entering the structure. The three highest readings were in the vicinity of the enclosed balcony. The expert concluded from the condition of the timber drillings that there was severely decayed timber behind the cladding in at least one of the tested locations.
- 5.3 Copies of the expert's report were provided to each of the parties. The territorial authority accepted the report without comment and the owner responded with comments by their consultant in a letter dated 28 June 2004. The comments can be summarised as:
- The drip edge was not necessary due to the depth of the soffit and the gap at the door junction;
  - The cracks are minimal and can be sealed and painted over;
  - The locations at the garage door and tiled deck and the base embedment do not show excessive moisture levels, and the garden can be lowered;
  - The colour shadowing is believed to be from an uneven coating of paint;
  - Based on investigations carried out to date, the dwelling does not require re-cladding;
  - The balconies are constructed outside the main body of the house and should be easily treated; and
  - Apart from some vulnerable locations, the cladding meets the provisions of the building code.

## 6 THE AUTHORITY'S VIEW

### General

- 6.1 The Authority has considered the submissions of the parties, the expert's report and the other evidence in this matter. The Authority's approach in determining whether building work complies with clause 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.

## Weathertightness risk

- 6.2 Recent New Zealand data and experience indicates that the impact of weathertightness problems in monolithic clad houses can be minimised if good and effective design and construction practices are followed.
- 6.3 The installation of exterior cladding to manufacturer's specifications and to accepted good trade practice is a fundamental requirement to ensure good weathertightness performance.
- 6.4 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:
- 6.5 The main areas for consideration 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.
- 6.6 Any likely 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%.
- 6.7 In relation to these characteristics, the Authority finds that the unit:
- Has no eaves projections at the main roof level and only generally minor projections at the flat roof areas, which means that there is virtually no effective shielding of the cladding in this respect;

- Is in a low wind zone;
- Is constructed to three levels;
- Has several wall/roof or deck intersections;
- Has an overall envelope that is relatively simple on plan;
- Has membrane clad roofs to certain lower levels;
- Has three major balconies of which one is constructed entirely over a living space and one is built over the balcony below;
- Has two small cantilevered balconies under two windows;
- Has excessive volumes of rainwater discharging onto one balcony;
- Has a large internal gutter to the main roof with only one rainwater head discharge;
- Has no drainage cavity where the cladding is face fixed; and
- Has external frames constructed from untreated timber.

### **Weather-tightness performance**

- 6.8 The Authority finds that the cladding in general does not appear to have been installed according to good trade practice or to the manufacturer's instructions. The Authority agrees that the list of faults listed in the Notice to Rectify and the expert's report are an accurate assessment of the condition of the cladding. As a result, there are numerous defects as set out in the expert's report and summarised in paragraph 5.1 and in the territorial authority's Notice to Rectify that have contributed to the penetration of water.
- 6.9 The Authority notes that the internal gutter between the units is a high-risk detail. The cross sectional area of the gutter should meet requirements set out in E2/AS1, and there should be provision for overflow if the downpipe or rainwater head is blocked.
- 6.10 Referring to the principal points of the territorial authority's main submission (refer section 3.3 previous), the Authority
- (i) accepts that the performance of many of the materials questioned in the territorial authority's submission has been established through successful use in practise, but
  - (ii) acknowledges that the building science surrounding such successful use is not so well known, or established, and
  - (iii) considers that, in the absence of peer reviewed scientific research evidence to the contrary, the approved use of these materials should be based on their established performance in building work to-date in New Zealand, plus additional margins of safety to reflect known uncertainties.

Consequently, the new Acceptable Solution on timber treatment (B2/AS1) and the draft Acceptable Solution on external moisture (E2/AS1) which covers weather-tightness detailing, both rely on established building science as well as observed field performance of the building systems concerned and building elements within these systems, in order to establish code compliant details for local use. Both these documents have been reviewed by appropriately qualified parties with experience across the building industry, and have been subject to the public consultation process as required by Section 49 of the Act.

The territorial authority's submission effectively questions the technical basis of a number of the benchmarks for assessing likely code compliant performance of timber-framed construction in New Zealand as contained within these documents and proposes that an



alternative (and more conservative) benchmark be used to assess likely Building Code compliance for monolithically-clad buildings within its jurisdiction.

- 6.11 The Authority has carefully reviewed the general aspects of the territorial authority's submission, alongside the benchmark provision it has already established to evaluate the anticipated overall performance of monolithically clad buildings in New Zealand. It has determined that the performance of building elements as now installed in this house should be based on the abovementioned code compliance benchmarks together with observations of the current state of the building, and not on the higher (albeit more conservative) performance levels suggested in the territorial authority's submission.
- 6.12 The distinction does need to be made between the reliance on comparison with benchmarks when assessing a consent application for as yet unbuilt work and the assessment of a completed work for code compliance purposes when the actual performance of the building can be established. Use of the risk matrix in this situation will also be of lesser significance.
- 6.13 In other words, the Authority believes, based on the evidence currently available to it, that if the territorial authority's submission on the likely performance of fibre cement-based systems constructed without a cavity was soundly based, it would expect to see a far greater prevalence of failure in external walls of buildings with face-fixed monolithic claddings that were not subject to external moisture ingress than in fact has been the case. Having said that, the Authority has noted the territorial authority's concerns and will ensure that theoretical investigations of the type referred to in the territorial authority's submission are incorporated into any future development of the Authority's wide work on durability and weather-tightness.

## 7 CONCLUSION

- 7.1 The Authority is satisfied that the performance of the cladding system has been reduced because it has not been installed according to good trade practice and manufacturer's instructions. In addition, the Authority has identified the presence of a range of known weathertightness risk factors and the absence of design features that can reduce the risk of damage from water ingress. The presence of the risk factors on their own is not necessarily a concern. The Authority is concerned, however, when these risk factors are present in a cladding system not installed to good trade practice, and in an overall structure that does not exhibit good weathertightness design features. For the reasons set out above, therefore, the Authority is not satisfied that the cladding system as installed complies with clause E2.3.2 of the building code.
- 7.2 In the circumstances, and taking account of the expert's indicative moisture content tests, the Authority declines to incorporate any waiver or modification of the building code in its determination.

## 8. WHAT IS TO BE DONE?

- 8.1 It is not for the Authority to decide how the building is to be brought to compliance with the building code (subject to any waivers or modifications granted by the territorial authority). 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.

- 8.2 Commonsense indicates that the high moisture levels should be addressed as soon as possible. The Authority suggests that the owner commission a more extensive investigation of the cladding that involves removal of sufficient panels to allow confirmation of moisture levels and the extent of the decay.
- 8.3 The Authority also suggests that the Council and the owner together examine options that could improve the performance of the cladding. Clearly the faults in the cladding will need to be addressed to maintain the weathertightness of the building. In addition, the balcony requires careful inspection to ensure its continuing stability and safety. The owner may decide to remove and reinstate some or all of the exterior cladding, and reapply for a code compliance certificate. If the owner does not wish to apply for a code compliance certificate, we would strongly recommend that the faults be remedied and that an agreed regular monitoring and maintenance program be put in place to extend the life of the building by identifying and remedying new leaks before they caused other damage. If the territorial authority issues a notice to rectify that requires the cladding to be made compliant, the owner is required to rectify any building work that has not been carried out in accordance with the building code.

## 9 THE AUTHORITY'S DECISION

- 9.1 In accordance with section 20 of the Building Act, the Authority hereby determines that the cladding system as installed does not comply with clause E2.3.2 of the building code and accordingly confirms the territorial authority's decision to refuse to issue the code compliance certificate.

Signed for and on behalf of the **Building Industry Authority** on this 16<sup>th</sup> day of August 2004.



**John Ryan**  
Chief Executive