Determination 2005/45

Refusal of a code compliance certificate for a building with a "monolithic" cladding system: House 39

1 THE DISPUTE TO BE DETERMINED

1.1 This is a determination of a dispute referred to the Chief Executive of the Department of Building and Housing ("the Chief Executive") under section 17 of the Building Act 1991 as amended by section 424 of the Building Act 2004 ("the Act"). The applicants are the owners of the property ("the owner") and the other party is the territorial authority ("the TA"). The application arises from the refusal by the TA to issue a code compliance certificate for a 9-year old house unless changes are made to its monolithic cladding system.

1.2 My task in this determination is to consider whether I am satisfied on reasonable grounds that the external monolithic wall cladding as installed ("the cladding"), to the majority of the walls of this house, complies with the building code (see sections 18 and 20 of the Act). By "external monolithic wall cladding as installed" I 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 This determination is made under the Building Act 1991 subject to section 424 of the Building Act 2004. That section came into force ("commenced") on 30 November 2004, and its relevant provisions are:

> ". . .on and after the commencement of this section,—
>
> "(a) a reference to the Authority in the Building Act 1991 must be read as a reference to the chief executive; and
>
> "(b) the Building Act 1991 must be read with all necessary modifications to enable the chief executive to perform the functions and duties, and exercise the powers, of the Authority . . . "

It should be noted that the new legislation does not amend the determination process set out under the 1991 Act, other than to transfer the power to make a determination from the Building Industry Authority ("the Authority") to the Chief Executive.

1.4 This determination refers to the former Authority:

(a) When quoting from documents received in the course of the determination, and

(b) When referring to determinations made by the Authority before section 424 came into force.

1.5 In making my decision, I have not considered any other aspects of the Act or the building code.

1.6 The house itself is described in paragraphs 2.1 to 2.3, and paragraph 8 sets out my decision.

2 PROCEDURE

The building

2.1 The building is a two-storey detached house situated on a level excavated site in a medium wind zone in terms of NZS 3604: 1999"Timber framed buildings". The house is of conventional light timber frame construction on a concrete block foundation wall. Approximately two-thirds of the external ground floor walls are plastered blockwork and the remaining external walls, including the gables between the varying roof levels, are sheathed with monolithic cladding. It is of a relatively simple shape but the roof has numerous intersections and junctions with the cladding underneath. The aluminium external joinery units are generally recessed within the cladding. There is one balcony deck set into the roofing at the upper level and this is constructed over a living space. The deck is sheathed with a waterproof membrane over plywood sarking and is drained by an internal gutter formed in the membrane. Hardwood slatted decking on timber framing is fixed over the membrane. The balcony has a timber-framed balustrade, with the cladding applied to both faces and the top finished with a timber capping. The drawings show a different balustrade construction and configuration than that shown on the plans. There is a portico secured to the house below the balcony, consisting of two blockwork columns supporting timber beams and rafters. The eaves and gables have 500 mm wide projections and the roof has been extended over the main entry.

2.2 The framing in the external walls is untreated Douglas Fir.

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 20 mm thick stucco sand and cement plaster reinforced with mesh. The plaster in turn is finished with an acrylic paint system.

Sequence of events

2.4 The TA issued a building consent on 17 January 1995.

2.5 The TA carried out various inspections during the course of construction, and approved the pre-lining building inspection on 29 June 1995. The TA carried out a final inspection in late 1995 and informed the owner that 8 items required attention. None of these items involved the cladding. The TA carried out a further final inspection on 5 April 2004, and the final comment on the "Final Check List" was:

> All items checked-all OK:
>
> NOTE Cladding monolithic (2 thirds) - [Named supplier] and 20 mm solid plaster face fixed

Neither the owner nor the TA offered any explanation for the delay between the 1995 and the 2004 final inspections.

2.6 The TA wrote to the owner on 23 April 2004, stating that it had inspected the house, regretted that it may not comply with the building code in a number of respects and described the TA's current concerns as regards weathertightness problems involving monolithic clad buildings. The TA attached a copy of a Notice to Rectify dated 23 April 2004 to this letter.

The "Particulars of Contravention" attached to the Notice to Rectify noted that in regard to the cladding:

1. The following items have not been installed per the manufactures [sic] specifications

   - Control joints, both horizontally and vertically are required with both solid plaster and masonry walls. No visible evidence was found to support that the vertical control joints have been installed in either system.
   - The claddings shall overhang below the bottom plate by a maximum of 50mm. This overhang is greater than this.
   - The bottom edge of the cladding system is to finish a minimum of 100mm above the paved surfaces and 175mm above unpaved surfaces. The cladding has been taken closer that these measurements and in some cases is below finished ground/paved level.
   - Drip edges are to be provided, so that surface water drips of [f] the cladding and is prevented from migrating into the surface. Drip edges have not been installed. .
   - The manufacturer makes recommendations in respect to window flashings and in most cases these flashings (head and sill) should be visible. As the windows have been sealed the installation or omission of these flashings could not be ascertained.
   - The bottom edge of the sheet must be capped to stop any water wicking. This has not been done.

2. The following items have not been installed per the acceptable solutions of the building code, (no alternative solutions have been applied for)

- Buildings shall have claddings that are waterproof, also aluminium joinery units have insufficient flashings to deflect water.

- The minimum finished floor level to finished ground level is 150mm to paved surfaces, and 225mm to unprotected ground. This clearance has not been achieved.

3. The following items have not been installed per accepted trade practice

   - All flashings are to be installed in such a way as to direct water away from the building, and prevent ingress of water. This has not been achieved.

   - Horizontal surfaces are to be formed with sufficient fall to prevent water from ponding on them. The deck barriers and several sills have flat horizontal surfaces.

   - A minimum clearance of 50mm is required between the cladding and adjacent surfaces. There is minimal clearance has not been achieved (*sic*).

   - Drip edges are required to prevent surface drips off the cladding, preventing capillary action, gravity or wind pressure. Drip edges have not been installed.

   - Sill (tray) flashings are to be taken 30mm past the edge of the window joinery. This has not been achieved.

   - Where a downpipe discharges onto a lower roof, at the point of discharge an approved spreader should be installed to ensure concentrated water is dispersed evenly over the membrane roof.

4. Ventilated cavity system

   - The Council has recently received information which shows that monolithic cladding systems without a drainage plane/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 TA also noted:

> The Council cannot be satisfied that the above building meets the performance requirements of Clauses B1 Structure, B2 Durability, E2 External Moisture, E3 Internal Moisture, G4 Ventilation and H1 Energy Efficiency Provisions of the Building Code…This is in breach of Sections 7(1), of the Building Act 1991…

Also 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

The TA also provided a set of photographs relating to the cladding.

2.7 The owner applied for a determination on 25 May 2004.

3 THE SUBMISSIONS

3.1 The owner made a submission that briefly set out the background leading up to this determination. The owner noted that the Notice to Rectify did not reflect the conversation that the owner had with the TA inspector who inspected the house on 16 April 2004. The owner, referring to the Notice to Rectify, concluded:

> The areas of contravention have been unreasonably embellished, quoting measurements, trade practice and acceptable solutions obtained from a 30 minute inspection and a series of photographs taken at time of inspection. At no time during the inspection or to the best of my knowledge subsequently have [the TA] made physical measurements…

The owner also provided copies of:

- The building plans;
- The consent documentation;
- The TA's inspection documents;
- Correspondence with the TA;
- A list of trades people employed on the project;
- The Notice to Rectify; and
- The manufacturer's specification for the backing sheets.

3.2 The TA 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, and stated that:

- The principle design and current construction methods are the primary failure in the stucco wall system comprising stucco, backing boards building paper, timber frame, fibreglass insulation and plasterboard in that it is defectively designed as in Auckland conditions it results in a RH (relative humidity) in the timber wall cavity sufficiently high for mould and rot to grow. Current construction methods do not provide for ventilation and a drainage plane.
- The secondary failure is that work in excess of normal maintenance is required to keep the stucco and wall elements of sufficiently low moisture content to prevent the effects of the primary failure from reoccurring even if all the water entry points were eliminated.
- The third failure of the stucco system is that it is an inflexible cladding and does not allow for the expected movement associated with timber frame construction, and thereby cracks form and sealants tear letting water in.

- Fourthly the building materials in the wall assembly are inadequate and there is no allowance for the consequence of failure of the system components or the system as a whole. Especially the timber frame the end result means the timber will degrade and be incapable of lasting 50 years as required by the Building regulations.

- The [TA] points out that there are already numerous defects in the cladding envelop and even if all these were repaired this will not alter the four principle failures identified above and the building will remain in contravention of the Building Act.

3.3 The submission also included a copy of the Notice to Rectify and a set of photographs, illustrating some of the TA's concerns.

3.4 The TA 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 TA in a letter to the Authority dated 1 July 2004, elaborated on its original submission and stated that its areas of concern were those itemised in the Notice to Rectify and then listed them in detail. The TA, using the risk matrix contained in the revised Acceptable Solution E2/AS1, calculated the weathertightness risk to the house to be moderate. The TA noted that the cladding had been in place for a period of 9 to 10 years and questioned whether the cladding could continue to comply with the durability requirements of the building code for a further 15 years after the issue of the code compliance certificate.

3.6 The copies of the submissions and other evidence were provided to each of the parties. Neither the owner nor the TA made any further submissions 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 TA's decision to refuse to issue 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. The relevant provisions of the building code provide:

Clause B2—DURABILITY

B2.3.1 Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:

(a) The life of the building, being not less than 50 years, if:

(i) Those building elements (including floors, walls, and fixings) provide structural stability to the building, or

(ii) Those building elements are difficult to access or replace, or

(iii) Failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building.

(b) 15 years if:

(i) Those building elements (including the building envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or

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

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 cladding is not accredited under section 59 of the Act. I am 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 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 ("the expert") to inspect and report on the cladding. The expert inspected the building and furnished a report, which noted that a cursory inspection suggests that the cladding is satisfactory, there is limited evidence of cracking, the paint finish is in good condition and there are no visible signs of dampness. However, the moisture content readings, (which are referred to below) indicates moisture levels that are above acceptable levels with the threat of decay to the framing. In addition there is evidence of some severe cracks that have been sealed and painted over. The expert's report made the following specific comments on the cladding:

- Based on exploratory drilling, the expert was of the opinion that there are no metallic jamb and sill flashings in place to the exterior joinery units and while there are head flashings, these are buried in the plaster and there is no provision for drainage above them. The expert questioned the long-term performance of the units' installation due to the high water levels recorded adjacent to some of them;

- No provision has been made for control jointing where the cladding adjoins the masonry on both the horizontal and vertical planes and the plaster has been formed continuously across these junctions. There are also other locations where vertical control joints are required;

- The end of the barge board to the southern elevation of the main house is poorly connected to the cladding;

- There are no deflector flashings at the end of the apron flashings to the east and west sides of the living area;

- The pergola ribbon plate has been fixed directly to the cladding by nailing and the applied sealing is inadequate;

- The plaster has been extended directly into the ground without any provision for drainage to almost all of the timber framed lower level walls;

- The connection of the balcony balustrade to the main house wall is unsatisfactory as there are no flashings installed and the joint is entirely reliant on sealants;

- The junction between the timber capping to the balcony balustrade and the cladding is difficult to waterproof properly and the capping has mitres and is penetrated by handrails;

- There are no flashings between the timber facings to the east elevation bay window and the claddings; and

- There is no overflow provided to the balcony deck and as the downpipe outlet is concealed below the slatted decking, blockages may not become apparent.

5.2 The expert carried out a series of destructive tests, involving drilling holes in the external plaster to allow probes of an intrusive meter to measure the moisture content at the outside of the wall framing. A total of 16 readings were taken, 9 were above 18% and 3 of the latter read 32.7% at the rear of the garage, 38.4% at window lintel below the wall/roof abutment on the western elevation, and 35% at the wall/roof abutment on the eastern elevation. The expert considered that it was possible that advanced decay had occurred behind one test hole because of the lack of resistance to the drill. Apart from these three readings, all readings were corrected for Douglas Fir. Moisture levels above 18% recorded after cladding is in place generally indicate that external moisture is entering the structure. Even where readings of less than 18 % were recorded, the expert had serious concerns about the state of the timber framing at these areas.

5.3 Copies of the expert's report were provided to each of the parties.

6 DISCUSSION

General

6.1 I have considered the submissions of the parties, the expert's report and the other evidence in this matter. The 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 an important but not the only requirement to ensure good weathertightness performance.

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

6.5 Important matters 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 incidence;

- While most reported leaks are substantially caused by defects in the cladding that require little or no wind pressure differential, I believe 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 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 countered by a combination of effective drainage, ventilation of the drainage cavity and moisture tolerance in the external wall framing timber. In particular:

- The structure should allow water that has penetrated the cladding to drain out as quickly as possible. I believe 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, I believe 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, I find that this house:

- Has 500 mm wide eaves and gable projections that provide reasonable protection to the cladding;
- Is in a medium wind zone;
- Is two stories high;
- Has flashings to the heads of the exterior joinery units, but these are incorrectly installed. There do not appear to be any jamb or sill flashings installed;
- Has an overall envelope that is simple on plan, but with a roof that has numerous intersections and junctions with the cladding;
- Has a balcony deck, which is constructed over a living space;
- Has a pergola fastened directly to the cladding; and
- Has external walls constructed with untreated Douglas Fir, which is relatively ineffective in delaying the onset of decay.

Weathertightness performance

6.8 I find that the cladding in general does not appear to have been installed according to good trade practice and to the manufacturer's instructions. As a result, there are a number of identified defects, which are set out in paragraph 5.1 and in the expert's report, which have contributed to the penetration of the moisture already evident in several areas.

6.9 I consider that, as the faults apparent in the cladding are so manifest, I cannot accept that the cladding complies with the relevant requirements of the building code. The major areas of concern are:

- The exterior joinery units lack the appropriate jamb and sill flashings, the head flashings are buried in the plaster and there are no flashings between the bay window facings and the cladding;
- Vertical control joints are missing in some instances;
- The junctions between the cladding and the blockwork are inadequately formed;
- The end of one barge board is poorly connected to the cladding and two apron flashings lack deflector flashings;
- The pergola is fixed directly to the cladding;
- The plaster extends directly into the ground; and
- The balcony is inappropriately connected to the main cladding, the capping has potential weatherproofing problems, and there is no overflow to the balcony deck.

6.10 I find that the design and construction of this building lacks provisions that can compensate for the lack of a drained and ventilated cavity.

6.11 I note that 1 elevation of the building demonstrates a moderate weathertightness risk rating and the other 3 elevations a low risk rating when calculated by the E2/AS1 risk matrix. The matrix is an assessment tool that is intended to be used at the time of application for consent, but must be supplemented at the time of issuing a code compliance certificate by careful inspection of the building as actually built.

6.12 I have carefully considered the principal points in the TA's main submission (and outlined in paragraph 3.2).

6.13 I note the TA's view that daily heating and cooling cycles will generate high relative humidity (RH) levels within face fixed fibre cement cladding and that those high RH levels will cause timber decay to start even when the wall is completely sealed against external moisture.

6.14 I note that despite some notable weathertightness failures, there are a large number of face-fixed fibre cement clad buildings that are meeting the performance requirements of the code. In other words, they are remaining dry and are not subject to decay. I believe that if the TA's premise was true, it could expect to see a more general and widespread failure of face-fixed fibre cement claddings, particularly in high humidity climates. I have seen no evidence of this happening in practice. I believe that, in the majority of cases, decay in external timber frames can be attributed to moisture ingress, which in turn is due to discrete failures in the external cladding. I believe that these failures can usually be attributed to poor design and installation of the

cladding and that the risk of cladding failure increases with increasing design and overall shape complexity – in other words, the weathertightness risk factors.

6.15 I therefore do not agree with the TA's claim that the lack of a drained and ventilated cavity in this case will result in high relative humidity levels and cause decay in the absence of any external moisture ingress.

6.16 I agree that effective maintenance of monolithic claddings, and especially stucco and fibre cement claddings, is important to ensure ongoing compliance with clause B2 of the building code. That maintenance is the responsibility of the building owner. The code assumes that the normal maintenance necessary to ensure the durability of the cladding is carried out. For that reason clause B2.3.1 of the building code requires that the cladding be subject to "normal maintenance". That term is not defined and I take the view that it must be given its ordinary and natural meaning in context. In other words, normal maintenance of the cladding means inspections and activities such as regular cleaning, re-painting, replacing sealants, and so on. I consider that it is possible to maintain stucco cladding to the required standard and therefore finds that the TA cannot conclude that this cladding is not code compliant solely because it will require maintenance in the future.

6.17 I note that the performance of stucco cladding questioned in the TA's submission has been established through successful use in practice over many years. However I acknowledge that the building science surrounding such successful use is not so well known, or established. It therefore considers that the use of stucco cladding should be based on its established performance in building work to-date in New Zealand, with additional margins of safety to reflect known uncertainties. The acceptable solution on external moisture, E2/AS1, reflects this approach and outlines acceptable details for stucco cladding. This document has been reviewed by appropriately qualified parties with experience across the building industry, and has been subject to the public consultation process as required by Section 49 of the Act. I therefore find that the use of stucco cladding is, in itself, not a reason for withholding a code compliance certificate.

7 CONCLUSION

7.1 I am satisfied that the performance of the cladding has been reduced because it has not been installed according to good trade practice. In particular, it demonstrates the key defects listed in paragraph 6.9. I have also identified the presence of a range of known weathertightness risk factors in this design. The presence of the risk factors on their own is not necessarily a concern, but they have to be considered in combination with the significant faults identified in the cladding system. It is that combination of risk factors and faults that indicate that the structure does not have sufficient provisions that would compensate for the lack of a drained and ventilated cavity. Consequently, I am not satisfied that the cladding system as installed complies with clause E2.3.2 of the building code.

7.2 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. Because the cladding faults in the house are allowing the ingress of moisture in the future, the house does not comply with the durability requirements of clause B2.3.1.of the building code.

7.3 I find that because of the apparent complexity of the faults that have been identified with this cladding, I am unable to conclude, with the information available, that remediation of the identified faults, as opposed to partial or full recladding, could result in compliance with clauses B2.3.1 and E2.3.1.

7.4 In the circumstances, I decline to incorporate any waiver or modification of the building code in its determination.

8 THE DECISION

8.1 In accordance with section 20 of the Building Act 1991 I hereby determine that the cladding system as installed does not comply with clauses B2 and E2 of the building code and accordingly confirms the decision of the TA decision to refuse to issue a code compliance certificate.

8.2 I note the TA has issued a Notice to Rectify requiring the owner to reclad the house with cladding that incorporates a drained and ventilated cavity. Under the Act, a Notice to Rectify can require that the owner bring the cladding into compliance with the code, but I have already found in a previous determination (2000/1) that the Notice to Rectify cannot specify how that compliance is to be achieved. I consider that this Notice to Rectify should therefore be put aside. A new Notice should be issued that requires the Owner to bring the cladding into compliance with the code without specifying the features that are required to be incorporated.

8.3 How the cladding is to be brought to compliance with the building code is a matter for the owner to propose and for the TA to accept or reject, with either of the parties entitled to submit doubts or disputes for another determination.

8.4 I consider that the cladding on the building will require on-going maintenance to ensure its continuing code compliance, and that this maintenance programme should be undertaken after consultation with the TA. This is particularly important, as the cladding has now been in place for some 9 years or so.

Signed for and on behalf of the Chief Executive of the Department of Building and Housing on 15 April 2005.

John Gardiner
Determinations Manager