Determination 2006/94

Refusal of a code compliance certificate for two earth brick buildings at 187 Whau Valley Road, Whangarei

1. The dispute to be determined

1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004[1] ("the Act") made under due authorisation by me, John Gardiner, Determinations Manager, Department of Building and Housing, for and on behalf of the Chief Executive of that Department. The applicant is the Whangarei District Council ("the territorial authority") and the other party is the owner/builder, Mr Ropata ("the owner").

1.2 The dispute for determination is whether the territorial authority's decision to decline to issue a code compliance certificate for the 2-year-old buildings because it was not satisfied that the earth brick walls of the buildings complied with clauses B2

[1] The Building Act 2004 is available from the Department's website at www.dbh.govt.nz.

"Durability", E2 "External Moisture" and E3 "Internal Moisture" of the Building Code[2] (First Schedule, Building Regulations 1992) is correct.

1.3 The questions to be determined are:

1.3.1 Issue 1: The cladding

1.3.1.1 Whether I am satisfied on reasonable grounds that the plastered earth brick cladding system as installed to the walls of the buildings ("the cladding"), complies with the Building Code (see sections 177 and 188 of the Act). By "the plastered earth brick cladding system as installed" I mean the components of the system (such as the earth bricks, the plaster coatings, the flashings and the sealants) as well as the way the components have been installed and work together.

1.3.2 Issue 2: The durability considerations

1.3.2.1 Whether the cladding is able to comply with clause B2 of the Building Code, considering the particular risks and special durability considerations that apply to the type of construction used in these buildings.

1.3.3 Issue 3: The internal moisture considerations

1.3.3.1 Whether the buildings comply with clause E3 of the Building Code.

1.4 In making my decision, I have considered the submissions of the parties, the reports of the independent expert ("the expert") and an independent specialist experienced in earth building construction ("the specialist"), both commissioned by the Department to advise on this dispute, and the other evidence in this matter. I have evaluated this information using a framework that I describe more fully in paragraph 7.1. I have not considered any other aspects of the Act or the Building Code.

2. The buildings

2.1 The building work consists of two detached buildings situated on a flat semi-rural site, which is in a low wind zone for the purposes of NZS 3604[3]. The larger building ("Unit 1") is two storeys high and accommodates bedrooms and living areas, while the smaller building ("Unit 2") is one storey high and contains a kitchen and living area. Both buildings are very simple in form, with timber-framed floors, 25° profiled metal gable roofs and second-hand timber windows. The buildings are specifically engineered, with concrete block foundation walls, 300mm thick reinforced load-bearing earth brick walls, perimeter reinforced concrete bond beams and timber board and batten wall cladding to gable ends. Eave and verge projections are 900mm above all walls, with exposed rafters and round ridgepoles projecting at gable ends.

2.2 The timber windows and doors are recessed within the wall thickness, with re-used hardwood sleepers used as lintels above most openings. Several openings in the earth

[2] The Building Code is available from the Department's website at www.dbh.govt.nz.
[3] New Zealand Standard NZS 3604:1999 Timber Framed Buildings

brick walls have recessed infill panels (formed from plastered polystyrene) into which a variety of decorative glass bottles have been set.

2.3 A timber-framed slatted floor deck, supported on timber posts, extends from an upper bedroom on the east elevation of Unit 2. Further timber decks are constructed at ground floor level, with a deck walkway linking the two buildings. The owner has advised that, in the future, a covered walkway will link the buildings.

2.4 The exterior walls of the buildings are constructed from 300mm x 300mm x 120mm "adobe" bricks, which were hand-made on-site. The bricks are composed of clay, cement, lime, sand and PVA bonding, and were cured for one month prior to laying. The walls are finished externally with a plaster slurry (applied in 2 to 3 coats), and internally with rough cast plaster with a lime-based whitewash finish. Exterior and interior surfaces are otherwise unpainted as they are intended to be vapour permeable.

3. Sequence of events

3.1 The territorial authority issued a building consent on 10 September 2001, based on a building certificate, dated 7 September 2001, issued by Building Certifiers (Whangarei) Ltd ("the building certifier"). Construction appears to have commenced in October 2001.

3.2 The building certifier carried out various inspections during construction, with the last inspection recorded on 29 November 2002. It appears that the building certifier subsequently ceased operating as I have received no records of any further inspections until 2004, when the owner authorised the territorial authority to complete inspections and issue a code compliance certificate.

3.3 The territorial authority carried out a "preline" inspection (of the internal partitions) on 8 December 2004. It appears that no further inspections were carried out until the territorial authority undertook a final inspection on 8 May 2006, which identified a number of outstanding items.

3.4 The territorial authority issued a notice to fix dated 19 May 2006, which made no reference to the outstanding items identified in the final inspection but instead suggested that the owner may wish to seek a determination from the Department as:

> In Whangarei District Council's opinion, this building will not comply with NZBC E2, E3 and B2 and will not reach Code Compliance Certificate.

3.5 The territorial authority completed an application for a determination, which was received by the Department on 1 June 2006.

4. The submissions

4.1 The territorial authority noted that the matters for determination were in relation to:

> Non-compliance with E2, E3 and B2 of NZ Building Code.

4.2 The territorial authority forwarded copies of:

- the plans and specifications
- the consent documentation
- the inspection records
- the notice to fix
- various producer statements, engineering calculations and other statements.

4.3 The owner made a submission in the form of a letter dated 2 June 2006 which outlined the history of the building work and commented in detail on the outstanding items identified in the final inspection, noting that all items had now been satisfactorily completed. The owner also explained that he was willing to undertake any further items that might be required as he risked being unable to refinance his existing mortgage without a code compliance certificate, noting:

> I have been advised by the Head Building Inspector and the Manager of the WDC that they will not be carrying out any further inspections of my dwellings and that they cannot and will not tell me what I need to do to get a Code of Compliance.

4.4 Copies of the submissions and other evidence were provided to each of the parties. Neither party made any further submissions in response to the submission of the other party.

5. The expert's report

5.1 The expert inspected the buildings on 24 July 2006, and furnished a report that was completed on 27 July 2006. The expert noted that the workmanship and finish to the walls were of a very basic level and appeared to lack "quality and attention to detail". The expert noted that a number of plastered polystyrene panels had been installed into the walls, into which glass bottles had been inserted. The expert also noted that the exposed rafters were sealed against the claddings.

5.2 The expert noted that the timber windows were installed within timber frames that were set into the brick walls, with silicone sealant used at the junctions. An additional head flashing had been installed above the main door to the lower south elevation (apparently following the final inspection).

5.3 The expert took a number of non-invasive moisture readings of the brick walls, and noted that the readings were elevated and of an inconsistent pattern. However, there was no evidence of moisture entry into the walls and the expert was unclear as to the level of moisture readings that might be expected from this type of construction. The expert advised that further investigation should be undertaken by a specialist who is experienced in earth brick construction.

5.4 The expert made the following specific comments on the walls:

- There is a poorly fixed batten on the south gable end.
- One of the inset glass bottles is broken.

5.5 The expert made the following additional comments:

- The board and batten cladding to the gable ends relies on an overlap for weatherproofing the junction with the brick walls.
- The plaster slurry under the upper deck had been chipped back to the concrete bond beam.
- The plaster appears to be inconsistent in depth and quality, although there are no apparent cracks.
- Landscaping is incomplete and the ground levels around the buildings are unfinished, with some levels just below the ventilation grilles to the subfloor spaces.

5.6 Copies of the expert's report were provided to each of the parties on 1 August 2006. The owner responded in a letter to the Department dated 29 August 2006, stressing the urgent need to expedite the determination and commenting on a number of items including the following:

- The moisture readings were taken in mid-winter following considerable rain.
- The appearance of the wall surfaces is a matter of personal taste and does not affect the weathertightness of the walls.
- The type of moisture meter used might be suitable for timber framing but is unlikely to give reliable readings for adobe brick walls.
- There is no intention of blocking any subfloor vents with future paving or landscaping.
- The new door head flashing was installed after the final inspection. A covered walkway is intended to be built between the two buildings in future.
- The junction between the board and batten and the bricks is adequately weatherproofed and well sheltered by the 900mm eaves.
- The batten was left unfixed to allow inspection of the weathergrooves, and has since been fixed.
- The broken bottle can easily be replaced.
- The removal of the plaster under the upper deck is only an aesthetic matter and should not affect the walls.

I have considered the owner's comments in the preparation of this determination.

6. The specialist's report

6.1 The specialist reviewed the submissions, the expert's report and other evidence, inspected the buildings on 16 August 2006, and furnished a report that was completed on 23 August 2006. The specialist noted that the applicable standards for earth buildings are NZS 4297:1998, NZS 4298:1998 and NZS 4299:1998. The specialist assessed the site as equivalent to "urban and sheltered", as some localised protection is provided by buildings and trees. The specialist's general impression was that although the standard of finish could "charitably be described as rustic, and the buildings are partially unfinished", the walls and coatings appear to be performing adequately with no indication of water ingress or internal moisture problems. The following summarises the main issues discussed in the specialist's report.

6.2 The brick walls

6.2.1 One section of wall had not been plastered, which allowed inspection of the underlying brick wall. Inspection showed well-laid bricks in cement/sand mortar, with no apparent problems in the bricks or construction methods.

6.2.2 The bricks have an unusually high cement content and, while no test data was available, the reported compression strength of 18 MPa is very high for earth bricks.

6.2.3 The external plaster slurry appears to be well-adhered and provides a tough but vapour permeable coating, which should be weather resistant. The internal white-wash is a highly permeable traditional surface.

6.2.4 A pile of left-over bricks allowed assessment of the brick durability. These bricks were on wet ground and exposed to the weather, so providing a harsher in-situ test than required by the standards. The exposed bricks have remained in good condition, so the brick walls are considered adequate to provide the expected durability of 50 years minimum.

6.2.5 There are no control joints provided in the brick walls (usually provided at the sides of windows or at 3.6m maximum centres). However, there are no signs of significant cracking or movement and no problems were detected. Some windows have infills below, which effectively provides control joints in these walls.

6.2.6 While the tops of the concrete block foundation walls have not been coated, both sides of the walls have been coated with asphalt damp-proofing and there are no signs of rising damp in the earth brick walls.

6.2.7 The specialist noted he could not explain the high moisture readings taken by the expert, as there were no indications of any moisture problems. He noted that the meter used may be inappropriate for this type of construction and (in the absence of other indications of moisture problems) considered that the moisture testing was not relevant.

6.3 The windows

6.3.1 The upper windows of Unit 1 and the windows of Unit 2 are all well sheltered by the 900mm eaves. However, the windows of the lower level of Unit 1 are more exposed (although these windows are also easily accessible for inspection and maintenance).

6.3.2 The re-used sleepers that form lintels are of durable hardwood timbers, with malthoid DPC separating the timber from the brick. No durability problems are anticipated, and the rough grain of the timber provides natural drip edges.

6.3.3 It appears that DPC was wrapped around the timber window frames, with compressible foam used at the junction with the bricks, which was then silicone-sealed and mortared over.

6.3.4 The junctions of the decorative polystyrene infill panels with the bricks have been plastered (with no flashings), but there is no sign of cracks or moisture penetration.

6.3.5 Although there are no sill flashings under the recessed windows, the high cement content in the bricks should provide adequate weatherproofing to the sills.

6.3.6 There is no sign of moisture penetration around the doors and windows. Should there be any future moisture penetration, this would be very obvious (allowing prompt remedial action) and would not adversely affect the brick walls. The specialist noted that, in the unlikely event of failure, the windows would be easily replaced.

6.3.7 The specialist noted that the sill to the door to the upper deck is embedded in mortar. This should be removed and an outward sloping sill provided to the top of the earth brick. The owner has since advised that this has now been completed.

6.4 Internal moisture

6.4.1 The specialist noted that the inner faces of the exterior brick walls appeared to be at similar cool temperatures to the faces of the interior brick walls and there were no discernable temperature differences between walls on sunny and shaded sides of the buildings.

6.4.2 There was no evidence of condensation or mould (even in the bathrooms), and the presence of spiders indicated a dry interior environment.

6.4.3 The specialist noted that there was no impervious splashback to the washbasin in the lower floor bathroom, and that seals to splashbacks elsewhere appeared poorly constructed and should be checked.

6.5 The specialist's conclusions

6.5.1 The specialist recommended that:

- the mortar at the sill to the door to the upper deck be removed, with an outward sloping sill provided to the top of the earth brick

- a splashback be provided to the washbasin in the lower floor bathroom, and the seals to splashbacks elsewhere be checked and repaired as necessary.

6.5.2 The specialist concluded his inspection suggested that:

- there is unlikely to be any problem with the earth walls meeting the requirements of clause B2 given normal maintenance
- there is unlikely to be any problem with the earth walls meeting the requirements of clause E2 given normal maintenance (including an annual inspection)
- there is unlikely to be any problem with the earth walls meeting the requirements of clause E3, given normal maintenance
- overall (with annual inspections as part of regular maintenance) the earth walls of the buildings will continue to perform adequately with respect to clauses B2, E2 and E3.

7. Evaluation for code compliance

7.1 Evaluation framework

7.1.1 In evaluating the design of a building and its construction, it is useful to make some comparisons with the relevant Acceptable Solution[4], in this case E2/AS1, which will assist in determining whether the features of this house are code compliant. However, in making this comparison, the following general observations are valid:

- Some Acceptable Solutions cover the worst case, so that they may be modified in less extreme cases and the resulting alternative solution will still comply with the Building Code.
- Usually, 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.

7.1.2 The approach in determining whether building work is weathertight and durable and is likely to remain so, is to apply the principles of weathertightness. This involves the examination of 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 Department and its antecedent, the Building Industry Authority, have also described weathertightness risk factors in previous determinations[5] (refer to Determination 2004/1 *et al*) relating to cladding and these factors are also used in the evaluation process.

[4] An Acceptable Solution is a prescriptive design solution approved by the Department that provides one way, but not the only way, of complying with the Building Code. The Acceptable Solutions are available from the Department's website at www.dbh.govt.nz.
[5] Copies of all determinations issued by the Department can be obtained from the Department's website.

7.1.3 The consequences of a building demonstrating a high weathertightness risk is that building solutions that comply with the Building Code will need to be more robust. Conversely, where there is a low weathertightness risk, the solutions may be less robust. In any event, there is a need for both the design of the cladding system and its installation to be carefully carried out.

7.2 Weathertightness risk

7.2.1 In relation to these characteristics I find that these buildings:

- are built in a low wind zone
- are a maximum of one and two storeys high
- are very simple in plan and form
- have eaves projections of more than 900mm above all walls, which provide good protection to most walls and windows beneath them
- have plastered earth brick exterior walls
- have no timber wall structure that would be adversely affected by moisture.

7.2.2 When evaluated using the E2/AS1 risk matrix, the elevations of these buildings demonstrate a low weathertightness risk. The matrix is an assessment tool that is intended to be used at the time of application for consent, before the building work has begun and, consequently, before any assessment of the quality of the building work can be made. Poorly executed building work introduces a risk that cannot be taken into account in the consent stage but must be taken into account when the building as actually built is assessed for the purposes of issuing a code compliance certificate.

7.3 Weathertightness performance

7.3.1 Generally the exterior walls appear to have been installed with reasonable workmanship and in accordance with reasonable trade practice. However, some junctions are not well constructed, and these areas are as described in paragraph 5.4 and paragraph 6.5.1, as being the:

- lack of fixing to a batten on the south gable end
- broken bottle in one of the decorative insert panels
- sill of the door to the upper deck
- lack of a splashback to the washbasin in the lower bathroom and the seals to splashbacks elsewhere.

7.3.2 I note the expert's comments in paragraph 5.5, and the owner's comments in paragraph 5.6 and (taking into account the conclusions of the specialist) accept that these items are adequate in the circumstances.

7.3.3 I also note the consultant's comments in paragraph 6.5.2, and accept that ongoing inspection and maintenance is critical to preserve the weathertightness of these buildings. I therefore consider that appropriate inspection and maintenance regimes should be established for these buildings; with specified maintenance requirements, which include annual checking of plaster and seals.

8. Conclusion

8.1 I am satisfied that the current performance of the cladding is adequate because it is preventing water penetration into the buildings at present. Consequently, I am satisfied that the cladding system as installed on the buildings complies with clause E2 of the Building Code.

8.2 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 minor cladding faults identified in the building are likely to allow the ingress of moisture in the future, the buildings do not yet comply with the durability requirements of clause B2.

8.3 Subject to further investigations that may identify other faults, I consider that, because the faults that have been identified with the cladding system occur in discrete locations, I am able to conclude that satisfactory rectification of the items outlined in paragraph 7.3.1, together with the maintenance described in paragraph 7.3.2, should be expected to result in the buildings remaining weathertight and in compliance with clauses B2 and E2.

8.4 Effective maintenance of claddings (in particular of this type of earth construction) is important to ensure ongoing compliance with clauses B2 and E2 of the Building Code and is the responsibility of the building owner. Clause B2.3.1 of the Building Code requires that the cladding be subject to" normal maintenance", however that term is not defined in the Act.

8.5 I take the view that normal maintenance is that work generally recognised as necessary to achieve the expected durability for a given building element. With respect to the cladding, the extent and nature of the maintenance will depend on the material, or system, its geographical location and level of exposure. Following regular inspection, normal maintenance tasks should include but not be limited to:

- where applicable, following manufacturers' maintenance recommendations
- washing down surfaces, particularly those subject to wind-driven salt spray
- re-coating protective finishes

- replacing sealant, seals and gaskets in joints.

8.6 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.

Issue 1: The cladding

9. The decision

9.1 I am satisfied that the current performance of the cladding is adequate because it is preventing water penetration into the buildings at present. Consequently, I am satisfied that the cladding system as installed on the buildings complies with clause E2 of the Building Code.

9.2 In addition, the buildings are 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 on the buildings are likely to allow the ingress of moisture in the future, the buildings do not comply with the durability requirements of clause B2.

9.3 Because the faults that have been identified with the cladding system occur in discrete areas, I also find that rectification of the items outlined in paragraph 7.3.1 will consequently result in the buildings remaining weathertight and in compliance with clause B2. Work to correct these items may expose additional associated defects that are not yet apparent. All rectification work is to be completed to the approval of the territorial authority.

9.4 A new notice to fix should be now issued (based on the items in paragraph 7.3.1) that requires the owner to bring the cladding into compliance with the Building Code, without specifying the features that are required to be incorporated. It is not for me to decide directly how the defects are to be remedied and the cladding 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. It is important to note that the Building Code allows for more than one method of achieving compliance.

9.5 I would suggest that the parties adopt the following process to meet the requirements of paragraph 9.4. Initially, the territorial authority should issue a notice to fix, listing all the items that the territorial authority considers to be non-compliant. The owner should then produce a response to this in the form of a detailed proposal, 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.

9.6 Finally, I consider that the cladding will require on-going inspection and maintenance to ensure its continuing code compliance.

Issue 2: The durability considerations

10. The decision

10.1 I determine that the territorial authority is to amend the consent for the buildings to incorporate conditions on the required maintenance regime, including:

- visual checks for cracks annually and after strong wind or earthquakes
- regular monitoring for signs of moisture penetration.

10.2 Following this amendment, any code compliance certificate subsequently issued by the territorial authority should be issued in line with the amended building consent.

Issue 3: The internal moisture considerations

11. The decision

11.1 I am satisfied that there is no evidence of undue internal moisture within the buildings at present. I am also satisfied that rectification of the items included in paragraph 7.3.1 will consequently result in the buildings remaining in compliance with clause E3.

Signed for and on behalf of the Chief Executive of the Department of Building and Housing on 20 September 2006.

John Gardiner
Determinations Manager