



Determination 2017/021

Regarding the decision to issue a code compliance certificate for a then 9-year-old house with earth brick walls at 380 Rangiora-Leithfield Road, Rangiora



Summary

This determination is concerned with the durability of pressed earth brick external walls in a 19-year-old building and considers whether the authority was correct to issue the code compliance certificate.

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1. The matter to be determined

- 1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004¹ (“the current Act”) made under due authorisation by me, John Gardiner, Manager Determinations and Assurance, Ministry of Business, Innovation and Employment (“the Ministry”), for and on behalf of the Chief Executive of the Ministry.
- 1.2 The parties to the determination are:
- the current owner of the house, N Purdom (“the applicant”) acting via a builder (“the builder”)
 - Waimakariri District Council (“the authority”), carrying out its duties as a territorial authority or building consent authority.
- 1.3 The authority issued a code compliance certificate for Stage Two of the then 9-year-old house in 2008. This determination arises because the applicant is of the view that the building work did not comply with relevant clauses² of the Building Code (Schedule 1, Building Regulations 1992) when the authority issued the code compliance certificate. The applicant’s primary concerns regarding compliance of the building work relate to the durability of the pressed earth brick walls of the house.
- 1.4 The matter to be determined³ is therefore the authority’s exercise of its powers of decision in issuing a code compliance certificate for Stage Two of the house. In deciding this matter, I must consider:
- whether the external walls of the building complied with Clauses B1 Structure, B2 Durability and Clause E2 External Moisture of the Building Code at the time the code compliance certificate was issued. The external walls include the components of the system (such as the pressed earth bricks, mortar, plaster, the windows, the flashings and the coating) as well as the way the components have been installed and work together.
 - whether the pressed earth brick walls comply with Clause B2 of the Building Code, insofar as it relates to Clauses E2 and B1, considering the particular risks and special durability considerations that apply to the type of construction used in this house.
- 1.5 Matters outside this determination**
- 1.5.1 The house was constructed in two stages, with a separate building consent⁴ for the foundations and floor slab (“Stage One”): the determination does not consider the Stage One work.
- 1.5.2 This determination is limited to the completion of the house under building consent no. 96/0989 issued on 3 September 1996 (“Stage Two”).
- 1.5.3 Except for incidental items observed by the expert, this determination is limited to the external walls of the house and the matters outlined in paragraph 1.4 and does not consider other building elements or compliance of the house with other clauses of the Building Code.

¹ The Building Act, Building Code, compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.building.govt.nz or by contacting the Ministry on 0800 242 243.

² In this determination, unless otherwise stated, references to sections are to sections of the Building Act and references to clauses are to clauses of the Building Code.

³ Under sections 177(1)(b) and 177(2)(d) of the Building Act

⁴ Building consent no. 93/1140 issued on 10 February 1994

1.6 The evidence

1.6.1 Evidence considered in this determination includes a number of reports provided to the former owners, the applicant, and the builder by a variety of advisors. In making my decision, I have considered:

- the submissions of the parties
- reports and statements for the former owners by:
 - the design engineer for the house (“the design engineer”)
 - a builder experienced in earth construction (“the earth builder”) in 2006
 - a consulting structural engineer (“the consulting engineer”) in 2007
- the reports of property consultants engaged by the authority to assess the external walls in 2007 (“the authority’s contractor”)
- the report of the engineer engaged by the applicant to assess the external walls in 2015 (“the second consulting engineer”)
- the report of the independent expert experienced in earth building construction (“the expert”), commissioned by the Ministry to advise on this dispute
- the other evidence in this matter.

1.6.2 Within the above evidence various terms are used for the manufactured earth units used in the subject walls. In this determination I have used the term “pressed earth bricks” except when I use direct quotations or outline arguments about possible distinctions.

2. The building work

2.1 General

2.1.1 The building work consists of a split-level single-storey detached house situated on a gently sloping rural site. The expert has noted that the house is open to the south and west, and more sheltered on the north and east. The site is therefore assessed as being in a wind zone ranging from medium to very high for the purposes of NZS 4299⁵. The house is reasonably simple in plan and form, with pressed earth brick walls, profiled metal roofs and timber windows.

2.1.2 The house is specifically engineered, with concrete block and reinforced concrete foundation walls and reinforced concrete slabs to most of the house, with a timber framed floor to the upper level living and kitchen area. The reinforced pressed earth brick walls are tied together at the top with reinforced concrete bond beams. The pressed earth bricks provide structural stability to the building and are exposed on the outside and inside. Timber windows and doors are recessed within the wall thickness, with exposed timber lintels and sloping plastered sills.

2.1.3 The profiled metal hipped roofs include gables at three different levels, with timber framed intersections. Although consent drawings show a 2.5m deep veranda extending most of the west elevation and eave projections of 600mm above most other walls, the veranda has been omitted and overhangs reduced to below 400mm. A chimney structure projects through the eaves on the south wall of the lounge.

⁵ New Zealand Standard NZS 4999:1998 *Earth buildings not requiring specific design*

2.2 The pressed earth brick walls

- 2.2.1 Exterior and interior walls of the building are constructed from 300 x 150 x 150mm pressed earth bricks, which were factory-produced by a company that ceased trading in 2000. The manufacturer's instructions at the time included a requirement for walls to be coated with a clear water-repellent siloxane-based penetrating sealer ("the sealer").
- 2.2.2 I have seen no information on the composition of this particular proprietary product, but the expert noted that pressed earth bricks are generally composed of clay, silt, sand, cement, and sometimes gravel, mixed to form a homogeneous mixture before compression into bricks, followed by curing.
- 2.2.3 The manufacturer's 'technical information' stated that the pressed earth bricks had been tested for various qualities and noted that 'these tests have been appraised' by BRANZ⁶. In 1995, BRANZ carried out tests for density, drying shrinkage, compressive strength and accelerated erosion on the proprietary pressed earth bricks. In a letter to the manufacturer dated 18 December 1995, BRANZ noted the following:
- there was no standard for earth wall construction
 - the erosion test was 'designed to evaluate performance of brick in cyclone-prone areas, which could be regarded as an extreme test for weathering performance in New Zealand'
 - a minimum eave overhang of 600mm⁷ was recommended for 'all earth brick houses to provide additional protection against the weather'
 - the sealer should be applied within three months, then recoated at five year maximum intervals depending on surface moisture absorption after rain
 - providing surface sealing is maintained, 'the [pressed earth brick] should be able to provide weathering protection for up to 50 years'.
- 2.2.4 In 2000 BRANZ completed further reports on the pressed earth bricks following concern about the weathering performance of the product and, taking into account recently released earth building standards⁸, concluded that the proprietary earth bricks did not comply with NZS 4298 and were not suitable for use as a cladding in situations where house design and location will cause it to be exposed to the erosion effects of wetting, drying, wind and frosts.

3. Background

3.1 General

- 3.1.1 The foundations and floor slab of the house were constructed as Stage One under building consent No. 93/1140. The code compliance certificate for this work was issued on 19 January 2005. Building consent No. 96/0989 for completion of the house (Stage Two) was issued on 3 September 1996: both consents were issued under the Building Act 1991 ("the former Act").

⁶ Building Research Association of New Zealand

⁷ The manufacturer's 'Terms of business' also called for 'a 600mm overhang on roof.'

⁸ NZS 4297:1988 *Engineering Design of Earth Buildings (Specific Design)*, NZS 4298:1988 *Materials and Workmanship for Earth Buildings*, and NZS 4299:1988 *Earth Buildings not requiring Specific Design*

- 3.1.2 The consent application for Stage Two was made by the design engineer on behalf of the then owners and included within the documentation was a Producer Statement – PS1 – Design, which was limited to the ‘roof beams and trusses’. In regard to the pressed earth brick walls, the design engineer provided a statement titled ‘Structural design basis for adobe walls’, which described the underlying engineering principles.
- 3.1.3 The design engineer monitored construction of the pressed earth brick walls and the roof, in accordance with the consent documentation (see paragraph 3.2.4). The only recorded inspection by the authority is for drainage on 10 March 1998, and a final inspection carried out on 24 April 1998 which passed. No further inspection was carried out and no code compliance certificate was issued.
- 3.1.4 By 2000, the authority had engaged consultants (“the contractor”) to ‘finalise all building consents issued prior to 1 July 1998’. The contractor first visited the property on 5 July 2000.
- 3.1.5 The authority subsequently became aware of problems associated with the proprietary pressed earth bricks used for the house walls. In a letter to the former owners dated 12 March 2001, the authority noted that it had ‘decided to put a memorandum on your property file so that it may alert potential purchasers of your property about [the earth bricks].’
- 3.1.6 In 2005, the former owners sought advice about the condition of the pressed earth brick walls from a builder with experience in earth buildings. The earth builder inspected the house on 19 July 2005 and provided a statement dated 8 March 2006, which said:

There appears to be very little discernible deterioration to the blocks since I initially visited the house in 1998. The blocks are generally in good condition and, with minimal maintenance, should not present any concern during the life of the building as specified by the building regulations (50 years for structural elements).

3.2 The refusal to issue the code compliance certificate

- 3.2.1 The former owners, acting through a lawyer, continued to seek a code compliance certificate from the authority and correspondence passed between the parties in relation to this request.
- 3.2.2 The authority wrote to the owners on 12 December 2006, noting that it would not issue a code compliance certificate because the house ‘has not been shown to meet the structural and durability clauses of the Building Code’. The authority noted that the particular pressed earth bricks had been used quite widely in the South Island and the product ‘quickly demonstrated a lack of durability and potential to fail’. The authority concluded (in summary):
- a code compliance certificate would not be issued for the building without a determination as to compliance
 - information would be added to the LIM report to alert future potential purchasers
 - a certificate from ‘an appropriately qualified engineer’ confirming that the bricks are structurally sound can be added to the property file to allow prospective purchasers to consider that information.
- 3.2.3 The former owners formally requested a code compliance certificate on 13 April 2007 and the authority responded in a letter dated 16 May 2007, confirming that the documentation required was a Producer Statement Construction Review (“PS4”) for

the design and monitoring of the pressed earth brick structure in order for the authority to be ‘satisfied that the durability of the structure will meet the required 50 year standard.’

3.2.4 In a letter to the authority dated 10 May 2007, the design engineer attached a Producer Statement – PS4 – Construction Review dated 8 April 2007. The engineer said (in summary) that the PS1 for design covered the roof beams and trusses, so the PS4 for construction review is limited to those elements (see paragraph 3.1.3). The construction monitoring of the pressed earth brick walls was carried out and in regard to Clause B1 Structure, it is believed that these have ‘been completed to the extent required by the building consent.’

3.2.5 The contractor carried out a further inspection of the house on 17 May 2007, with the purpose of the inspection noted as ‘site inspection of the condition of the earth blocks’. The inspection record noted:

The blocks on the exposed sides of the dwelling are showing signs of breaking down at the edges. The areas of concern are at the edges of blockwork around doors and windows. A few blocks have a small amount of face deterioration.

3.3 The contractor’s report

3.3.1 Following his inspection on 17 May 2007 (see paragraph 3.2.5), which was limited to the building’s exterior, the contractor provided a preliminary inspection reports. A further site inspection was held on 22 June 2007 and the contractor provided an expanded report at the authority’s request: it appears the report was completed in July 2007.

3.3.2 Within the report, the contractor noted (in summary):

- a number of bricks have an exposed aggregate surface as a result of deterioration of the outer face, with areas at random locations ‘soft to the touch and crumble easily when rubbed’, which could be due to manufacturing defects and/or spalling as moisture ingress
- some corner cracking of some bricks at joinery openings, which may allow moisture into the brickwork that would increase risks of delamination
- cut faces of bricks may not be as durable as the compressed finished faces, which is reinforced by a hollow sound when tapping on the cut face and in time reinforcing cover may be reduced
- there is evidence of repairs to individual bricks which appear to have used a plaster with a much higher cement content than the original bricks
- the degree of deterioration is sufficient to cast doubt on whether the bricks would meet the 50 year durability requirement
- although the earth builder’s report (refer paragraph) noted ‘very little discernible deterioration’ over a 7 year period (see paragraph 3.1.6), deterioration observed in the following two years indicates ‘an accelerated degree of deterioration’.
- without expert opinion, durability was uncertain and a specific review by an independent specialist experienced in earth building is needed, given the type of construction and ‘obvious performance deficiencies noted to date’.

The contractor recommended the authority confirm its refusal to issue a code compliance certificate.

3.4 The consulting engineer's 2007 report

- 3.4.1 In a fax to the authority dated 2 August 2007, the lawyer noted that the owners intended to engage a consulting engineer with previous experience with the proprietary pressed earth bricks who had worked with the earth builder in the past. The engineer would be asked to comment on durability compliance, any required rectification and recommended maintenance.
- 3.4.2 Commenting on the proposal in an email to the authority dated 6 August 2007, the contractor noted (in summary):
- Even if bricks were repaired to meet building code requirements, it would not resolve remaining 'untouched ones'.
 - Given that the earth builder had not noticed any deterioration until the recent inspection and the house is now 10 years old, the damage has occurred over a short time and is likely to accelerate over the next few years.
- 3.4.3 The consulting engineer inspected the external walls of the house and provided a report dated 5 October 2007 to the then owners, which noted that the purpose was to determine whether the walls complied with Clauses B2 and E2 of the Building Code. The engineer noted that he had designed 29 earth buildings since 1987.
- 3.4.4 In regard to the 12 house designs built between 1995 and 2001 which used the proprietary pressed earth bricks, the engineer stated:
- Over the past three years I have reinspected three of these houses and found little in the way of durability problems where the external walls have been subject to regular maintenance. The houses were constructed using the 300mm thick [bricks], not the thinner veneer bricks.
- 3.4.5 The engineer tested random bricks 'with a small hammer to test integrity' and on 10 September 2007 the earth builder carried out accelerated erosion tests⁹ on 10-year-old brick, which showed that:
- The [bricks] performed well in the erosion tests, as expected for a cement stabilised earth product, with erosion of less than 2 millimetres. This indicates a durability index of 1, the optimum for earth [bricks] under [the standard].
- 3.4.6 In regard to appearance, the engineer observed:
- no signs of widespread brick failure
 - about 5% of exterior bricks are showing signs of weathering deterioration
 - random bricks have been manufactured with rough surfaces
 - some spalling to exterior corner bricks, common to other inspected houses and caused during manufacturing by high stress concentration in corner moulds
 - bricks with 'drummy' sound when tapped resulted from random manufacturing faults.
- 3.4.7 The engineer considered that immediate attention was needed to:
- repair exterior corners
 - repair all brick surfaces with eroded depths of more than 5mm
 - spray all walls with the siloxane-based sealers.

⁹ The bricks were in-situ, but tests were generally in accordance with NZS 4298:1998 though depth of moisture penetration was not recorded and surface coatings had been applied to the pressed earth bricks in the past. There is no indication of where the 'random' bricks were located on the walls and what condition these were in when tested.

3.4.8 The engineer concluded that:

...the exteriors walls are capable of sustaining a durability of 50 years provided that immediate minor repairs are carried out, and that regular maintenance is scheduled.

3.4.9 The engineer attached an appendix that included a 'Maintenance Schedule every 5 years' with a 'Procedure for Pressed Block Repairs'. These included:

- For 5-yearly maintenance:
 - inspecting external faces of bricks, with repair of any surface spalling
 - checking external corners for spalling and 'grind off if required'
 - treat all external walls with the siloxane based sealer.
- For repairs to the brickwork, different procedures incorporating a bonding liquid were provided for:
 - erosion less than 75mm in depth
 - erosion greater than 75mm in depth
 - face repairs
 - mortar mix when inserting replacement bricks.

3.4.10 The lawyer forwarded the engineer's report and maintenance schedule to the authority on 11 October 2007; noting the conclusions of the report and stating:

Given this, our clients intend to immediately conduct the minor repairs [my emphasis]. As such, we would anticipate that the [authority] will have no difficulties in providing a final Code Compliance Certificate in relation to the property.

3.5 Further correspondence

3.5.1 Commenting in a letter to the authority dated 30 October 2007, the contractor noted that the report appeared satisfactory but the following was still required:

- Confirmation of frequency of re-sealing by the sealer manufacturer.
- Submission of report, appendices and maintenance schedule for a formal approval of an amendment to the building consent.
- Resolution of the date from which the durability periods should apply.
- Inspection and approval of the repairs and 'a further comprehensive final inspection of the completed building', with the owners being made aware that other matters requiring attention may be revealed.

3.5.2 The authority forwarded the above to the lawyer on 2 November 2007, noting that the comments had also been discussed with the (then) owners, who were aware of the matters raised by the contractor. The lawyer responded on 9 November 2007, challenging items raised by the contractor and maintaining that there was 'absolutely no need for a re-inspection', all other issues had been resolved in past inspections and the consulting engineer's report satisfied the matter of the walls. The lawyer stated:

In conclusion [the owners] believe they have provided everything to the [authority] now that should be necessary. The provision of a maintenance schedule with the [authority] records should facilitate any issues regarding maintenance, but the durability issue has now been resolved to any reasonable person's satisfaction.

3.5.3 Further correspondence continued over the next month in order to resolve the remaining issues, with the authority insisting on the requirement for a final inspection of the entire building.

3.6 Final re-inspections and the issue of the code compliance certificate

- 3.6.1 The authority's contractor inspected the exterior of the house on 18 December 2007 and the inspection record noted that, although instructed to 'complete a full final inspection'; this could not be carried out because the then 'owners adamant that I only look at repairs/maintenance to exterior of [brickwork].' The contractor observed 'plastered repairs to some [bricks]' and 'jamb [brick] corners chamfered', but also noted signs of dampness to areas under window sills, the chimney appearing to be damp, and mortar cracks to window lintels. The inspection also identified other exterior items requiring attention and noted that a re-inspection was required.
- 3.6.2 Notwithstanding the above, the lawyer wrote to the authority on 18 December 2007, claiming that the contractor was satisfied with the repairs and all outstanding matters were now resolved and there was therefore 'absolutely no reason why a Certificate cannot be issued in the next few days'.
- 3.6.3 The authority responded on 19 December 2007, confirming the need for 'a complete and passed final inspection', without which it could not issue a code compliance certificate. The house was re-inspected on 21 January 2008 and the authority wrote to the owners on 22 January 2008, identifying 13 outstanding items to be attended to before a code compliance certificate could be issued. At the owners' request, the contractor confirmed the list as being 'the finite list of remedial work and once completed, inspected and deemed to comply a Code Compliance [certificate] can be issued.'
- 3.6.4 Outstanding documentation was provided and the contractor carried out a 'final re-check' of the house on 22 February 2008, with all items ticked off as completed. The authority issued a code compliance certificate dated 22 February 2008.

3.7 Continuing deterioration of the pressed earth brick walls

- 3.7.1 The applicant purchased the property in May 2010 after a builder's pre-purchase inspection and the house apparently 'looked fine at that time.' The applicant was aware of the requirement to seal the pressed earth bricks and informed the expert in 2016 that sealer had been applied on dry days three times since purchasing the house.
- 3.7.2 As the first major Canterbury earthquake took place in September 2010¹⁰ the damage to the walls was initially 'put down to earthquake damage', but approaches to the Earthquake Commission ("EQC") following the sequence of earthquakes were apparently met with the response that most damage was not earthquake-related. Despite continuing maintenance, the applicant was unable to arrest the deterioration and was unable to find a builder or engineers prepared to assist.
- 3.7.3 In March 2015, the applicant requested the builder provide a price for 'earthquake damage repairs' and the builder inspected the walls with his engineer in order to 'price the work so we could make an EQC claim'. However, 'the more we looked the more we could tell most of the problems were not from the earthquake damage.' During the winter of 2015, the applicant reportedly found the house too cold to live in because of damp walls and vacated the house for the winter months.

¹⁰ The Canterbury Earthquake Sequence includes the 'Darfield Earthquake' of 4 September 2010 with a moment magnitude of 7.1, followed by a series of aftershocks that included a 6.3 magnitude earthquake on 22 February 2011.

3.8 The second consulting engineer's 2015 report

- 3.8.1 The applicant engaged the builder's engineer to carry out 'a structural review' of damage to the external walls of the building. The second consulting engineer inspected the inside and outside of the walls on 12 June 2015 and provided the applicant with a report dated 30 July 2015.
- 3.8.2 The engineer noted that his survey was primarily to check damage to the external walls and report on the cause and was limited to a visual inspection. No assessment of the structure's capacity was carried out. The engineer described the construction and some of the background of the building, noting that the veranda and eaves shown in the consent drawings had been reduced to less than 400mm roof overhang.
- 3.8.3 The engineer inspected the exterior faces of walls, marking areas of the worst observed damage onto the elevations. The engineer observed that:
- the west and south facing walls were in poor condition, with:
 - mortar cracks
 - cracks to the bricks, erosion and face delamination
 - plaster sill failure/delamination
 - delamination and cracking of some past repairs
 - apparent lack of reinforcing where the brick interior was revealed by damage
 - the east and north facing walls are in better condition, with smaller areas of erosion visible, except for an area of eroded and cracked brickwork on the north east corner of the entry.
- 3.8.4 The engineer inspected inside faces of exterior pressed earth brick walls, noting the following:
- In the lounge:
 - expanded bricks below window with skirting pushed away from wall
 - reported water entry via a control joint in the concrete floor
 - hairline mortar cracks to south wall
 - bowed sill and two replaced bricks under south window
 - crack from fireplace opening
 - soft crumbling earth brick work, particularly to south wall
 - horizontal brickwork crack below truss on north wall indicating movement of the truss, with mortar cracks reflecting those on exterior
 - In the kitchen/family area:
 - soft crumbling brickwork below south window sill
 - expanded brickwork below window with skirting pushed away from wall
 - raking cracks to both sides of kitchen window
 - vertical crack above north window timber lintel
 - In the study:
 - vertical crack at junction of north and west walls
 - crumbling and expanding sill bricks below window sill
 - In the master bedroom:
 - brick replaced below west window
 - crumbling and mortar cracks below west window and beside north door

- In laundry/toilet/bathroom:
 - signs of past repairs
 - small areas of soft crumbling brickwork
- In bedroom 2 and lobby area office:
 - crumbling brickwork and mortar cracks below window
- In bedroom 3 and bedroom 4:
 - crumbling brickwork and mortar cracks below window
 - full height crack to west wall/interior wall junction
- In bathroom 2:
 - crumbling brickwork and mortar cracks below north window.

3.8.5 The engineer discussed likely causes of the damage observed, noting that most damage was due to moisture-related deterioration of the bricks, including the:

- mortar, joint and brick cracks
- face delamination
- spalling of plaster sills
- brick erosion
- brick expansion due to moisture ingress.

3.8.6 Some damage appeared to be earthquake-related, but was considered to be minor in comparison to the pressed earth brick deterioration. This included:

- mid-height cracking beside master bedroom exterior door
- cracking under the lounge truss
- vertical cracking to corner beside main entry door
- full height crack to west wall/interior wall junction of bedrooms 3 and 4
- vertical crack at junction of north and west study walls.

3.8.7 The engineer also commented on other damage, including (in summary):

- Minor hairline cracking is most likely caused by moisture, with the worst damage to elevations exposed to driving rain from the south and west, and to lower walls below windows.
- Almost all plastered sills are cracked, delaminated or spalling, with no overhang or drip groove and no waterproofing beneath the sill plaster to prevent water entering the wall.
- Although most intact bricks had a hard outer surface probably helped by the sealer, many were soft and crumbly beneath the surface. Once the outer surface was lost, such bricks have expanded in volume and rapidly deteriorated, with damage reflected on the interior face.
- Flooding in the lounge was likely due to water entering via weathertightness defects to the south chimney structure, then tracking along floor control joint.
- The crack beside the fireplace is likely due to the corrosion and expansion of the uncoated steel lintel bar embedded into moisture-compromised bricks.

- 3.8.8 The engineer considered guidance used for the original design of the house along with the 1998 earth standards, noting (in summary):
- roof overhangs based on NZS 4299 would result in about 1.8m to west wall
 - however, NZS 4297 allows eaves width to be determined by specific design based on the ‘Erodability Index’ of the earth brick material (a reported index of 1, based on erosion tests seems to allow eaves of 200mm)
 - the wet/dry appraisal test in NZS 4298 should eliminate unsuitable earth building materials which may pass strength and other durability tests but are likely to fail in service after repeating wetting and drying.
- 3.8.9 The engineer concluded that the majority of damage observed was due to weathering of the pressed earth brick, particularly on walls exposed to driving rain. The engineer considered this indicates the bricks’ low tolerance to wetting and drying, exacerbated by the omission of the veranda to the west. Some past repairs have failed and walls now need ‘extensive repairs’ well beyond normal maintenance, and the engineer therefore considered that the ‘the durability of the brick walls does not meet the intention of Clause B2 of the Building Code’.
- 3.8.10 Without further investigation and testing of random samples to establish ‘whether the bricks are sufficiently durable to survive the remaining design life of the dwelling’ the engineer considered it was not appropriate to recommend a repair strategy. However, if testing results were favourable, a strategy would include:
- construction of wide eaves to the west and south elevations
 - redesign and replacement of existing plaster sills
 - improvement of weathertightness details such as junctions and flashings
 - repair and/or replacement of damaged bricks.
- 3.9 I have no seen no record of what, if any, correspondence between the parties followed the completion of the above report. The Ministry received an application for a determination from the builder on behalf of the applicants on 15 February 2016, and sought information from the parties which was received on 1 March 2016.

4. The submissions

4.1 The submissions on the application

The applicant’s submission

- 4.1.1 On behalf of the applicant, the builder outlined the background to his involvement as outlined in paragraph 3.7.3 and noted that the authority’s records that were able to be found ‘have been very poor and incomplete’. The builder stated:

..the matter in dispute from us is how the [authority] issued the CCC for this work.

The [authority] knew about the problems that the [proprietary pressed earth bricks] were having before the CCC was issued.

- 4.1.2 The builder provided copies of:
- some of the consent documentation
 - the as-built drawings
 - the earth builder’s 2006 and 2007 reports

- the contractor's 2007 report
- the consulting engineer's 2007 report
- the 2007 maintenance schedule
- correspondence from the authority up to 2007
- the second consulting engineer's report in 2015
- various statements, photographs and other information.

The authority's submission

4.1.3 The authority made no submission, but forwarded a CD-ROM, which contained additional documents pertinent to this determination including:

- the authority's building inspection records
- inspection records and correspondence from the authority's contractor
- code compliance certificates for Stage One and Stage Two
- correspondence from the former owners' lawyer
- various producer statements, file notes and other information.

4.2 The first draft determination and submissions in response

4.2.1 A first draft of the determination was issued to the parties for comment on 19 August 2016. The draft concluded that:

- there was insufficient evidence to determine whether the earth brick walls comply with Clause B1, and
- the earth brick walls do not comply with Clause B2 insofar as it applies to Clause B1, and do not comply with Clause B2 and E2, and
- the authority did not correctly exercise its powers of decision when it issued the code compliance certificate for Stage Two.

The draft determination also reversed the authority's decision to issue the code compliance certificate.

4.2.2 In an email on 26 August 2016, the applicant accepted the draft without further comment.

4.2.3 The authority provided a submission by email on 21 November 2016, stating that it did not accept the finding in the draft that it had not correctly exercised its powers in issuing the code compliance certificate. The authority maintains the view that at the time of its decision to issue the certificate it was satisfied on reasonable grounds that the building work complied with the Building Code. The authority submitted (in summary):

- Subsequent to the authority raising concerns about durability, it had received certification and assurances from the design engineer, the owner/builder, and an independent chartered professional engineer that the design and construction complied and would continue to comply if a maintenance schedule was followed (refer paragraphs 3.4.8 and 3.4.9). The authority took a robust approach to ensuring it had reasonable grounds to be satisfied as to compliance.

- The building consent was amended to include the maintenance schedule as well as for the durability periods to begin at the date of practical completion in 1997. The durability period, which the authority considers to be 15 years, expired in 2012. The maintenance schedule sets out the maintenance requirements, and these fall under the provisions of normal maintenance. If the maintenance schedule was adhered to, then damage could not continue unabated.
- Based on the work completed by the then owners and the assurance and certification from the engineers, the authority was of the view at that time it did not have reasonable grounds to issue a notice to rectify under section 43(6) of the former Act¹¹, and that it had reasonable grounds on which to issue the code compliance certificate for the amended consent.
- The authority is of the view that the determination has assessed the construction of the house against standards that were not in place in September 1996, and that insufficient weight has been given to the engineer's certification.
- While the 2007 PS4 from the design engineer was limited to the roof beams and trusses (refer paragraph 3.2.4), the letter went further and the design engineer confirmed he carried out construction monitoring and that his statements applied to the variations or amendments in the design; there was no concern raised with regard to eave width or exclusion of the veranda from the design. The design engineer provided his opinion that a code compliance certificate should not be withheld 'on a structural basis covered under Clause B1...' and it was reasonable for the authority to rely on the letter as evidence of structural compliance.
- The summary of the contractor's report (refer paragraph 3.3.2) omits the contractor's conclusion that there were no concerns over compliance with Clause B1 and does not include the full recommendations made by the contractor. The contractor's recommendations were implemented and completed before the code compliance certificate was issued.
- The 2010 pre-purchase inspection report, which the authority has not seen, would appear to support the authority's view as to compliance having completed a visual inspection only and in reliance on evidence from chartered professions engineers.
- The invasive testing carried out by the expert was not available to the authority nor recommended by the engineers at the time of the authority's final inspection.
- The fact that repairs are noted to have failed in 2015 (refer paragraph 5.3.2) is not evidence that those repairs would have appeared inadequate in a visual inspection in 2008. Repairs required before the code compliance certificate was issued do not imply or suggest ongoing failure of Building Code requirements.
- In regards to the expert's comments concerning the Producer Statement (refer paragraph 5.6), the engineer's letter dated 10 May 2007 (refer paragraph 3.2.4)

¹¹ I note that the date at which the authority made its decision to issue the code compliance certificate it was the Building Act 2004 that was in force and not the former Act. Accordingly, it is section 164 of the current Act that would apply in respect of a decision to issue a notice to fix (the equivalent of the notice to rectify under the former Act).

was presented as the equivalent to a PS4; the design engineer ‘confirmed that he carried out construction monitoring of the wall framing’.

- The ‘intrinsic defects’ could not reasonably have been detected by the authority at the time (refer paragraph 5.10.1).

4.2.4 The authority agreed that given the evidence of current failure it may be appropriate to reverse the code compliance certificate and the authority had no objection to that; however the authority does not agree with the finding that it did not correctly exercise its powers when it decided to issue the code compliance certificate in 2008.

4.2.5 In response to the authority’s comments on the Standards referred to by the expert not being in place at the time the consent was issued, and the BRANZ report post-dating the construction of the house, I note that the determination considers not the granting of the consent but the issue of the code compliance certificate. The certificate was issued in 2008, and the information available through the Standards and in the BRANZ report would have been available for the authority to consider at the time it made its decision to issue the code compliance certificate. Building consent authorities can take into account information available to them at the time the authorities are making a decision whether to issue a code compliance certificate.

4.2.6 The authority has referred to the earth brick cladding as being required to meet durability performance for a period of 15 years only (refer paragraph 4.2.3, bullet point #2). I note that in this case the walls provide structural stability to the building and the durability period under clause B2.3.1 is for 50 years.

4.3 The second draft determination and submissions in response

4.3.1 After considering the submissions received the evidence was reviewed and a second draft of this determination was issued to the parties for comment on 21 December 2016. The second draft concluded:

- the external pressed earth brick walls do not comply with Clause E2, nor Clause B2 insofar as it applies to Clauses E2 and B1; and reversed the decision to issue the code compliance certificate for building consent no. 96/0989; and
- non-compliance with Clause B2 would have been apparent at the time the authority made its decision to issue the code compliance certificate; accordingly the authority incorrectly exercise its powers of decision when it issued the code compliance certificate.

4.3.2 In a response received on 23 January 2017, the applicant accepted the findings of the second draft determination without further comment.

4.3.3 The authority did comment or provide any further submissions in response to the second draft determination.

5. The expert’s report

5.1 General

5.1.1 As mentioned in paragraph 1.6, I engaged an independent expert to assist me. The expert is the Chairman of the Standards Technical Committee for NZ earth building standards and has been the primary author for BRANZ on earth building guidelines in New Zealand.

- 5.1.2 The expert inspected the house on 3 April 2016 with the applicant and the builder, providing a report completed on 29 June 2016, which was forwarded to the parties on 1 July 2016. The expert also discussed the situation with the applicant, who described the background as outlined in paragraph 3.7.
- 5.1.3 The expert noted that his ‘investigation was carried out to provide information required’ by the Ministry about the background, the pressed earth brick walls and their current and past performance with regard to compliance with parts of Building Code Clauses B1, B2 and E2. The expert noted that his report was based on his ‘long experience with earth buildings and earth bricks including [the proprietary pressed earth] bricks in particular’ together with the current earth building standards NZS 4297, 4298 and 4299.
- 5.1.4 The expert observed that generally ‘pressed bricks are made from a friable mixture of clay, silt, sand and sometimes gravel, thoroughly mixed with some cement to form a homogeneous mixture’, with about 5-10% of clay for cohesion, 7-10% cement for strength and minimal water before being mechanically compressed then cured.
- 5.1.5 The expert commented on the history of arguments regarding a distinction between earth veneer bricks and pressed earth bricks; and agreed with the authority’s position that it was immaterial because ‘the underlying issue was the brick material, which was the same in either case, and the performance when weather exposed.’ The proprietary pressed earth bricks ‘are load bearing and laid on their flat into exterior and interior walls with a nominal thickness of 300mm.’

5.2 Current condition of the pressed earth brick work

- 5.2.1 The expert noted that the engineer’s 2015 report accurately surveyed and recorded the damage, with only minor differences and some progression of damage observed in the brickwork. The expert observed the following (in summary):
- Mortar appears to be a regular sand/cement mortar finished flush to avoid horizontal edges where water can sit, but has a textured surface.
 - Bricks are laid with compression planes horizontal – generally in accord with NZS 4298, which states that bricks should be laid with the compression planes at right angles to the weather face to lessen the risk of delamination.
 - Some damage observed at corners and wall ends could be due to half bricks being laid with compression planes vertical.
 - There is a lot of damage under window sills, where the upper surface of the laminar structure is more exposed to moisture from above.
 - Water penetration is evident damage is translated through to the interior and where moisture has penetrated into bricks below windows, this has resulted in expansion and bowing of window sills
 - Water penetration and damage was noted to walls adjacent and under window sills with some interior bricks having been replaced, timber sills bowed due to water penetration, and timber skirtings being pushed off the wall due to swollen bricks behind.
 - Where bricks have crumbled away, no brick material is left with adhered mortar, showing a lack of bonding between the mortar and pressed earth brick.
 - The worst damage is generally where bricks are most exposed to the weather – on the west and south faces, with some to more exposed parts of other walls.

- Even on exposed faces, damage is variable, with bricks either:
 - appearing sound
 - sounding ‘drummy’ when tapped
 - exhibiting loss of surface or deeper material
 - severely eroded, particularly at some window jambs, under sills, at corners and sometimes at random locations
 - displaying progressive crumbling within the brick
 - having cracks able to be seen within the body of the brick.
- No very sheltered bricks appeared moisture damaged, while some very exposed bricks still appeared sound.
- On internal walls where bricks had always been dry and remained sound, there was variation in ‘surface tightness when rubbed by hand’, with some having a ‘tight hard surface and others a looser, more textured and dustier surface.’
- Apart from testing for softness with a knife blade, it was not possible to verify the full extent of the depth of damage to some bricks.

5.3 Design and repairs

5.3.1 Commenting on design, the expert noted:

- Openings were not detailed on the plans at heads, jambs, or sills; and joinery is installed with no jamb rebates with a metal strip cut into the brick reveal to act as a flashing.
- Cement plastered bricks are used as window sills, with no allowance to throw water clear of lower walls and no waterproofing under plaster that has cracked/fallen away - allowing water into the body of the lower brickwork
- Although no control joints are installed to limit cracking around openings, in long walls, or at changes of wall heights, this does not appear to have caused any particular issues.
- Scanning for reinforcing revealed horizontal steel every two courses, with some walls appearing to have limited vertical steel. However, it could not be determined whether the reinforcing present was structurally adequate.
- The omission of the west veranda and the reduction of eaves have significantly increased the exposure of walls to rain and, although NZS 4297 provides a method of assessing eaves width by specific design for durability, the standard still suggests good eaves overhangs as a prudent measure.
- B2/VM1 provides NZS 4297 and 4299 as Acceptable Solutions for meeting durability requirements¹². In 2006 eaves overhangs were verified by calculation against NZS 4297, but this took no account of failures to date and of B2/VM1 section 1.0.1a) ‘in service history’ when assessing durability.
- Although NZS 4299 includes some repair of damage or deterioration as part of ‘normal maintenance’ of earth buildings¹³, it also recommends eaves of 600mm minimum¹⁴ ‘to satisfy the durability requirements of this Standard’.

¹² B2/VM1 Section 3.4.1

¹³ NZS 4299:1998 Section 2.5.1.2

¹⁴ NZS 4299:1998 Section C2.5.1

- Paragraph 2.10 of NZS 4299 prescribes eaves as part of a means for non-specific design compliance with Clause E2 of the Building Code. The eaves of this building fall far short of what would be required under that Standard.

5.3.2 Commenting on past repairs, the expert noted that:

- many repairs have failed, and others are drummy – indicating imminent failure
- the repair strategy for corner cracking was to grind off corners; which exposed deeper layers of the brick to moisture, so generating deeper cracks
- failure of past repairs is noticeable at corners of bricks to jamb reveals and sills, where large portions of brick material has broken away
- some interior sealer has failed, taking surface brick material with it.

5.4 General manufacturing method

5.4.1 The expert described the general manufacturing method for pressed earth bricks and noted that there were possible areas where problems could occur, which included:

- uneven batching or mixing can result in variable brick quality from:
 - variable composition of earth in mix
 - variable content or quality of cement
 - variable moisture content
- pressing operations causing quality problems from:
 - pockets of clay in mix can later swell if moisture enters brick
 - trapped air in mix can result in cavities within finished brick
 - small volume changes of mix in a fixed volume press can lead to variations in density and compressive strength
 - half-size bricks produced in fixed volume presses¹⁵ can result in compression planes at right angles to ram direction.
- curing the bricks unevenly or inadequately.

5.4.2 Commenting on possible manufacturing faults that could explain the type, inconsistency and variation of damage observed in these pressed earth bricks, the expert noted that one or a combination of the above manufacturing faults could have resulted in the damage outlined in paragraph 5.2.1.

5.5 Unstabilised clay content

5.5.1 The expert took samples of crumbly material from deep within two failing bricks and passed them each through a sieve. Three simple tests indicating unstabilised clay content were carried out on moistened material, which showed that samples could:

- be rolled into a ball, with ball once dry offering ‘moderate resistance to crushing between fingers’
- be rolled by hand into a ‘worm’ up to about 80mm long before breaking under own weight when held by one end
- be rolled into a strip, marked with a specific dimension then oven-dried, with the strip showing shrinkage of 2-3%.

¹⁵ The manufacture of the proprietary bricks used a 300mm² x 150mm high fixed volume press, with a steel plate used to reduce the volume to produce 150 x 150 x 300mm half-size bricks

5.5.2 Commenting on effects of unstabilised clay in a pressed earth brick, the expert noted:

- that cement stabilises clay by reducing its ability to react with water and therefore the likelihood of the clay expanding when wet
- that cyclic wetting/drying over time leads to deterioration over variable lengths of time, depending on variations in composition, strength, frequency of moisture exposure and the amount of moisture involved
- a secondary effect can be freeze/thaw, particularly at window sills or in walls where moisture enters and freezes, which can cause brick material to spall off
- the presence of unstabilised clay means that any repairs to damaged bricks are ‘almost certain to fail unless the bricks are kept dry.’

5.5.3 The expert noted that a BRANZ appraisal is considered as good supporting evidence for alternative solutions such as earth bricks. However in the case of the proprietary bricks, only an opinion was obtained and the expert noted that:

- the opinion on an expected durability of 50 years was based on testing a small number of unidentified samples using 300 x 300 x 150mm bricks which, in the absence of any other information may have been given undue significance
- although sealing requirements of the manufacturer¹⁶ may have been met, eaves were reduced to below minimum recommendations and there is no record that eaves widths and the reductions were questioned
- it is also unlikely that a 600mm overhang would have been sufficient to protect these particular bricks from failure (although I note the omission of the 2.5m west veranda, which should have protected walls beneath).

5.6 Compliance with Clause B1 Structure

5.6.1 The expert noted that a producer statement for design of the pressed earth brick walls was not required when the building consent was issued, with the engineer describing the basis of his design and stating that the building was designed in accordance with NZS 4203:1984 – which could have been certified in a producer statement.

5.6.2 The consent documents also called for the engineer to ‘supervise and monitor all construction’, which the expert considered ‘implies a much more extensive involvement that involves taking full responsibility for the work as it is all done under direct supervision’ and as such is a higher standard of care than ‘periodic observation’.

5.6.3 Commenting on structural aspects, the expert noted that:

- cyclic wetting and drying over time of defective pressed earth bricks has caused deformation and collapse of brick material with subsequent loss of amenity
- continued deterioration could allow moisture to corrode reinforcing steel
- corrosion to the fireplace steel lintel initiating cracking could not be confirmed
- the adequacy of reinforcing present within walls could not be confirmed.

¹⁶ NZS 4298 provides for improvement of durability by surface coatings only if samples are subject to specific design

5.6.4 The expert stated that, despite the damage observed, he had:

...not seen anything in this building that suggests to me that damage to the earth brick walls has yet progressed to a stage where the structural integrity is adversely affected, but if damage continues unabated then the building is most unlikely to meet a 50-year minimum life requirement.

5.7 Compliance with Clause B2 Durability

5.7.1 The expert noted that by issuing the code compliance certificate, the authority accepted that ongoing repairs and re-coating of the pressed earth brick walls ‘would or could be required at 5 yearly maximum, or even lesser intervals.’

5.7.2 In regard to maintenance, the expert noted that:

- “normal maintenance” as outlined in paragraph 2.1.3 of B2/AS1 is regarded as fairly light activities such as washing or re-coating, and not major repair work
- B2/VM1 provides NZS 4297 and 4299 as Acceptable Solutions for meeting durability requirements¹⁷, and NZS 4299 includes:
 - repair of damage or deterioration as part of normal maintenance
 - structures expected to withstand expected wear and deterioration without ‘the need for undue maintenance’
 - deterioration of pressed earth brick walls dependent on severity of wind-driven rain, with an eaves width of 600mm minimum recommended to satisfy durability requirements of the standard
- what constitutes ‘normal’ as compared to ‘undue’ maintenance is debatable but, given the history of failure prior to 2007 and the accepted repairs and maintenance schedule (see paragraph 3.4.9), this appears to be ‘undue maintenance at the least’
- the extent and level of repair work required now and in the future is ‘more in the nature of reconstruction or major renovation’ – especially if no effort is made to remove sources of wind-driven rain.

5.7.3 The expert concluded that in his opinion, the house has failed to ‘meet many of the assessment criteria’ in B2/VM1 and also the provisions of NZS 4299 for durability:

...both by depth of damage to the walls and its need for undue maintenance. The building is now in need of reconstruction or major renovation....

Overall it has failed to meet the provisions of NZBC B2 in terms of Clause B2.2, and B2.3.1 a) i) and c) i).

5.8 Compliance with Clause E2 External moisture

5.8.1 The expert noted that Clause E2.3.2 states:

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

5.8.2 The expert commented on design and detailing as outlined in paragraph 5.3.1 and observed the moisture damage outlined in paragraph 5.2; concluding that:

In my opinion, the earth bricks used in the walls of this building have failed to meet the requirements of Clause E2.3.2 quoted above as they have not prevented the penetration of water, nor prevented damage to building elements.

¹⁷ B2/VM1 Section 3.4.1

5.9 Compliance with Clause E3 Internal moisture

5.9.1 Although a shower is located adjacent to earth walls and some water splash is likely over the years (and also to bathroom and laundry window sills), the expert noted no evidence of any significant damage as a result.

5.9.2 The expert observed that the pressed earth brick internal walls had some dustiness and areas of surface deterioration, which could have resulted from exposure to rain before or during construction of the house and concluded that there was no evidence of failure in relation to Clause E3.

5.10 Summary

5.10.1 In summary, the expert noted that:

- in 2006 general failures of the manufactured brick product was known of and this house had a history of progressive and possibly accelerating failure of some areas of brickwork
- the authority initially considered that the house did not comply with Clauses B1, B2 and E2 and also sought amendments to the building consent and producer statements for the pressed earth brick walls
- extensive repairs were carried out, beyond what would be considered normal maintenance and a code compliance certificate was issued in 2008
- the pressed earth bricks used in the building contain intrinsic defects within some bricks due to their method of manufacture
- although bricks may be adequate if they remain in a relatively dry condition, when exposed to prolonged wetting and drying they progressively fail
- reliance on a surface coating system has not provided adequate weather protection for walls frequently exposed to driving rain.

5.10.2 The expert concluded that:

In my opinion the ... earth brick exterior walls of this building have failed to satisfy NZBC Clause B2 and E2 and are unlikely to satisfy B1 in respect of the 50-year minimum durability period for the building's structure.

6. Discussion

6.1 General

6.1.1 The Stage Two building consent was issued under the former Act, and accordingly the transitional provisions of the current Act applied when the authority made its decision to issue the code compliance certificate for work completed under that consent. Section 436(3)(b)(i) of the transitional provisions of the current Act required the authority to issue a code compliance certificate only if it was 'satisfied that the building work concerned complies with the building code that applied at the time the building consent was granted'.

6.1.2 In order to determine whether the authority correctly exercised its power in deciding to issue a code compliance certificate in 2008, I must therefore consider whether at the time of the authority's decision the house complied with the provisions of the Building Code that applied when the consent was issued, and if the building work did not comply whether that would have been, or should have been, apparent to the authority at the time of its decision.

6.2 Compliance of the pressed earth brick walls

- 6.2.1 The approach in determining whether building work is weathertight and durable and is likely to remain so involves the examination of the design of the building, the surrounding environment and any design features intended to prevent the penetration of water into the walls. In the case of this particular house, the expert has described the risks of this particular type of construction and also the observed consequences of water penetrating these pressed earth brick walls.
- 6.2.2 It is clear from the expert's report that the pressed earth bricks used for the construction of these walls contained intrinsic defects which have resulted in deterioration and damage, and that this has been exacerbated by some walls not being protected in accordance with good earth-building practice current at the time of the original construction.
- 6.2.3 The expert's and the second consulting engineer's reports both establish that the current performance of the pressed earth brick walls is not adequate because there is evidence of moisture penetration into the walls over an extended period of time. Consequently, I am satisfied that some walls currently do not comply with Clause E2 of the Building Code.

6.3 The authority's decision to issue the code compliance certificate

- 6.3.1 Having considered all of the information presented to me, I have reached the conclusion that there is insufficient evidence to establish that the earth brick walls did not comply with Clause E2 at the time the authority made its decision to issue the code compliance certificate in 2008. The evidence provided to me does not suggest that the walls had failed to such an extent at that time that the performance Clause E2.3.2 was no longer being met.
- 6.3.2 However, I consider the non-compliance of the bricks with durability Clause B2 was apparent or should have been apparent at the time the authority issued the code compliance certificate. By 2007, there was clear evidence of deteriorating walls and a history of general failures of the pressed earth brick product, which indicated a lack of compliance with Clause B2. In addition, the omission during construction of the west veranda and the reduction in other eaves overhangs had increased the exposure and hence the risks for some walls.
- 6.3.3 While in September 2007 the engineer had observed only 5% of the bricks were showing signs of weathering deterioration, the history of failure of the proprietary bricks was well known to the authority at the time. The brick walls had also required repairs that I consider are not "normal maintenance", particularly given the repairs were required within the relatively short time period of approximately 10 years after construction; there had been failure of the sealant; and the "maintenance schedule" provided in support of the application for a code compliance certificate anticipated the likelihood of significant repairs. I conclude therefore that the authority did not have reasonable grounds to be satisfied that the earth brick walls complied with Clause B2 at the time it made the decision to issue the code compliance certificate.
- 6.3.4 In this case the earth brick walls also provide structural stability to the building, and the performance requirement under Clause B2.3.1 for structural elements is a minimum of 50 years.
- 6.3.5 The brick cladding is failing to meet Clause B2 with respect to Clause E2 External moisture; the moisture penetration and damage indicates that moisture ingress into the pressed earth bricks over an extended period, resulting in significant deterioration

of the walls. Because the pressed earth bricks are likely to continue to allow moisture into some of the walls in the future resulting in further deterioration and damage of the bricks, I conclude the building work also does not currently comply with the durability requirements of Clause B2 insofar as it applies to Clauses B1 Structure.

- 6.3.6 The long-term maintenance schedule anticipates the likelihood of further significant repairs by listing treatment of erosion, grinding of spalling at brick corners as well as resealing walls, with repairs describing the procedure for repairing erosion greater than 75mm in depth and for replacing damaged bricks. I concur with concerns raised by both the expert and the second consulting engineer about the level of repair needed now and in the future. Those concerns raise serious doubts about the durability, and hence the compliance with the Building Code, of some walls of this house, taking into consideration the particular risks involved in this particular pressed earth brick construction and its specific maintenance requirements.
- 6.3.7 Taking account of the reports to date, it is not clear whether the damaged walls can be made weathertight and durable. Any repair proposal should be produced in conjunction with a suitably qualified person and should include appropriate investigation of the existing work: the nature and extent of this work will depend upon the remedial solution the owner elects to use.
- 6.3.8 In summary, prior to the issue of the code compliance certificate in 2008, I am of the opinion that the following was or should have been apparent to the authority at the time it made the decision to issue the code compliance certificate:
- general information contained within the 1998 earth brick standards
 - problems experienced elsewhere associated with the particular pressed earth brick
 - past deterioration and repairs to some areas of brickwork that I consider was beyond 'normal maintenance'
 - the sealer's past failure to protect some exposed bricks; with evidence of damage and of failure of the sealer, the bricks, and also of past repairs
 - the likelihood of significant repairs anticipated by the maintenance schedule
 - the proposed repairs and maintenance schedule being unlikely to achieve adequate long term compliance, due to that strategy relying on:
 - failed and likely flawed pressed earth brick products
 - a sealer coating that had not protected bricks in the past
 - walls that did provide adequate eaves protection on what is an exposed site.

7. The decision

7.1 In accordance with section 188 of the Building Act 2004, I hereby determine that:

- the external pressed earth brick walls do not comply with Clause E2, nor Clause B2 insofar as it relates to Clauses E2 and B1; accordingly I reverse the authority's decision to issue the code compliance certificate for building consent no. 96/0989
- non-compliance with Clause B2 would have been apparent at the time the authority made its decision to issue the code compliance certificate; accordingly I consider the authority did not correctly exercise its powers of decision in issuing the code compliance certificate.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 7 April 2017.

John Gardiner

Manager Determinations and Assurance