The New Zealand Earth Building Standards:

their history and current status

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Introduction

This paper outlines the history of the development of the suite of three earth building standards in Aotearoa New Zealand and the efforts being made to keep these current. Building with earth has a long history in Aotearoa as evidenced by the fact that some of our oldest surviving buildings are built with earth: Pompallier House in Russell 1842 and Broadgreen House in Nelson 1864 for instance. After falling out of favour in the early twentieth century a renewed interest in earth building began in the 1950s and slowly grew. By 1990 enough people became interested in building in earth to call it a movement. They were driven by an awareness of environmental issues and a subsequent desire to reduce their carbon footprints and/or to build their own houses. A core group of engineers, architects and builders had been developing earth building systems specific to the New Zealand environment, systems that could withstand both earthquakes and a climate that ranges from sub-tropical to dry temperate. During the 1990s, under the auspices of Standards New Zealand (SNZ) and with the support of the Earth Building Association of New Zealand (EBANZ), this group of experts developed a set of standards to support these earth building systems. The standards were published in 1998. As they are cited as means of compliance with the NZ Building Code, they have provided building officials, architects, engineers, builders and home owners with a clear and confident path to assess, design, and build earthen walled houses. There has been no reported failure to date of any earth building that fully complies with the earth building standards. For the past eight years EBANZ members, many of whom were on the 1998 standards committee, have been working on updating the standards which are now twenty years old. Over 80 percent of the work has been done. The support of SNZ and MBIE, along with industry wide funding, is now required to complete a process which will ensure that building with earth remains a viable option in Aotearoa.

History

Background

Earth has been used as a construction material in Aotearoa New Zealand since the arrival of first Maori and then Europeans. During the first half of the twentieth century it fell out of favour, chiefly because of the increasing availability of processed timber which made the building process faster. By the time earth reappeared as a 'new' material in the 1950s, New Zealand had building regulations in place[1], and those who promoted their use were required to prove that earthen walls were fit for purpose, just as they would for any other material.

P. J. Alley, an engineering lecturer at the University of Canterbury and earth wall advocate, began experimenting with and testing soil cement walls in the late 1940s[2]. He provided the technical expertise for several dozen houses built in Canterbury and further afield during the 1950s, 60s and early 70s. The most significant of these were the six State Rental houses built out of soil cement in Wainuiomata in 1958 which were approved by the Housing Division of the Ministry of Works and financed by the State Advances Corporation[3]. These houses are still in use.

In 1971 Alley provided advice to architect Graeme North for the construction of a rammed earth house in Northland. North continued to work with earth and in 1984 he teamed up with engineer Thijs Drupsteen to design the first earth buildings to comply with "NZS 4203: Code of practice for the general structural design and design loadings for buildings." Engineers Gary Hodder and Richard Walker were doing similar work in Nelson. In 1988 the Earth Building Association of New Zealand (EBANZ) was formed and by the early 1990s a core group of professional engineers and architects began publishing guidelines and working towards creating a code of practice for earthen construction[4].

At the same time as Alley began his experimental work in the late 1940s, similar work was being undertaken across the Tasman by architect G. F. Middleton at the Commonwealth Experimental Building Station in New South Wales. Middleton's bulletin, "Earth-wall Construction" first published in 1950 and updated regularly until 1992, was a key guidance document in New Zealand as well as in Australia[5].

Development of the NZ Earth Building Standards 1993-8

In 1993 SNZ were approached by the Standards Association of Australia (SAA) to write a joint standard for earth construction. SNZ then approached North about setting up a Joint Technical Committee (JTC) of SNZ and SAA. In 1994 the JTC met and began work on the standards. The New Zealand members of the committee, chaired by North, were: North (EBANZ), Drupsteen (EBANZ), Miles Allen (EBANZ), Jenny Christie (Victoria University of Wellington), Hugh Morris (University of Auckland), Gary Hodder (IPENZ), and Min Hall (NZIA). Gary Hodder was later replaced by Richard Walker and Bob Gilkison joined the committee as a further EBANZ representative. Ian Brewer was the SNZ sectretary to the committee.

From 1994 to 1996 the committee worked on the draft of three complementary standards but in early 1997, after various technical, legislative, and building culture differences between Australia and New Zealand, it became too difficult to carry on as a JTC. The decision was made to go ahead with New Zealand-only standards. In late 1997 drafts of the three standards: NZS 4297: Engineering Design Of Earth Buildings, NZS 4298: Materials And Workmanship For Earth Buildings, and NZS 4299: Earth Buildings Not Requiring Specific Design[6], were released for public comment. After final technical editing, provision of illustrations, and consultation with the Building Industry Authority (BIA), the suite of standards was published in October 1998. The following year all three standards were cited as Acceptable Solutions and Verification Methods in the New Zealand Building Code (NZBC) clauses B1, B2, E2 and H1.

Recognition – National and International

In 2000 Graeme North received an NZIA Research Award for his contribution to the creation of the Earth Building Standards and the following year Standards New Zealand awarded committee members a Meritorious Service Award.

The New Zealand standards are highly regarded internationally and have been cited in the ASTM Standards E2392 "Standard guide for design of earthen wall building systems" since 2010. They are also cited in the SAA document "The Australian Earth Building Handbook HB 125" and have been used by a number of international agencies for rebuilding projects in Haiti and Nepal after devastating earthquakes in both those countries.

Review of the Earth Building Standards: 2010-2018

EBANZ review and revision of the standards

Minor amendments have been made to NZS 4298 and 4299 over the years to keep them current. In 2004 the BIA hurriedly amended clause E2 of the NZBC in response to the leaky building saga but failed to re-cite NZS 4299 as a means of compliance. After much lobbying from EBANZ a new acceptable solution, E2/AS2, was added in 2008 to rectify the omission. When clause H1 was updated in 2007 the new provisions for solid wall construction catered for earthen walls so it is still possible to satisfy those requirements.

By 2010 EBANZ recognised that the standards were at risk of becoming out of date and after consultation with SNZ undertook to start a review process. A committee of expert professionals, including seven members of the 1998 SNZ committee, was set up to undertake a revision of all three standards. A summary of the main areas of change in the proposed revisions and some new sections are attached to this document[7].

Seismic performance and systems testing

Not long into the revision process the Canterbury earthquakes occurred. This provided a real-life test of the performance of earth buildings built pre and post the 1998 standards. EBANZ funded reconnaissance trips by four committee members after both the September 2010 and February 2011 quakes and their findings are recorded in several papers authored by engineers Hugh Morris, Richard Walker and Thijs Drupsteen[8]. In a nutshell: earth buildings built according to the 1998 standards performed very well, even those very close to the epicentres. A similar EBANZ funded reconnaissance trip was undertaken in December 2016 after the Kaikoura earthquakes with similar findings.

EBANZ and the University of Auckland (UOA) have also provided the funding for a series of simulated seismic tests on earth brick veneer construction on full scale walls. The tests took place in Nelson in 2016 and the results are reported in a paper by Hugh Morris et al[9]. The results of these tests inform the proposed sections of internal earth brick veneer construction in the revised standards.

SNZ involvement

In 2013, when the revision drafts were nearing completion, EBANZ approached SNZ to set up an official committee to complete a formal review. At that time SNZ was undergoing a restructuring process and it was not until late 2016, by which time it had become a business unit within MBIE, that SNZ set up a Development Committee to undertake the review. By this stage EBANZ had spent over $42,000 on research, review, and revision related items, and EBANZ members had volunteered hundreds of hours of time with a value well over $200,000.

Under the auspices of SNZ, new committee members were appointed to provide a wider representation over and above those representing SNZ, MBIE, and EBANZ. Representatives were appointed from the New Zealand Institute of Architects (NZIA), Institution of Professional Engineers of New Zealand (IPENZ), Structural Engineering Society (SESOC), Building Officials Institute of New Zealand (BOINZ), Building Consent Authorities (BCA), Universities of New Zealand, Unitec Institute of Technology (UNITEC), New Zealand Certified Builders (NZCB), and the National Association of Women in Construction (NAWIC). A two-day meeting was set up for May 2017 but, two weeks before the meeting date, the Building System Performance (BSP) unit, the entity within MBIE that oversees building regulations, informed the committee that funding was to be suspended for at least

twelve months and that the meeting would not go ahead. That decision was subsequently amended to allow the first formal SNZ Committee meeting to take place before the funding suspension came into effect. At the meeting the current drafts, including new sections on veneer construction, low density earthen materials, strawbale and strawclay, were worked on and specific tasks were assigned to committee members.

Current status

Since May 2017 EBANZ has continued lobbying for the reinstatement of funding for the completion of the revision. In March 2018, Graeme North, Chair of the Development Committee for the review of the Earth Building Standards submitted a request to SNZ and BSP for another Committee meeting to be held in August 2018. The response from Bruce Klein, Team Leader BSP, informed the Chair that MBIE was now withdrawing all support as well as funding for the revision of the standards (email dated 3rd April 2018 attached[10]). The reasons given for this decision was a reallocation of resources following the failure of Wellington's Statistics House in the 2016 Kaikoura earthquakes and a focus on the new Government's initiatives including Kiwibuild and healthy homes standards.

For the committee members who have devoted so much time to this project and to the professional bodies they represent, this decision is inexplicable and seems at complete odds with the BSP's new management team's commitment "to see standards and their review as an important priority" as expressed in the attached email from Klein dated 15th December 2017[11]. A letter was sent by Graeme North to the Minister of Building and Construction, the Honourable Jenny Salesa, querying the decision and asking for support but the Minister declined to be involved and referred North back to Klein and the BSP[12].

Discussions have continued between committee members, EBANZ and SNZ around trialing a more streamlined approach to revisions of Standards. This approach would mean SNZ only takes on the minimum work necessary to ensure that correct process is followed: issuing drafts for public comment and ensuring that other statutory processes are followed. The work would require an administrator who is not part of the formal committee and Ian Brewer, who was the SNZ Secretary for the initial standards, has volunteered to undertake this role. This approach would cost less, requiring around 60 percent of the funding originally allowed for by SNZ.

The revision work is very close to completion with NZS 4297 ready for final formatting and the insertion of figures and tables, and at least 80 percent of the work on the content of NZS 4298 and NZS 4299 done. All that work is set to go to waste without the all-important process of finalising the drafts, putting them out for formal public comment, considering submissions and then issuing the updated standards. Three full formal committee meetings (with input from various sub-committees) are required to wrap everything up: one two-day meeting to review content, one final meeting prior to public comment, and one to consider public comments. The first two of these meetings will take place this year, 2018.

However, this new approach, an industry partnership with SNZ, still requires funding to enable SNZ to carry out its various necessary roles. Funding is estimated to be around $95,000. EBANZ is now working in partnership with SNZ to bring development work on the Standards to its conclusion, and to fund this work, EBANZ needs to launch a fund raising campaign.

Conclusion

The current New Zealand Earth Building Standards published in 1998 embody decades of the specific expertise of a core group of building professionals engaged in earth construction. The suite of three standards are highly regarded internationally and, within New Zealand, have supplied a clear and confident path to compliance for building officials, architects, engineers, builders and home owners. Since 2010 EBANZ has led a review and revision of the Standards and in 2016 SNZ set up a Development Committee to complete the process. One full committee meeting was held but funding and support have subsequently been withdrawn by BSP of MBIE. Currently EBANZ and SNZ are exploring an industry partnership model, where the role of SNZ is reduced, and the necessary funding is sourced from within industry. It is also hoped that MBIE will reconsider its position and reinstate support for this revision.

Building with earth has a long history in Aotearoa New Zealand. Earthen walls have a low carbon footprint and are relatively easy to construct, making them imminently suited for owner-builders or community housing projects, in other words – making them affordable. The New Zealand Earth Building Standards are an essential mechanism for making the continuation of this low carbon, affordable building method possible and it is imperative that the review process be completed.

Min Hall and Graeme North

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[10] Klein, B email to G North 3 April 2018

[11] Klein, B email to G North 17 December 2017

[12] Salesa, J letter to G North 30 January 2018