

Hempcrete Compliance with New Zealand Building Code

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Author - Antoine Tane - Kohu Hemp (antoine.tane@kohuhemp.nz - 0204 154 1192)

Introduction

Hempcrete is a relatively new building system to New Zealand but is a simple system based on materials and principles that are as old as building itself. BRANZ building industry magazine 'Build' ran an article in 2016 titled '[Hemp Construction](#)' which explores and praises hemp construction but notes;

"There are no ready-made compliance paths for the designer to follow – hempcrete is entirely an alternative method. The designer will draw heavily on history of use and comparisons to other similar construction systems to convince the building consent authority of the worthiness of the consent application."

Hempcrete has no equal as a natural building product, sequestering carbon dioxide for the life of the building. Created by simply combining water, hemp aggregate and a lime-based binder it produces a building product with excellent thermal insulating and acoustic properties. Hempcrete walls are as durable as masonry walls and as sustainable as Light Earth walls. The insulation forms the entire wall with the load bearing timber frame fully encased. Hempcrete is not just an insulator - it buffers temperature and humidity, prevents damp and mould growth, making the building a comfortable healthy environment.

Hempcrete is installed using a shutter system as formwork to create a monolithic wall which encases the vertical wall studs and framing, forming the interior and exterior cladding as well as the cavity insulation roles of the structure. This reduces any thermal bridging between internal and external temperatures.

Hempcrete solves many design and building performance problems and is a material that councils should be encouraging the use of, as it;

- Has fantastic insulative properties (350mm wall = R 4.1)
- Is rot / mould / termite / rodent resistant
- Is breathable and leads to better moisture control, reducing levels of condensation resulting in a healthier internal environment
- Is highly fire resistant
- Has a high acoustic performance
- Is carbon negative (pulls carbon from the air to harden the lime over time)
- Is a fast-renewable and low-embodied energy resource
- Is non-toxic and is fully biodegradable - creating no chemically toxic building waste.

This system is the essence of sustainable and smart building practices and has been used widely and proven overseas. Several houses have now been consented by other councils in New Zealand but this is the first proposed for Tasman. Details of one of these houses, in New Plymouth, are attached and this design uses the same hempcrete system we are proposing in our design.

<https://www.nzherald.co.nz/entertainment/grand-designs-has-featured-one-of-new-zealands-first-hemp-homes/B6ZUQVWZDUJ33PO2WDRSHEKYKA/>

Attached are sets of plans of two Hempcrete homes in Wanaka, 162 The Heights & 7 Baker Grove, by [Erkhart Construction](#), which also have regular eaves and are monolithic in construction for already NZ approved hempcrete construction.

Hempcrete is an approved solution in the UK, France and Australia, having been used for decades, has codemark certification in these jurisdictions, but it hasn't been pre-approved yet in New Zealand as it is a relatively new system. See section below titled '**Conformity with Australian Building Code (BCA)**'.

This document intends to show how the Tradical Hempcrete system used in our design can meet the individual relevant criteria in the NZ building code and be used as an alternative solution.

B1 & B2 Structure and durability

The Common House is intended to be constructed on a slab with a traditional timber frame superstructure, using large timbers (200x250mm) and mortise and tenon construction - an ancient technique that stands for 100's of years, Japanese temples were built using this technology and some are still standing over 1000 years later. This structural framing will carry the load of the roof, so any structural load bearing is transferred via the timber framing to the subfloor. The hempcrete is not a structural element. It encases the studs in a rigid wall infill system that is applied as a moist mixture and hardens to form a stiff and insulative casing around the structural components (See supplied OzHemp Tradical HC Install Manual, section 14 - Pg 21 for detail). The timber does not need to be treated as the lime mixture actively desiccates and hardens over time, creating a low moisture and rot-resistant environment, with an elevated pH. From the product importer:

Timber in hempcrete will not rot. This is because inside the hempcrete environment, humidity is in transit. Hempcrete walls and timber are both Hygroscopic, with the ability to absorb or adsorb moisture/water from its surroundings. The vapour-permeability and hygroscopic nature of hempcrete means the timber framing are preserved whether they are treated or untreated.

Building Research Establishment (BRE) Scotland have conducted water penetration determination tests on walls constructed from a mixture of hemp and lime mortar. On completion of the 96 hour water spray test there was no evidence of water penetration through the complete thickness of any of the four test walls. The results indicate that provided the render coating remains well adhered and crack free it is unlikely that rain penetration will transverse the complete thickness (200mm) of the hemp/lime mortar wall. Please see page 23 of the BRE Client report number 209-717 Rev1, in attached document 'projects.bre.hemphomes.pdf'

The hempcrete also provides support and racking strength for the studs.

The **Durability** of hempcrete is innate in its chemical properties – the lime & binder which takes carbon from the atmosphere and becomes harder the longer it is in situ. The hempcrete wall will have two thick layers of lime plaster to protect it from the elements which will be maintained on a regular basis and treated with a breathable water-repellent product (See E2 section). Inside the wall,

the organic hemp shiv is encased in lime and protected from anything that would cause it to degrade.

C – Protection from fire

Hempcrete has very high fire protection properties and is non-combustible. (See supplied OzHemp Tradical HC Install Manual, Pg 8).

Hempcrete complies with the Australian Building code for CP2, P2.3.1 – Spread of Fire, and GP5.1, P2.3.4 Bushfire prone areas. See codemark verification in section below, and the attached codemark certificate & testing results.

Hempcrete Intertenancy Wall - IT Wall

Many duplex and terrace buildings across Europe, US and Australia have successfully used Hempcrete as an Intertenancy Wall. Within the Takaka Cohousing Neighbourhood we're intending to use 300mm hempcrete Intertenancy Walls.

E2 & E3 Moisture

We have drawn from Acceptable Solution E2/AS2 1.0 Earth buildings for compliance with E2. Hempcrete is a similar natural material and has similar properties but outperforms earth building in some areas. The departure from this acceptable solution is fairly minor, and most of the moisture management practices we have adopted, such as the detail for the soffits, and opening designs.

The gable-pitch coloursteel roof protects the building from direct rain, and with 800mm eaves (larger than conventional builds) all of the way around the building this also provides protection from wind-driven rain.

The moisture that does come into contact with the walls accumulates and runs down the wall and falls off via the drip edge on the top coat of lime plaster at the base of the wall and away from foundations. Where an opening occurs, flashings and window/door opening design provide a barrier and diversion for this moisture around the opening, as in conventional buildings.

Since lime renders and hempcrete are vapour permeable and not a complete moisture barrier, some moisture is absorbed into the material. Tests have been carried out to determine the level of water ingress into the material and even with continuous spraying of water, moisture will not penetrate the hempcrete wall. *Again, see page 23 of the BRE Client report number 209-717 Rev1, in the attached document.* When the external moisture drops (stops raining) the reverse process occurs, and the walls actively lose the accumulated moisture and dry out. In this wall system no drained cavity is required because the material itself conducts moisture and dries out. However, this moisture ingress can be greatly reduced by using a breathable water repellent such as: <https://www.resene.co.nz/comn/textures/aquashield.htm> , causing water to bead and run off while retaining breathability.

E3 is where Hempcrete really excels and will readily outperform most acceptable solutions in terms of internal moisture management. Being breathable, there is no build-up of excessive moisture leading to better air quality and a healthier home. Temperature regulation is improved with the

insulative properties meaning it is cooler inside on hot days and warmer inside on cold days, and retains internal generated heat better than most other wall materials owing to its thermal mass and insulative performance.

Hempcrete has been certified by an independent international testing body as a DTC - Deemed to comply (Australian equivalent of Acceptable solution) for The Australian 'Performance Requirements' for Weatherproofing which requires;

P2.2.2 Weatherproofing

A roof and external wall (including openings around windows and doors) must prevent the penetration of water that could cause—

(a) unhealthy or dangerous conditions, or loss of amenity for occupants; and

(b) undue dampness or deterioration of building elements.

See Conformity with Australian Building Code (BCA) section below.

G1 Airbourne & Impact Sound

The Suffolk Housing Society conducted acoustic performance tests on hempcrete intertenancy walls for duplex show that the acoustic test averaged at 57dB which is well within the building code requirements of 50-59dB for IT Walls.

Construction of Intertenant walls tested:

*The partitions between Plot 9 and Plot 8 were of hemp construction also with a large step and stagger. These partitions were built using 100mm x 50mm timber frames at 600mm centres and constructed on site using plywood shuttering to form the Isochanvre (hemp/hydraulic lime plus water)/lime mix in two 150mm thick leaves either side of a 75mm cavity. The finished density of the mix is 550 kg/m³. The shuttering was moved up as the build progressed.' **Please see page 26 of the BRE Client report number 209-717 Rev1***

Below is the table of results for the Hemp Construction IT wall acoustic tests in comparison with an identical conventional build in the same development.

Test No	Source Room	Receiver Room	$D_{nT,w} (C ; C_{tr})$ (dB)
Traditional Construction			
01_0070	Lounge, Plot 10, Park Road	Kitchen, Plot 11, Park Road	63(-1 ; -5)
01_0071	Bedroom, Plot 11, Park Road	Bedroom, Plot 10, Park Road	64(-1 ; -5)
Hemp Construction			
01_0072	Lounge, Plot 8, Park Road	Kitchen, Plot 9, Park Road	58(-1 ; -5)
01_0073	Bedroom, Plot 9, Park Road	Bedroom, Plot 8, Park Road	57(-2 ; -6)

OzHemp Tradical Hempcrete have had the Hempcrete system CertMark approved, in their **Certificate of Conformity CodeMark and CertMark Australia** (attached) the acoustics are approved as reaching the following performance:

The OzHemp Tradical® Hempcrete achieves a variety of acoustic performances for walls and floors as detailed in the installation manual with an $R_w + C_{tr}$ of at least 57 (-2; -6).

This therefore shows that a 300mm hempcrete IT wall is acoustically proficient to meet the requirements of the Building Code.

H1 Energy Efficiency

The inclusion of hempcrete in our design was so that we could achieve a high level of thermal comfort for minimal energy inputs into our buildings, in this regard the hempcrete offers excellent properties. With an R value of 4.1 for our 350mm thick walls, and 3.5 for our 300 mm walls (see section 6, page 7 of the supplied OzHemp Tradical HC Install Manual), the insulative properties of the hempcrete material well exceed the required building code. The insulation for the roof and floor are using conventional building methods.

Hygrothermal properties

Hempcrete is proactive and consistently regulates the variations in temperature and relative humidity within the buildings to guarantee stable and comfortable indoor conditions. This natural characteristic of hempcrete keeps a consistent ambient air quality, cool in the summer and warm in the winter. (See section 2 , p10 of the OZHemp Tradical HC Install Manual)

Energy efficiency and carbon sequestration

The UK Renewable House Monitoring Programme Report 2015 attached writes:

“One of the significant technical outcomes of this project is the contribution to establishing a scale of the reductions in the energy consumption and carbon emissions rising from using Hemcrete® (A UK Trademarked version of hempcrete). Simulation analysis work by Jankovic (2014)2 at Birmingham City University used new approaches and monitoring data from this project to develop and validate a more accurate modelling approach than that available with other commercially available tools.”

“The Renewable House Monitoring Report research demonstrated that the insulating property of Hemcrete® mean that heating plant can be reduced in size, reducing corresponding energy consumption and carbon emissions, which could be in the range between 50% and 80% lower than in buildings with conventional brick and block construction insulated to the same U-value as the Hemcrete® construction. The lower energy demand in-use, combined with the negative embodied carbon footprint (carbon sequestration potential) of the Hemcrete® structure at -4.3 tonnes CO2 (compared with +10.7 tonnes CO2 for brick-block house of same dimensions).”

See page 3 of 2.170701 BCA free standing dwellings published copy.pdf (attached)

Hempcrete has independently verified tests confirming that it complies with the Australian Building Code JP1, P2.6.1 Thermal. See the **CodeMark Certification Scheme _ Australian Building Codes Board** (attached).

Compliance with Australian Building Code (BCA)

Hempcrete has passed the many relevant externalised tests (from Codemark International) to demonstrate compliance with Australian building codes in the same areas as required by the New Zealand building codes C, E2, E3, and H1.

More info RE: Codemark and Conformity to BCA:

CodeMark Certification Scheme _ Australian Building Codes Board.pdf (supplied)

Hempcrete Certmark CMA-CM40184.pdf (supplied)

While I realise that the CodeMark certificate cannot be accepted as an acceptable solution for compliance with the NZ Building codes, I do think that it shows how hempcrete has been independently tested and verified to comply with relevant Australian building standards which endeavour to achieve the same or greater standards of building performance required by the NZ Building codes.

I’ve cross referenced the relevant NZ Building Codes with their Australian counterparts below;

NZBC Section C

= AUS NCC P2.3.1

P2.3.1 Protection from the spread of fire

- (a) A Class 1 building must be protected from the spread of fire from—*
 - (i) another building other than an associated Class 10 building; and*
 - (ii) the allotment boundary, other than a boundary adjoining a road or public space.*
- (b) A Class 10a building must not significantly increase the risk of fire spread between Class 2 to 9 buildings.*

NZBC Section E

= AUS NCC P2.2.2

P2.2.2 Weatherproofing

A roof and external wall (including openings around windows and doors) must prevent the penetration of water that could cause—

- (a) unhealthy or dangerous conditions, or loss of amenity for occupants; and*
- (b) undue dampness or deterioration of building elements.*

NZBC Section H

= AUS NCC P2.6.1

P2.6.1 Building

A building must have, to the degree necessary, a level of thermal performance to facilitate the efficient use of energy for artificial heating and cooling appropriate to—

- (a) the function and use of the building; and*
- (b) the internal environment; and*
- (c) the geographic location of the building; and*
- (d) the effects of nearby permanent features such as topography, structures and buildings; and*
- (e) solar radiation being—*
 - (i) utilised for heating; and*
 - (ii) controlled to minimise energy for cooling; and*
- (f) the sealing of the building Open link in same envelope against air leakage; and*
- (g) the utilisation of air movement to assist cooling.*

History of use

NZ

New Zealand has a handful of buildings that have successfully been built to demonstrate compliance with the New Zealand Building Code. One of these is attached – 175 Paraite Road, New Plymouth. Consented by NPDC 23rd July 2013. I have a copy of this consent and it can be supplied on request.

<https://thisnzlife.co.nz/build-house-hemp/>

Another house was consented and constructed in Taranki and featured on 'Grand Designs NZ'

<https://www.stuff.co.nz/life-style/home-property/84829779/grand-designs-nz-hemp-house-proves-green-rass-is-greener>

Australia

Australia is well down the path with Hempcrete and has numerous hemp building companies that specialise exclusively in building consented modern hempcrete clad homes

<http://www.hempbuildingwa.com/gallery>

<https://www.maitlandmercury.com.au/story/4909647/hemp-sweet-home/>

<https://hemphomesaustralia.net.au/project-gallery/>

Worldwide

A search of the internet reveals that there are hundreds, if not thousands of buildings from tiny houses to giant industrial warehouses that have been consented and constructed in Europe. Some notable ones are attached:

A high profile housing development by 'Grand Designs UK' host, and Architect Kevin Macleod in 2011:

<https://www.theguardian.com/tv-and-radio/2011/nov/19/kevin-mccloud-housing-triangle-swindon>

A large 13,700 sqM supermarket & warehouse in UK constructed in 2012 with precast hempcrete:

<https://corporate.marksandspencer.com/stories/blog/mands-cheshire-oaks-store>

More can be provided on request

Other articles from trusted institutions about the use of hempcrete

<https://www.buildmagazine.org.nz/assets/PDF/Build-154-84-Sustainability-Hemp-Construction.pdf>

<https://www.rics.org/oceania/news-insight/future-of-surveying/sustainability/natural-building-materials-hemp/>

In summary

As outlined above, hempcrete is a new system based on old technology that outperforms many existing building systems in terms of building performance. The costs of hempcrete are more than a conventional home, but these costs are saved in the long run due to the building energy and hydrothermal performance.

I hope that I've been able to demonstrate in this document that this system has already been tested and shown to comply with building standards that are equal to New Zealand's building code.

If there are any points that need further clarification, or if you have any further questions for me then please feel free to email me at antoine.tane@kohuhemp.nz, or phone me on 0204 154 1192.

Thank you,

A handwritten signature in black ink, appearing to be 'Antoine Tane', with a stylized, looped initial 'A' and a horizontal line extending to the right.

Antoine Tane

Director

Kohu Hemp Ltd

www.kohuhemp.nz