Selecting External Wall Claddings for Multiple Unit Housing

- Options and Selection Process

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1.0 Introduction

1.1 Title

Selecting External Wall Claddings for Multiple Unit Housing, Options and Selection Process.

1.2 Research Question

What are the alternative cladding solutions for medium density housing and what are the considerations designers need to make when selecting these solutions?

1.3 Research Rationale

The increasing demand for housing in New Zealand, in particular affordable housing, has resulted in an increase in residential building activity across New Zealand, with Auckland and Christchurch currently experiencing strong growth. The construction industry is responding to this demand in a number of ways, with the development of large-scale residential developments being seen as a cost effective way to address this demand. Due to the scale of these new neighborhoods and the **repetitive nature of mass housing**, designers are looking for ways to **ensure character, personality and variation** is occurring within these neighborhoods. The existing default for our housing stock is **timber weatherboards and brick,** mainly due to the cultural perception these materials have for quality, availability and the existing knowledge and experience of our contractors. As designers look to design new housing typologies for these neighborhoods, alternative cladding solutions are continuously being sort after.

1.4 Research Methodology

The research project will initially involve the investigation of precedents and case studies, which are specifically orientated towards Studio Pacific Architecture. The existing cladding options that are currently at use on their medium density housing will be established; which will allow an investigation into finding alternative uses or options for those cladding systems; that are yet to be utilized. Fully alternative-cladding systems will then be investigated in hopes of further widening the 'typical cladding selection', however must be available to the New Zealand market. These claddings will be analyzed in regards to the requirements to achieve building compliance via alternative solution. This exercise will be speculative and will assist in identifying any implications and issues, which may prevent achieving the code compliance. To assess the usability of the product at Studio Pacific Architecture, the cladding system will be assessed against other claddings systems (existing systems) and applied to a 'live' project to evaluate the more qualitative (i.e. visual aesthetics) aspects of the cladding.

This research project will establish a premise for future consideration / directionality in exploring new cladding systems, which will further add distinction to Studio Pacific Architecture's pallet of cladding options for medium density housing. It can also be resource for individuals (such as students and graduates) to gain a grasp of Studio Pacific Architecture's medium density housing projects, and factors to consider when selecting such cladding systems.

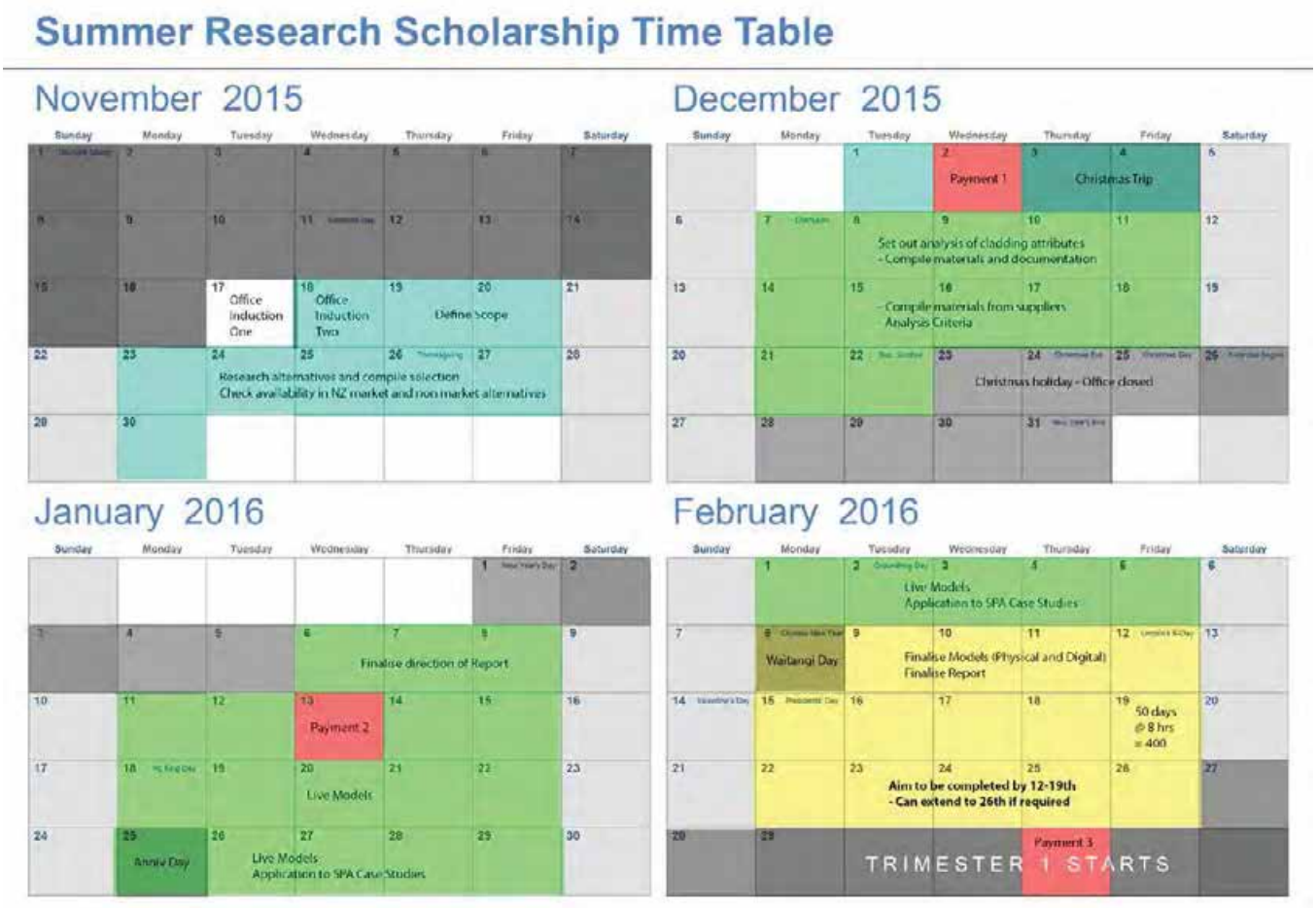
1.5 Research Milestones

The following milestones shall be reached as required.

- **1/3 (Early December)**: A selection of alternative cladding systems will be established with focus on several which will suit the needs of Studio Pacific Architecture. An initial collection of potential New Zealand suppliers may also be identified.
- **2/3 (Late January):** An assessment of selected cladding systems will be analyzed based on predefined factors (i.e. cost, durability etc.) within an assessment criteria matrix. An initial application of cladding systems to various case studies specific to Studio Pacific Architecture will be conducted.
- **3/3 (Mid February / End of Summer period):** Completion of draft report and generation of live models.

1.6 Research Timetable

The following timetable depicts the major dates during the summer scholarship period.



1.7 Medium Density Housing in New Zealand

Medium density housing in New Zealand is a progressive urban development strategy, which is present in most New Zealand Cities, particularly in the Auckland region (Turner). This strategy promotes and caters for population growth within an intensified urban form (essentially increasing/doubling the amount of dwellings per section). Typical medium density housing typologies include 'stand-alone dwellings', 'terraced housing', and apartment complexes (Ferreira).

As stated earlier, due to the scale of these new neighborhoods and the repetitive nature of mass housing, the issue of generating variation and character becomes limited with the default to using typical wall cladding systems present on the New Zealand market. This default is suggested to result primarily from the cost and 'understanding' of the material. Well-established cladding options such as timber weatherboards are generally perceived as 'affordable and traditional' options.

The following examples are common medium density housing typologies present in New Zealand.

Examples of Detached Medium Density Housing Typology (source: www.mfe.govt.nz)

Location: Takanini, Auckland

Location: Delmain, Christchurch

Examples of Terraced Medium Density Housing Typology

Location: Glen Innes, Auckland

Location: Manukau, Auckland

Examples of Apartment Type Medium Density Housing Typology

Location: Mt Cook, Wellington

Location: Ellerslie, Auckland

1.8 Early Wall Claddings in New Zealand

Early European settlers to New Zealand had generally used natural materials such as stone or earth (clays and sods) to replicate dwellings found in Britain, which were constructed from brick and stone. This notion of using permanent materials was believed to carry a 'higher social status' compared to impermanent materials such as timber. Timber structures progressively became a dominant construction material due to its availability and durability, especially during the Wellington earthquakes of 1848 and 1855. However, brick claddings were still popular and widely used (Schrader).

A significant period of New Zealand's history in regards to housing developments was witnessed during the early 1900s where the New Zealand Government established a major state housing scheme, which saw thousands of public housing being erected throughout New Zealand (Ministry for Culture and Heritage). Much of these state houses were standardized in terms of form and building materials (typically of light timber framing), however, some methods were employed to achieve varying aesthetic appearances – which included the use of alternating wall claddings and colours (Renovate).

State housing were typically cladded in affordable and durable materials, including; bevel-backed weatherboards, brick veneer, or asbestos-cement sheets. Many privately owned houses were cladded in the same fashion, with the addition of stucco finishes. During the 1960s, a wider range of cladding materials were used – especially 'architect-designed homes' which introduced alternative materials, including; plywood, timber board and batten, vertical weatherboards such as shiplap and Hinuera stone (Renovate).

Examples of early state housing in New Zealand (source: www.nzhistory.net.nz)

Location: Naenae, Lower Hutt

Location: Petone, Auckland

1.9 Current Wall Claddings in New Zealand (Typical)

Many new claddings have since been developed to cater for aesthetics, technical advancement, and changes in building regulations (regulations generated primarily to create a framework to regulate construction standards for the interest of the public/occupants). Regulations include the requirement of using treated timbers and cavity systems behind wall claddings (BEAL), while other regulations include managing the types of cladding systems which are 'acceptable' to use. These regulated cladding systems are substantiated and documented in the compliance documents within the NZBC – specifically in E2AS1 – External Moisture, which contain minimum requirements and means (an "Acceptable Solution') to create a code complying project.

Codes and standards are also developed for the cladding systems, i.e. NZS 4210:2001 - Masonry construction: Materials and workmanship – which deals with the installation and treatment of Brick / Masonry materials.

The following cladding systems are stated in E2/AS1 – External Moisture which contain 'acceptable solutions' to gain building compliance.

As per E2AS1

- Timber Weatherboards
- Plywood Sheeting
- Fibre Cement Sheeting – Weatherboards and Panels
- Profiled Metal Cladding – Vertical and Horizontal Profiles
- Brickwork
- Plaster / Stucco
- EIFS (Externally Insulated Finishing System)

As per E2AS2

- Earth Buildings – Such as Rammed Earth

As per E2AS3

- Concrete – Precast, Insitu, and Concrete Masonry

Of course there are numerous other cladding systems available in New Zealand – such as the use of natural stone claddings or fully integrated systems such as structurally insulated wall panels; which differs partially or completely to those described as an acceptable solution mentioned above. These systems will typically fall under the 'Alternative Solution' category. Refer to section **4.2 - Implications With Alternative Cladding Systems** for details and processes involved with alternative solutions in regard to building code compliance.

Examples of contemporary claddings often used in New Zealand housing projects.

EIFS system by STO
(Source: www.sto.co.nz)

Aluminium panels by Ullrich Aluminium
(Source: www.aluminiumcladding.co.nz)

2.0 What are the Current Wall Claddings used at SPA?

2.1 Medium Density Housing Projects at SPA

Studio Pacific Architecture is involved with multiple medium density housing projects, which are primarily observed to be within the Auckland region. The housing often includes the detached and terraced dwelling typologies.

Some of the medium density housing projects in which Studio Pacific Architecture is currently (as of summer 2015-2016) involved with are:

- **Hobsonville**, Auckland (2013 – Current) **Client:** Willis Bond & Co
  Source: Resource Consent Set – 17 April 2014 – Road A4 Elevations

- **Overlea Central**, Auckland (2014 – Current) **Client:** Housing New Zealand
  Source: Developed Design Set – 18 November 2015 – Eistree Avenue Elevations

- **McLennan**, Auckland (2014 – Current) **Client:** Housing New Zealand
  Source: Resource Consent 1C Set – 24 November 2015 – Block Elevation (West)

The particular drawing issues were selected as they were submitted during Resource Consent (which suggests that the form will not deviate dramatically from this point) while the Overlea Central Developed Design set, was suggested by the SPA team.

2.2 Client Requirements for Medium Density Housing

Much of the medium density housing projects are established by the **Housing New Zealand Corporation** – a government agent whom provides housing for the New Zealand's impoverished that are in-need of affordable accommodation. Housing New Zealand's focus is generally towards the management of state-housing and its tenancies. Currently, the agency manages approximately 68,000 properties nationwide, including some 1500 houses for community groups. It is estimated that more than 193,000 individuals live in Housing New Zealand's properties. (Housing New Zealand Corporation)

Within these projects, Housing New Zealand will provide a set of requirements / standards in their 'Housing Standard – Design (2015)' document; which is to be executed by the designer/architect. These requirements will determine the direction of the architecture and its aesthetic – ultimately affecting the exterior wall claddings to be used.

Housing New Zealand's controls are in accordance with the '1947 Housing Improvement Regulations', which lends provisions to ensure that *"Housing New Zealand's housing can be adapted for a range of long time needs and withstand accelerated wear, are cost efficient to operate and have increased safety features to meet the needs of our customers"*

Four critical areas to respond to are being:

- **Dry;** The Building Envelope must be **weather-tight and durable**, protected from internal moisture and mold.
- **Warm;** The Thermal Envelope shall have adequate thermal performance and effective heating.
- **Safe;** The dwelling must be safe for its tenants and include security, driveway safety, early fire warning systems, and protection from accidental injury.
- **Essential Amenity;** Include services, product and amenity, which are to be, energy efficient, healthy, sustainable, and adaptable for a range of user needs.

The passages within the Housing New Zealand, Housing Standard – Design (2015); which deal specifically with the cladding system are as follows;

Section	Clause / Table	Criteria
Housing – Typical A - Space	• 1.0 Dry - Weather-tight and Durable	• NZBC E2/AS1 Risk Matrix assessment score must be 12 or less
Housing – Typical B - Systems	• 2.0 Building Envelope and Structure **-** Cladding	• All cladding systems include a 20mm drained and ventilated cavity and with vermin stop protection. • All paint finishes are in accordance with HNZ (Dulux) specifications to ensure long term warranties and performance. • Plywood cladding, single skin exterior insulating finish system, polystyrene and plaster cladding systems, horizontal profiled metal cladding, and stucco cladding systems are not permitted. • Stained finishes are not allowed.

Not all medium density housing projects by Studio Pacific Architecture will be directed by the Housing New Zealand Corporation, however they may share similar performance requirements, as they are similar in terms of locality, scale, costing considerations etc.

In addition to those requirements mentioned on the preceding page, the following requirements are also to be considered, which can be applied to most housing projects;

- **Cost effective**, as many of these medium density-housing schemes are Developer or State driven, cost becomes an essential factor to produce a viable project.
- Relatively **available** in the New Zealand (both the product itself and ample suppliers), which will assist in reducing costs.
- Relatively **low maintenance / durable** to further reduce costs and minimizing requirements for continuous up-keep, which will ultimately mitigate potential risks when accessing the cladding (for cleaning or replacing).
- Is already **compliant** or is **able to be compliant to the NZBC,** as there are numerous homes generated (medium density housing projects); therefore having compliance via 'acceptable solution' will ultimately reduce potential risks in 'failure' of the system and reducing risk and liability with the Architect/Designer.

  (Sourced from SPA Team)

2.3 Typical Cladding Options Used on Medium Density Housing

The following cladding systems are found to be the most typically used and prominent in Studio Pacific Architecture's current medium density housing projects (as of Summer 2015):

Cladding Type	Primarily Witnessed in	Configuration	Finish	Other Notes
Masonry Block / Brick Veneer	• Overlea Central • McLennan • Hobsonville	• Stack Bond (concrete) • Running Bond (Brick)	• Natural • Painted • Bagged	• Fire rating and used can be used at boundary lines
Timber Weatherboards	• Overlea Central • McLennan • Hobsonville	• Horizontal: Bevel back, Shiplap • Vertical: Shiplap	• Painted • Stained (HNZC - TBC)	• Pine and cedar typically used. Cedar considered a premium option
Profiled Metal	• McLennan • Hobsonville	• Vertical layout	• Powdercoat	• Trough Profile has been suggested

Note: These claddings are based on Resource Consent and Developed Design Drawings;

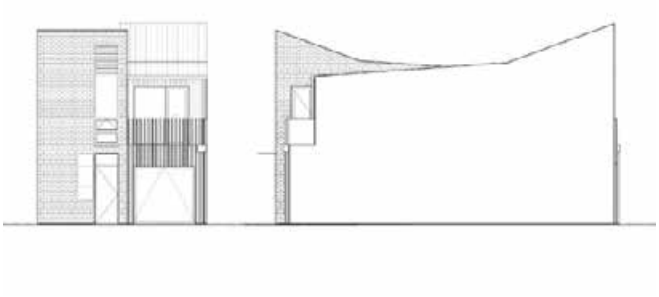
- **Hobsonville**, Auckland – *Resource Consent Set – 17 April 2014*
- **Overlea Central**, Auckland – *Developed Design Set – 18 November 2015 (as suggested by SPA team)*
- **McLennan**, Auckland – *Resource Consent 1C Set – 24 November 2015*

It should be noted that other cladding materials such as fibre-cement have been suggested as a substitute for timber weatherboards; while other cladding systems, may have been explored in previous or subsequent drawing issues. However these systems will be excluded for the purpose of simplifying this section of the investigation.

Although these cladding systems are typical in the building industry, Studio Pacific Architecture is able to generate visually unique designs by the employment of specific configurations of claddings to produce a contemporary aesthetic, while being practical also. As observed, the cladding types stay consistent throughout the housing development while containing a noticeable hierarchy of materials where certain materials are used more predominantly than others (a ratio of materials). Typically there is a primary, secondary, and at times, a tertiary material. These materials are used to juxtapose against each other to further accentuate certain architectural features. Alternating colour schemes is also introduced to create further variation between structures and within the streetscape.

The following are examples of cladding configurations witnessed in each of the medium density housing developments mentioned earlier. These particular housing typologies represent some of the more 'typical' housing styles found within these projects (Also are housing typologies suggested by SPA team).

Hobsonville, Auckland – *'Flick Flack' Terraced Housing Unit*



Primary: Brick Veneer in running bond

Secondary: Vertical Shiplap Cedar boards

Tertiary: Concrete Panels / blocks at Boundaries

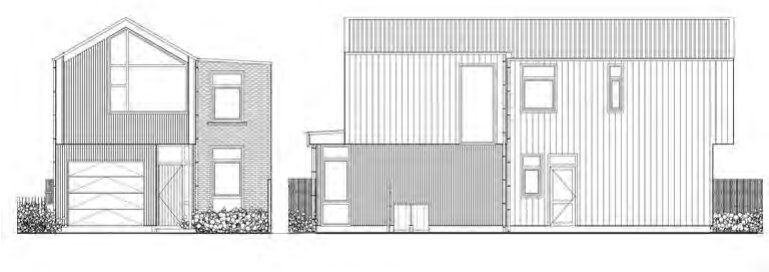
Overlea Central, Auckland – *'Type A1' Detached Housing Unit*

Primary: Vertical Shiplap Pine boards

Secondary: Vertical Shiplap Cedar boards

Tertiary: N/A

McLennan, Auckland – *'Type H' Detached Housing Unit*



Primary: Vertical profiled metal cladding

Secondary: Vertical shiplap Cedar boards

Tertiary: Brick Veneer – Running Bond at Boundary

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3.0 Are Alternative Options Available for These Current Wall Claddings?

The following section will explore potential alternatives to the previously mentioned cladding systems that are not typically witnessed on the medium density housing projects (Hobsonville, Overlea Central, and McLennan) at Studio Pacific Architecture.

The investigation will involve the establishment and analysis of the **primary visual characteristic** evident in that particular cladding - i.e. it may be the modularity or the horizontal / vertical lines which is the principal element in that cladding. This characteristic will be further explored and its availability to New Zealand must be considered. By exploring this certain element will assist in refining and simplifying this part of the investigation. Finishes will not be included.

3.1 Alternative Options for Brick

Key Characteristic: Unit Modularity and Order

Common Finishes: Unfinished, Coloured – brick and mortar (infused / painted), mortar pointing, texture (such as bagged)

Currently the options for brick are limited in order to be compliant to the NZBC. According to E2AS1. Section 9.2.2 – *'Masonry Units shall be laid up in running bond'*, which does limit the extent of 'alternative' configurations which can be obtained using brick; as stretchers (long face of the brick) can only be offset by 25%-75% (recommended by MidlandBrick.co.nz). Some alternative bonds can include:

- Common Bond, English Bond, Flemish Bond, Stack Bond

However, stack bonds are outside of the scope of the NZBC and will require a 'Specific engineering design' (Firth NZ).

Although brick modules typically conform to an ordered and flush configuration, alternating the brick by extending bricks outward or inward beyond the typical finished face of the façade, can add further dynamism to the typical 'flat' façade.

This can be witnessed in a local commercial development – the Light House Cinema at 29 Wigan St, Te Aro, demonstrating an effective yet subtle patterning to an otherwise, plain wall.

The following table displays local trade branches that were contacted, which were involved in projects, which involved alternative brick configurations.

Suppliers	Location	Phone	Email	Website
Creative Brick and Stone	Wellington	04 234 8049	chris@creativebrickandstone.co.nz	http://www.creativebrickandstone.co.nz/

Recent systems have been developed which the brick modules have integrated backings as a substrate to be fixed to – called 'Brick slips' rather than pure reliance on mortar as the bonding agent between bricks. This in fact may foster alternative bonding to be easily achieved, such as stack bonds. Brick slips are not the only material that can be utilized in this type of system. Stone tiles can also be used which can add further elegance and sense of 'quality' to a residential development.

The following table displays local trade branches that were contacted, which supplied information in regards to the installation of brick slips.

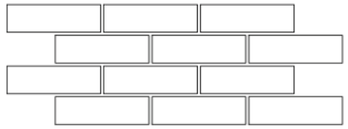
Suppliers	Location	Phone	Email	Website
Brick and Stone Si	Christchurch	03 349 5006	shane@brickandstonesi.co.nz	http://www.brickandstonesi.co.nz

Brick Veneer

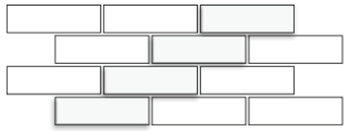
Typical System Used

Alternative Configuration / Profile

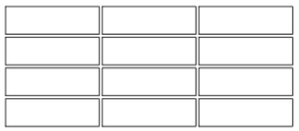
Configuration Diagrams



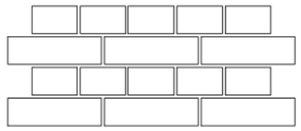
Running Bond (As per E2/AS1)



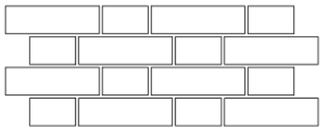
Running Bond with ‘out of plane’ bricks



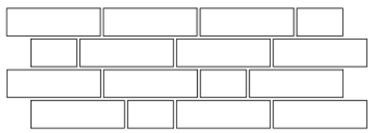
Stack Bond



English Bond



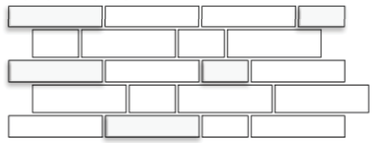
Flemish Bond



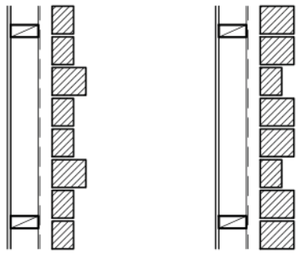
Randomised Bond - alternating header and stretcher

Running Bond with alternating brick widths

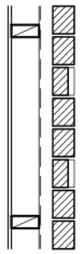
Randomised Bond - alternating header and stretcher with alternating brick widths

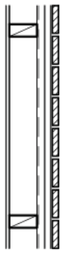


Randomised Bond - alternating header and stretcher with alternating brick widths with out of plane bricks



Diagrams depicting how ‘out of plane’ bricks is achieved by the use of 70 and 110 series bricks
Note: 40mm cavity must be maintained



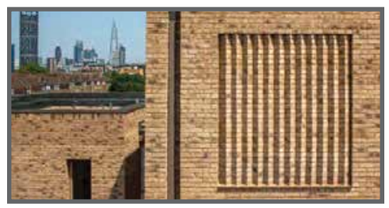


Brick slips on substrate on drainage cavity

Live Examples

Stack Bond - Typically will require ‘specific design’

Out of Plane Bricks - Produced by BrickandStone NZ



Examples of ‘out of plane’ bricks

Examples of randomised brick modules

3.2 Alternative Options for Timber Weatherboards

Key Characteristic: Horizontality / Verticality and Order

Common Finishes: Unfinished, Coloured – Painted or stained

As timber weatherboards are typically **fixed to a specific profile** – depending on the manufacturer, the extent of alternative configurations may be limited to the predetermined sizes (typically depth).

However, it may be possible to vary the board widths either by using various predetermined widths or custom cutting, to create a unique and stratified aesthetic.

Additionally, weatherboards, which also alternate in thickness – called 'random thickness and width' – a proprietary product produced by JSC Timber; has also been developed – which further accentuates the stratified characteristic.

The following table displays local trade branches that were contacted, which produces a proprietary product that integrates a 'random width and depth' weather boards.

Suppliers	Location	Phone	Email	Website
JSC Timber (actual product)	Auckland	09 412 2800	sales@jsctimber.co.nz	http://www.jsctimber.co.nz/
	Christchurch	03 348 9726		

An effective technique and what is primarily witnessed in New Zealand is finishing timber weatherboards by staining (coloured or transparent) and painting. These finishes however, will require maintenance or re-application in order to ensure the continuous protection of the timber from moisture.

- It recommended that stained timbers should be recoated every 4-5 years (BRANZ).
- It is recommended that painted timbers should be recoated every 7-10 years (BRANZ).

However, the exterior should be continuously washed and inspected every year.

The timber used has also an implication on durability – i.e. such as the use of cedar or pine. Pine (Radiata pine) tends to be less stable than cedar. JSC Timbers suggest that Radiata is best to be used as bevel-back weatherboards with light colours, and not in a ship-lap profile.

An interesting finish to a timber boarding called **'Shou-Sugi-Ban'** originating in Japan (Translated as 'the burning of Japanese Cypress') is a finishing process, which is becoming increasingly popular internationally. The process involves the timber to be subjected to an open fire / flame to achieve a charred finish (approximately 3-5mm deep).
It is suggested that the charred surface renders the timber to be nearly 'maintenance free', making it resistant to fire, rot, and pests. It is also suggested that this method extends the life span of the timber to an excess of 80 years. (Johnson).

It should be noted that the highly dark finish to the exterior will impact on heat gain, therefore may cause increase in cooling costs. The incorporation of ventilated cavities and ventilation openings has been used to alleviate heat gain (Johnson). However, some suppliers do suggest that the use of such a product should be carefully considered and avoidance from direct weathering should be maintained.

There are no specific suppliers of this product / finish in New Zealand. However, it has been used occasionally, such as in New Zealand's 2014 Home of the Year located near Kaiwaka, by Cheshire Architects of Auckland.

(http://cheshirearchitects.com/projects/eyrie)

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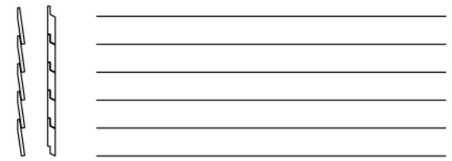
Timber Weatherboards

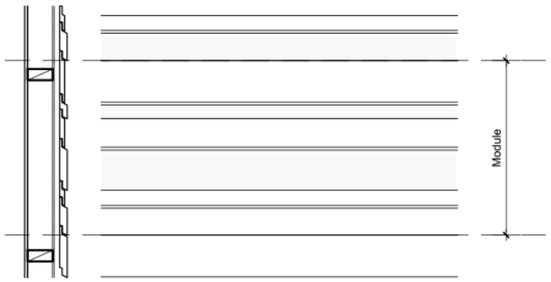
Configuration Diagrams

Typical System Used

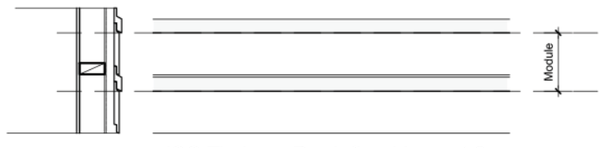


Horizontal: bevel back weatherboards,
Vertical: Shiplap weatherboards

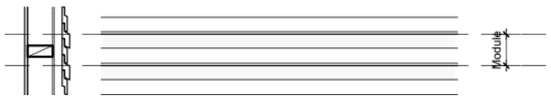
Alternative Configuration / Profile



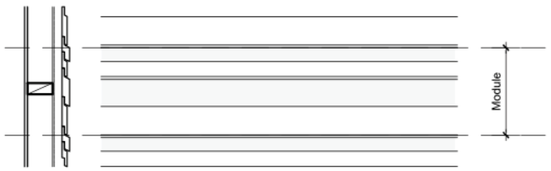
JSC Timber - Predefined Layout 1



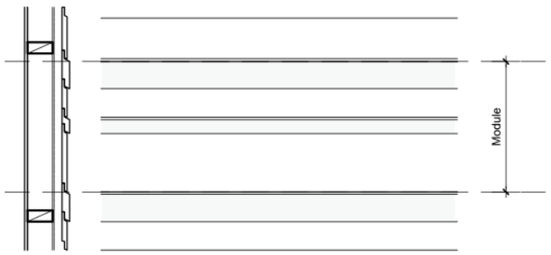
JSC Timber - Predefined Layout 2



JSC Timber - Predefined Layout 3



JSC Timber - Predefined Layout 4

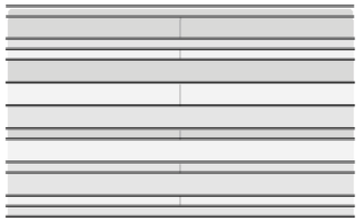


JSC Timber - Predefined Layout 5

Vertical layout with similar
characteristics available with JSC timber

Weatherboards with randomised
heights (Two Heights)

Weatherboards with randomised
heights (Three Heights)



Weatherboards with randomised
heights (Three Heights and alternate
colouring)

These varying weatherboards
can be achieved by using the
JSC or Herman Pacific ‘Custom’
Weatherboard range

Live Examples

Examples of the Shou-Sugi Ban.
The Third Image depicts an example of
this cladding used in New Zealand by
Cheshire Architects of Auckland.

Use of Weatherboards with vertical
elements at the YN-13 House by Morris
Sato Studios

Use of Weatherboards on a lapped
panel at the Communication Centre at
Pangbourne, UK

Randomised Weatherboards
varying in height

Randomised Weatherboards varying in
height and depth
- Produced by JSC Timber

Randomised Weatherboards
- coloured

3.3 Alternative Options for Profiled Metal Cladding

Key Characteristic: Horizontality / Verticality and Order

Common Finishes: Unfinished, Coloured – Painted and powdercoated. Alternative materials can also achieve differing aesthetic, such as Zinc, Galvanised steel, Aluminum, copper etc. Metal claddings are typically rolled from steel sheet or steel composite.

The use of any profiled metal claddings is dependent on its 'rib' or 'peak' shape / configuration as each of these demonstrates a highly differing aesthetic. These ribs are generally based on the following profiles:

- Corrugate Profile, Trapezoidal Profile, Trough Profile

Similarly to timber weatherboards, profiled metal claddings are typically predefined depending on the manufacturer. However, it is possible to create custom profiles to suit a certain project. This is witnessed on a local Wellington project – the Nouvo Urban Village, situated at 7 Alfred Street, Basin Reserve. The custom profile deviates from the standardized / regular profiles mentioned above, while having the beneficial properties of profiled metal – being durable, ease of constructability, and low in maintenance.

The more contemporary profile (in comparison) is perhaps the trough profile; which also consists of various jointing / seam profiles that add further distinction to the application. Troughs are also available in various widths; therefore the generation of a custom 'barcode' aesthetic on an exterior is easily achieved. However, troughs are rolled from pre-defined 'coils' of differing widths. Anything that deviates from these coil sizes will incur additional costs (Suggested by 'Roofing Industries' of Auckland).

The following table displays local trade branches that were contacted, which is able to generate custom corrugate sizes, or have alternative corrugation sizes available.

Suppliers	Location	Phone	Email	Website
Idiens Sheetmetal & Roofing	Christchurch	03 379 9694	greg@sheetmetals.co.nz	http://www.sheetmetals.co.nz
Eurometals	Waikanae	04 293 6422	lizzie@eurometals.co.nz	http://www.eurometals.co.nz
VMZinc	N/A	027 704 9367	Shane.chalmers@ap.umicore.com	http://www.vmzinc.co.nz/

The following table displays local trade branches that were contacted, which is able to generate custom trough details to create a 'barcode' type aesthetic.

Suppliers	Location	Phone	Email	Website
Roofing Industries	Auckland (Head Office)	09 414 4585	office@roof.co.nz	http://www.roof.co.nz

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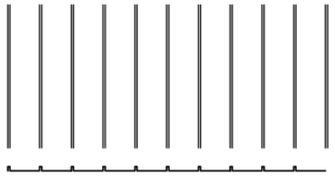
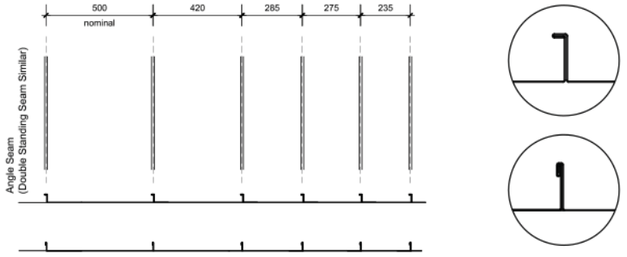
Profiled Metal

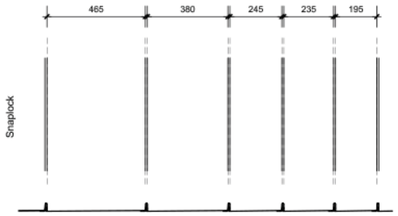
Configuration Diagrams

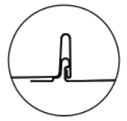
Typical System Used



Regular spacing on metal profile - exact profile / style is undefined

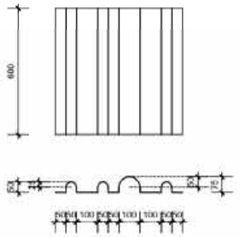




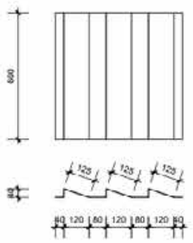


Alternative Configuration / Profile fabricated by Idiens

Square profile witnessed at Nouvo Apartments (exact dims unknown)

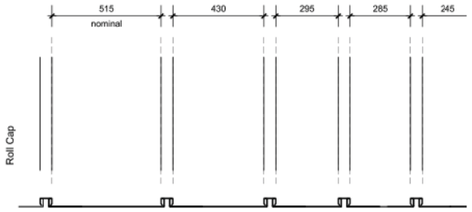


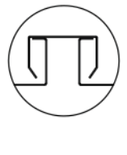
Circular profile

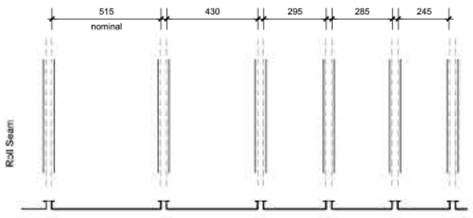


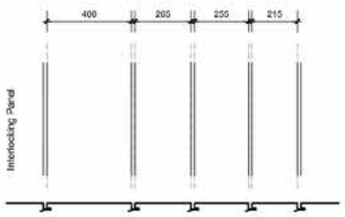
Triangular profile

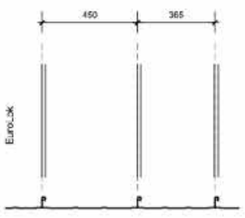
Alternative seam / pan profiles available to trough profile











Live Examples

‘Barcode aesthetic’ produced on various residential projects by TrayRoofing

‘EuroLok’ system which offers a larger / extended square rib. Can be applied without substrate.
- produced by Roofing Industries NZ

Custom rectangular Profiles at the Nouvo Apartments
- Produced by Ideins Roofing

‘Barcode aesthetic’ produced on the Ohakea Air Movements Terminal by Roofing Industries NZ

Zig Zag profile produced by Prefa (Eurometals is the New Zealand distributor)

4.0 Are There Alternative Wall Cladding Systems Available?

4.1 Alternative Cladding Systems – Preliminary Investigation

The following section will consist of a preliminary investigation of alternative wall claddings which have been produced and applied to various architectural projects; both locally and internationally. The intention of generating an brief library of alternative wall claddings is to promote a better understanding of what is available in terms of new systems – which **has the potential** to be integrated into New Zealand's market.

The sections will be simply categorized into the material types, **similar to what is demonstrated in E2/AS1**, then into its speculated composition / structural build-up. The categorization will be based on the author's own understanding and perception of that cladding system, and may be subjective.

The cladding types will be categorized into the following;

Full Systems – Includes Structure and Cladding

- **Integrated**: Structure and cladding is **visually one element.**
- **Opening**: A unique treatment of an opening – typically the cladding is a continuous element and fully integrated with the opening.

Screen Systems – A completely separate building element, which is **visually independent** from the building structure and is typically a sun / weather-screen.

- **Paneling**: Enclosed paneled system.
- **Opening**: Typically treated as a rain screen or sun-screen with glazing behind.

Surface Finishes – More of a decorative motif, which is applied to the surface and will have no real effect on structure and weatherproofing.

- **Paneling**: Replication of a decorative motif in a panelized form.
- **Printed:** Application of a surface pattern which can be integrated into the structure or by a third party applicator.
- **Natural:** No artificial colours added.
- **Colorized:** Application of artificial colour, which is not typically, witnessed 'naturally' in that material.

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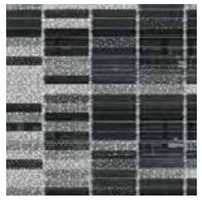
Full Wall Systems		Screen Systems		Surface Finishes			
Fully Integrated	Openings	Panelling	Openings	Panelling	Engraved	Printed	Colourised
							
							
							
							
							

‘Other’ Wall Claddings

Conclusions;
These options are not specifically covered in the New Zealand Building Code.

- Stone
- Glass
- Polycarbonate / plastics
- ‘green façades’
- Fabrics / netting

Full Wall Systems		Screen Systems		Surface Finishes			
Fully Integrated	Openings	Panelling	Openings	Panelling	Engraved	Printed	Colourised
							
							
							
							
							
							

Rammed Earth

Conclusions;
Natural construction option, which includes many benefits including;

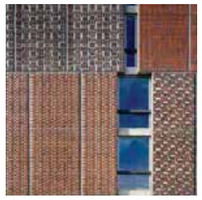
- Is natural, therefore eco-friendly
- Low cost of materials
- Highly durable
- Low maintenance
- Passive heating
- Non combustible

However, the disadvantages include;

- Higher contract cost
- Time issues (soil testing)
- Design limitations (height / opening widths are limited)

Full Wall Systems		Screen Systems		Surface Finishes			
Fully Integrated	Openings	Panelling	Openings	Panelling	Printed	Natural	Colourised














Brick / Terracotta Wall Claddings

Conclusions:
Depending on locality, some brick patterns cannot be achieved - such as brick modules containing ‘openings’ - especially in New Zealand and earthquake zones.

Full Wall Systems		Screen Systems		Surface Finishes			
Fully Integrated	Openings	Panelling	Openings	Panelling	Engraved	Printed	Colourised









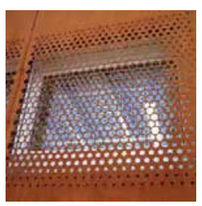






Concrete Wall Claddings

Conclusions:
Most cost effective option would be the application of a surface finish or patterning. Integration of complex patterns into the structure escalates costs.

Full Wall Systems		Screen Systems		Surface Finishes			
Fully Integrated	Openings	Panelling	Openings	Panelling	Printed	Natural	Colourised
							
							
							
							
							
							
							

Metal Wall Claddings

Conclusions:
Alternative treatments with intricate patterning would be predominantly in a screen form – acting purely as a decorative element for openings.

Full Wall Systems		Screen Systems		Surface Finishes		
Fully Integrated	Openings	Panelling	Openings	Panelling	Natural	Colourised

Timber Wall Claddings

Conclusions:
Timber is a very traditional material, especially within the New Zealand building industry, as it is versatile – being used as both structure, cladding / weather screen (once treated).

4.2 Implications with Alternative Cladding Systems

The primary factor with introducing an alternative cladding solution is that it will typically deviate from what is deemed as an 'Acceptable Solution' – stated in the New Zealand Building Code. The alternative cladding will then be categorized as an 'Alternative Solution'; therefore obtaining building consent can require additional action (compared to the standard/simpler Acceptable Solution avenue).

To obtain a building consent for the alternative solution, a building consent applicant must **demonstrate that the proposed alternative solution will comply** with the requirements of the Building Code. This will generally include supplementary documents such as; appraisals from relevant institutions (i.e. BRANZ) Manufacturer's literature, comparisons with existing products/compliance documents etc. (Ministry of Business, Innovation, and Employment).

This direction of building compliance can be perceived as 'difficult' and can incur additional cost, time, and ultimately more risk for the designer. Therefore the default to predefined acceptable solution systems is typically witnessed.

The following steps are stated by Building New Zealand (*Also Refer to http://www.building.govt.nz/blc-alternative-solutions*) is the process required to obtain building compliance – for an alternative solution. This process may be required for the alternative cladding systems defined within this report.

Topic	**Requirements**	
Scope of the Project	Determine which parts of the project are not covered by a Compliance Document. These parts will require an alternative solution.	
Identify the Building Code Clauses, including the specific Performances, that are relevant	E.g. E2/AS1 Durability E2/AS1 External Moisture	
Providing Evidence	The evidence should identify that the performance criteria of all relative clauses mentioned above will be met. These usually include either quantitative or qualitative measures (or both) to verify compliance. These can include:	
	Calculation or test methods	Models, calculations, simulations to demonstrate the viability of the solution
	Comparison with a compliance document (The better the relationship, the higher the chance for compliance)	Using the compliance documents as a guideline for assessing the robustness of the alternative solution/cladding
	Comparison with a product accepted by a building consent authority	A product which is accepted by another building consent authority which may not specifically been covered by Compliance Documents.
	Comparison with an existing determination	A binding decision made by the Ministry of Business, Innovation, and Employment. These are typically case-specific which deals with a dispute in regards to obtaining code compliance for a project. Determinations may be useful as a guideline. Refer to the link to find a list of determinations: http://www.building.govt.nz/determinations-view-past-determinations

	Trade literature	If it is a proprietary product, it may also include technical data which will support the proposal.
	Appraisals	Appraisals made by third party testing institutions (ie BRANZ) to certify the systems adherence to the NZBC
	In-service history	The application of the system used in a similar project. International examples can be used, however the unique environmental conditions in New Zealand should be considered.
	Assessment of actual conditions on the site	Conditions on the site itself may affect the proposed system. Such as a highly sheltered site could alleviate some of environmental conditions
	Expert evidence	These can include collaborative expert support, peer reviews, or options obtained from credible organisations.

The preceding requirements/evidence are not purely for alternative claddings. Alternative solutions can encompass entire projects, or parts of projects; including applications such as composting toilets, alternative water supplies, eco-houses, etc.

Also Refer to the Appendix for an example of a Proposal for an Alternative Solution with regards to stone cladding. This example was produced under SARC364 – Building Code Compliance Course at Victoria University of Wellington, 2014.

4.3 Selection of Alternative Cladding Systems

From the initial identification of alternative cladding examples, the following five claddings are selected for further analysis. These cladding systems are selected not only for their unique disposition; the following criteria are also of consideration (mentioned earlier in section 2.2 - Client Requirements for Medium Density Housing:

- The cladding **must be available** in New Zealand. This is the most significant factor in this portion of the investigation.
- It is preferably a **proprietary product** which will have **sufficient supplementary documentation** that will assist in obtaining code compliance – especially if it does not fall under the standard 'acceptable solution'.
- It is **speculated to be cost effective**. The speculation is based in previous industry knowledge e.g., it is understood that some materials which are more difficult to source and to install (such as stone) requires additional costs over materials which are ample and relatively simple to install (such as timber weatherboards).
- Relatively **low in maintenance / durable** which will reduce upkeep costs.
- **Visually unique** to ensure aesthetic diversity.

The following cladding systems are just some, which were **found as of Summer 2015/2016**. New cladding systems may have been developed or new suppliers have established since this period.

4.4 Alternative Cladding System – Timber Shingles

Timber shingles are a traditional cladding system, which is prevalent particularly in North America, and in some applications in New Zealand today.

Timber shingles consists of individual components laid in overlapping rows to cover the roof or wall. Traditionally shingles were available as a straight edge, however, contemporary designs have been introduced, which incorporates intricate designs such as rounded, diamond, coves, and octagonal edges, or even patterns engraved into the face of the shingle. Square / rectangular shingles also offer wider diversity, as these can be staggered (both vertically and horizontally) or contain alternating heights to create a stratified aesthetic.

In New Zealand, the prominent shingle type that is available is the straight edged shingle, which is typically 450mm in height with varying widths.

According to the 'Exterior and Interior Wall Manual' by the Cedar Shake and Shingle Bureau' and documentation by South Pacific Shingles, the shingles do require a substrate (typically plywood) for support / fixing to.

Notes:

Nails: Must be stainless steel (within salt water zone) or hot dipped zinc gav (outside salt water zone).

Nails to be fixed approx. 19mm from edge, and 25mm from top of successive course.

Spaces: 3mm-6mm space between shingles (for No.1 Grade certi-label Western cedar shingles) 6mm space between shingles (for No.2 Grade Rebutted / Rejointed certi-label Western cedar shingles). Every 102mm of shingle, the expansion of 3mm is expected.

Side lap of at least 38mm between joints in successive course.

Surface/face exposure: There is a maximum 'side wall exposure' for the timber shingles. Typically for 450mm high shingles, there is to be a 200mm maximum exposure.

The following table displays local trade branches that were contacted, which is supplies the straight edged timber shingle.

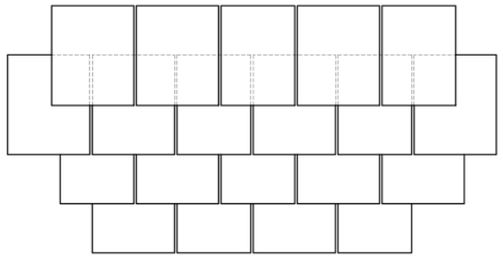
Suppliers	Location	Phone	Email	Website
South Pacific Shingles	Auckland	09 573 3017	enquiries@southpacificshingles.co.nz	http://www.southpacificshingles.co.nz
Rosenfeld Kidson & Co	Auckland	09 573 0503	N/A	http://www.rosenfeldkidson.co.nz/
Herman Pacific	Auckland	09 421 9840	info@hermpac.co.nz	http://www.hermpac.co.nz/

The following Images will depict some varying configurations available for timber shingles.

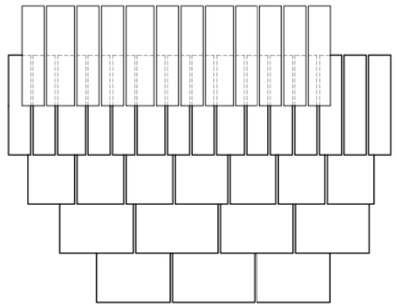
Timber Shingles

Configuration / Profile Available

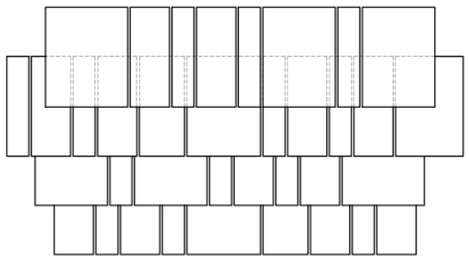
Configuration Diagrams



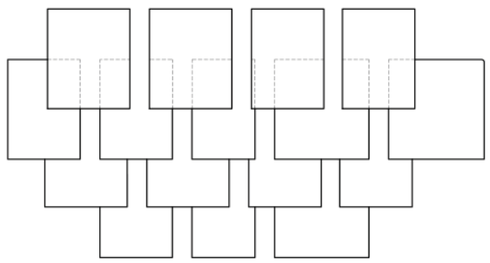
Standard Layout with regular widths



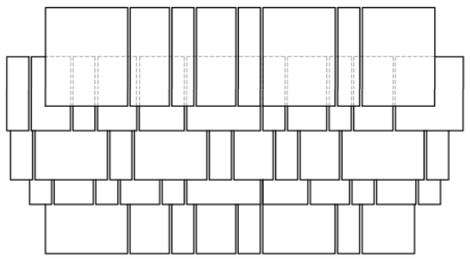
Granulated layout



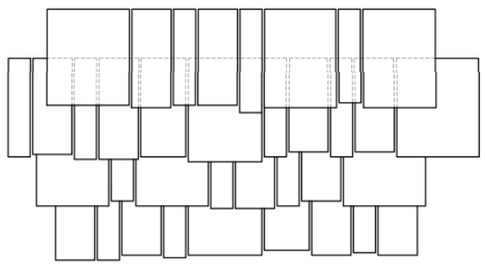
Standard Layout with irregular widths
- This is typically what is available in New Zealand



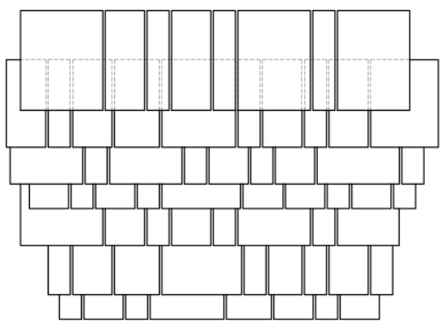
Open slated layout



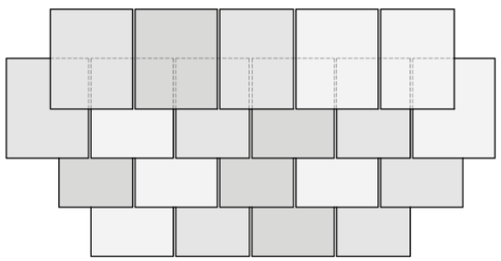
Stratified layout with irregular widths
(two differing shingle heights)



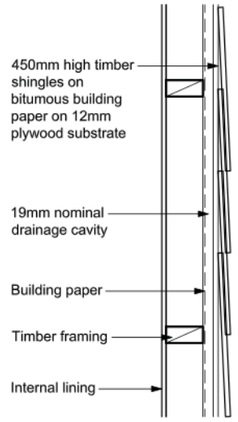
Stratified layout with irregular widths and heights



Stratified layout with irregular widths
(three differing shingle heights)



Standard Layout with regular widths
(with alternating colour scheme)



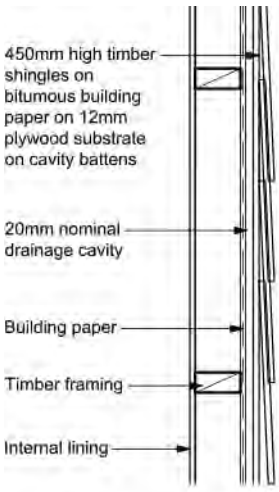
Live Examples

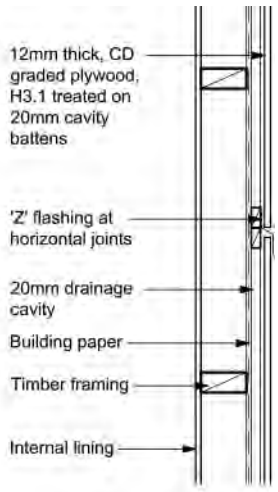
Colourised shingles used at a
Berlin Residence by brandt simon
architeckten

Examples of custom shingle profiles

Examples of straight edged /
ordered shingle configuration

The following table will briefly speculate how one may obtain (if required) the Alternative Solution by satisfying the requirements mentioned i.e. 'Providing Evidence'. Note: There may be alternative avenues that could be taken which have not been stated in the following table.

<table>
<tr><td colspan="2">Compliance through Alternative Solution: Timber Wall Shingles</td></tr>
<tr><td colspan="2">Scope of the Project:
The Alternative Solution is applied specifically to the exterior wall cladding, which is to be timber wall shingles. Timber wall shingles are not currently documented or stated as a 'Suitable Wall Cladding' as per Table 3 – E2/AS1 – External Moisture.
The wall cladding in question will be installed over 12mm plywood substrate, on 20mm cavity on ex100x50mm H3.2 timber framing.</td></tr>
<tr><td colspan="2">Identify the Building Code Clauses, including the specific Performances, that are relevant:
B2/AS1 Durability
E2AS1 External Moisture</td></tr>
<tr><td colspan="2">Providing Evidence:
Note: The following information will be based on Manufacturer's / Technical information provided by South Pacific Shingles.</td></tr>
<tr><td>Calculation or test methods</td><td>South Pacific Shingles supply both Pinus Radiata and Western Red Cedar / Alaskan Yellow Cedar shingles in No.1 grades – which are correctly treated for use as both roof or wall applications.</td></tr>
<tr><td>Comparison with a compliance document</td><td>Timber shingles shares similarities with the fundamental building up of bevel back timber weatherboards and plywood sheeting – where boards are laid and lapped over each other to create a suitable surface in which water can be shed. Additionally the shingles are laid on bituminous building paper on plywood sheeting on cavity battens. This composition will further prevent any water penetrating into the wall structure. The plywood substrate is to be compliant to the requirements stated in E2/AS1 – External Moisture, Section 9.8 Plywood Sheet.
The system shall be manufactured to AS/NZS 2269, grade CD
Minimum of 5 Ply
Minimum of 12mm in thickness
And treated as required by NZS 3602. (A minimum of H3.1 for non-structural elements) 

Timber Shingle on plywood substrate with drainage cavity
 

Typical Plywood detail with drainage cavity as per E2/AS1 - 9.8 Plywood

Additionally, BRANZ has also issued a bulletin; BU443 – Timber shingles and shakes which outlines the selection, performance and installation of timber shingles and shakes under New Zealand conditions.</td></tr>
</table>

Comparison with a product accepted by a building consent authority	Stated by a Representative of Herman Pacific, the use of the Exterior and Interior Wall Manual by the Cedar Shake and Shingle Bureau has been sufficient to support the use of timber shingles on a project.
Comparison with an existing determination	There are no current determinations which directly applies to the performance of timber shingles
Trade literature	• Generic Installation Details • Installation Details and Cross Sections produced by South Pacific Shingles • Exterior and Interior Wall Manual published by the Cedar Shake and Shingle Bureau, dated 2011. • Technical Information / Specifications for Timber Shingles and Shakes, dated 2010
Appraisals	The South Pacific Shingles – Timber shingles being the Western Red Cedar, Alaskan Yellow Cedar, and Pinus Radiata have been certified by Structural Engineers – Harrison Grierson Consultants Ltd in 2005.
In-service history	Timber shingles have been used extensively in New Zealand homes for decades. They were occasionally used to cladd the entirety of the house or as a decorative feature – as 'infills' in gables or under the sills of bay windows. This is specifically witnessed in traditional New Zealand bungalows. The use of Western Red Cedar shingles were typically imported and was very common and used in large quantities.  The traditional use of timber shingles in the gables on an early New Zealand Bungalow (source:www.renovate.org.nz)  Commonage Close Villas in Queenstown designed by Mason and Wales Architects in Dunedin *(Source: www.southpacificshingles.co.nz)*
Assessment of actual conditions on the site	Site Specific – This will not be entered for the purpose of this report.
Expert evidence	The South Pacific Shingles – have been certified by Structural Engineers – Harrison Grierson Consultants Ltd in 2005, as mentioned earlier.

4.5 Alternative Cladding System – uPVC Weatherboards

uPVC weatherboards are essentially a manufactured plastic adaptation of a standard timber weatherboard – in terms of aesthetics. uPVC weatherboards have been available in New Zealand as early as the 1970s (Renovate), and has gained continuous popularity as an alternative to standard timber weatherboards. They are typically an extruded, prefinished, proprietary product, and are available in many configurations – that interlock and clip together. The popularity is attained by its high durability, low maintenance, and consistent nature; compared to its timber counterpart. However, it should be noted that the common perception of plastic claddings is its vulnerability to UV (especially in the context of New Zealand). Although this may be true to an extent, continuous technological advancement in such products have improved its stability. Many manufacturers, such as 'Palliside' products are tested to the New Zealand climate, include guarantees, and have attained appraisals from BRANZ (DYNEXbuild).

An additional benefit is many manufacturers also produce supplementary accessories to accompany the weatherboard, such as corner soakers / molds, and soffit linings. This assists in eliminating the requirement of introducing other products into the system while attaining a more homogenous finish to the project.

Weatherboard lengths typically come in 6.0m lengths with an effective cover of 260mm.

Notes (Palliside):

Guarantee: Palliside guarantees their uPVC weatherboards from defects for 25 years.

Structural: Can be used in Extra High wind zone, and specific design zones. Can be used in SH risk group classification and 1.0m from site boundary. Can be used on curved walls (radius of 3m min).

Profile: Available as a double profile and in rusticated or bevel-back, and in smooth or woodgrain surface treatments.

Nails: Fixed with Palliside approved nails – Stainless steel or galvanized steel nails.

Nails are fixed directly into top edge without need of pre-drilling, and are concealed.

Surface finish: Gradual fading or chalking is expected (and is standard with all exterior pigmented finishes) Chalking can be removed by periodic cleaning. Palliside products can be painted.

The following table displays local trade branches that were contacted, which supplies uPVC weatherboards.

Suppliers	Location	Phone	Email	Website
Palliside	Auckland	09 820 2800	pallisideinfo@dynex.co.nz	http://www.palliside.co.nz
Masada		0508 62 72 32	N/A	http:/www.masada.co.nz
Heritage Cladding	Te Aroha	0800 500 780	nigel@heritagecladding.co.nz	http://heritagecladding.co.nz
Vinyl Cladding NZ		0800 648 836	info@vinylcladding.co.nz	http://www.vinylcladding.co.nz

The following Images will depict some varying configurations available for Palliside uPVC Weatherboards and composition comparison to other similar products available in New Zealand.

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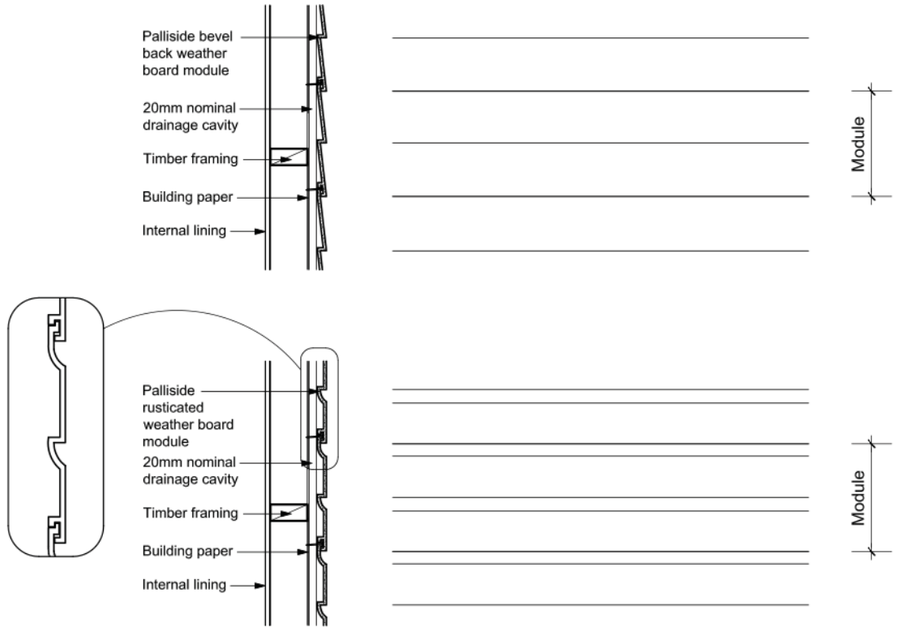
Palliside uPVC Weatherboards

Other uPVC Weatherboards

Configuration Diagrams



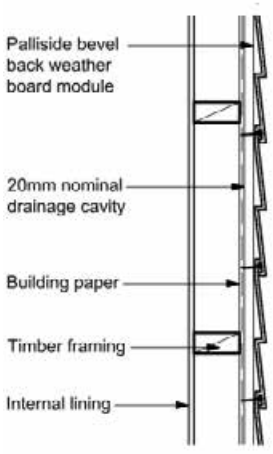
Live Examples

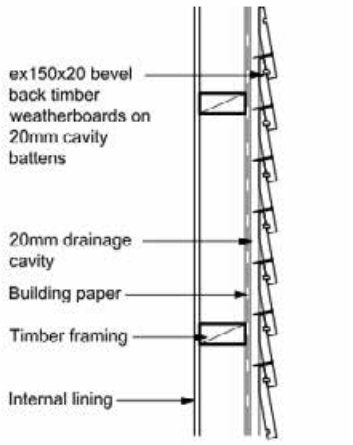
Various projects using Palliside uPVC weatherboards. Images sourced from Trends Magazine.

Comparison of Palliside uPVC weatherboards with other weatherboards typically on the market

The following table will briefly speculate how one may obtain (if required) the Alternative Solution by satisfying the requirements mentioned i.e. 'Providing Evidence'. Note: There may be alternative avenues that could be taken which have not been stated in the following table.

<table>
<tr><td colspan="2">Compliance through Alternative Solution: Palliside uPVC Weatherboards</td></tr>
<tr><td colspan="2">Scope of the Project:
The Alternative Solution is applied specifically to the exterior wall cladding, which is to be Palliside uPVC Weatherboards. uPVC weatherboards are not currently documented or stated as a 'Suitable Wall Cladding' as per Table 3 – E2/AS1 – External Moisture.
The wall cladding in question will be installed over ex100x50mm H3.2 timber framing, with an incorporated 20mm drainage cavity.</td></tr>
<tr><td colspan="2">Identify the Building Code Clauses, including the specific Performances, that are relevant:
B1/AS1 Structure
B2/AS1 Durability
E2AS1 External Moisture
F2/AS1 Hazardous Building Materials</td></tr>
<tr><td colspan="2">Providing Evidence:
Note: The following information will be based on Manufacturer's / Technical information provided by Palliside, which is a division of the Dynex Extrusions Ltd Company.</td></tr>
<tr><td>Calculation or test methods</td><td>The Palliside Cavity Cladding System has been independently appraised as an external cladding system by BRANZ. BRANZ Appraisal No. 491 (2015) The cladding system has been tested and appraised in accordance to the requirements of NZBC E2/AS1. The cladding system is also appraised for use with aluminium window and door joinery (The joinery however, must meet the requirements of NZS 4211: Specification for Performance of Windows).</td></tr>
<tr><td>Comparison with a compliance document</td><td>The Palliside Cavity Cladding System is essentially based on traditional profiles such as the standard bevel-back timber weatherboards or rusticated timber weatherboards, however are manufactured from a resilient uPVC material and encompass two lapped elements rather than one (the individual weatherboard panel). Each cladding panel interlocks with the following panel to create a surface to shed any water. The joint also incorporates weather-grooves to minimise the effects of capillary action.
The Palliside Cavity Cladding System also incorporates a 20mm drainage cavity to further restrict water penetration.

Palliside uPVC bevel back weatherboard on drainage cavity
 

Timber bevel back weatherboard detail with drainage cavity as per E2/AS1 - 9.4 Timber Weatherboards</td></tr>
</table>

Comparison with a product accepted by a building consent authority	The Palliside Cavity Cladding System shares similarities with the Mitten Cambridge and Cedarline Vinyl Cladding System, which has been appraised by BRANZ. BRANZ Appraisal No.814 (2013). However the difference between the two systems is the additional extruded polystyrene backing which is also incorporated into the Mitten Cambridge and Cedarline Vinyl Cladding; and the thickness of the uPVC in both systems. (Palliside is thicker by a factor of x5)
Comparison with an existing determination	There are no current determinations, which directly apply to the performance of uPVC weatherboards.
Trade literature	• Palliside Technical Guide • Pallisde Drained Cavity Guide (Direct Fixed Guide, and On Steel Framing Guide is also available) • Palliside Masterspec Specification • Palliside Maintenance Guide • Palliside Product Guarantee (of 25 years) • Palliside Environmental Statement (conforming to the requirements of ISO 9001, and ISO 14001)
Appraisals	The Palliside Cladding System (Both for direct fixed and with cavity) are both appraised by BRANZ For Direct Fixed: BRANZ Appraisal No. 490 (2015) For Drainage Cavity: BRANZ Appraisal No. 491 (2015)
In-service history	The Palliside system is primarily used in a residential setting – ranging from small scale alterations to high end housing developments throughout New Zealand. The system has also been featured in several 'Trends New Home Series'. The following housing projects will demonstrate the Palliside cladding system being applied.  Residence located at Landscape Road in Auckland by Morrison Architects of Auckland. The cladding system used is the traditional bevel back weatherboard profile. *(Refer to Trendideas.com – Ref No. 40374)*  Residence located in the Beachlands in Auckland by Xsite Architects. The cladding system used is the traditional bevel back weatherboard profile. *(Refer to Trendideas.com – Ref No 'bravo ltd')* Case studies above have been sourced from the Palliside Website and from Trendsides Website. (Source: www.palliside.co.nz, and www.trendsideas.com)
Assessment of actual conditions on the site	Site Specific – This will not be entered for the purpose of this report.
Expert evidence	The Palliside Cavity Cladding system (as well as the Palliside Direct Fixed Cladding System) has been appraised by BRANZ to suit the requirements of the NZBC, as mentioned earlier.

4.6 Alternative Cladding System – Zinc Panels (Configurations)

Zinc (which is often alloyed with titanium and copper to increase strength) is a traditional roofing material used in the building industry; dating back to the 1800s (metal roofing.org.nz). The benefits of zinc are due to its malleability as it can be crafted into a variety of profiles and forms – which can be applied to both walls and roofs. The nature of zinc allows it to be resistant to adverse weather conditions because of zinc's 'self-protecting patina (vmzinc.co.uk); hence it is often used in galvanizing processes – to protect more weather sensitive materials such as steel (metal roofing.org.nz). It is suggested that zinc claddings can contain a design life span of 80 years (VMZinc)

Zinc is typically available in a steel coil form in which profiles (such as seamed trays) are custom generated for a particular project – as suggested by VMZinc and RHEINZINK); with various dimensions, joints and types to select from. These profiles are designed to interlock with each other to create a homogenous element where seams / joints are often pronounced. The jointing system (similarly found on profiled metal trough systems), it is the jointing system, which lends to its aesthetic.

Note: Zinc should not be mistaken with the zinc and aluminum alloy coated steel called 'Zincalume' produced by New Zealand Steel.

Although the selection of zinc claddings is vast, the application of some profiles is more commonly used than others. Panel systems are generally witnessed – which are rectilinear in nature (square panels or rectangular). Alternative sections are also available such as rhomboid/diamond profiles. These unique profiles can be considered 'exotic' however will add a sense of elegance / distinction, and have been extensively used internationally in residential developments. These alternative diamond profiles will be explored.

Notes (Rheinzink):

As the Rheinzink range is an international product, information is limited and is to be confirmed by New Zealand distributor Eurometals of Waikanae.

Guarantee: Rheinzink includes a 30-year guarantee on their zinc façade products.

Installation: Will require specialized installer (Eurometals).

Structural: Must be fixed to a substrate (typically plywood) using both mechanical fixings/concealed clips (nailed to substrate) and interlocking joints (for each zinc tile).

The following table displays local trade branches that were contacted, which is able to supply unique zinc panel alternatives.

Suppliers	Location	Phone	Email	Website
VMZinc NZ		027 704 9367	shane.chalmers@ap.umicore.com	http://www.vmzinc.co.nz
Eurometals (supplier of RHEINZINK and Prefa zinc products)	Waikanae	04 293 6422	lizzie@eurometals.co.nz	http://www.eurometals.co.nz

The following Images will depict some varying configurations available for metal panel systems.

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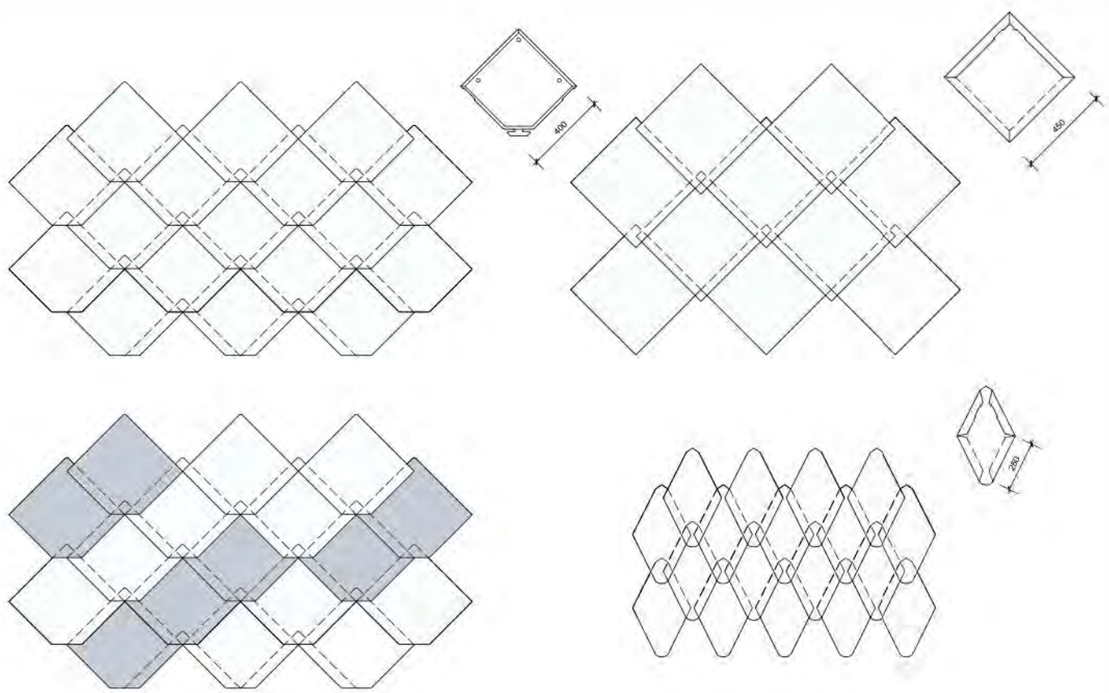
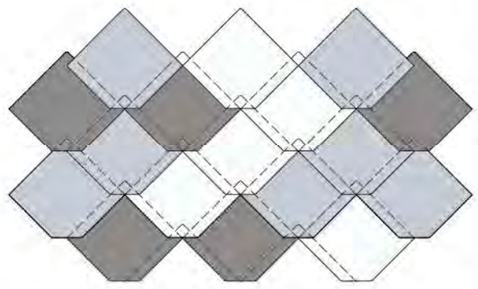
Configuration / Profile Available

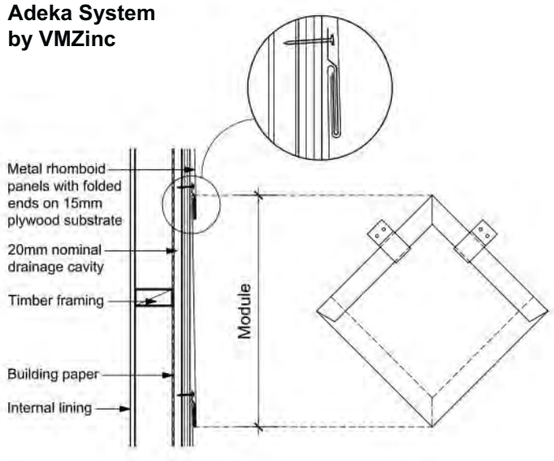
Configuration Diagrams



Diamond Systems by Rheinzink



Adeka System by VMZinc



Live Examples

Rhomboid shape zinc panels (Adeka) produced by VMZinc

Rhomboid shape zinc panels produced by Prefa

Prfalz panels produced by Prefa

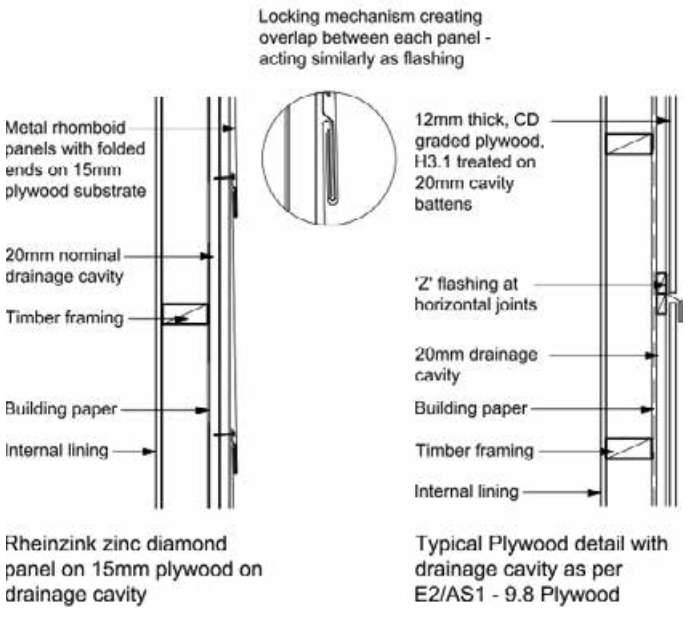
Rhomboid shape zinc panels produced by Rheinzink

Trapezoidal shape aluminium panels produced by Prefa (Eurometals is the New Zealand distributor)

FX.12 panels produced by Prefa (Eurometals is the New Zealand distributor)

The following table will briefly speculate how one may obtain (if required) the Alternative Solution by satisfying the requirements mentioned i.e. 'Providing Evidence'.

Note: There may be alternative avenues that could be taken which have not been stated in the following table.

<table>
<tr><th colspan="2">Compliance through Alternative Solution: Zinc Diamond Tiles</th></tr>
<tr><td colspan="2">Scope of the Project:
The Alternative Solution is applied specifically to the exterior wall cladding, which is to be 'Rheinzink zinc diamond tiles supplied by Eurometals. The diamond tiles are not currently documented or stated as a 'Suitable Wall Cladding' as per Table 3 – E2/AS1 – External Moisture.
The wall cladding in question will be installed over 12mm plywood on 20mm drainage cavity over ex100x50mm H3.2 timber framing.</td></tr>
<tr><td colspan="2">Identify the Building Code Clauses, including the specific Performances, that are relevant:
B1/AS1 Structure
B2/AS1 Durability
E2AS1 External Moisture</td></tr>
<tr><td colspan="2">Providing Evidence:
Note: The following information will be based on Manufacturer's / Technical information provided by Eurometals. The diamond tiles are not produced in New Zealand and are supplied by international manufacturer – Rheinzink in Germany.</td></tr>
<tr><td>Calculation or test methods</td><td>Tests on the zinc sheeting has been carried out and certified by the international institution TUV Rheinland Product Safety and Quality Certification mark – which ensures the manufacturer's products have met applicable safety requirements and Quality Standards. Rheinzink also includes a 30 year warranty on their zinc products.</td></tr>
<tr><td>Comparison with a compliance document</td><td>The interlocking / jointing mechinism is the notable diviation from the compliance documents. However, from product literature, the diamond tiles are fixed to a substrate (to plywood via concealed clips) with a drainage cavity. The drainage cavity system is an integral component of E2/AS1 – External Moisture, which manages water penetration that could occur at the cladding, which can be shed via weep holes at the base. In regards to the plywood substrate, it is to be compliant to the requirements stated in E2/AS1 – External Moisture, Section 9.8 Plywood Sheet.
The system shall be manufactured to AS/NZS 2269, grade CD
Minimum of 5 Ply
Minimum of 12mm in thickness
And treated as required by NZS 3602. (A minimum of H3.1 for non-structural elements) 

Rheinzink zinc diamond panel on 15mm plywood on drainage cavity
Typical Plywood detail with drainage cavity as per E2/AS1 - 9.8 Plywood</td></tr>
</table>

Comparison with a product accepted by a building consent authority	A similar product by VMZinc – carried out by Classic Metal NZ, has been installed on a residence in Eastbourne, Wellington. The system used a similar jointing system – 'Diamond Shaped Hook Seam Profile' with 0.7mm zinc tiles. The hook seam is essentially formed with hooked flat seams at panel edges and smooth flat pan; designed to be site installed sequentially by clipping the lower edge of each panel to upper edge of panel below. Panels mechanically attached to plywood support using concealed clips (*source: www.classicmetal.co.nz*)  In regards to the project itself, the residence is situated in a specific design wind zone / relatively close to the coast, therefore it can be assumed the cladding system and jointing system is suitable for this particular / severe conditions. The Designers are Moore Design and Draughting Ltd of Lower Hutt. Refer to: *http://www.classicmetal.co.nz/images/stories/project_profiles/Eastbourne%20Residence%202.pdf*
Comparison with an existing determination	There are no current determinations, which directly apply to the performance of Rheinzink diamond tiles.
Trade literature	There is currently no trade literature in regards to the installation of Rheinzink diamond tiles provided by Eurometals. This Documentation is to be confirmed.
Appraisals	There is currently no New Zealand or Australian appraisals found for the Rhenzink diamond tiles found.
In-service history	The Rheinzink diamond tiles have been extensively used in international projects ranging from both residential and commercial applications. The Rheinzink company has been established since 1966 and has developed products which have been used by international architects such as, Daniel Libeskind, Frank O. Gehry and Zaha Hadid.  A commercial development being the Bishop Challoner Catholic Collegiate School in London, England by Perkins Ogden Architects Ltd, Alresford.  The Rheinzink diamond tiles can be used as both a wall cladding and roof cladding as stated on the Rheinzink website (www.rhenzink.com). The Rheinzink diamond tiles have been installed as a roofing cladding on the following residence located in the Kapiti Coast, installed by Eurometals.
Assessment of actual conditions on the site	Site Specific – This will not be entered for the purpose of this report.
Expert evidence	There is currently no expert evidence in regards to the Rheinzink diamond tiles. However, the hook seam is an established interlocking system used in many metal cladding applications.

4.7 Alternative Cladding System – 'Laminam' Porcelain Panels

Porcelain tiles have been used on many building applications and are still a popular cladding option today due to its highly durable, stability and maintenance free disposition – as it is completely manufactured and contains no organic material. A relatively new porcelain panel generated by Laminex called 'Laminam' extends the format of porcelain tiles (which is traditionally 300x600mm Jacobson's) to a larger 3000x1000mm. The benefits, from having a larger format - reduces junctions between tiles, while allowing a more monolithic aesthetic to be created. The system is relatively lightweight – the thinnest panel being 3mm weights approximately 7kg m^2.

The intended application of this product would be more specific to walls, in a high traffic area and will require a fire rating – which is typically treated by using fire-rated fibre-cement or brick veneer / Masonry blocks (witnessed in the medium density housing of SPA, specifically in the Hobsonville projects). The Laminam porcelain tiles are certified to be non-combustible and achieves a Group 1 Rating thus would be a suitable finish to walls, which require fire rating.

Notes (Laminam):

Installation: Will require specialized installer – approved by Laminex Group Ltd.

Shop Drawings: Shop drawings are required to show general arrangement of the Laminam panel system.

Structural: Porcelain is typically installed/adhesive fixed on the CS45 aluminum frame system, with use of a rigid air barrier.

Screw: CS45 aluminum frame fixed to timber framing using Class 4 Finish or stainless steel Tek Screws.

Surface finish: Many are available in stock, however alternative finishes may be required to be imported from Italy.

Format: Porcelain panels can be easily cut into the required sizes.

The following table displays local trade branches that were contacted, which generates the large format 'Laminam' panels.

Suppliers	Location	Phone	Email	Website
Laminex / Laminam	Auckland	09 571 4444	NA	http://www.laminam.co.nz/
	Wellington	04 568 4200		
	There are multiple branches throughout New Zealand. The only branches displayed are from the three major city centers.			

The following Images will depict some varying configurations available for Laminam Porcelain Panels.

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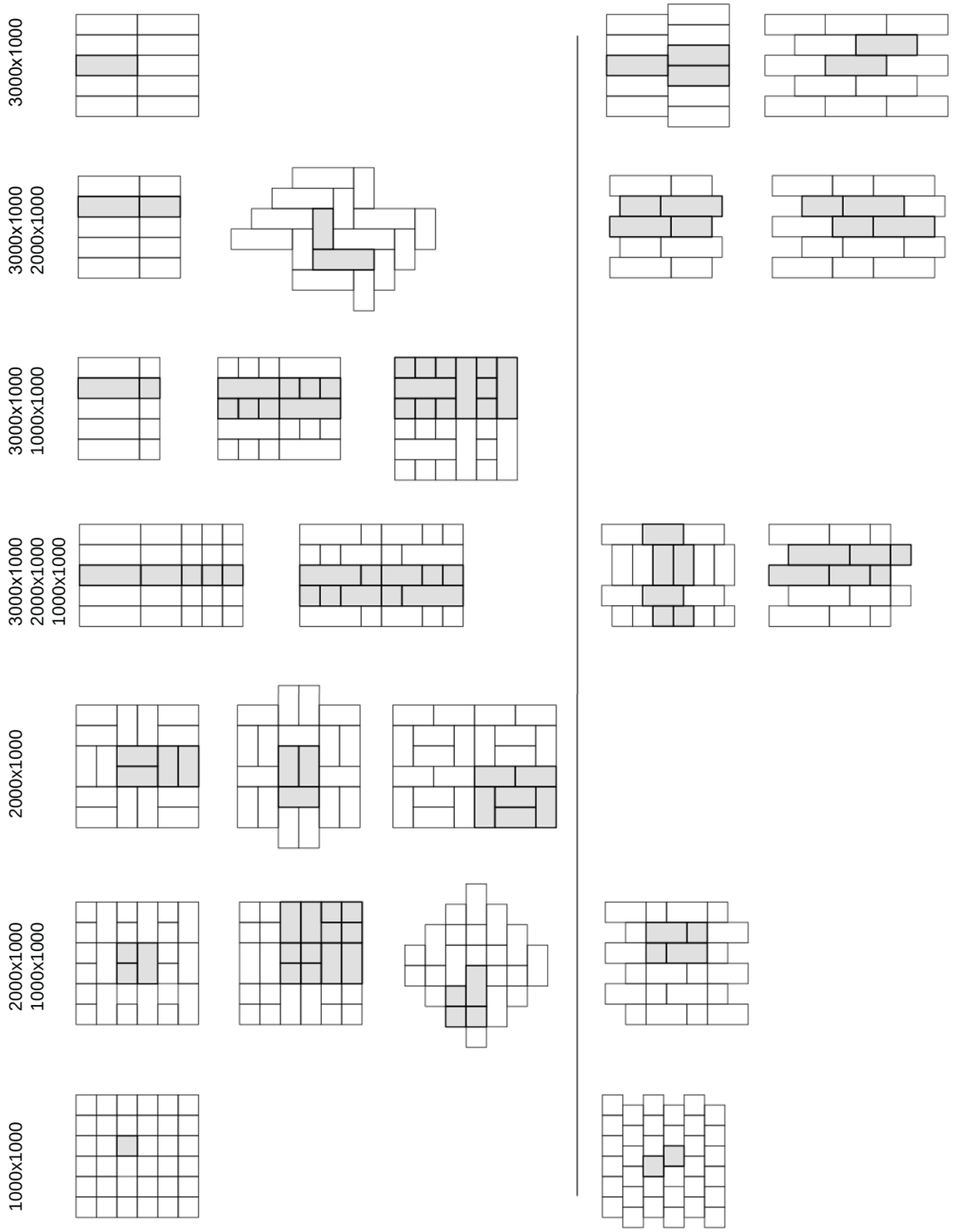
Configuration Diagrams

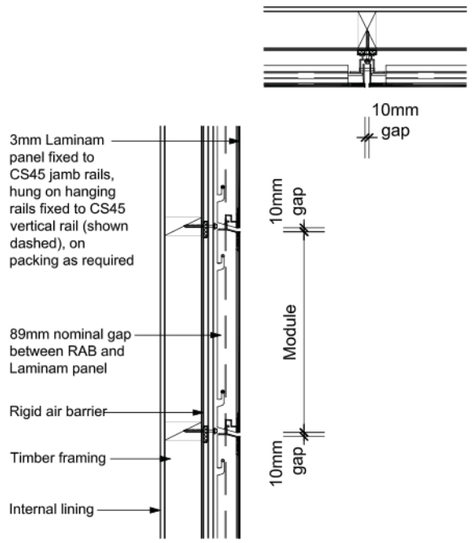
Various Tile Layouts

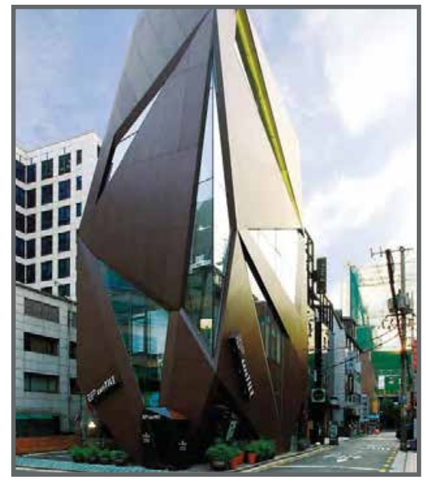
Orthogonal Layouts

Staggered Layouts



Live Examples





Jewellery Store, Seoul, South Korea

Use of varying coloured Laminam panels at the Radiology Clinic in Taurunga, New Zealand

Laminam panels in standard panel format

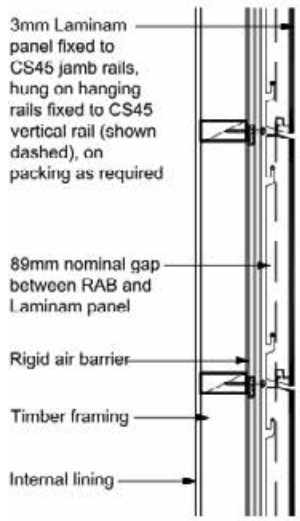
Laminam panels used at the Creyke House in Christchurch - showing use of exterior / interior

The following table will briefly speculate how one may obtain (if required) the Alternative Solution by satisfying the requirements mentioned i.e. 'Providing Evidence'.

Note: There may be alternative avenues that could be taken which have not been stated in the following table.

<table>
<tr><th colspan="2">Compliance through Alternative Solution: 'Laminam' Porcelain Panels</th></tr>
<tr><td colspan="2">Scope of the Project:
The Alternative Solution is applied specifically to the exterior wall cladding, which is to be the 'Laminam' porcelain panels (Specifically the CS45 Cavity Façade System by Laminex New Zealand.
Laminam porcelain panels are not currently documented or stated as a 'Suitable Wall Cladding' as per Table 3 – E2/AS1 – External Moisture.
The wall cladding in question will be installed over ex100x50mm H3.2 timber framing.</td></tr>
<tr><td colspan="2">Identify the Building Code Clauses, including the specific Performances, that are relevant:
B2/AS1 Durability
E2AS1 External Moisture
F2/AS1 Hazardous Building Materials</td></tr>
<tr><td colspan="2">Providing Evidence:
Note: The following information will be based on Manufacturer's / Technical information provided by Laminam, which is a division of the Laminex New Zealand Company.</td></tr>
<tr><td>Calculation or test methods</td><td>The Laminam CS45 Cavity Façade System has been independently tested by FMI Research Ltd in Auckland – Test Report No.12/15.
The performance tests was in accordance with the requirements stated in AS/NZS 4284:2008 – Testing of Building Facades. Tests were conducted on a timber framed support structure with the Laminam CS45 Cavity Façade System installed.

Lamainam panels have been fire tested – Test Report No. FH5190, BRANZ; to be in accordance with NZBC Verification Method C/VM2 Appendix A.</td></tr>
<tr><td>Comparison with a compliance document</td><td>The main component with the CS45 Cavity System is the already integrated drainage cavity behind the Laminam porcelain panels. The cavity – called the 'cassette system' is an aluminium rail system, which allows for a generous 45mm cavity; allowing ventilation and pressure equalisation (air pressure would be the same on both sides of the cladding – therefore there is no pressure difference which could drive water through openings).
The drainage cavity system is an integral component of E2/AS1 – External Moisture, which manages water penetration that could occur at the cladding, which can be shed via weep holes at the base.

 
Laminam porcelain panels on CS45 rails on RAB board

The cavity system in the CS45 rail system shares similarities with the fundamental principals depicted in E2/AS1 - External Moisture - in regards to drainage cavities. However, the porcelain panels and CS45 system deviates significantly to those in the compliance documents and are specifically / custom designed by Laminex Corporation.</td></tr>
</table>

Comparison with a product accepted by a building consent authority	Currently there is no similar product that has been found.
Comparison with an existing determination	There are no current determinations, which directly apply to the performance of the Laminam CS45 Cavity System.
Trade literature	As Laminam is available for multiple applications, the following trade literature will be specifically for the application to exterior walls. • Laminam Written Specification (for the CS45 Cavity System) • Laminam Tile Installation Guide • Mapei Thin Porcelain Tile Installation Guide • Laminam Cleaning Guide • Library of CAD details in DXF, DWG, PDF formats http://www.laminam.co.nz/technical.php#
Appraisals	The Laminam CS45 Cavity System has been appraised by Les Boulton & Associates Ltd, Material and Corrosion Consultants – Report No. 121021, in regards to the requirements with B2/AS1 – Durability
In-service history	The Laminam CS45 system has been established internationally – especially in Italy. It is a relatively new cladding system in New Zealand, however has been applied to several commercial and residential projects. The following are residential projects in which the Laminam system has been applied to.  Residence located at Mount Maunganui in the Bay of Plenty by Andrew Laurent of Creative Space Architectural Design Ltd in Tauranga. The system made use of the Laminam 'Blend Grigio and Oxide Perla' range of tiles.  Commercial premises – the Creyke House by Architects Plus Ltd in Christchurch. The use of the Laminam system on this project was the first of its kind in Christchurch. The system made use of the Laminam 'Oxide Moro'. Case studies above have been sourced from the Laminam Website and from eboss Website. (Source: www.laminam.co.nz and www.eboss.co.nz) La
Assessment of actual conditions on the site	Site Specific – This will not be entered for the purpose of this report.
Expert evidence	The Laminam CS45 system has been appraised by Les Boulton & Associates Ltd, Material and Corrosion Consultants and FMI Research Ltd as mentioned earlier.

4.8 Alternative Cladding System – Plywood (Configurations)

It is stated in the Housing New Zealand Corporation's housing design guide; 'Housing Standard – Design (2015)' that plywood is not permitted. However for the purpose of this report - in which is investigating 'alternative cladding options', plywood will also be included, as it does contain properties, which would suit the requirements for the medium density housing projects, such as durability. These could also be applied to projects, which are not established by Housing New Zealand.

Plywood itself is a manufactured product and is composed of multiple layers of timber veneer, which are 'layered' with the grain direction at right angles and glued together using structural adhesives. This type of bonding greatly improves rigidity, stability; while being highly uniform – to prevent warping and twisting. (Wood Solutions)

Plywood sheeting is versatile and does come in a variety of timber species, thicknesses and grades to suit the application – such as structural plywood, which is used for structural beams and braced walls (NZ Wood).

As with any timber product – plywood (if not manufactured from a durable timber such as cedar) it will also require treatment if used on an exterior to improve its weather tightness and durability. **Edge joints are particularly vulnerable to moisture**, therefore must also be coated or covered.

There are proprietary plywood products such as 'EcoPly' and 'ShadowClad' by Carter Holt Harvey are available who manufactures and supplies their own range of plywood products. However for the purpose of this investigation is to explore alternative plywood panel configurations that will deviate from what is depicted in E2/AS1. The alternative configuration of interest is lapped plywood sheets using Carter Holt Harvey plywood panels as the material.

Notes:

Initially within the investigation, no proprietary products were found that differed from the standard panelized system offered by Carter Hold Harvey, therefore more 'speculative approaches' were initiated.

However, it was later found that Plytech International Ltd of Auckland does produce proprietary plywood configurations. (Refer to: http://www.plytech.co.nz/exterior-systems/). These alternative configurations were not fully investigated. It should be noted, that the Plytech International Ltd would likely have supplementary documentation and information to support application for code compliance.

The following Images will depict some varying configurations available for Plywood Sheet Panels.

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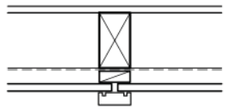
Plywood Configurations

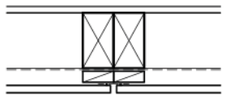
Cladding System Diagrams

Alternative Joints not of E2/AS1

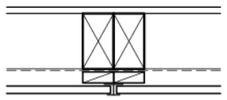
As per E2/AS1



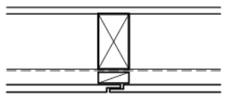
Standard batten min ex75x25mm



Membrane behind joint

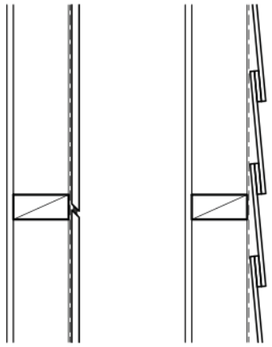


Aluminum jointer



Shiplap joint

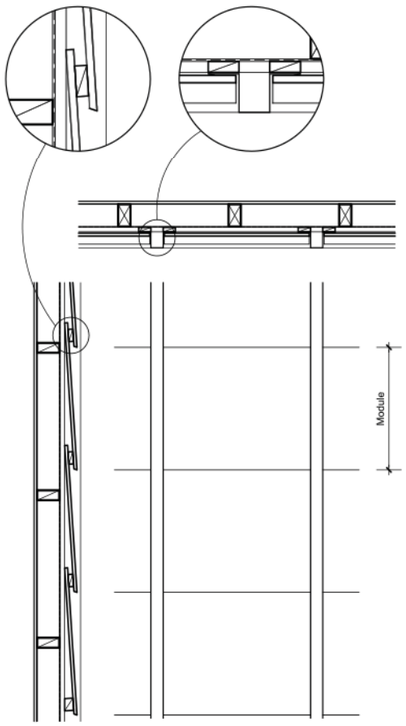
Alternative Configuration by Determination



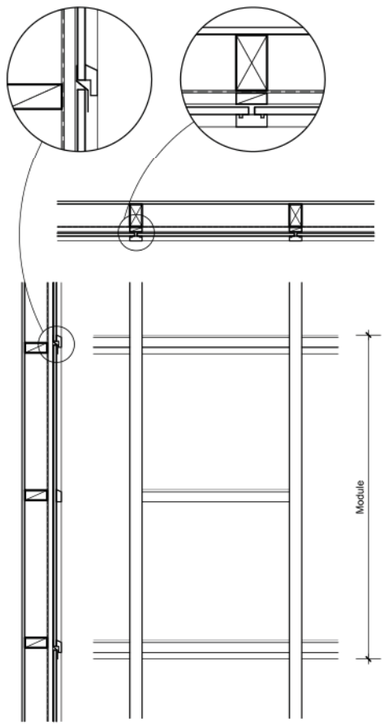
45deg butt joint with sealant

200mm high lapped plywood sheets

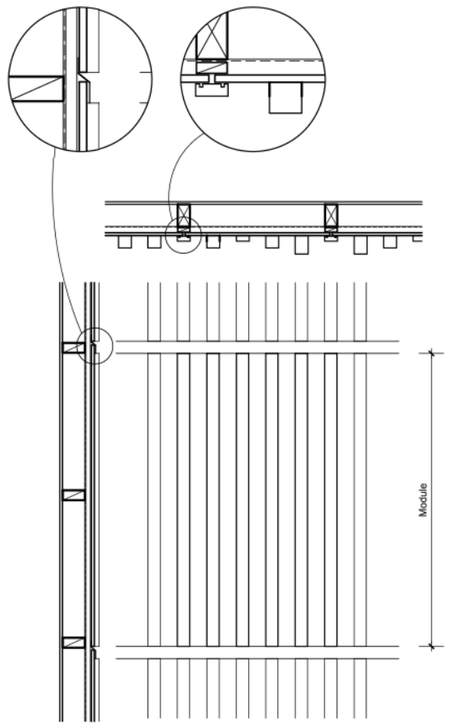
Alternative Configuration / Profile



Lapped Plywood configuration

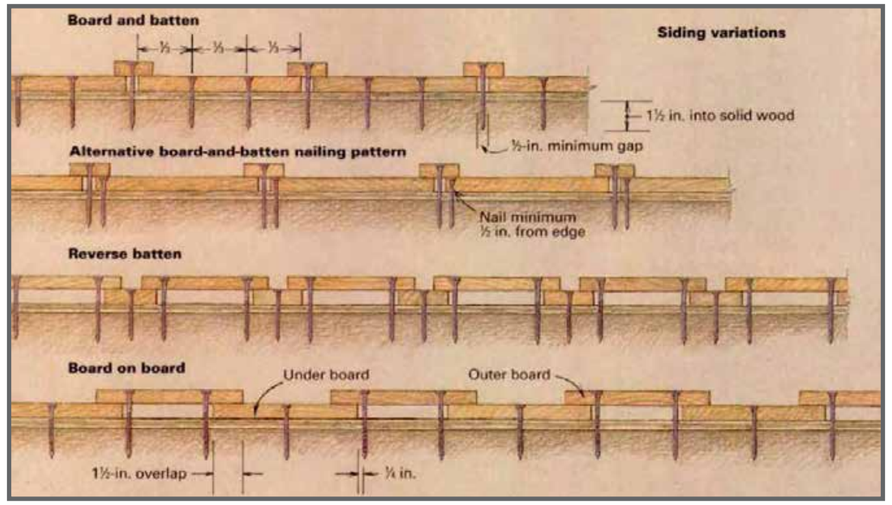


Orthogonal Plywood configuration



Vertical timber battens on Plywood substrate configuration

Live Examples



Various board and batten configurations by www.finehomebuilding.com

Examples of alternative board and batten configurations

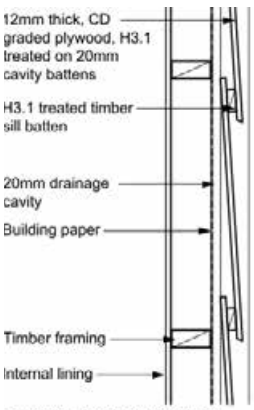
Examples of alternative plywood sheet configurations

The following table will briefly speculate how one may obtain (if required) the Alternative Solution by satisfying the requirements mentioned i.e. 'Providing Evidence'. Note: There may be alternative avenues that could be taken which have not been stated in the following table.

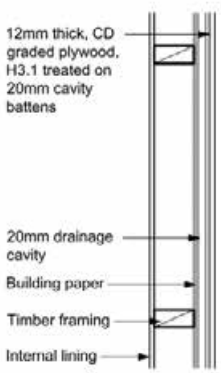
<table>
<tr><th colspan="2">Compliance through Alternative Solution: Lapped Plywood Sheets</th></tr>
<tr><td colspan="2">Scope of the Project:
The Alternative Solution is applied specifically to the exterior wall cladding, which is to be lapped plywood sheets. Lapped plywood sheets are not currently documented or detailed in E2/AS1 – External moisture. The typical accepted plywood sheet configuration is flat sheets with vertical battens at the vertical joints, and metal 'z' flashings at the horizontal joints. This lapped plywood configuration will deviate from this standard jointing system. The wall cladding in question will be installed over ex100x50mm H3.2 timber framing, with an incorporated 20mm drainage cavity.</td></tr>
<tr><td colspan="2">Identify the Building Code Clauses, including the specific Performances, that are relevant:
• B1/AS1 Structure
• B2/AS1 Durability
• E2AS1 External Moisture</td></tr>
<tr><td colspan="2">Providing Evidence:
Note: As lapped plywood sheets has yet to be developed as a proprietary product (From what I could establish), however, the plywood sheets will be supplied by Carter Hold Harvey Woodproducts for the purpose of this investigation.</td></tr>
<tr><td>Calculation or test methods</td><td>There are currently no calculations or tests applied to this particular plywood-sheeting configuration. However the plywood sheets may be supplied by Carter Holt Harvey, in which their plywood products are manufactured and monitored to comply with AS/NZS 2269:2012 Plywood Structural.</td></tr>
<tr><td>Comparison with a compliance document</td><td>The proposed system is essentially the amalgamation of two established systems – being plywood sheet panelling and timber bevel back weatherboard construction. However, 600x600mm plywood sheets will be used in lieu of solid timber weatherboards.

The plywood sheets themselves are to be compliant to the requirements stated in E2/AS1 – External Moisture, Section 9.8 Plywood Sheet.
• The system shall be manufactured to AS/NZS 2269, grade CD
• Minimum of 5 Ply
• Minimum of 12mm in thickness
• And treated as required by NZS 3602. (A minimum of H3.1 for non-structural elements)

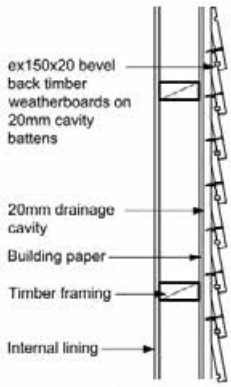
The lapped plywood sheeting draws parallels with the angular nature of timber weatherboards. It can be suggested that the angled plywood would in fact, positively deflect rain, thus being more effective in terms of weatherproofing than a purely vertical plywood panel – as suggested in E2/AS1.

Lapped plywood panels on cavity battens (note: lapping batten sill optional)

Typical Plywood detail with drainage cavity as per E2/AS1 - 9.8 Plywood

Timber bevel back weatherboard detail with drainage cavity as per E2/AS1 - 9.4 Timber Weatherboards</td></tr>
</table>

	Vertical battens elements are also formed from 1.0mm aluminium flashing which the lapped plywood sheets will butt up against. This will be based on the Internal corner flashings on cavity battens found in Figure 79: Internal corners for horizontal or vertical weatherboards.
Comparison with a product accepted by a building consent authority	No similar proprietary products have been produced or found.
Comparison with an existing determination	Currently there is one determination which closely relates; Determination 2009 -108. The determination deals with the use of cut plywood sheets at 200mm wide with a glue fixed thickening at one end to create the slant; and directly fixed to the framing (no drainage cavity). The determination involved opinions of the local authority and two building experts to inspect the cladding system. The main concerns were generally in regards to B2/AS1 – Durability. The primary issues were raised: • Use of 3 ply plywood • Use of 7.5mm thick plywood • Grade of ply being DD • Lack of weather grooves (however it was suggested these were not required) • Minimal treatment to cut edges • Application of glue used to stick the ply and packer (owner applied) • Durability of the butt joints to neighbouring boards (using copper soakers) • Lack of proven in-service performance Overall – the system was found to sound and did not show any evidence of water penetrating the cladding. From a building experts opinion, they stated: *"Had the system being (sic) designed with a thicker 5 ply plywood, it would likely have the makings of a very innovative, alternative, durable, and effective system that would clearly be expected to satisfy the requirements of the building code"* (second expert. Point 5.1.21)
Trade literature	As the plywood sheets will be supplied with square cut edges by Carter Holt Harvey which will include specifications for the plywood sheets.
Appraisals	No similar proprietary products of similar nature have yet to be produced.
In-service history	The application of this type of system is witnessed in international projects – designed by Tham & Videgard Hansson Arkitekter of Sweden. These projects include the K House in Stocksund, Sweden, completed in 2004, which used a combination of 600/900/1200x900 18mm thick plywood panels on timber framing. The Kalmar Museum of Art in Kalmar also has a similar wall cladding application. It should be noted that both projects are located in the southern / south-eastern portion of Sweden which experiences a relatively mild climate – having snowy winters with temperatures typically just below 0. The summer period, the region experiences moderately humid temperatures of 15 – 25 degrees Celsius. These weather conditions share similarities during the cooler seasons in New Zealand (to be confirmed).   The K House in Stocksund, Sweden by Tham & Videgard Hansoon Arkitekter. *(Image Source: www.archdaily.com)*

Assessment of actual conditions on the site	Site Specific – This will not be entered for the purpose of this report.
Expert evidence	There is currently no expert evidence in regards to this particular plywood cladding configuration, Note: Obtaining confirmation of the system in question by a Registered Builder is also a recommendation to determine the viability of this particular plywood-sheeting configuration.

Other Plywood Configurations of interest.

From the investigation into determinations, an alternative horizontal jointing system was established, involving the Thames-Coromandel District Council. As per determination No. 2011/108, a jointing system which diverted from the accepted metal 'Z' flashing; used a 45 degree beveled edge with the application of glue for the horizontal joint. This technique was applied to approximately 40 Houses (as of 2011), and was approved by the plywood manufacturer initially in 1999. However the manufacturer did state that the key element of this detail being successful is on-site workmanship and shall be inspected and approved by the authority. It should be noted that the builder has since ceased using this system.

4.9 Alternative Cladding System that were also Investigated

During the course of establishing alternative cladding systems, multiple claddings were found which are of interest. However, these claddings were not included in the primary selection, which was further analyzed. These will be included in the cladding comparison matrix.

Extruded Horizontal Corrugated Aluminum

The benefit of the extruded aluminum profile by Paynes Aluminum Ltd is the concealment of fixings and being a 'heavier body' in nature, thus being much more robust compared to thinner rolled aluminum profiles. Aluminum is also lightweight and durable.

Suppliers	Location	Phone	Email	Website
Paynes Aluminium Ltd	Dunedin	03 489 5760	aluminium@paynes.co.nz	http://www.paynes.co.nz

FX.12 Faceted Aluminum Panels

The FX.12 panel is formed from 0.7mm aluminum with a durable 'P10 coil coating'. The system integrates non-repeated irregular facets in to the face of the panel, which promotes a dynamic interplay of light and shadow as the sun's position changes. The panels are connected with each other via overlapping / interlocking joints which allows faster installation, expansion and to assist in sheading water.

Suppliers	Location	Phone	Email	Website
Eurometals (supplier of RHEINZINK and Prefa zinc products)	Waikanae	04 293 6422	lizzie@eurometals.co.nz	http://www.eurometals.co.nz

Oko Skin – Concrete Panels

Oko Skin cladding is constructed from glass-fibre reinforced concrete in a 13mm thick panel format. The panels can be cut to size and drilled (for screw fixing) on site and does not require sealing at the edges. Similar to the Laminam panels, they are not combustible, therefore are suitable to in applications that require fire ratings. As Oko skin is formed from all natural materials, it can be completely recycled.

Suppliers	Location	Phone	Email	Website
The Tile People (supplier of Oko Skin panels)	Auckland	09 303 0143	carleen@tilepoeple.co.nz or Glen Obery (contacted MR and RB)	http://tilepeople.co.nz/

As mentioned earlier in the report:

uPVC Weatherboards – Vertical Profile / Horizontal Profile with foam backing.

A slight deviation from what is produced by Palliside, the alternative uPVC weatherboards are generally 1.2mm thick with polystyrene foam backing (whereas Palliside produces the 6mm thick profiles). The benefits are still similar in regards to the speed of installation and cost.

Suppliers	Location	Phone	Email	Website
Vinyl Cladding NZ		0800 648 836	info@vinylcladding.co.nz	http://www.vinylcladding.co.nz

20mm Brick Slips (supplied information in regards to Brick Slips)

Brick slips can be an alternative option for brick or stone veneer to be adhesive fixed to a substrate – either new, or existing. In addition to the information provided earlier, Creative Brick NZ recommends the use of whole bricks rather than brick slips due to its durability, total cost, and removing the reliance on third party materials (i.e. substrates and adhesives).

It should be noted that brick slips could generally be formed by tradesman - on site by cutting larger bricks and fixed using approved adhesives. The company below was contacted for information regarding this technique.

Suppliers	Location	Phone	Email	Website
Brick and Stone Si	Christchurch	03 349 5006	shane@brickandstonesi.co.nz	http://www.brickandstonesi.co.nz

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5.0 Can the Alternative Claddings be adopted to SPA?

5.1 Assessment Criteria Matrix – A Comparison to other Claddings

An assessment criteria matrix will be used as a tool to allow a better understanding of each individual cladding system while enabling comparisons with other claddings to determine the usability of the system.

The matrix will include multiple criterions that are deemed **significant** in regards when selecting cladding materials – and are based on the criteria / requirements mentioned earlier in this report (By Housing New Zealand Corporation and general requirements).

A scoring system between 1 (red) to 5 (Green) is generated to evaluate the strengths and weaknesses of each cladding system. The following criteria will be assessed:

Cost

$0 - $50	5
$100 - $200	4
$300 - $400	3
$500 - $600	2
$700+	1

Cost of the cladding system will be established purely through its physical / 'material cost' as cost of the installation may contain inconstancies and vary between installers throughout New Zealand. A Quantity Surveyor may be involved to provide price estimates of the cladding material.

Durability

Solid, Rigid and self-supporting	5
Medium, is somewhat rigid and requires coating for protection	3
Delicate, recommended that a substrate is used	1

Dependent on the strength of the material and if there are implications with use in high traffic areas and weather resistant.

Maintenance

'No maintenance'	5
10+ Years	3
3-5 Years	2
1-2 Years	1

Maintenance is a critical factor, which will affect the extent of safety when accessing the cladding system for general maintenance. The lower the maintenance period; potentially, safer the product is for an individual.

Availability

4+	5
3	4
2	3
1	2
No Suppliers	1

The supply of the base material is relatively accessible throughout New Zealand. Higher the number of suppliers; greater the availability.

Compliance – Available Documentation

All Documents (details, certified, warranty etc), and is part of compliance documents	5
Most Documents, however is not part of compliance documents	4
Some Documents, however not appraised by established testing institutions (ie Branz / Code Mark)	3
Some Documents, however not appraised by established testing institutions (ie Branz / Code Mark), and seldom used / seen in the Industry	2
No Documents, not yet used in NZ	1

The presence of quality supplementary documentation such as; Branz, Codemark, NZBC, and certification by Structural Engineers, details, installation guides. Preferably the cladding system will include most of these.

Meet the requirements of HNZC

Yes	5
No	1

Can it incorporate a 20mm drainage cavity and is it a restricted material?

Visual Uniqueness

Rarely Seen	5
Seldom Seen	4
Uncommon	3
Common	2
Very Common	1

In terms of aesthetic appeal and uniqueness compared to other standard cladding systems generally witnessed in New Zealand.

Other Unique Properties or Additional Notes

Other unique characteristics inherent within the cladding system, which will increase the premise for selecting that material. These may include additional properties such as heightened Fire-ratings or Acoustic-ratings.

5.2 Cladding Systems to be Assessed

The claddings to be assessed will incorporate both the new claddings and current systems which typically used in Studio Pacific Architecture. These claddings will be incorporated into the comparative cladding matrix.

Typically Used

- Timber weatherboards (Painted)
- Profiled metal (Eurotray – Trough profile)
- 70 Series Brick (standard Running Bond)

Typically Used Material with Alternative Profile

- Timber weatherboards – Random height and thickness (JSC timber)
- Custom Corrugates (Idiens Roofing)
- 70 Series Brick (with out of plane bricks)

Primary Alternative Claddings Investigated

- Timber Shingles (Straight Edge, Natural)
- uPVC Weatherboards (Palliside)
- Zinc Diamond Tiles (By Eurometals / Rheinzink)
- Laminam Ceramic Tiles (with cassette system)
- Lapped Plywood Sheets

Other Alternative Claddings Investigated

- Extruded Horizontal Corrugated Aluminum
- FX.12 Panels (by Eurometals / Prefa)
- Diamond Tiles (by Eurometals / Prefa)
- uPVC Weatherboards (Mitten)
- Brick Slips (by Brick & Stone SI)
- Glass Reinforced Concrete Panels (by Oko Skin)

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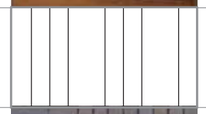
Criteria Matrix — Comparisons of Materials

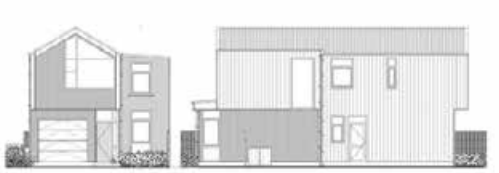
			Cost (supplier)	Cost (QS)	Durability	Maintenance	Availability	Compliance Documentation	Requirements of HNZC	Visual Uniqueness	Other Notes
Typically Used	Vertical Timber Shiplap Weatherboards (Cedar - Painted)		**$109m²** Pre primed. $106 - Oiled	**TBC**	**3** Requires coating to protect wood. Paint is typically most durable	**3** Painted weatherboards recommended to be repainted 7-10 years	**5** Dominant material used / manufactured in New Zealand	**5** Part of compliance documents E2/AS1	**Yes**	**1** Very common aesthetic	
Typically Used	Metal Profile (Eurotray)		**$160m²** Dependant on pan size/seam used	**TBC**	**1** Requires substrate, however cladding is typically solid	**3** Dependent on if paint applied or left natural	**5** Dominant material used / manufactured in New Zealand	**5** Part of compliance documents E2/AS1	**Yes**	**1** Very common aesthetic	Trough profiles typically will require additional installation costs
Typically Used	70 series Brick (Running Bond)		**$110-$140m²** Dependant on colour.	**TBC**	**5** Highly durable will typically have 30 year Warranty (Brick&Stone)	**5** If natural, typically will not require maintenance	**5** Dominant material used / manufactured in NZ	**5** Part of compliance documents E2/AS1	**Yes**	**1** Very common aesthetic	Can be used as a fire-rated material
Alternative Profile	Horiz Random Height and Thickness boards, Layout 5 - Oiled (JSC Timber)		**$170m²** $109 for Layout 1 (2x similar depth)	**TBC**	**3** Requires coating to protect wood. Paint is typically most durable	**2** Stained weatherboards recommended to be re-stained 3-5 years	**1** Currently produced by JSC in Auckland	**4** - Appraised by BRANZ with full documentation	**Yes**	**4** Stratified aesthetic typically not seen in horizontal format	Vertical format also available
Alternative Profile	Custom Corrugate (Idiens Metals)		**TBC**	**TBC**	**TBC** Yet to be tested	**3** Dependent on if paint applied or left natural	**1** TBC - only one fabricator contacted	**2** Custom made / untested. Compliance maybe based on E2/AS1 details	**Yes** Not horizontal in profile	**5** Custom profiles giving 'one of a kind' aesthetic	Custom profile, therefore if damaged, will require custom fabrication
Alternative Profile	70 series Brick (Out of Plane Bricks)		**$140m²** Similar price to standard brick, and dependant on colour	**TBC**	**5** Highly durable will typically have 30 year Warranty (Brick&Stone)	**5** If natural, typically will not require maintenance	**4** Will be dependent on skill of contractors	**5** Part of compliance documents E2/AS1 - installed correctly	**Yes**	**4** Brick configurations can vary dramatically	Can be used as a fire-rated material
Primary Alternative Claddings Investigated	Timber Shingles (Cedar - Stained)		**$190m²** No Underlays/ substrate included	**TBC**	**3** Requires coating to protect wood. Paint is typically most durable	**2** Stained weatherboards recommended to be re-stained 3-5 years	**4** Currently two major suppliers in NZ, can be purchased at Bunnings	**4** - Certified by Harrison Grierson Consultants Ltd & Cedar & Shake Bureau	**Yes** Not a restricted material	**3** A traditional material, yet not fully utilised	
Primary Alternative Claddings Investigated	PVC Weatherboards (Palliside)		**$90m²**	**TBC**	**5** Durable compared to other uPVC boards, stable in NZ climate	**5** No paint required, is recommended to be washed	**2** Currently two major suppliers in NZ	**4** - Appraised by BRANZ with full documentation	**Yes** Not a restricted material	**1** Very common aesthetic	Very efficient and fast to install
Primary Alternative Claddings Investigated	Ceramic Tiles (Laminam)		**$650m²** CS45 Cassette System included	**TBC**	**5** Highly durable and is suitable to be installed in high traffic areas	**5** 'anti graffiti' and does not require continuous upkeep	**4** Part of Laminex, thus has many suppliers throughout NZ	**4** - Appraised by Les Boulton and Associates Ltd	**Yes** Not a restricted material	**2** Panellised system - shares similarities with fibre-cement panels	Can be used as a fire-rated material, and light weight
Primary Alternative Claddings Investigated	Rhomboid Zinc Tiles (Rheinzink)		**$195m²** No Underlays/ substrate included	**TBC**	**1** Requires substrate, however cladding is typically solid	**5** Zinc tends to be maintenance free and will patina	**1** Currently Rheinzink is only available through Eurometals	**1** **TBC** - Documentation not received from Eurometals	**Yes** Not a restricted material	**5** Seldom seen in New Zealand / Specialised	
Primary Alternative Claddings Investigated	Plywood (Lapped Sheets)		**TBC**	**TBC**	**3** Yet to be established, however can be durable if correct ply is installed	**2** If stained, will require further maintenance.	**TBC** Yet to be established	**1** Only a determination available which shows similar application	**No** Plywood is not a permitted material	**5** Speculative system which has yet to been used (observed) in NZ	
Other Alternative Claddings Investigated	Extruded Corrugated Aluminium (Paynes)		**$98m²**.	**TBC**	**5** Durable compared to other rolled corrugates.	**3** Dependent on if paint applied or left natural	**2** Suppliers in Dunedin and Christchurch	**2** Certified by John Yolland and associates, is seldom used	**No** Horizontal metal profile is restricted. However is much more durable	**1** Very common aesthetic, however has concealed fixings	
Other Alternative Claddings Investigated	FX.12 Aluminium Panels (Prefa Aluminium)		**$160m²** No Underlays/ substrate included	**TBC**	**3** Durable coating, however may need substrate	**5** 'Maintenance free P10' coating applied	**1** Currently one supplier, and special ordered from Italy	**1** Yet to be established in New Zealand	**Yes** Not a restricted material	**5** Yet to be observed in New Zealand, very Dynamic	Visually - changes throughout the day
Other Alternative Claddings Investigated	uPVC Weatherboards (VinylCladdingNZ)		**$85m²**	**TBC**	**1** Very thin outer layer, typically requires foam backing for support	**5** No paint required, is recommended to be washed	**1** Only one supplier in New Zealand - TBC	**4** - Appraised by BRANZ with full documentation	**Yes** Not a restricted material	**1** Very common aesthetic	40m² Coverage an be achieved per day
Other Alternative Claddings Investigated	Brick Slips (By Brick & Stone SI)		**$40-60m²** Installation can be intensive	**TBC**	**3** It is durable, however there is a large reliance on 3rd party adhesives	**5** Technically similar to full brick veneer	**5** Dominant material however will require specialised installer	**2** Not appraised, is fully based on quality of adhesive / installation	**Yes** Not a restricted material	**1** Very common aesthetic	Onerous to install compared to full bricks. recommended for existing projects
Other Alternative Claddings Investigated	Terracotta Tiles (Occo Skin)		**$164-187m²** Depended on colour / quantity. Uses aluminum brackets	**TBC**	**5** Highly durable and is suitable to be installed in high traffic areas	**5** Fibre-glass reinforced concrete does not require maintenance	**1** Only one supplier in New Zealand	**3** Has been used in NZ. Supplier confirms the 'ease' of compliance	**Yes** Not a restricted material	**2** Very similar aesthetic to terracotta tiles which is relatively established	Surface fixed, can be easily installed and replaced

5.3 Case Study - Aesthetics

The following case study will be focused on applying a variety of alternative cladding systems (as described in the earlier sections of the report) to medium density housing projects carried out by Studio Pacific Architecture. The study will essentially determine the alternative cladding's viability in a live setting – in terms of aesthetics – in comparison to the existing claddings already used.

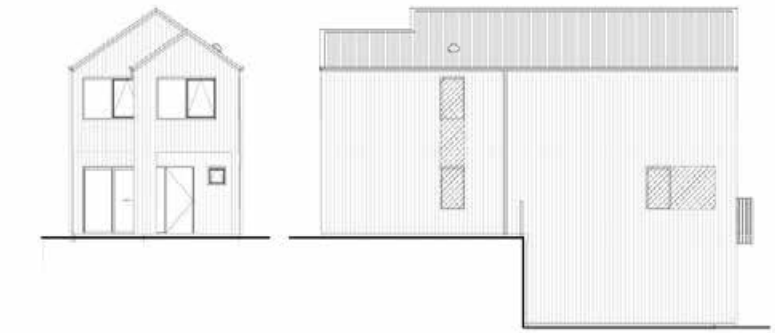
The case study will be directed to one particular house type – which is to be the **Overlea Central, Auckland – *'Type A1' Detached Housing Unit*** as it demonstrates 'simpler' characteristics – in terms of form and materiality / cladding, in comparison to the other housing types (being the 'Flick Flack' in Hobsonville, and the 'Type H' in McLennan) – as shown below.

Hobsonville, Auckland – 'Flick Flack' Terraced Housing Unit



McLennan, Auckland – 'Type H' Detached Housing Unit

Overlea Central, Auckland – *'Type A1' Detached Housing Unit*



Current Cladding Materials

Primary:	Vertical Shiplap Pine boards
Secondary:	Vertical Shiplap Cedar boards
Tertiary:	N/A

The alternative claddings to be applied on the Overlea Central – Type A1 Detached Housing Unit will be a 'sample' of the claddings explored which demonstrated a visually unique aesthetic, which fully deviates from the vertical paneling exhibited in this housing type.

The following cladding systems will be applied:

- Timber weatherboards – Random height and thickness (Painted)
- Timber Shingles (Straight Edge, Natural)
- Zinc Diamond Tiles (Quartz Zinc / Natural finish)
- FX.12 Panels (P10 Charcoal)

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Existing Claddings used

Cladding materials used:
Vertical shiplap weatherboards
- painted / natural (TBC)

Alternative Claddings

Wall Cladding One
(Primary Cladding)

Vertical Shiplap Weatherboards
- Painted

Wall Cladding Two
(Secondary Cladding)

Straight Edge Shingles
- Cedar, Unpainted

Roof Cladding
(As per original drawings)

Notes

Due to the Type A1 Housing position on the site, the proposed cladding options are only applied three elevations (as the forth elevation is directly on the boundary and the proposed cladding material may be unsuitable. (only two depicted in the street perspective to the right).

A combination of the existing cladding system and 'new' alternative cladding system will be explored. The principle of 'ratio of materials' will be applied (as mentioned earlier in the report).

The roofing material will be similar to what is already applied to the A1 housing - as per the drawing issue.

Alternative Cladding Material:

450mm high with varying widths, Western cedar shingles on bituminous building paper, on 12mm H3.1 plywood, on 20mm H3.2 drainage cavity, on building paper, on ex100x50mm H3.2 timber framing.

Perspective from Street

Existing Claddings used

Cladding materials used:
Vertical shiplap weatherboards
- painted / natural (TBC)

Alternative Claddings

Wall Cladding One
(Primary Cladding)

Straight Edge Shingles
- Cedar, Unpainted

Wall Cladding Two
(Secondary Cladding)

Vertical Shiplap Weatherboards
- Painted

Roof Cladding
(As per original drawings)

Notes

Due to the Type A1 Housing position on the site, the proposed cladding options are only applied three elevations (as the forth elevation is directly on the boundary and the proposed cladding material may be unsuitable. (only two depicted in the street perspective to the right).

A combination of the existing cladding system and 'new' alternative cladding system will be explored. The principle of 'ratio of materials' will be applied (as mentioned earlier in the report).

The roofing material will be similar to what is already applied to the A1 housing - as per the drawing issue.

Alternative Cladding Material:

450mm high with varying widths, Western cedar shingles on bituminous building paper, on 12mm H3.1 plywood, on 20mm H3.2 drainage cavity, on building paper, on ex100x50mm H3.2 timber framing.

Perspective from Street

Existing Claddings used

Cladding materials used:
Vertical shiplap weatherboards
- painted / natural (TBC)

Alternative Claddings

Wall Cladding One
(Primary Cladding)

Random width and depth Cedar Weatherboards
- Painted

Wall Cladding Two
(Secondary Cladding)

Vertical Shiplap Weatherboards
- Cedar / Natural

Roof Cladding
(As per original drawings)

Notes

Due to the Type A1 Housing position on the site, the proposed cladding options are only applied three elevations (as the forth elevation is directly on the boundary and the proposed cladding material may be unsuitable. (only two depicted in the street perspective to the right).

A combination of the existing cladding system and 'new' alternative cladding system will be explored. The principle of 'ratio of materials' will be applied (as mentioned earlier in the report).

The roofing material will be similar to what is already applied to the A1 housing - as per the drawing issue.

Alternative Cladding Material:

JSC Timber random width and depth cedar weatherboards - painted. Weatherboards are in 'Layout 5' on 20mm H3.2 drainage cavity, on building paper, on ex100x50mm H3.2 timber framing.

Perspective from Street

Existing Claddings used

Cladding materials used:
Vertical shiplap weatherboards
- painted / natural (TBC)

Alternative Claddings

Wall Cladding One
(Primary Cladding)

400mm Zinc Adeka tiles by VMZinc
- Quartz Zinc Finish

Wall Cladding Two
(Secondary Cladding)

Vertical Shiplap Weatherboards
- Cedar / Natural

Roof Cladding
(As per original drawings)

Notes

Due to the Type A1 Housing position on the site, the proposed cladding options are only applied three elevations (as the forth elevation is directly on the boundary and the proposed cladding material may be unsuitable. (only two depicted in the street perspective to the right).

A combination of the existing cladding system and 'new' alternative cladding system will be explored. The principle of 'ratio of materials' will be applied (as mentioned earlier in the report).

The roofing material will be similar to what is already applied to the A1 housing - as per the drawing issue.

Alternative Cladding Material:

400mm square 'Adeka' tiles by VMZinc in 'Quartz Zinc' finish, screw fixed on 15mm H3.1 plywood, on 20mm H3.2 drainage cavity, on building paper, on ex100x50mm H3.2 timber framing.

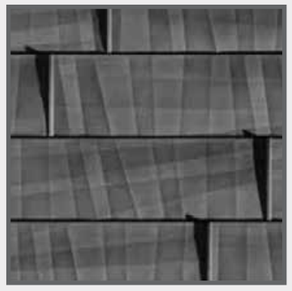
Perspective from Street

Existing Claddings used

Cladding materials used:
Vertical shiplap weatherboards
- painted / natural (TBC)

Alternative Claddings

Wall Cladding One
(Primary Cladding)



400x700mm and 400x1400mm FX.12 aluminium panels by Prefa - P10 charcoal finish.

Wall Cladding Two
(Secondary Cladding)

Vertical Shiplap Weatherboards
- Cedar / Natural

Roof Cladding
(As per original drawings)

Notes

Due to the Type A1 Housing position on the site, the proposed cladding options are only applied three elevations (as the forth elevation is directly on the boundary and the proposed cladding material may be unsuitable. (only two depicted in the street perspective to the right).

A combination of the existing cladding system and 'new' alternative cladding system will be explored. The principle of 'ratio of materials' will be applied (as mentioned earlier in the report).

The roofing material will be similar to what is already applied to the A1 housing - as per the drawing issue.

Alternative Cladding Material:

400x700mm and 400x1400mm FX.12 aluminium panels by Prefa screw fixed on 15mm H3.1 plywood, on 20mm H3.2 drainage cavity, on building paper, on ex100x50mm H3.2 timber framing.

Perspective from Street

6.0 Conclusions

Question:

What are the alternative cladding solutions for medium density housing and what are the considerations designers need to make when selecting these solutions?

The identification and analysis of current wall claddings typically used within Studio Pacific Architecture – specifically medium density housing, was required to lend a foundation for the project. Only then, one is able to identify alternative cladding solutions, which are not typically applied to these medium density housing projects. These wall claddings are determined from three major medium density housing projects currently being developed by Studio Pacific Architecture (as of Summer 2015). The projects being, Hobsonville, Overlea Central, and McLennan, typically witnessed timber weatherboards, brick veneer, and occasionally profiled metal wall claddings. These are relatively standard materials are defaulted to as they are cost effective, durable, maintainable, and are 'understood' within the public realm and building industry.

By initially investigating these existing cladding materials, gave a wider appreciation of what can be accomplished with the seemingly 'fixed' material – such as accentuating the 'modularity' in brick by simply alternating the depth of the brick, in a way, which is still compliant with the NZBC. Although a simple solution, it successfully deviates from the typical regularity / flush surface generated from standard configurations. Additionally, customization of metal profiled claddings was also achieved which were highly 'exotic' in form – such as triangular and circular ribs, rather than the standardized trapezoidal and corrugated.

Alternative cladding solutions were also introduced which were not previously used on Studio Pacific Architecture's medium density housing projects. Five claddings were selected primarily on availability in New Zealand, speculated costs, durability, maintenance, and visual uniqueness. These claddings are Timber shingles, Porcelain panels, uPVC weatherboards, Zinc tiles, and Plywood panels (alternative configuration). The claddings were subjected to the suggested requirements to obtain 'alternative solution', which revealed that some claddings are much more difficult to obtain compliance; primarily due to insufficient manufacturer's documentation (such as the Zinc panels) insufficient manufacturers details (Timber shingles) and potential durability issues and in service history (in the case of alternative plywood configurations).

The investigation did suggest that metal claddings – both profiled or panels demonstrated flexibility, as they were able to be custom formed (such as the case of the Nouvo Apartments in Wellington, depicting a custom square profile). Metal panels (in this case, aluminum and zinc were investigated) are also available in alternative forms and shapes (Zinc diamond tiles), or even incorporate unique surface treatments – adding further distinction (FX.12 aluminum panels).

The high degree of flexibility is notable in comparison to other materials such as brick or weatherboards which were 'fixed' to their predefined modularity.

In regards to the alternative claddings versus the existing cladding systems typically used on Studio Pacific Architecture's medium density housing, some of the alternative claddings were found to be 'a premium cladding' which may not suit the cost requirements as stated earlier (such as the Laminam porcelain panels exceeded initial speculative costs), however it's durable and maintenance free disposition, could in fact make it a viable solution. The Palliside uPVC weatherboards suited many of the requirements – being cost effective, ease of installation, being durable and maintenance free with appropriate appraisals / documentation.

This investigation demonstrates an initial examination into the subject of alternative cladding systems and their use at Studio Pacific Architecture. Future investigations can certainly be established – to update the pallet witnessed in this report. Further investigations can also be made for the alternative cladding systems – perhaps focusing on the implications / costs involved with treating window and door openings, the inclusion of various finishes to the claddings, or even the potential submission of the alternative solutions to City Councils in New Zealand to further 'test' the viability of the cladding systems. This may very well establish 'Stage Two' of this investigation.

It should also be mentioned that these alternative claddings were available as of summer 2015, therefore additional cladding systems may have been introduced or new developments in the existing cladding pallet, since this time.

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8.0 Appendix

Table 20: Material selection

This table shall be read in conjunction with Table 21 and Table 22 and Paragraph 4.0.
Refer relevant *cladding* and *flashings* paragraphs for material and coating specifications.
Paragraphs 2.2 b), 4.2.2, 4.2.3, 4.3, 4.3.1, 4.3.3, 4.3.4, 4.3.8-10, 4.4, 7.3.2 b), 8.1.4, 8.2.4, 8.3.4.1, 8.4.3.1, 9.6.3.1, 9.6.6 d) and 9.8.5

Material		Exposure	Durability 15 yrs	Durability 50 yrs
Aluminium, copper, lead, zinc, stainless steel		Hidden	✓	✓
		Exposed to weather	✓	✓
		Sheltered	✓	✓
Aluminium-zinc coated steel AZ150 uncoated, or coated to NZS 4217		Hidden	✓	✓ (2)
		Exposed to weather	✓ (1)	✓ (4)
		Sheltered	✓ (3)	✓ (6)
Aluminium-zinc: AZ150 factory-coated to AS/NZS 2728		Hidden	✓	✓
	Type 4	Exposed to weather	✓	✓ (4)
	Type 5		✓	✓ (3)
	Type 6		✓	✓ (1)
	Type 4	Sheltered	✓ (3)	✓ (6)
	Type 5		✓ (1)	✓ (5)
	Type 6		✓	✓ (3)
Bituminous material, uPVC		Hidden	✓	✓
		Exposed to weather	✓	✘
		Sheltered	✓	✓
Butyl rubber		Hidden	✓	✓
		Exposed to weather	✓	✘
		Sheltered	✓	✘
Galvanized steel Z450 uncoated, or coated to NZS 4217		Hidden	✓	✓ (4)
		Exposed to weather	✓ (3)	✓ (6)
		Sheltered	✓ (5)	✓ (3)
Galvanized steel: Z275 factory-coated to AS/NZS 2728		Hidden	✓	✓
	Type 4	Exposed to weather	✓ (1)	✓ (6)
	Type 5		✓	✓ (4)
	Type 6		✓	✓ (1)
	Type 4	Sheltered	✓ (3)	✓ (6)
	Type 5		✓ (1)	✓ (6)
	Type 6		✓	✓ (4)
FIXINGS: Aluminium, bronze, monel and stainless steel		Hidden	✓	✓
		Exposed to weather	✓	✓
		Sheltered	✓	✓
FIXINGS: Hot-dipped galvanized steel to AS/NZS 4680		Hidden	✓	✓ (2)
		Exposed to weather	✓ (2)	✓ (6)
		Sheltered	✓ (4)	✘
Screws to AS 3566: Part 2	Class 3	Hidden	✓	✓ (2)
	Class 4		✓	✓
	Class 3	Exposed to weather	✓ (2)	✓ (6)
	Class 4		✓	✓ (4)
	Class 3	Sheltered	✓ (4)	✘
	Class 4		✓ (2)	✘

LEGEND: ✓ Suitable for *durability* requirement in all NZS 3604 exposure zones, including sea-spray zones
✘ Not suitable for *durability* requirement
✓ (no.) Conditionally suitable – refer relevant acceptable zone number

Acceptable zones as per NZS 3604: (1) Zones 1, 2, 3 and 4; (2) Zones 1, 2 and 3; (3) Zones 2, 3 and 4; (4) Zones 2 and 3; (5) Zones 3 and 4; (6) Zone 3

Note: *Durability* may be improved by regular washing of sheltered materials.
The term "sheltered" is as defined in AS/NZS 3604, Figure 4.2.
The term "hidden" is defined as concealed behind another element that would need to be removed to allow monitoring of performance or maintenance. A hidden *flashing* may be exposed to H_2S in geothermal areas, but not to salt spray in coastal zones. If exposed to salt spray, it is classified as "sheltered".

Table 21: Compatibility of materials in contact

This table shall be read in conjunction with Table 20 and Table 22.
Refer relevant *cladding* and *flashings* paragraphs for material and coating specifications.
Paragraphs 2.2 c), 4.2.4, 4.4, 4.5.2 a), 8.2.4, 8.4.11 a) and c), 8.4.11.1 b), 9.6.7 f) and 9.8.5

	Aluminium, anodised or mill-finish	Aluminium, coated (1)	Butyl rubber	CCA-treated timber (2)	Cedar	Cement plaster (uncoated)	Ceramic tiles (cement grout)	Clay bricks (cement mortar)	Concrete carbonated (unpainted)	Concrete green (unpainted)	Copper/brass	Fibre cement (unpainted)	Glass	Glazed roof tiles	Lead (including lead-edged)	Plastics	Stainless steel	Steel coil-coated	Steel, galvanized (unpainted)	Zinc (unpainted)	Zinc/aluminium (unpainted)
Aluminium, anodised or mill-finish	✓	✓	✓	✘	✓	✘	✘	✘	✓	✘	✘	✘	✓	✓	✘	✓	B	✓	✓	✓	✓
Aluminium, coated (1)	✓	✓	✓	B	✓	✘	✘	✘	✓	✘	✘	✘	✓	✓	B	✓	B	✓	✓	✓	✓
Butyl rubber	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘
CCA-treated timber (2)	✘	B	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B	✘	✘	✘
Cedar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘
Cement plaster (uncoated)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✘
Ceramic tiles (cement grout)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘
Clay bricks (cement mortar)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘
Concrete old (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Concrete green (unpainted)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✓	✓	✘	✘	✘	✘
Copper/brass	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	B	✓	B	✘	✘	✘	✘
Fibre cement (unpainted)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘
Glass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Glazed roof tiles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lead (including lead-edged) unpainted	✘	B	✓	✓	✓	✘	✓	✓	✓	✘	B	✓	✓	✓	✓	✓	B	B	B	B	✘
Plastics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stainless steel	B	B	✓	✓	✓	✓	✓	✓	✓	✓	B	✓	✓	✓	B	✓	✓	B	✘	✘	B
Steel coil-coated	✓	✓	✓	B	✓	✓	✓	✓	✓	✘	✘	✓	✓	✓	B	✓	B	✓	✓	✓	✓
Steel, galvanized (unpainted)	✓	✓	✓	✘	✘	✓	✓	✓	✓	✘	✘	✘	✓	✓	B	✓	✘	✓	✓	✓	✓
Zinc (unpainted)	✓	✓	✓	✘	✘	✓	✓	✓	✓	✘	✘	✘	✓	✓	B	✓	✘	✓	✓	✓	✓
Zinc/aluminium (unpainted)	✓	✓	✓	✘	✘	✘	✘	✘	✓	✘	✘	✘	✓	✓	✘	✓	✘	✓	✓	✓	✓

LEGEND:

✓ Materials satisfactory in contact.

✘ Contact between materials is not permitted. Minimum gap of 5 mm is required to prevent moisture bridging.

B Avoid contact in sea-spray zone or corrosion zone 1.

NOTES:

(1) Coated – includes factory-painted, coil-coated and powder-coated.

(2) Includes copper azole and copper quaternary salts.

Table 22: Compatibility of materials subject to run-off
This table shall be read in conjunction with Table 20 and Table 21.
Refer relevant *cladding* and *flashings* paragraphs for material and coating specifications.
Paragraphs 2.2 c), 4.2.4, 4.4, 4.5.2 a), 8.2.4, 8.4.11 a) and c), and 9.8.5

Material that water flows from \ Material that water flows onto	Aluminium, anodised or mill-finish	Aluminium, coated (1)	Butyl rubber	CCA-treated timber (2)	Cedar	Cement plaster (uncoated)	Ceramic tiles (cement grout)	Clay bricks (cement mortar)	Concrete carbonated (unpainted)	Concrete green (unpainted)	Copper/brass	Fibre cement (unpainted)	Glass	Glazed roof tiles	Lead (including lead-edged)	Plastics	Stainless steel	Steel coil-coated	Steel, galvanized (unpainted)	Zinc (unpainted)	Zinc/aluminium (painted)	Zinc/aluminium (unpainted)
Aluminium, anodised or mill-finish	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Aluminium, coated (1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✘
Butyl rubber	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘	✘
CCA-treated timber (2)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘	✘	✘
Cedar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘	✘
Cement plaster (uncoated)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✘	✓	✓	✓	✘	✘	✘	✘
Ceramic tiles (cement grout)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✘	✘	✘	✘
Clay bricks (cement mortar)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✘	✘	✘	✘
Concrete old (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
Concrete green (unpainted)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✘	✓	✓	✘	✘	✘	✘	✘
Copper/brass	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘	✘	✘
Fibre cement (unpainted)	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✘	✘	✘	✘
Glass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Glazed roof tiles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Lead (including lead-edged) unpainted	✘	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘
Plastics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Stainless steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Steel coil-coated	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓
Steel, galvanized (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zinc (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zinc/aluminium (unpainted)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✘	✘	✓	✓

LEGEND:
✓ Materials satisfactory with water run-off as indicated.
✘ Water run-off is not permitted as indicated.
A Etching or staining of glass may occur with run-off.

NOTES:
(1) Coated – includes factory-painted, coil-coated and powder-coated.
(2) Includes copper azole and copper quaternary salts.

PROPOSAL FOR AN ALTERNATIVE SOLUTION

New Residence at
123 Atawhai Drive
Nelson

Prepared by: Chi Tran 30063422
SARC364 Building Code Compliance
Date: 28 March 2014

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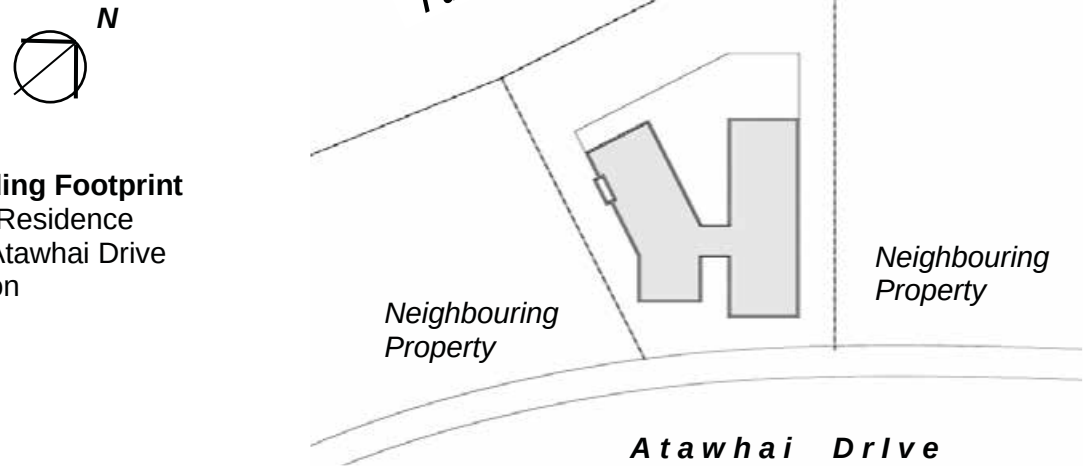
1.0 Project Description

1.1 Dwelling Concept

The proposed project is a detached single story family dwelling situated at 123 Atawhai Drive, Nelson; oriented towards the Tasman Bay.
The dwelling incorporates a simple 'duel' wing design which separates the communal family areas from the sleeping quarters. A central glazed corridor or 'Gallery' acts as an intermediary connection between the two wings which frames the Courtyard Terrace; allowing for an outdoor living space that maximises the magnificent view towards Tasman Bay.

1.2 Dwelling Construction

The dwelling is typically of concrete blockwork construction with timber strapping and lining within the interior. Wall claddings include smooth plasterwork and selected stone tiles.
The majority of glazing will be installed on the north-west elevations to maximise both view and evening sun.



Building Footprint
New Residence
123 Atawhai Drive
Nelson

2.0 Project Scope

The stone veneer cladding mentioned above is not covered in the New Zealand Building Code and **will require an alternative solution**.

The use of a stone cladding is an important feature of the design, not only is it specified by the Client; it is a popular natural robust material which performs well in regards to weathering durability. Furthermore, the stone cladding deviates from the typical accepted claddings found in the NZBC – adding diversity to the urban grain.

2.1 Cladding System

The Client has specified 600x300x30mm limestone tiles (Colour and finish to be confirmed) as the exterior cladding, to complement the smooth plasterwork.
Stone tiles will be mechanically fixed to the concrete blockwork via a stone anchoring system – **Stoneclip** system produced by Stoneclip.

The Stoneclip is a relatively new fixing system for stone tiles which has developed from the traditional anchor pins/angles or adhesives which are widely used for fixing of stone tiles.
The Stoneclip system fixes the stone tiles with steel disks which are inserted into the edges of the stone tile, and anchored back to the main structure (which in this case is concrete blockwork). Refer to Appendix for images of the Stoneclip system.
The advantage of the Stoneclip system is the adjustable disks which allow efficient installation and highly accurate/flush finish.

2.2 Cladding Location

The stone tiles are installed on the entirety of the exterior, in-conjunction with the smooth plasterwork.
The stone tiles are full height in most areas where there is no smooth plasterwork. The maximum height from Ground Level to the underside of the eave is 4.0m – which falls well under the 10m height restriction for the Stoneclip system. Refer to appendix for Stoneclip Technical Information.
However; at the chimney stack, the stone tiles will extend past the eave line and 'wrap' around the perimeter of the chimney – including into the interior space. Provisions will be made to accommodate the aluminium window joinery to allow for this transition.

3.0 Building Code Clauses in Effect

The following NZBC Causes are to be considered:

- Clause B1/AS1 Structure
- Clause B2/AS1 Durability
- Clause E2/AS1 External Moisture
- Clause F2/AS1 Hazardous Building Materials

4.0 Performance

The project is a Specific Engineering Design due to the concrete block construction and requirement of structural steelwork at the windows on the north-west elevations. The dwelling is also situated on the Tasman Bay coastline within in a high wind zone, thus designed to suit these environmental conditions.
In regards to the the stone cladding system – it is a non-structural element, and is independent from the wall structure. The stone tiles themselves will be permeable to water, thus the wall structure (concrete blockwork) will require appropriate waterproofing to prevent moisture penetration.

Set out by the requirements stated in the NZBC Clause B2/AS1; Durability, the cladding shall have no less than 15 years of durability while the wall structure is to have no less than 50 years of durability.

The Stoneclip system will fall into the 50 years durability requirement category as Clause B2/AS1: Table 1: Durability Requirements of Nominated Building Elements Notes: “all hidden elements have at least the same durability as that of the element that covers”

The Stoneclip system also allows for the stone tiles to be off-setted from the wall structure, naturally creating a vented drainage cavity system. Within this project, a minimum of 20mm cavity will be maintained where there are stone tiles installed.
Furthermore; the Stoneclip is also formed from stainless steel which increases its durability; especially as the proposed dwelling is situated along the coastline.

All details associated with the installation of the stone tiles will be strictly in accordance to the Stoneclip technical literature. The Stoneclip system does not have any preference to a specific stone type or manufacturer; however lays guidelines in maximum stone sizing; which will be adhered to within this project.

5.0 Supplementary Information

5.1 Performance Verification

The Stoneclip system has not yet been appraised by BRANZ, however has been assessed by Sheetly & Partners Pty Limited – Structural Engineers Queensland, Australia.
The following assessments have been established in accordance with Australian Standards – which is also employed in New Zealand (i.e. AS/NZS):

- The Stoneclip system’s components have been designed in accordance with AS 4673:2001 – Cold Formed Stainless Steel Structures.

- Loading which are applied to Panel Dead Loads is 1.35 in accordance with AS1170.0:2002 – Structural Design Actions

- The Stoneclip are designed for a strength limit state pressure of 2.53 kPa. Cladding heights shall be at a maximum of 10m in accordance with AS1170.2:2002 – Structural Design Actions – Wind Actions

- Stoneclip design capacity tables have been established for maximum vertical and horizontal loadings for each Stoneclip type. Refer to Appendix for vertical and horizontal loading tables.

5.2 Comparison with Acceptable Solution

Standard stone veneer claddings are currently not included in the NZBC Clause E2/AS1 External Moisture.

However, stone tiles does share similar characteristics with masonry veneer - both materials being pourus in nature, non-structural, and fixed using mechanical fixings. Masonry veneer systems have been established in the NZBC Clause E2/AS1 - 9.2 Masonry Veneer, as an acceptable solution.
Similar details can be extrapolated and reapplied to accommodate stone veneer instead of the Masonry veneer. Such details include the incorporation of a drainage cavity system, anchor ties and minimum clearances from the ground and acceptable window head, jamb and sill detailing.

The installation of stone tiles using the Stoneclip system is relatively simpler and only requires the Stoneclip component at 'x' centres which are anchored into the structure.
Similarly the masonry veneer; it acts as a non-structural enclosure, where moisture removal occurs at the wall structure, not at the cladding. As mentioned in section 4.0 Performance; where concrete blockwork is used (which is the primary wall structure in this project) it shall be sealed using appropriate waterproofing to prevent moisture penetration.

5.3 Comparison with Accepted Product

There are multiple stone fixing products which have been appraised by BRANZ. However, these products are used to form 'natural, schist styled' finishes – Which is not the aesthetic desired for this dwelling.
Fixing of the stone typically require bonding to a substrate, fixing over cavity battens and to the wall structure. Alternatively; mechanical fixings such as steel angles or anchor pins maybe used to support stone tiles at its edges via steel pins. However, these systems have not been appraised by BRANZ, and can be onerous to install.
The Stoneclip fixings does appear to be a simpler system by comparison - with its ease of installation (as mentioned earlier in section 2.0 Project Scope – Cladding System), with the removal of other materials/systems i.e. cavity battens, substrates, and control joints etc. This will ultimately reduce risk in regards to faulty products or installation.

5.4 Existing Determination with Similar Product

According to the Department of Building and Housing website, there is no current determination with this particular product or similar products at this point in time (21/03/2014). Determinations regarding stone cladding were primarily for those which employed a 'stone adhesive fixed to substrate on cavity battens' system mentioned above.

5.5 Proprietary System

The Stoneclip is a proprietary system. Suppliers in New Zealand include:

Timaru Bluestone
94 Coonoor RD, Timaru, New Zealand
Tel: (64) 3 688 4158
Fax: (64) 3 688 4159
Web: www.stoneclip.co.nz

Stone and Tile Solution Ltd
6 Iversin Terrace
Christchurch, New Zealand
Tel: 03 365 9725
Fax: 03 365 9730

The Stoneclip system does set out basic guidelines including: Nominal tile sizes (LxWxD), in-conjunction with drainage cavity depth, and method of installation. Engineering details are also included in the technical literature – produced by Qantec McWilliam Consulting Engineers. Refer to Appendix for Engineering Details.

However, quality of finish/installation accuracy will be dependent on the knowledge of the installer. Installation shall be made by an experienced stone tile installer, with knowledge of the Stoneclip system.

5.6 Existing Applications

The Stoneclip system has been used within the New Zealand building industry for many years. The following are examples of projects using the Stoneclip system.

Otago University Plaza Building - Forsyth Barr Stadium - Dunedin
The front façade of the Otago University Plaza Building cladded with Ormaru limestone panels. Designed by Warren and Mahoney of Christchurch.

Images sourced from www.timarubluestone.co.nz

Downer EDi Works - Head Office Building - Dunedin
Portions of the envelope consisting of Bluestone panels. Designed by Stevenson Design of Dunedin

Images sourced from www.timarubluestone.co.nz

Integrated Terminal Project - Christchurch Airport - Christchurch
The use of engraved Bluestone tiles behind the Check- in counters within the Airport Entrance Lobby. Designed by Hassell and Warren and Mahoney of Christchurch.

Images sourced from www.timarubluestone.co.nz

Entrance Lobby - Forsyth Barr House – Christchurch (Structural Integrity)
Basalt stone panels weighing up to 80kg each, supported by 3 x Stoneclips with a cavity of 50mm retained its structural stability after the 7.2 magnitude earthquake in Christchurch on 03/09/2012. The building itself sustained extensive damage with partial collapse of its primary stair well.

Images sourced from www.stoneclip.com and www.tvnz.co.nz

5.7 Local Environmental Conditions

The site is situated on the Nelson coastline and fully exposed. The selection of a robust cladding material and suitable fixings are required to combat the local environmental conditions. The mechanical fixings being of stainless steel and highly durable will be very suitable system for these conditions.

5.8 Collaborative Expert Advice

The primary structure is being concrete blockwork, and did required specific design by a Structural Engineer. The Engineer involved with this project has approved the Stoneclip system to be used in conjunction with the concrete blockwork; and should be structurally sound.

Note: Producer Statement from the Structural Engineer will be included with this application after it has been completed.

As mentioned earlier in 5.0 Supplementary Information – Performance Verification; the Stoneclip system has been assessed by Structural Engineers against AS/NZ Building Standards, and has met the requirements of those standards.

6.0 Conclusion

We believe we have adequately presented information to substantiate the usability of the Stoneclip system within this project.
Although the Stoneclip system is relatively new to the industry, it is based on existing forms of mechanical fixing already used for stone tile cladding installations. However; based on the information provided by Stoneclip and from existing building applications, it does suggest the system is more efficient (in terms of installation) and requires less systems to be installed – i.e. substrates, cavity battens, control joints etc. This will ultimately reduce risks that may arise from faulty products or poor installation.

The Stoneclip system naturally allows for a drainage cavity system behind the stone tiles, and is independent from the wall structure. The stone tiles do not require sealing or waterproofing as all waterproofing shall be at the wall structure – further removing weathertightness risks may be associated with the wall cladding (i.e. faulty installation).

The Stoneclip system is more than adequate for the use on this relatively simple project.

7.0 Appendix

Examples of the Stoneclip system

www.stoneclip.com

WALL PANEL CLADDING

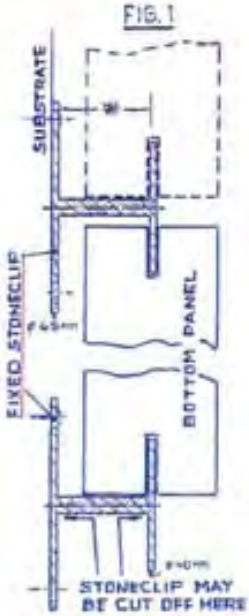
Stoneclip

INSTALLATION BROCHURE

CLADDING WITH THE AID OF STONECLIP IS VERY ECONOMICAL. WHILE MATERIAL COSTS ARE SLIGHTLY HIGHER IT IS CONSIDERABLY CHEAPER ON LABOUR COSTS AS IT IS QUICK TO INSTALL COMPARED TO OTHER PRODUCTS AVAILABLE. WITH STONECLIP ONE IS NOT RESTRICTED TO A GIVEN HEIGHT OF INSTALLED PRODUCT PER DAY. AS MUCH PRODUCT CAN BE INSTALLED AS MANPOWER/RESOURCES ALLOWS.

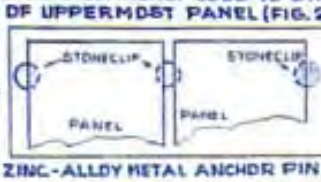
THERE IS A FIXED AND AN ADJUSTABLE STONECLIP AVAILABLE

FIG. 1



HOW TO INSTALL FIXED STONECLIP

1. CUT SLOTS INTO BED (WIDTH) OF PANELS, USING STONECLIP-CUTTER. CUTS MUST BE MADE CENTRALLY. MEASURE ALWAYS FROM FRONT (FACE) OF PANEL – THIS ASSURES THAT FRONT OF CLADDING IS FLUSH EVEN IF PANELS VARY IN THICKNESS (SEE FIG. 3).
2. START WITH SECURING BOTTOM BRACKET. THIS MAY BE A FULL STONECLIP OR A HALF CLIP. HALF CLIPS ARE COMMONLY USED TO START ABOVE FLOOR LEVEL AND TO SECURE TOP OF UPPERMOST PANEL (FIG. 2).
3. FIT PANEL ONTO BOTTOM BRACKET AND SECURE TOP WITH STONECLIP. (AFTER POSITIONING IN REQUIRED SPOT DRILL A HOLE INTO WALL (SUBSTRATE) THROUGH MOUNTING HOLE. THEN DRIVE IN ZINC-ALLOY METAL ANCHOR PIN, USING HAMMER AND PUNCH TO AFFIX STONECLIP).



TOP CLIPS ARE FOR PLACEMENT OF PANELS ONLY

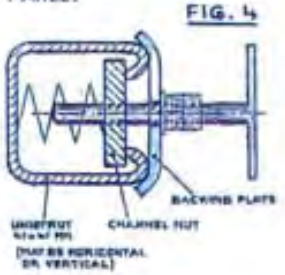
FIG. 2

- IT IS RECOMMENDED TO FILL TOP SLOTS WITH SILICONE JUST PRIOR TO INSTALLATION TO TAKE UP ANY PLAY IN PANEL AND TO STOP MOISTURE COLLECTING IN SLOTS.
- WHEN CLADDING IS DONE WITH OPEN JOINTS (EG. 3 MM) THAN SLOTS MUST BE FILLED WITH EPOXY JUST PRIOR TO MOUNTING. USE NYLON "X" SPACERS BETWEEN PANELS – TO BE REMOVED ONCE EPOXY HAS CURED.

FIXED STONECLIP SIZES AVAILABLE	
⌀	TO SUIT PANEL THICKNESS
15 MM	20 MM
20 "	30 "
28 "	40 "
33 "	50 "

NOTE: SLOTS IN TOP AND BOTTOM BED ARE USUALLY CUT 100 MM FROM SIDES OF PANEL.

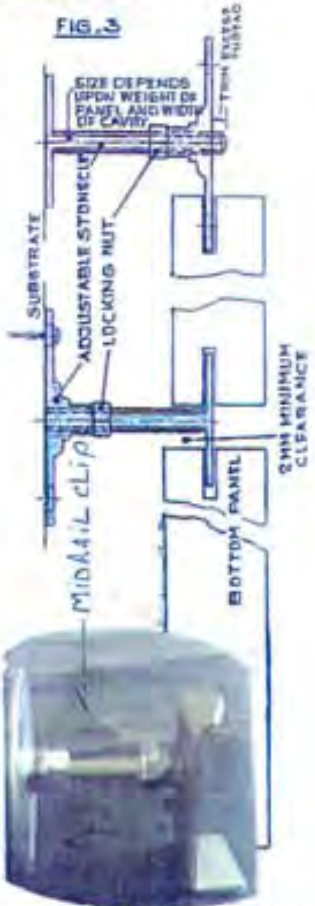
FIG. 4



USING THE ADJUSTABLE STONECLIP (FIG. 3)

1. MAKE CUTS IN PANELS (SEE 1)
2. FIX BOTTOM CLIP TO REQUIRED POSITION (IF NOT STARTING ON SOLID FOOTING)
3. MOUNT PANEL ONTO BOTTOM CLIP
4. LOCATE STONECLIP WITH FRONT FACE (SMALL DISC) TO SUBSTRATE AND ADJUST TO EXACT SIZE REQUIRED (RED CLIP – FIG. 3)
5. THEN LOCK NUT IN PLACE
6. REMOVE STONECLIP FROM PANEL AND TRIM OFF EXCESS THREAD (IF ANY) FLUSH WITH BACK PLATE (LARGE DISC)
7. RE-INSTALL STONECLIP WITH LOCKING NUT SECURELY LOCKED IN PLACE AND IN FORWARD POSITION (BLUE CLIP IN FIG. 3)
8. THEN DRILL A HOLE IN SUBSTRATE AND ... (AS IN 5)

FIG. 3



ABOVE SUPPORT SET-UP IS USED WHEN STARTING IN AN UNSUPPORTED SITUATION EG. OVER OPENINGS (DOORS, WINDOWS ETC)

SEE ALSO STONECLIP CAPACITY TABLES

STONECLIP *the simple, cost-effective mechanical fixing system for stone cladding*

New Product

Versatile Design

Saves Time

Easy to Install

Engineer Approved

Stainless Steel

STONECLIP is a new simple and effective fixing bracket for stone cladding that will reduce the time and cost of installation for 20mm-50mm stone and other materials.

The ***STONECLIP*** was developed to meet the demands of architects, builders and the requirements identified by the new Australian building code.

The new stainless steel ***STONECLIP*** has a patent application pending and has been tested and approved by Mr John Gibson, the senior Engineer from Qantec McWilliams consulting engineers. Mr Gibson believes that the "*...well thought out fixing/support details has many applications in the building industry.*"

- *Your insurance policy when fixing product over 32kg/m^2*
- *More Cost-Effective with Larger Format Stone*
- *Now Available in Adjustable Version for those "Out of Plumb" Walls*
- *Quotes Available upon request for your Specific Application*
- *Competent Installers Available in QLD, NSW and VIC*
- *Used to fix Stone, Wood, Aluminium and many other materials*

CINAJUS PTY LTD

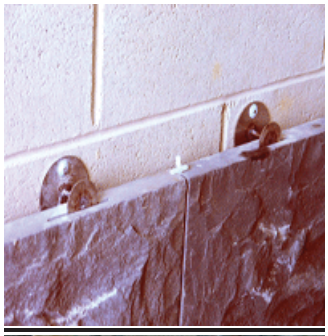
Tel: 02 9521 1971 Fax: 02 9521 1918

Email: info@cinajus.com

Online Catalogue: www.cinajus.com

1	Start at Ground level and ensure that the starting row is level.
2	Cut slots as required in stone cladding using standard biscuit cutter fitted with diamond cutting wheel. Always cut slots measured from front face of panels to ensure plumb/flush faces.
3	Mount panel onto bottom brackets and insert Stoneclips into upper panel slots. Hold clip in place ensuring centre spindle sits on upper edge of stone panel.

4	Drill into wall through top mounting hole of Stoneclip. Drive in zinc-alloy metal hit anchor pins using hammer and punch to affix Stoneclip. It is recommended to fill the slots in the top of the panels with silicone sealer to take up any play in the panels and to stop moisture pooling in the slot.
5	Use nylon "X" spacers between panels to provide even spacing. Fix the top edge of the final row of panels with Stoneclip.



	USING ADJUSTABLE STONECLIPS
a	Make cut in panels with biscuit cutter (as before) and indent if panel is to be flush-fitted.
b	Put panel into position and hold whilst drilling 14mm diameter hole to a depth of 14mm to accommodate nutsert, either installed forward or reversed, to suit plumb position of the wall. As all concrete block walls are slightly out of plumb, the addition of some dobs of fix or glue to the back of the panel will give extra rigidity.

c	Locate Stoneclips with front face to wall and set the adjustment to exact size required. Then lock the nut in place.
d	Remove Stoneclip from panel and trim off excess thread.
	Re-install Stoneclip with nutsert located in the recess drilled in the wall. Then drill hole in wall for fixing pin through Stoneclip fixing hole.

e	Drive in zinc-alloy metal hit anchor pins using hammer and punch to affix Stoneclip
	Check for plumb before repeating process.
	***Note**: to comply with building codes & engineers report angle strip needs to be affixed every 3 vertical metres.*

1. Purpose

This Note is intended to give an overview of some typical stone fixing methods and highlight the advantages of the Eco-StoneClip system.

2. Overview of Stone Fixing Methods

Applied Fixers is when you restrain stone paneling with Adhesive fixers, the two mainly-used methods are:

Cement Based Adhesives. These are cement based products that can be applied to the back of the cladding and put into position. This method is restricted to a maximum weight of 32 kg/m^2 or 4 kg/piece of material. This maximum weight limit is a restrictive barrier and you move outside this limit at your own peril. Adhesive companies will not carry any claims from any failures if you exceed this guideline. Always use the best adhesive fixer available.

Epoxy Adhesives. These substances are very good at carrying weight and fixing material to substrates well above load capacity of Cement Based Adhesives. However, you very often find that the fixer (epoxy) is stronger than the surface of the product that you are bonding. Failures may still occur as it can tend to pull the back off the bonded material. It is very good with products like Granite and most marbles, but can pull apart some Sandstones and Limestone. The good thing about epoxy based fixers is that they are available in 5 minute and 24 hr setting times.

Pinned Epoxy Adhesive. This is a combined Mechanical/Adhesive Fixing System and is the method by which epoxies are most successfully used in the industry. In this system you have to drill a pin into place in the stone panel and bond it with epoxy. Then you have to drill and epoxy the pin into the substrate you are fixing to. This method has restraints and it is not recommended to exceed 2000mm height/day of installed stonework as the loading is not safe on the epoxy .This is a very successful way of restraining panels but is very hard for anyone not trained in its use to do and thus it is very costly /m^2 to install.

Mechanical Fixing methods rely on purely mechanical of the stone to the substrate. These are available in a variety of systems typically incorporating metallic clips, bolts, nuts and washers but tend to be tricky to install, costly and designed/approved for the specific project application.

StoneClip is one solution that is quicker than any of the methods mentioned above for fixing heavy stone cladding to substrates. This method is an Engineered Approved generic system for fixing panels. With this method you are not restricted to a given height of installed product per day. You can install as much product as determined by the available manpower/resources. This method is slightly more expensive in material costs for a given project but considerably cheaper on labour costs as it is quick to install compared to other methods available. The number of clips required to restrain a panel is nearly always two, but more are needed when the panels get larger and deeper. You can decide what level of joint you use, simply by imbedding the joining pin in the stone or not and then leaving a grout joint to be either filled or left open for ventilation. With this system it is also easier to fix Lateral fixing pins (Side fixing to prevent suction by wind and bending from thermal expansion/contraction of panels) to the panels and substrate. The specific Project will determine the extent of restraint needed on each panel, these will be called up by the project architect/engineer.
There is provision with StoneClip to fix stone panels from 20–50 mm in thickness and up to 1000mm x 500mm overall dimension. Larger sizes can be accommodated if the correct fixing details are followed . StoneClip is available in both FIXED and ADJUSTABLE versions.

3. ECO StoneClip

This method is mainly applicable to the use of rectangular stone from 20 to 50mm thick and panels from 500mm x 250mm x 20 mm (i.e - rock faced panels with a 20mm bed and up to 60mm crown in the middle and thus called 20–60 mm rock faced). These panels are mainly being used in the landscape industry for covering garden walls made out of concrete block, but are used in all other formats as well. The product is of considerable weight, approximately 94kgs/m^2. With this type of stone product it is not possible to use cement based adhesives alone. Rapid-Set Epoxy adhesives can be used as a fixing medium, but remember that the daily installation height restriction applies. An alternative method for fixing heavy stone panels is therefore required.

The ECO-StoneClip method is a real alternative to full Mechanical fixing. The method requires that the stone be installed in a ***Stretcher bond*** configuration used in conjunction with a cement based adhesive. The easiest installation method is to start from the left hand side and work towards the right. Follow these steps to use the ECO-StoneClip method:

1. Start with a half block and put the incisions in the stone panel with the biscuit cutter or 100 mm diamond grinder, top of panel only;
2. Apply the adhesive fix to the panel and tap into place (plumb and level), insert the StoneClip and fix it to the wall with an approved restraint, pin or screw. Use either Fixed or Adjustable StoneClip as required;
3. Cut a slot into the next full panel (in the top only again), on the left hand side of the panel only. Be sure to leave the desired joint width selected as this will effect the stone that is placed on top of it in the next row;
4. Apply the adhesive fix to the back of the panel and tap into place, ONLY install StoneClip into the top left hand side incision of the panel, then fix, plumb and level the stone panel;
5. Repeat this process until the end of the row is reached. It may be necessary to adjust the length of the last few panels to finish flush. Remember to only install the StoneClip into the top left hand corner slot;
6. When starting the next row make incisions with the biscuit cutter or grinder into both the top and bottom of the full panel. It is only necessary to cut slots at the TOP LEFT and BOTTOM RIGHT of the panels. With half stones slot the panel in the center of both the top and bottom edges. This will become evident very quickly and save you time with the installation process as well as diamond cutting costs;
7. Always use a good quality cement based adhesive from a reputable manufacturer;
8. This will allow you to achieve the same m^2/day installation rate (or even greater than) as when using the full Mechanical fixing method with StoneClip. However there will be no restraint from any possible twisting of the panels;
9. Considerable savings on the number of StoneClips/m^2 will be made with this system. Between 4-6 clips/m^2 will be saved depending upon panel sizes;
10. This considerably reduces installation material costs. Bringing costs down to around AUD40 to 60/m2 depending upon panel sizes.

This method, if followed, allows the user to fix panels with the competence of a qualified tradesperson.

StoneClip / Cladding Type	Clips/m2		Tiles/m2	Clips / Tile				
				Top		Bottom		Side (Lateral)
	Standard	EcoClip		Standard	EcoClip	Standard	EcoClip	
500 x 500 x 30mm Sawn/Honed/Polished	10		4	2	1	2	1	
500 x 500 x 40mm Sawn/Honed/Polished	10		4	2	1	2	1	
600 x 250 x 15mm Rock Face	16	10	6.6	2	1	2	1	
600 x 250 x 30mm Rock Face	16	10	6.6	2	1	2	1	
600 x 250 x 30mm Sawn/Honed/Polished	16	10	6.6	2	1	2	1	
600 x 300 x 20mm Sawn/Honed/Polished	12	7	5.5	2	1	2	1	
600 x 300 x 30mm Sawn/Honed/Polished	12	7	5.5	2	1	2	1	
600 x 300 x 30mm Rock Face	12	7	5.5	2	1	2	1	
600 x 300 x 40mm Sawn/Honed/Polished	12	7	5.5	2	1	2	1	
600 x 400 x 30mm Sawn/Honed/Polished	10	6	4.2	2	1	2	1	
600 x 400 x 40mm Sawn/Honed/Polished	10	6	4.2	2	1	2	1	
600 x 600 x 30mm Sawn/Honed/Polished	10		2.8	2	1	2	1	
600 x 600 x 40mm Sawn/Honed/Polished	10		2.8	2	1	2	1	
800 x 400 x 30mm Sawn/Honed/Polished	8	5	3.1	2		2		
800 x 400 x 40mm Sawn/Honed/Polished	8	5	3.1	2		2		
1000 x 500 x 20 & 30mm Sawn/Honed/Polished	6		2	2		2		
1000 x 500 x 40mm Sawn/Honed/Polished	6		2	2		2		
1000 x 1000 x 40mm Sawn/Honed/Polished	4		1	2		2		

[illegible] in conjunction with StoneClips when the wall being clad exceeds [illegible] clad area, or expansion joints for

Cladding Panels in Vertical Position

Panel Size (L x W x D)	Cavity Support (15-30mm)	Cavity Support (35-50mm)	Cavity Support (55-75mm)	Cavity Support (80-120mm)	Notes
800 x 400 x 30 Lateral	SB-1 x 2	SB-2 x 2	SB-3 x 2	SB-4 x 2	
1000 x 500 x 30 Lateral	SB-1 x 2	SB-2 x 2	SB-3 x 2	SB-4 x 2	
1200 x 600 x 30 Lateral	SB-1 x 2	SB-2 x 2	SB-3 x 2	SB-4 x 2	
1500 x 750 x 30 Lateral	EXT10 x 2	EXT10 x 2	SB-3 x 2	SB-4 x 2	
1750 x 1000 x 30 Lateral	EXT10 x 2 H/D8 x 1	EXT10 x 2 H/D8 x 1	SB-3 x 2 H/D8 x 1	SB-4 x 2 EXT10 x 1	
2000 x 1000 x 30 Lateral	EXT10 x 3 H/D8 x 1	EXT10 x 3 H/D8 x 1	SB-3 x 3 H/D8 x 1	SB-4 x 4 EXT10 x1	
2400 x 1200 x 30 Lateral	EXT10 x 3 H/D8 x2	EXT12 x 3 H/D8 x 2	SB-3 x 3 EXT10 x2	SB-4 x 3 EXT10 x 2	Centre Support Required
3000 x 1200 x 30 Lateral	EXT12 x 3 H/D8 x 2	EXT12 x 3 H/D8 x 5	SB-3 x 4 EXT10 x 5	SB-4 x 4 EXT10 x 5	Centre Support Required
3000 x 1500 x 30 Lateral	EXT12 x 4 H/D8 x 2	EXT12 x 4 H/D8 x 2	SB-3 x 4 EXT10 x2	SB-4 x 4 EXT10 x2	Centre Support Required

Key:

SB = Load Bearing Shelf Angle StoneClip

EXT10 = StoneClip

H/D8 = 8mm StoneClip

SM:/GA7142.001

December 2007

SHEEHY & PARTNERS
PTY LIMITED
CONSULTING ENGINEERS
STRUCTURAL AND CIVIL
A.C.N. 009 899 905
A.B.N. 52 009 899 905

TO WHOM IT MAY CONCERN

STONECLIP.COM "STONECLIP"

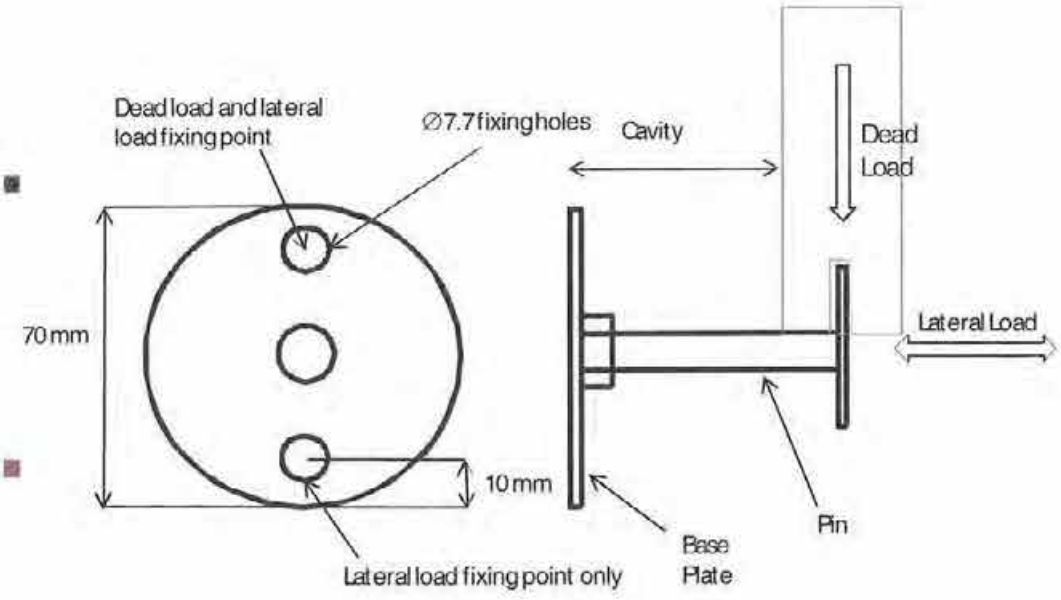
This is to certify that Sheehy & Partners have checked the design of the mechanical fixing known as "StoneClip". The StoneClip parameters and design capacities are summarised below. The limit state loading on the fixings to connect the StoneClip to the substrate are also provided on the following pages.

DESIGN ASSUMPTIONS

The design has been based on the following:

- StoneClip samples provided to this office.
- All components of the clip have been designed in accordance with AS 4673:2001- "Cold-Formed Stainless Steel Structures", other relevant codes, and in accordance with widely accepted engineering principles.
- The load factor applied to Panel Dead Loads is 1.35 in accordance with AS1170.0:2002 "Structural Design Actions".
- Where StoneClips are to resist lateral loads they have been designed for a strength limit state pressure of 2.53 kPa. For lateral wind loadings this is equivalent to buildings in wind region B and terrain category 2 and for a maximum cladding height of 10 m in accordance with AS1170-2:2002 "Structural Design Actions - Wind Actions".

STONE CLIP GEOMETRY



3 Gregory Terrace
SPRING HILL QLD 4000
Phone: (07) 3839 3644
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2.0 Lateral Loading Only

The following table is for StoneClips carrying lateral loading only (no allowance for vertical loading).

Each clip is fixed with two fixings through holes on opposite sides of the centre. Fixings are to be selected in accordance with fixing manufacturer's documentation.

Table 2.1 – Lateral load Capacity

Thickness of back plate [mm]	Tension Capacity [N]	Wind Area ^) [m²]	Fixing loading Tension *) [kN]
3	1594	0.63	0.80
2	708	0.28	0.35
1.5	399	0.16	0.20

^) The wind area is the maximum area that one StoneClip can resist based on the design wind pressure of 2.53 kPa, as noted in the design assumptions. For other wind loading situations engineered solutions based on the above tension capacity may provide increased/reduced wind areas.
*) Limit State Load

CERTIFICATION

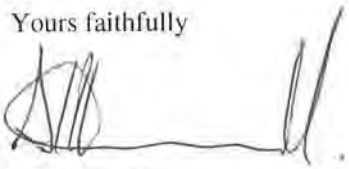
If the StoneClip installation is completed in accordance with the above design, the Stoneclip.com specifications and sound building practice, the "Stone-Clip" mechanical fixing is considered to be structurally adequate.

This certificate does not cover the strength of the stone panel or the transfer of load from the Stone Panel to the "StoneClip".

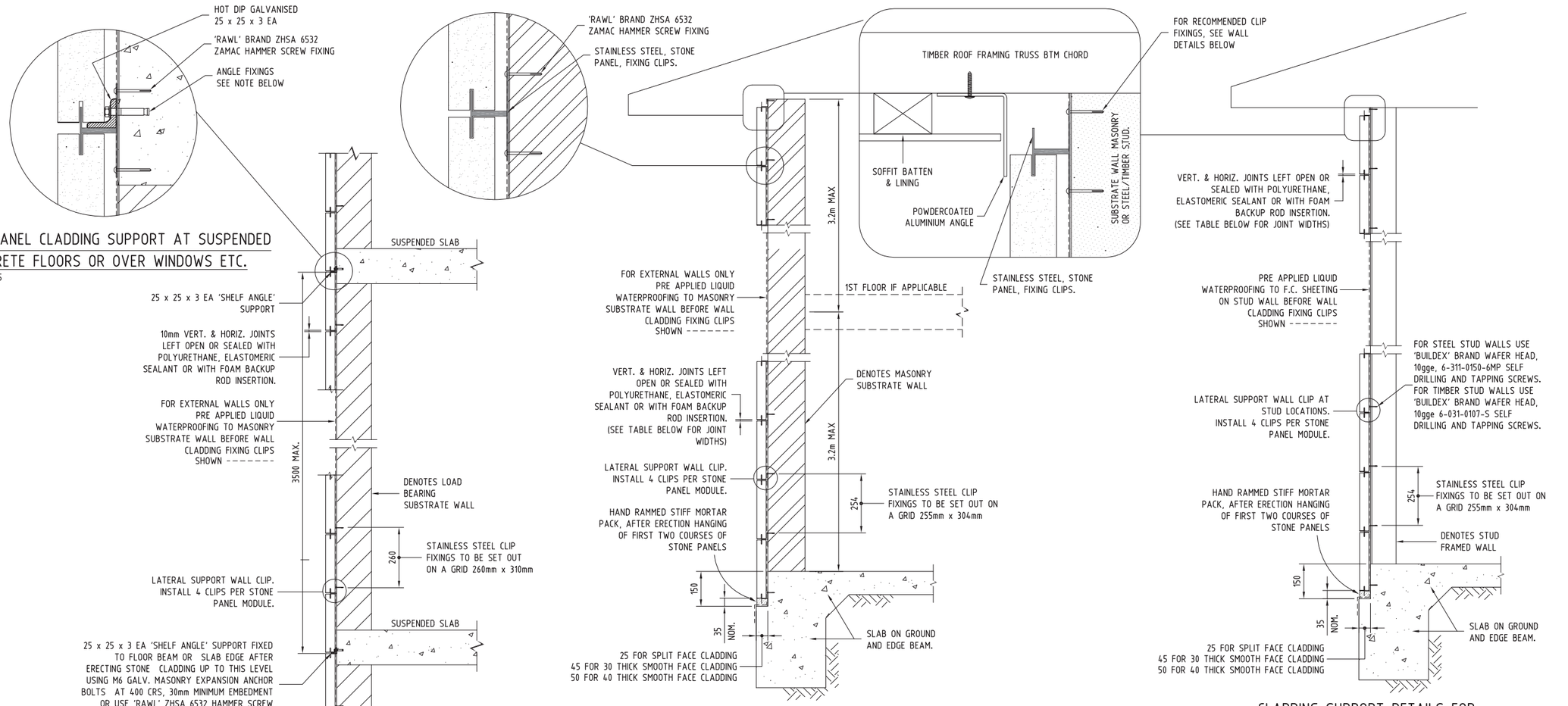
The certificate does not cover the fixing or the substrate to which the clip is attached. Proprietary fixings to the substrate are to be selected based on the strength limit state loading given in the above tables and based on the design capacities provided by the manufacturer of the fixing.

The undersigned is a Registered Practising Engineer in Queensland (RPEQ No. 8023)

Yours faithfully



S McDonald
for and on behalf of
SHEEHY & PARTNERS PTY LTD
Consulting Engineers



TYPICAL PANEL CLADDING SUPPORT AT SUSPENDED CONCRETE FLOORS OR OVER WINDOWS ETC.

SCALE 1:5

CLADDING SUPPORT DETAILS FOR MULTIPLE LEVEL BUILDING

SCALE 1:10

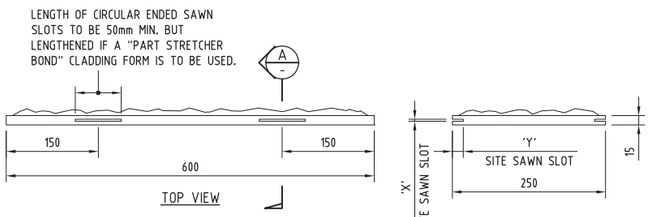
USE 40 THICK SMOOTH FACE CLADDING ONLY

CLADDING SUPPORT DETAILS FOR DOMESTIC 1 & 2 LEVEL MASONRY WALLS

SCALE 1:10

CLADDING SUPPORT DETAILS FOR DOMESTIC SINGLE STORY STUD FRAMED WALLS

SCALE 1:10

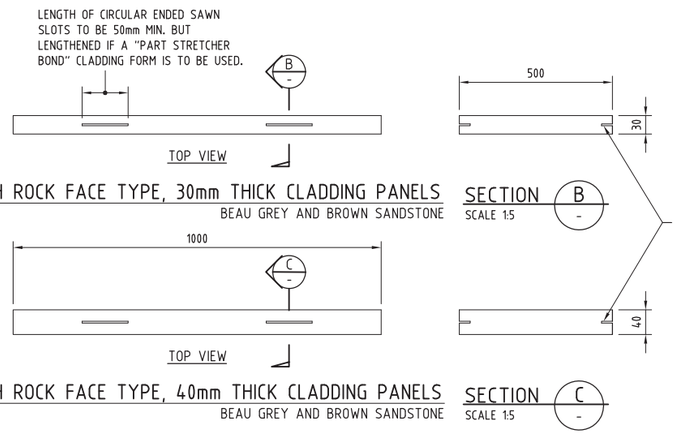


SPLIT ROCK FACE TYPE - CLADDING PANELS

SCALE 1:5 BEAU GREY AND BROWN SANDSTONE

SITE SAWN SLOTS DIMENSION TABLE

PANEL JOINT WIDTH DESIRED	'X'	'Y'
5mm	3mm	18mm
UP TO 10mm	3mm	15mm

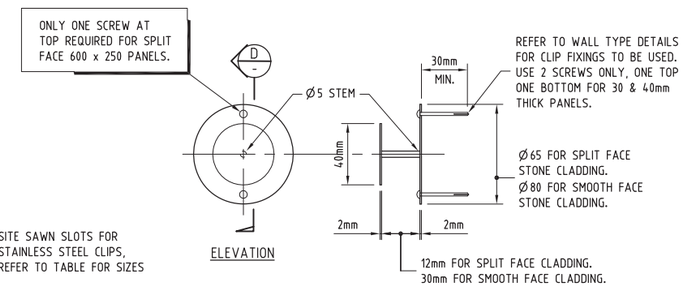


SMOOTH ROCK FACE TYPE, 30mm THICK CLADDING PANELS

SCALE 1:5 BEAU GREY AND BROWN SANDSTONE

SMOOTH ROCK FACE TYPE, 40mm THICK CLADDING PANELS

SCALE 1:5 BEAU GREY AND BROWN SANDSTONE



FABRICATED STAINLESS STEEL LATERAL SUPPORT, WALL CLIP - DETAILS

SCALE 1:2

NOTE:
SUPPORT CLIP IS FABRICATED FROM STAINLESS STEEL.
INSTALL 4 CLIPS PER STONE PANEL MODULE.

NOTE:

THE STAINLESS STEEL, DUAL CIRCULAR, STONE CLADDING FIXING CLIPS, DETAILED ON THESE DRAWINGS AND IN THE REPORT, HAS BEEN REGISTERED UNDER THE TRADEMARK OF "STONECLIP". THE PRODUCT AND ITS TRADEMARK NAME, MAY NOT BE COPIED, MARKETED OR REPLICATED, WITHOUT THE EXPRESS PERMISSION IN WRITING OF STONEHOUSE CREATIONS PTY. LTD. (PATENT PENDING)

ISSUE	AMENDMENT	DATE	INITIALS
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D. SHEEHAN PROJECT DIRECTOR	JULY 05 DATE (Copyright) ©

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PROJECT
STONEHOUSE CREATIONS PTY LTD.

CLIENT

ARCHITECT

DRAWING TITLE
BEAU GREY & BEAU BROWN SAWN SANDSTONE WALL CLADDING SYSTEM, AND FIXING ARRANGEMENTS

SCALES	CLIENT PROJECT No.
AS NOTED	
DRAWING No. 05B238 APPENDIX 'A'	ISSUE B

A1 SHEET
300mm
200mm
100mm
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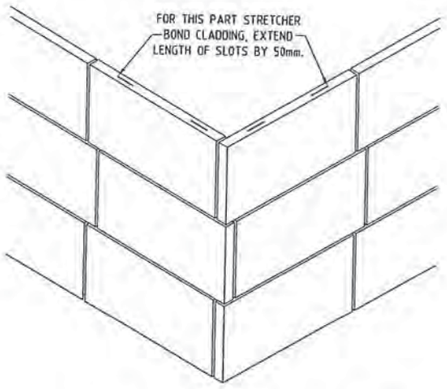
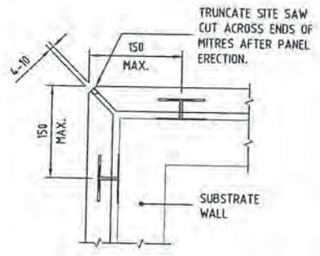
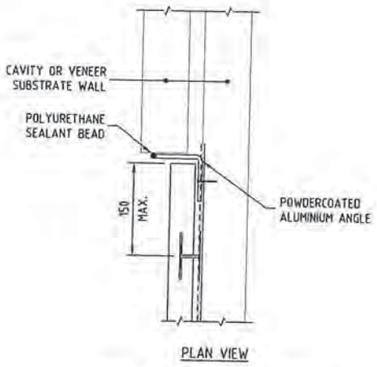


CORNER ISOMETRIC VIEW - USING PART STRETCHER BOND ALTERNATIVE
SCALE 1:10

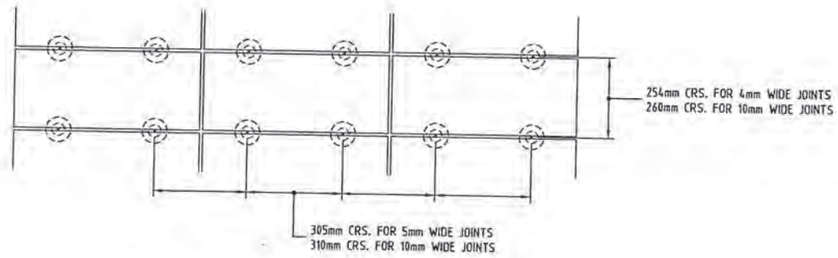


CORNER PLAN VIEW - MITRED JOINT
SCALE 1:10

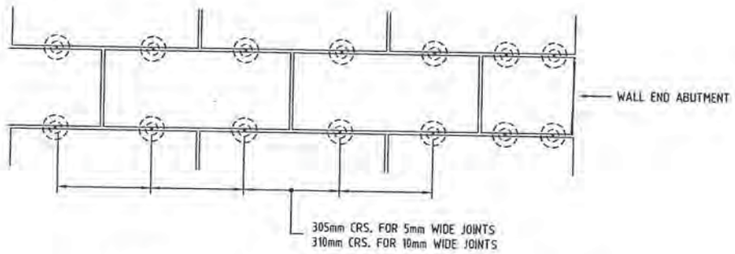


PLAN VIEW

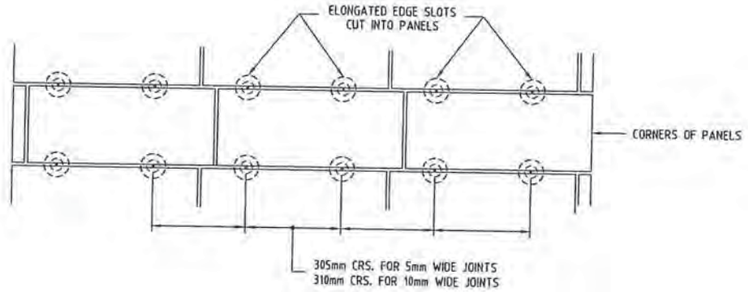
ABUTMENT CLADDING DETAIL
SCALE 1:5



TYPICAL STACK BONDED PANELS - ELEVATION
SCALE 1:10



TYPICAL FULL STRETCHER BONDED PANELS - ELEVATION
SCALE 1:10



TYPICAL PART STRETCHER BONDED PANELS - ELEVATION
SCALE 1:10

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PROJECT
STONEHOUSE CREATIONS PTY LTD.

DRAWING TITLE
BEAU GREY & BEAU BROWN SAWN SANDSTONE WALL CLADDING SYSTEM, AND FIXING ARRANGEMENTS

SCALES	CLIENT PROJECT No.
AS NOTED	
DRAWING No. 05B238 APPENDIX 'B'	ISSUE A

300mm A1 SHEET

VICTORIA UNIVERSITY OF WELLINGTON
Te Whare Wananga o te Upoko o te Ika a Maui

Faculty of Architecture and Design

Work Submitted for Assessment

Declaration Form

Student's full name : Chi Lac Tran

Course : SARC364_Building Code Compliance

Assignment/project : Assignment One - Alternative Solution

(number and title)

Date submitted : 27/03/2014

School of Architecture

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