A tale of

TWO SUSPENDED CITIES

THESIS BOOK I

JACOB DENCH

A TALE OF TWO SUSPENDED CITIES

BY

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*Tēnei au, tēnei au,
Te hāpai nei, Te tiri nei,
Te poupou nei,
I tōku teo, Mō tōku mana,
Mō tōku ihi, Te māpihi maurea,
Kia mau, Kia ita,
Haumi e, hui e, Tāiki e*

Ōku whenua Muaūpoko,
Tō koutou tāhuhu kōrero kua toitoi manawa ia i
ahau.

Ōku kaiako i Te Wānanga o Aotearoa,
Tenā koutou, tēna koutou,
tēna koutou katoa.
Kua whakaako koutou i ahau te Reo Māori. Mā te
mōhio, ka mōhio.

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A Darío, pensando en nuestra amor mi ha motivado
través de días solos oscuros. Me apasionas.

To the people of C.A.O.S, Terni Italy,
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Grazie ragazzi belli!

ABSTRACT

A TALE OF TWO SUSPENDED CITIES

This investigation looks to allegorical architecture as a means of enhancing our awareness of our environment.

This investigation began in early 2016 with the discovery of a little-known architectural history of the Muaūpoko people and their suspended tree-village, Te Pā Rākau, in Horowhenua Aotearoa. Later, the invitation to participate in the construction of a treehouse for the 2016 Terni International Performing Arts Festival in Italy, provided an opportunity for the development of two unique design projects for this thesis – and to explore how allegorical architecture could respond uniquely to two tales of two very different cities: one, a mythological tale called Octavia – born of the urban unrest of post-industrial Italy; and two, a true but little known tale called Te Pa-Rakau from the extraordinary architectural history of precolonial Aotearoa.

The tale that is told through the Octavia project is quite different from the one told through the Te Pā Rākau project, yet the formal outcomes have many similarities. In this way the two bodies of work are effectively reflections of one another. Each project is unified by the research aim of enhancing our awareness of nature through the creation of an ephemeral architecture of lightness as a starting point – but then each branches out in different directions based on a response to a unique narrative, unique cultural needs, environmental and contextual factors.

This investigation seeks to enhance our awareness of the importance of a human cultural context within two ‘natural’ environments of two antipodean countries.

Both environments have been transformed by humankind, fractured, to such a great degree that in Aotearoa while we still have some remnants of the original condition of our ancient lowland forests, they are just tiny fragments of what once was, and they are devoid of much of their former wildlife. In Italy this investigation focuses on an urban site in a region where there exists no intact original forests; the wild trees have been completely broken, reformed, reshaped by humankind so that they do not even look like naturally occurring trees anymore.

Both scenarios explore how architecture can be used to make people aware of how important a relationship to nature really is; how beautiful it is; and how we need to enable it rather than disable it. This design-led investigation addresses the following aims:

- TAHI: To create a lightweight, tensile architecture that touches lightly upon the delicate forested environment in which it is sited.
- RUA: To create an architectural environment capable of inspiring a sense of human belonging within the indigenous forest; and to encourage an understanding and custodianship for this environment.
- TORU: To incorporate storytelling design elements into architecture to encourage the telling of oral histories; and to re-imagine the tale of suspended cities through contemporary architectural intervention.
- WHA: To create an anthropomorphic architecture that expresses itself as a living part of the forest; and to express, through built form, the narrative of the vibrant wildlife that once existed in this environment.

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The suspended tree residence

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RESEARCH QUESTIONS

TAHI: Can an architecture of allegorical narrative aid an inhabitant's understanding of indigenous forest - and help foster a culture of custodianship for it?

RUA: How can architecture express an allegorical narrative to reawaken the tale of a lost or imagined suspended city for two unique cultures on opposite sides of the planet?

TORU: How can contemporary architecture encourage the telling of oral narratives, and safeguard the knowledge and understanding communicated through them?

POSITION

This design-led thesis investigation takes the position that an inspiring human space created within the trees could foster a closer relationship between a people and the lost indigenous forest of their culture.

An architecture of allegorical narrative can tell the tale of a lost suspended city. It can do so through formal expression of storytelling design elements.

Such an intervention could also encourage the practice of the tradition of oratory, the passing down of culture and understanding through storytelling narrative.

Two distinct cultural narratives drive this architecture of allegorical narrative. Aim Tahī, *Architecture of Lightness* and aim Rua: *Architecture + Humankind = Nature* are the guiding aims in Thesis Book I. They inform the design and construction of the suspended temporary tree residence of Octavia in Terni, Italy. Octavia is inspired by this investigation’s first tale, Italo Calvino’s suspended city by the same name from the book *Invisible Cities*.

TAHI: ARCHITECTURE OF LIGHTNESS	
AIM:	<i>To create a lightweight, tensile architecture that touches lightly upon the delicate forested environment in which it is sited.</i>
OBJECTIVE I:	To design a habitable tensile intervention amongst the trees that does not touch the ground floor - in order to free the ground plane for natural systems.
OBJECTIVE II:	To create a small-scale architecture light enough that it is able to be fully supported by living trees.
OBJECTIVE III:	To create a building that expresses its state of tension, whereby every designed element fulfils a clear structural role.

RUA: ARCHITECTURE + HUMANKIND = NATURE	
[Fostering a human relationship to nature through built form.]	
AIM:	<i>To create an architectural environment capable of inspiring a sense of human belonging within the indigenous forest; and to encourage an understanding and custodianship for this environment.</i>
OBJECTIVE I:	To allow users to experience an environmentally conscious human place amongst indigenous trees.
OBJECTIVE II:	To develop an architectural intervention that relates to the scale of the human body.
OBJECTIVE III:	To create an interior space that surrounds its users with nature - one that responds to natural light, and shadow; natural materiality; and views to the outside forest.
OBJECTIVE IV:	To work with temporality - to design with natural materials that can return to the earth.

In Thesis Book II the formal design outcomes from the Octavia design/construction project are used to inform the design of this investigation’s second tale: Te Pā Rākau of the Muaūpoko people of Aotearoa. This cultural narrative brings a second unique cultural context and site to the investigation.

TORU: AN ALLEGORICAL ARCHITECTURE FOR ORAL NARRATIVE.	
[Embodying storytelling symbology within an orator’s shelter]	
AIM:	<i>To incorporate storytelling design elements into architecture to encourage the telling of oral histories; and to re-imagine the tale of suspended cities through contemporary architectural intervention.</i>
OBJECTIVE I:	To create a suspended space for intimate cultural gatherings within the remnant trees of an ancient indigenous forest.
OBJECTIVE II:	To create a spatial environment relevant to its cultural context and narrative that could inspire the contemporary practice of an oral narrative.
OBJECTIVE III:	To derive a new typology tree-architecture from the spatial qualities of indigenous trees in order to communicate meaning.

WHA: ANTHROPOMORPHIC ARCHITECTURE OF FLIGHT	
[An allegorical narrative of extinct megafauna told through built form.]	
AIM:	To create an anthropomorphic architecture that expresses itself as a living part of the forest; and to express, through built form, the narrative of the vibrant wildlife that once existed in this environment.
OBJECTIVE I:	To create architectural form that plays with anthropomorphic qualities; to use form, composition, colour, and materiality to blur the boundary between human-made structure and living entity.
OBJECTIVE II:	To create an architecture symbolic of flight.

OCTAVIA

THE SUSPENDED TREE RESIDENCE

FOSTERING A HUMAN CONNECTION TO TREES IN AN URBAN ENVIRONMENT

Built for the 2016 Terni International Performing Arts Festival, Italy

JACOB DENCH

image: author's own

THE TALE OF TWO SUSPENDED CITIES

BOOK I:

OCTAVIA

THE SUSPENDED TREE RESIDENCE

PART I

I.3:

INTRODUCTION

TALE I OCTAVIA

Italo Calvino's inspiring tale of the suspended 'invisible city'

Staged within the centennial linden trees of a the post-industrial old city of Terni, Italy. This project was realised for the 2016 Terni International Performing Arts Festival. The construction of this intervention is documented in Book II of this thesis investigation.

Octavia, is a prototype for the creation of a built architecture of symbolic storytelling. This design and construction process is used to develop an architectural typology of lightness, anthropomorphia and human connection to nature. It is influenced by the tale of Octavia of Italo Calvino's *Invisible Cities and it is* shaped by the pollarded trees of an urban, post-industrial site. Through preliminary and developed design investigation of real world construction requirements Octavia demonstrates a basis for a new typology of tree-architecture informed through narrative.

OCTAVIA

INVISIBLE CITIES
ITALO CALVINO

If you choose to believe me, good. Now I will tell how Octavia, the spider-web city, is made. There is a precipice between two steep mountains: the city is over the void, bound to the two crests with ropes and chains and catwalks. You walk on the little wooden ties, careful not to set your foot in the open spaces, or you cling to the hempen strands. Below there is nothing for hundreds and hundreds of feet: a few clouds glide past; farther down you can glimpse the chasm's bed.

This is the foundation of the city: a net which serves as passage and as support. All the rest, instead of rising up, is hung below: rope ladders, hammocks, houses made like sacks, clothes hangers, terraces like gondolas, skins of water, gas jets, spits, baskets on strings, dumb-waiters, showers, trapezes and rings for children's games, cable cars, chandeliers, pots with trailing plants.

Suspended over the abyss, the life of Octavia's inhabitants is less uncertain than in other cities. They know the net will last only so long.

- Calvino 1972,
translation by Weaver 1997

SKETCH STUDY I – TENSILE CITY IN LANDSCAPE
Sketches exploring tension in landscape. Inspired by Calvino's city of Octavia
images: Author's Own

CHAPTER 3

SITE AND CONTEXT

PROMENADE OF AN EX-INDUSTRIAL AREA CENTENNIAL LINDEN TREES

The ancient forests that once covered Italy have long since disappeared. Some of the tree species live on however. Here on the edge of the old city of Terni, Umbria, a promenade of centennial linden trees line the entrance to an ex-industrial area. They are trees of the urban realm, but they are related to the ancient forests of this country. Their growth has been manipulated, their form contorted through the practice of pollarding throughout their century-long lives. Approximately twenty years ago the pollarding of these trees was stopped. Since then the branches above the tree trunk base have been left to rise vertically - enclosing a space within like cupped human hands.

This thesis investigation documents the design and construction of a temporary suspended treehouse residence that was occupied during a two-week period by a visiting artist for the 2016 Terni International Arts Festival. Its purpose is to not only house the artist, but to offer a means for the artist to experience a connection to nature within an urban environment.

Fig. 3.1 - Linden Tree Promenade

image:

Fig. 3.2 - Satellite Image of Terni Site
image: Google Earth

SITE PHOTOGRAPHY: LINDEN TREE PROMENADE

Historic industrial area, now CAOS performing arts museum.
Old city, Terni, Italy.

"EVERYTHING, TO ME
IT SPEAKS OF YOU."

An example of the romantic graffiti typical
throughout Terni; Author unknown.

image: Author's own

THE CENTENNIAL LINDEN TREE | Chosen to become the living backbone of the OCTAVIA Treehouse.
Jacob Dench
image: author's own photograph

ARTIST'S RESIDENCE SITE

Fig. 3.3 - Satellite Image of Terni Site
image: Google Earth

Ex 19th Century Industrial Area Tree Promenade.
image: google earth satellite imagery.

HUMANKIND, ARCHITECTURE

N A T U R E

Fostering a human relationship with nature through built form

KOROWAI TREEHOUSE,
Treehouse of the Korowai People,
Papua New Guinea highlands.

Fig. 3.4: The Korowai Treehouse
image: © George Steinmetz, Daily Mail UK

KA MATE TE WHENUA,
If the land dies,
KA MATE TE TANGATA;
humankind will die;
KA ORA TE WHENUA,
if the land lives,
KA ORA TE TANGATA.
humankind will live.

- Whakatouki, Māori Proverb
(B. Keane, 2017)

This chapter frames the thesis proposition that humankind, human culture, and our technology of architecture - can have a place alongside nature. It argues that architectural expression can help foster connectedness between endemic forests and sites of human habitation. The literature introduced guides the design development of an architectural intervention that could instil a sense of belonging within nature to the people of both the antipodean sites, the Muaūpoko iwi of Te Papaitonga Forest, Aotearoa; and the Ternani of Terni, Italy. Through this sense of belonging, design aims to instil a desire to become custodians of their respective remaining forest ecosystems.

Two existing precedent typologies of architecture for Aotearoa wilderness are introduced and analysed in this chapter. These include,

- The Standardised Backcountry Bivvy
The normative architectural responses for conservation areas in Aotearoa.
- The Korowai Treehouse
A living example of a traditional vernacular treehouse typology.

These architectural typologies are examined in terms of their formal relationship to a 'wilderness' site. Critical reflection questions how these typologies articulate a human connection to the natural world. These typologies are analysed in relation the objectives and aim 'Rua' of this investigation.

RUA: ARCHITECTURE + HUMANKIND = NATURE

[Fostering a human relationship to nature through built form.]

- AIM: *To create an architectural environment capable of inspiring a sense of human belonging within the indigenous forest; and to encourage an understanding and custodianship for this environment.*
- OBJECTIVE I: To allow users to experience an environmentally conscious human place amongst indigenous trees.
- OBJECTIVE II: To develop an architectural intervention that relates to the scale of the human body.
- OBJECTIVE III: To create an interior space that surrounds its users with nature - one that responds to natural light, and shadow; natural materiality; and views to the outside forest.
- OBJECTIVE IV: To work with temporality - to design with natural materials that can return to the earth.

There exists a predominant design response to the need for built environments within conservation forest in Aotearoa. This response adheres to the current dominant mantra for the design of conservation area architecture in this country. It is a response I will call 'conformity and camouflage',

Conformity and Camouflage

- A standardised rectilinear shelter is designed in a way that does not take into account the unique site conditions of distinct conservation land sites.
- A purely pragmatic interior empty of cultural references or symbology.
- A conservation site is chosen and this standardised shelter is installed regardless of unique site context.
- The shelter is coated in recessive colours as to camouflage its existence into the surrounding earth and forest tones of site.

In his text *Wild Heart: The Possibility of Wilderness in Aotearoa New Zealand* Abbott explains the underlining understanding that has led to this disconnection of architecture and nature.

The way we have let these public conservation lands be conceptualised as a wilderness apart from people continues to entrench us as the perennial corruptors of ecologically indigenous New Zealand. Rather than appreciating people as intrinsic participants in the well-being of our unique places, we hold to view that people must always remain as outsiders. Such a position restricts the ways we allow this country's deep history, to teach us more enduring, sustainable and resilient ways in which we could live here.

— M Abbott, R Reeve, 2011, pg 11]

Contrasting to this mantra is an understanding of human impact on the environment as a part of the nature of the anthropocene period. The anthropocene is a term that relates to the current geological age, in which human activity is the dominant influence on the environment (Oxford Dictionary 2016). We are living in an age in which human influence touches nearly everything on the planet. *"In a research paper for the U.S National Academy of Sciences Nichole Boivin writes that 'pristine' landscapes simply do not exist and, in most cases, have not existed for millennia."* (N, Boivin, 2016). She writes that it is too late to try to return environments to pre-human conditions. Boivin writes, *"These findings suggest that we need to move away from a conservation paradigm of protecting the earth from change to a design paradigm of positively and pro-actively shaping the types of changes that are taking place."*

— N Boivin, 2016

Continuing to visualise ourselves as outsiders to natural environments masks the opportunity we have to role make positive change in these environments. The anthropocene positions humankind within nature and responsible for nature. This research works towards two distinct designs in two distinct sites that can communicate a belonging within nature - one which tells the story of humankind's very interconnected role in nature; which highlights human presence in nature. It does this so that users might understand their relationship with nature in the anthropocene - that they might see there own place in natural systems and develop the motivation to foster a custodianship for their indigenous forests.

This investigation looks first to two existing typologies for the communication of human presence within nature.

4.1 - TYPOLOGY REVIEW I:

THE STANDARD BACKCOUNTRY BIVVY

THE UNCONTEXTUALISED STANDARDISED BIVVY

Fig. 3.5: The Standard Backcountry Bivvy Translocation.
image: Department of Conservation, Parks and Recreation website

The standard contemporary Department of Conservation D.O.C backcountry bivvy is an example of an architectural typology of 'conformity and camouflage'. This standard backcountry bivvy is the most common typology for new architecture of Aotearoa conservation areas. It is a typology which conforms to muted features, dull camouflaged surface colour and purely functional interior spatial arrangement.

CRITICAL ANALYSIS OF THE BACKCOUNTRY BIVVY

Fig. 3.6 , 3.7 . The Standard Backcountry Bivvy
images: Department of Conservation

These standardised bivvies solve the basic pragmatics of shelter and adhere compliantly to the current dominant conception of conservation land as ‘wilderness without people’, explained by Abbott. The problem with these simple standardised buildings however is the lack of formal expression of human place within the environments in which they are placed.

There are three ways in which these bivvies fails to achieve this investigation’s aim of fostering a human connectedness with nature:

- The interior space created does not respond to the innate human desire to be surrounded by nature. Natural light is provided through only small normative square windows; views to the outside forest are not properly oriented on a site specific basis; natural materiality is hidden under painted timbers.
- The design expresses no features reminiscent of the unique living life forms that surround it, nor the ecological history of a unique site. By using colour to camouflage it into its surroundings it expresses apology for its placement within nature - rather than a expressing human belonging.
- The design expresses no indigenous human history of the site.

This investigation seeks an architecture that can celebrate human presence. That can express the important role that people play in managing forests ecosystems and biodiversity from Aotearoa to Italy. By failing in the three ways identified, these bivvies miss the opportunity, as Abbott states, to “see themselves, their culture and their architecture as a part humankind’s long relationship to this environment” (M. Abbott, 2011).

CRITICAL REFLECTION

It must be said however that these failures are also the bivvy’s strength in terms of mere pragmatics as a basic human shelter. The uniformity reduces costs through prefabrication, and ensures that every facility has common amenities that the trumper can know to expect. The camouflage colours ensure that the bivvy detracts little from the landscape, so that trampers may see the landscape in the ‘pristine’ way void of human presence as per the dominant ethos of ‘wilderness as apart from people’ explained by Abbott. Paint ensures longevity in places where wood will quickly rot and other materials are too difficult to transport. These bivvies are highly cost-effective with a substantial life-span, and trampers can be confident that they provide certain basic required amenities when they prepare their packs.

Contrastingly, the architectural interventions that this thesis investigation proposes are ultimately not places which aim to be permanent - nor do they attempt to solve a means of providing the same pragmatic facilities as the backcountry bivvy. The two interventions that this investigation proposes are by contrast very ephemeral. They represent a kind of architectural space that need only exist as long as it takes to awaken people up (to their relationship with nature) when they participate in these ephemeral intervention. Their life-span is set in relation to the durability of their natural and traditional materials. In the case of the Te Pā-Rākāu project this durability could be up to ten years; or, as in the case of the Octavia project, just two weeks to temporarily house an artist in the Italian site.

4.2 - TYPOLOGY REVIEW II:

THE KOROWAI TREEHOUSE

OF THE PAPUA NEW GUINEA HIGHLAND FORESTS

The Korowai tree architecture - perhaps the closest vernacular tree architecture culture to that of the Muaūpoko and their pā-rākau of thesis book II - continues to be built today by the Korowai people of the highlands of Papua New Guinea.

Perhaps only coincidentally the word 'korowai' is also a word of the Te Reo Māori language. 'Korowai' in Māori is the name given to a traditional style of feathered cloak. This interesting side note is important to make clear because the korowai cloak will be introduced as an artefact of storytelling narrative in thesis book II.

Traditionally, the Korowai live in isolated conditions, in their own territory near their gardens in settlements of no more than five treehouses. A typical family home is built at about 8 to 12 metres above ground level. But in certain areas upstream, some of the houses are as high as 45 metres. These treehouses protect families not only against swarms of mosquitoes below, but also ward off annoying neighbours and evil spirits.

- Papua Heritage Foundation, 2009

As the original Muaūpoko Pā-Rākau village no longer exists, and as it was never visual documented, the only living information is through oral narrative or the writings of Māori theorist, Elsdon Best, as introduced in chapter 2 of thesis book II. The architecture of the Korowai people expresses an interconnectedness between human and nature. It blurs the perceived boundary of what is human architecture and what is nature. Architecture is expressed as a naturally occurring product of nature - just as humankind itself is a product of nature. Anderson explains how such an architecture can communicate humankind's belonging in nature.

On the small scale a building is what landscape is on the larger. Similar to how we, as inhabitants of the world, belong in a landscape, a building mirrors this belonging, reminding us of its reach and depth.

- D. Anderson, 2014

The support scaffolding structure and framework of ladders of this vernacular offer a very unique architectural response to a specific treetop environment. Below the thatch hut above, the timber scaffolding reads as if it were a part of the tree itself. The lightweight straight framework pieces appear as new vertically and horizontally aligned branches of the tree. The many climbing ropes that drape down the structure appear as living vines.

An example of a treetop vernacular architecture. The Korowai Treehouse of the Papua New Guinea highland forests offers an insight into how Te Pā Rākau of the Muaūpoko may have been constructed. With no surviving images or construction details of actual pā, this image is only meant to indicate a likely vernacular architecture that can paint an image of its construction and scale (not to document what actually was actually built by Muaūpoko).

Fig. 3.8: THE KOROWAI TREEHOUSE
image: copyright: George Steinmetz, Daily Mail UK]

CRITICAL REFLECTION

One reason for the attachment of their architecture to the tree stems from a parallel reason as Te Pā Rākau of the Muaūpoko, that is, safety from invaders (Papua Heritage Foundation, 2009). To this author it seems that this typology offers much more than this:

> Tree-architecture allows for a distinct human interaction with forest - that is, from the tree canopy down, rather than ground up.

> From above the scale and height of the forest is easily appreciated. This inhabitation of the forest canopy places people amongst the most biodiverse and light-filled level of a forest (C. Knight 2009).

> The trees, too, can be seen as benefiting from this kind of human relationship. By establishing a cultural need for tall trees, the Korowai people have developed a strong custodianship and culture of protection for the trees. The Korowai have a strong spiritual connection to their trees. (Papua Heritage Foundation, 2009). In this way this relationship becomes mutually beneficial.

TENSILE ARCHITECTURE

- OF -

L I G H T N E S S

TOUCHING LIGHTLY UPON THE EARTH

Tensile City in Landscape, inspired by Calvino's Octavia
String, card and Matai weatherboard model.
IMAGE: AUTHORS OWN

This chapter explores an expression of weightlessness in architecture inspired by Italo Calvino's Octavia of *Invisible Cities*. It frames the fantastical possibilities of tensile design.

Four project reviews are introduced in this chapter in order to show the possibilities of lightweight tension design - from fantastic paper architecture to pragmatic built projects. This Chapter shows that by using tension structure as a driver for formal design outcomes unique and inspiring spatial environments arise. Sketch experimentation in this chapter pursues form through a drive for the expression of perceived weightlessness.

I analyse the four projects through the lense of my aim 'Tahi' which deals with using lightweight design to minimise impact on the ground plane.

TAHI: ARCHITECTURE OF LIGHTNESS

- AIM: *To create a lightweight, tensile architecture that touches lightly upon the delicate forested environment in which it is sited.*
- OBJECTIVE I: *To design a habitable tensile intervention amongst the trees that does not touch the ground floor - in order to free the ground plane for natural systems.*
- OBJECTIVE II: *To create a small-scale architecture light enough that it is able to be fully supported by living trees.*
- OBJECTIVE III: *To create a building that expresses its state of tension, whereby every designed element fulfils a clear structural role.*

Letizia Modena, introduces a discussion on lightness and utopia with a quote from Yona Friedman:

I was once asked about the year 2000: what do you think of the architecture of the next millennium? And I told them: architecture will disappear.

- Yona Friedman, quoted in L. Modena 2011.

She describes Italo Calvino's *Città Sottili* (Thin Cities), in which the city of Octavia is introduced, as 'cities of disembodied materiality', that they represent the most abstract and least plausible cities of Calvino's writing. She explains that scholars have largely viewed these cities with ambiguity, seeing them as poetic essence rather than possibility. She elaborates to express the importance of these places. "[Calvino's Cities] are in effect visual exercises to train the imagination to think in terms of ascending lightness [...]. In essence, the architecture of lightness transmits the novel's most socially invested function: the utopian" (Modena, 131).

Calvino's Octavia offers a new perspective on how a built environment could impact on the condition of its site. It sets a tone for understanding architecture as not limited by traditional compression structures, heaviness and footprint - that architecture could defy this dogma and become ever lighter. It could even suspend itself, removing itself from its foundations and ground plane altogether. As Buckminster Fuller puts it:

You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.

- B. Fuller, 1973

Fuller was also inspired by this version of utopia. He spent his life addressing the practicalities of achieving a radical level of lightness in his architecture and design, in what he coined 'Ephemerisation'. Ephemerisation he describes is to do "more and more with less until eventually you can do everything with nothing" (B. Fuller, 1973).

Fig. 4.1: MATERIAL EFFICIENCY THROUGH ENGINEERING
image: B. Fuller 1963

Fuller's drive for material minimalism was ethically driven. He believed that with the ever-accelerating advancement of material technologies that building efficiencies could increase at an ever-accelerating rate also - that weight-to-volume efficiencies would eventually lead to practically immaterial buildings. He spoke of the need for ephemeralisation in all forms of human consumption. He saw it as the means of solving the global paradigm of an ever increasing human population (and ever increasing consumption of resources) within a finite planet system. In his book *Operating Manual for Spaceship Earth* he describes ephemeralisation as crucial in preventing the running out of global resources and a collapse of advanced society (B. Fuller, 1963).

Fuller's designs utilise 'tensegrity', a term he also coined, whereby tension and compression elements are held together in suspended equilibrium. His designs utilise steel cable tensile strength, compression rods, and membrane materials. The architecture of his 'geodesic domes' is an exercise in pragmatic efficiency - in enclosing ever more volume with less material weight.

Fig. 4.2, 'Manhattan Bubble' - images: B. Fuller 1963

Fig. 4.3, 'Geodesic Dome'

Fig. 4.4: MONTREAL BIOSPHERE B. Fuller (1961)
image: Arch Daily.

Tomás Saraceno is a sculptural artist who explores the spatial capability of lightweight tensile structures through his work. His exhibition, Hybrid Webs, explores an architecture on the opposite scale to that of Buckminster Fuller's geodesic domes. It looks to the micro-scale of the non-human architecture which inspired the fantastical city of Calvino's Octavia : the tensile micro-architecture of spiders.

Spiders are one of nature's greatest tensile architects (Saraceno, 2012). Hybrid Webs is an exhibition of sculpture orchestrated by artist Tomas Sacaceno, in which the intricate structure of spiders' webs are displayed. Inside Saraceno's glass cubes spiders have woven intricately connected geometries in mid-air. The way in which Saraceno has displayed these web systems gives the viewer the chance to see a common form of nature in new light - highlighting the incredible complexity of these structures. Saraceno describes his project: "Each sculpture appears as a unique galaxy floating within an expansive, infinite landscape." - (Saraceno, 2012)

During the building period of each sculpture, each cube is turned onto its various sides, dislodging gravity and interweaving silvery spider silk from different arachnid species. [...] They allude to their structures: as cosmic dust deposits on the webs, intricate filaments allude to dwarf and spiral galaxies, nebulae and quasars. [...] The idea of suspending the void, of capturing and separating it from the surrounding empty space, infuses the sculptures with a philosophical quality, prompting a reflection on human co-existence among themselves and with other species on Earth.

- (Saraceno, 2012)

SKETCH DESIGN EXPERIMENT:

Fig. 4.5: Tomás Saraceno. Hybrid Solitary, 2012
image: TomásSaraceno.com

Sketching the structure of spiders' webs. image: author's own

5.3 - HYBRID WEBS SKETCH STUDIES

Based on the structure of spider's webs these early sketch studies explored what minimal compression elements might be necessary in order to create enclosed spatial environments through tensile membranes which connect to them.

SKETCH STUDY 5 -
 TENSILE CITY IN LANDSCAPE
 inspired by Calvino's city of Octavia
 image: Author's Own

image: author's own

image: author's own

SKETCH STUDY - THE FORMAL POTENTIALS OF TENSILE
 Exploring formal outcomes of structures balanced in tension and compression.

5.4 - PROJECT REVIEW III:

TAKIS ZENTOS

UNE VILLE SUSPENDUE 1961

Figure 4.6: 'Isolation Pods within Une Ville suspendue' -
Takis Zentos 1961

Zentos' dystopic global city of 'Une Ville Suspendue' demonstrates how the tension structure forms exhibited in spiders' webs have the capacity to be applied at a drastically larger scale. Zentos's fantastical 'electronic urbanism' depicts an fibrous tensile architecture of global scale.

Imagine, not a single Eiffel Tower, but ten, twenty or even more, like an immense metal forest, connected by bridges, roads and platforms. Within this gigantic "three dimensional" spider-web there are arranged dwellings, schools, theatres, commercial enterprises.... The structure is lighter and more transparent than Eiffel could have dreamed in 1887. All the tension members are cables; those in compression are few, essentially lattice pylons. Scintillating coloured materials, lighter and smaller forms are threaded through this Cité Spatiale...

- A. Persitz, quoted in Banham 1976

SKETCH STUDY - CONNECTING ELEMENTS IN TENSION

Exploring formal outcomes of tension design through sketching
image: Author's sketches

1. Strings meet, held by connecting strings

2. Connecting strings diversified

3. Connecting strings diversified

Takis Zentos' work, like Calvino's tales of invisible cities, comes as a reaction to an urban crisis - the dense post-war monotonous and rapidly sprawling urban environments of Europe and their growing impact on landscapes and ecosystems. He saw that there are obvious concerns about the presence of traditional architecture in an environmentally sensitive world. As Barnett writes, "*Anything we built will have an effect on its landscape and ecosystem.*" (Barnett, 2012). This author accepts this notion, but is compelled by the notion of Takis Zentos, that through a lightweight tensile approach to architecture there is potentially no limit to how lightly architecture can touch the earth - how minimal negative effect can be.

Figure 4.7: 'Une Ville Suspendue' - Takis Zentos 1961
image: elasticeye

'Electronic Urbanism' is his eerie yet poetic view of the future urban realm of humankind. Zentos' array of high-rise pylon supports and intricate web of tensile cable structures could be imagined as spanning the entire globe, while its inhabitants are suspended in isolated pods - connected only to each other and the world via an electronic web (which this author sees as an interesting foresight from the pre-internet world). The earth's surface would be freed from the heavy footprint of a traditional urban environments - except only for a regular grid of sparsely separated pylon footprints.

Fig. 4.8: 'Une Ville suspendue' - Takis Zentos 1961

images: elasticeye

Tensile connection details of a suspended megastructure city.

Fig. 4.8: 'Une Ville suspendue' - Takis Zentos 1961

images: elasticeye

5.5 - UNE VILLE SUSPENDUE SKETCH STUDIES

The sketch exploration that follows is based on the case study of *Une Ville Suspendue*. These sketches illustrate that by touching the earth lightly, the potential for creative design outcome is not limited. Instead tensile design offers a means of diverging from normative approaches towards more innovative design.

The sketch experiments that follow came about as a means of coming to terms with and testing formal creation through tension structural needs - and discovering natural patterns within it.

SKETCH STUDY I

Exploring a splintered tensile connection. Leading to tree-like

image: author's own

SKETCH STUDY 2 - LIFE WITHIN THE GRID
 Exploring formal outcomes of tension design through sketching

SKETCH STUDY 3 - TENSILE ELEMENTS WITHIN A GRID
 Exploring formal outcomes of tension within a grid design through sketching

image: author's own

5.6 - CRITICAL REFLECTION

Though of course on a much larger scale than the interventions proposed for the two sites of this thesis investigation, Zentos' tensile design method achieves the objectives of my aim Tahi: 'Architecture of Lightness'.

STRENGTHS: Large-scale tensile-led interventions could free the ground plane from traditional architecture. Such design is founded not in solidity, but lightness achieved through a balance of tension and compression. With its inhabitants suspended above the ground plane it allows for a new human perspective of a wild landscape, one in which human activity does not negatively impact natural systems.

Both Fuller's and Zentos' designs are efficient in their weight and materiality, and are highly expressive of lightness. However I find that both are inappropriate precedents for the architectural interventions I propose for the Terni site in this thesis Book I and the Papaitonga site of Book II.

WEAKNESSES: The problem is not in relation to their enormous size - because both designs present themselves to me as capable of being scaled-down greatly with little design implications. Their inappropriateness stems from this: they have no specific relationship to a site, nor to the scale of the human body. The insistence of the grid arrangement of pylon support elements in 'Une Ville Suspendue' exemplifies a non-responsive site relationship to the landscape it overlays, as it ignores the conditions of site, producing a standardised outcome that is applied everywhere regardless of site conditions. These designs present themselves as a mere mega-overlay to any unspecific site condition. They do not engage formally with the environments and cultures of specific sites as this investigation seeks to do. Both Zentos' city and Fuller's geodesic domes are purely pragmatic engineering responses to the creation of an architecture of lightness. In that regard they are very compelling, and in that regard they inform my design development.

SKETCH STUDY 4 - COMPOSITE OVERLAY

Highlighting the array of tensile design possibilities that exist within a grid framework.

image: author's own

FULLER'S GEODESTIC DOME

images: (B, Fuller 1973),

MODULAR BACKCOUNTRY BIVVY

Department of Conservation | Te papa atawhai.

5.7 - PROJECT REVIEW IV: FREI OTTO

Das Institut für Leichte Bauwerke 1968

The tension draped architecture of Frei Otto's *Institut für Leichtbau Bauwerke*, (Institute for lightweight structures), forms a closer relationship to the human body and nature than the two previous projects reviewed.

Frei Otto was inspired by natural phenomena such as skeletons, spider webs and bubbles. His works express both lightness and stability, fusing architecture with landscape, wall with ceiling, and interior with exterior.

- U. Meyer, 2015

Fig. 4.9: INSTITUTE FOR LIGHTWEIGHT STRUCTURES
FREI OTTO, 1968
images: tumblr.com

Frei's building encloses a large, but intimate feeling interior space. Contrasting to the purely pragmatic use of efficient membrane surface materials of Fuller's domes, Frei shows a willingness to engage in the use of traditional natural materials at the expense of efficiency. In doing so his design transcends pure function and efficiency into the aesthetics realm of human comfort. The timber board and rafter finishing of the interior of this space expresses the familiarity, warmth and intimacy of a timber chapel but applies it with a modern engineered tension draped cable supported structure.

Fig. 4.10: TIMBER INTERIOR
image: tumblr.com

A phenomenal architecture calls for both the stone and the feather. Sensed mass and perceived gravity directly affect our perceptions of architecture.

- S. Holl 1996

In his book *Intertwining Intertwining*, Steven Holl talks of the importance of an expression of both lightness and weight. The timber materiality expressed in this building's interior brings a sense of familiarity and scale to this elegant tensile form. Where the ephemeral designs of Fuller and Zentos have no sense of scale attached to them, the timber materiality of Frei's structure means that scale is immediately readable to users of the space. Through this natural material the highly engineered structure gains a sense of domesticity. Where a lighter advanced membrane material might express ephemerality and weightlessness better, Frei's choice of timber brings a much greater sense of mass to the space. Timber structure does of course weigh much more than a high-tech membrane surface. In making this decision to use it Frei shows an empathy for the innate human desire to be surrounded by nature - and he is willing to express it at the expense of pure efficiency in lightness.

Fig. 4.9: INSTITUTE FOR LIGHTWEIGHT STRUCTURES
FREI OTTO, 1968
images: tumblr.com

5.8

LITERATURE AND PROJECT REVIEW II

ARCHITECTURE OF LIGHTNESS

CHAPTER CONCLUSIONS AND CRITICAL REFLECTIONS

In conclusion of this chapter the following strategic set of design principles are introduced. These protocols are incorporated into my design experiments that follow this chapter.

DESIGN PRINCIPLES ARISING FROM LITERATURE & PROJECT ANALYSIS:

- Implementation of tensile structure;
Tensile structure can be implemented into all scales of a project. Project reviews have shown tensile structure working from the micro-scale of the spider's web - right through to the mega-scale of suspended cities.
- Balancing efficiency with expression of nature;
A drive for efficiency in lightness of structure need not override human and desires for comfort and elegance.
- Prioritisation of natural materials;
The expression natural materiality, as shown in Frei's building can provide for a richer human experience of space. This factor of richer human experience must be balanced against the pragmatics of using stronger and lighter engineered materials.
- Embracing the natural curves of tensile structure;
Tensile design leads to elegant formal outcomes. Curves are achieved when tensile wires or membranes come under the force of gravity. The straight line is translated through gravity into a curvilinear line. This leads to formal outcomes more in keeping with the forms living entities and landscape than the traditional rectilinear architecture.

END OF PART I

As a tale of two suspended cities the development of this thesis investigation does not follow a single line, but two. Two separate narratives, sites and cultures lead the design process.

Before progressing to the preliminary design and prototype construction the reader may wish to understand the other influences that led to this design development. Part 1 of thesis book II introduces a distinct local site, culture, and narrative which has also influenced the design of the following preliminary design.

THESIS BOOK I:
O C T A V I A
THE SUSPENDED TREE RESIDENCE

P A R T I I

PRELIMINARY DESIGN

Suspended ARTIST'S RESIDENCE TREEHOUSE

PLAN

SCALE: 1:250

SUSPENDED FLOOR SURFACE EXTRAPOLATIONS

image: Author's own.

This preliminary design chapter shows an iterative process of design that is lead by the research question of this thesis book: *Can an architecture of allegorical narrative aid an inhabitant's understanding of indigenous forest - and help foster a culture of custodianship for it?* This research question was undertaken because there exists a perceived disconnection between humankind and nature introduced by M. Abbot in chapter 3. In this preliminary design chapter the design principles that where introduced in my literature and project review chapters will be tested further. This process works to achieve the design aims of an architecture that fosters connection to nature, and which expresses lightness through tensile structure. The design introduced expresses the story of Calvino's Octavia of *Invisible cities*.

This chapter begins with the competition brief for the 2016 Terni International Arts Festival. Conceptual design sketches are shown and lead to a final design for the international competition. This chapter then documents the twelve-day construction process of the building and critically reflects upon what was learnt.

6.1

ITERATIVE FORM DEVELOPMENT IN PLAN AND ELEVATION

This iterative process map shows the development of design. It begins from a simple wire structure with three points of contact to the trees and ends on the following page as a more resolved complex design. It integrates more complex geometries of a central spherical frame and gravity influenced membrane fabrics.

ITERATIVE FORM DEVELOPMENT

image: Author's own.

image: Author's own.

6.2

AN ARCHITECTURAL LANGUAGE DERIVED
FROM ITERATIVE DEVELOPMENT

MIXED MEDIA COMPOSITE IMAGE

In this final pre-competition brief design iteration, a suspended stairway is included.
The symmetry of the design in plan is maintained

6.3

INTERNATIONAL ARCHITECTURE COMPETITION DESIGN BRIEF

FORESTA DESIGN COMPEITION FOR THE 2016 TERNI FESTIVAL, ITALY

An external influence to preliminary design was the competition brief set by the Terni International Arts Festival. This competition allowed the opportunity to test the ideas of this investigation in a real 1:1 construction project.

The brief set specific requirements relate to building budget, size, weight and requirements of attachment to specific trees. This brief offered a level of restraint that was useful to create a preliminary design that was low cost, buildable, and made to express natural materiality.

Figure 6.1: Competition Brief Pages

images: FORESTA, CAOS Art Museum.

FORESTA

Open call for 5 Tree Houses

TERNI FESTIVAL 2016, in the frame of FORESTA project, launches an OPEN CALL for the making of 5 TREE HOUSES that will temporarily host artists in residency.

1. PROMOTERS

FORESTA is an idea developed by Leonardo Delogu (www.casadom.org) and Indisciplinate that will be articulated as a biennial project within the frame of TERNI FESTIVAL editions 2016 and 2017 (www.ternifestival.it).

2. PROJECT

During the next TERNI FESTIVAL edition, taking place in Terni from the 16th to the 25th of September, 5 national and international artists will live on 5 tree houses.

During their stay they will develop an artistic project investigating the link between artistic production, public sphere and urban regeneration.

The houses will be installed in trees placed along CAOS arts centre's main pathway: CAOS is a creative space settled in a former factory and it is currently the cultural centre of the city and the main venue of the festival.

3. AIM

The call is aimed at the selection of 5 ideas for the planning and making of 5 tree houses that will host the artists from the 12th to 25th of September 2016: the houses will be the beating heart of the project shaping the visible profile of FORESTA.

4. PARTECIPANTS

The call is open to architects, makers, craftsmen, individually or collectively organised, able to autonomously deliver the project, from the planning to the creation of the house according to the following criteria.

5. PROJECT CRITERIA

- to not entirely weigh on the tree structure (roots, branches, trunk)
- to not damage the tree structure in any way (roots, branches, trunk)
- to ensure the safety of the house for the artists who will live in it and the visitors of the space
- to be durable for a minimum of 1 month
- to ensure a comfortable habitability for 1 guest
- to be sustainable, by using available materials preferably biodegradable
- Ideas engaging local communities will be preferred.

Technical information:

The houses will be installed on centenary linden trees located along CAOS main pathway, in via Campofregoso 98, Terni (see attached photos).

Each house will be placed between the lowest branches of the tree: approximate measures of this area are 2,5 per 3mt.

Distance from the lowest branch (house location) and the ground is approximately 3 mt.

6. TIMEFRAME

The houses will be built in Terni from the 27th of August and the 7th of September 2016

8. HOW TO APPLY

To submit their ideas applicants have to send:

- a preliminary project of the house including 3 visual table A3 sized and a brief description of the concept, mentioning materials, timing of construction, people involved and eventual methodology of community engagement
- short CV and portfolio

Materials must be sent by e-mail subjected FORESTA_OPEN CALL to

indisciplinarte@pecimprese.it

or by post mail to CAOS arts center,
Via Campofregoso 98-05100 Terni
(as attested by the sending postmark)
before the 20th of June 2016.

holder of all copyrights of exploitation and reproduction of the submitted project. Therefore they assume full responsibility and relieve Terni Festival from any claims and / or actions by third parties.

By participating at the Call, the authors of each project and installation authorise the promoters to use personal datas for the purposes of the project .

The personal datas provided by candidates are treated in compliance with the provisions of Decree no.196 of June, 30th 2003 (Code regarding personal data protection) and the local regulations on privacy.

For more information contact:
foresta@ternifestival.it
forestaternifestival.tumblr.com

7. BUDGET

TERNI FESTIVAL provides:

- € 2,000 for the materials + € 1,000 as a fee for the design and construction of the house
- accommodation and meals for the working days (27th of August and the 7th of September 2016)
- production support on site and mediation with any community involved
- workspace and basic tools
- visibility of the project by main festival communication channels and a printed publication dedicated to FORESTA

9. SELECTION PROCESS

The selection and evaluation will be based on artistic quality, feasibility, sustainability, community engagement and coherence with the vision of the project.

The Committee will discuss the proposals on the 21st of June and the final results will be published by the 2nd of July 2016.

10. COPYRIGHTS AND PRIVACY

By participating at this Call, the candidates declare to be the legitimate author and

image: Author's own.

6.4

INTERNATIONAL ARCHITECTURE COMPETITION
DESIGN ENTRY

CAOS ART MUSEUM, TERNI, ITALY
COMPETITION CRITERIA

The following pages consist of the competition entry. All images, drawings, and models are my own work.

I images: Author's own.

TERNI FESTIVAL INTERNAZIONALE 2016
OPEN CALL PER CASE SUGLI ALBERI

JACOB DENCH
architect

CHRIS PUGSLEY
builder and creator.

RESIDING IN THE SUSPENDED CITY OF OCTAVIA

If you choose to believe me, good. Now I will tell how Octavia, the spider-web city, is made. There is a precipice between two steep mountains: the city is over the void, bound to the two crests with ropes and chains and catwalks. You walk on the little wooden ties, careful not to set your foot in the open spaces, or you cling to the hempen strands. Below there is nothing for hundreds and hundreds of feet: a few clouds glide past; farther down you can glimpse the chasm's bed.

This is the foundation of the city: a net which serves as passage and as support. All the rest, instead of rising up, is hung below: rope ladders, hammocks, houses made like sacks, clothes hangers, terraces like gondolas, skins of water, gas jets, spits, baskets on strings, dumb-waiters, showers, trapezes and rings for children's games, cable cars, chandeliers, pots with trailing plants.

Suspended over the abyss, the life of Octavia's inhabitants is less uncertain than in other cities. They know the net will last only so long.

- Invisible Cities, *Le città ragnatela*,
Italo Calvino, 1972.

images: Author's own.

image: Author's own.

PROJECT SPECIFICS

Materiality, construction and timing:

he central sphere living space (1) is constructed of sustainably sourced ply-wood sheets. Shapes are made of two layers of plywood sheets. Cut from standard 2.4x1.2m plywood sheets will be needed to create a stable structure. Layers are bend over form and glued together. Each ring is joined at their flat surfaces at three points. Remaining timber pieces are used to g, install seating semi-circle and construct hanging table surface. Lockable doors are also rom the remaining timber. The sphere structure will be supported by the tree horizontally 500mm over the shelf of the tree (7) - supported by tight rope to thick rising branches - ight evenly.

he residence will be partially prefabricated off-site; including cables, belt structures and brics. The timber elements will be cut and fitted together over a four day period. Three given to on-site assembly, and a further final three days will be devoted to rigorous safety esign tweaking.

ements of Foresta brief:

ntirely weigh on the tree structure (roots, branches, trunk)

merging outward horizontally from the sphere is the first tension wing built of a structural et system (2), as well as structural ropes and climbing knots. The horizontal wing stretches ie sphere and houses the sleeping space (3). It is supported by these light-weight tension 1 tensioned membrane sleeping surface. The tension structure links the sphere horizontally chor point attached to a neighbouring tree, or alternatively; a purpose built cable-supported ing wall structure.

he second wing rises up diagonally and is attached to a high branch of the tree. It is not a habited, but a display tower (4). The artist resident can exhibit their artwork to the public g their clothes to dry. A pulley system allows work to be raised and lowered.

he lowering wing stretches to the earth, where they ropes are anchored (10). This wing ible suspended entrance staircase (5).

amage the tree structure in any way (roots, branches, trunk)

he design is naturally flexible to allow for on-site adjustment. Extruding elements can be to have little impact on branches. Our team's understanding of the tree-biology will enable and the limits of our tree-host and make design decisions accordingly.

ure the safety of the house for the artists who will live in it and the visitors.

ension belts (2), cables are designed to be able to support great amounts of weight and ropean safely regulations. The residence will be enclosed in a flexible spandex membrane isure no chance of occupant falling. Stairway rope structure acts as hand-railing for user- circular door provides only access to the residence. It is lockable a provides security.

urable for a minimum of 1 month

he design enables the residence to be easily de-constructed from its tree host and elsewhere. Structural materials are designed to last a minimum of a year in good conditions.

re a comfortable habitability for 1 guest

he tensile membrane sleeping surface (6) will be tightly tensioned as to provide a stable and lace for good rest. A spandex membrane covering will enclose the space and screen light intaining a thermally insulated interior environment through the night. Water-proof sail- ovide weather-proofing for sleeping space. The sphere space is ergonomically designed to accommodate sitting or standing. A retractable hanging table and lamp (8) give a responsive his main space.

ustainable, by using available materials preferably biodegradable

he use of light-weight tension structure and spandex membrane results in a very lightweight h minimal material used for maximum inhabitable space created. All wooden components able and biodegradable. All tension elements and membrane can be re-used after.

engaging local communities will be preferred.

on-structural rope elements of the building have been designed in order to be installed by e imagine engaging with local volunteers teaching knotting and threading techniques fter construction. We hope to learn as much from the community as they could learn

ur tree house project invites the local community, visitors to engage with an architecture of ess. Our resident artist will experience the life in a possible urban future that is floating by r than weighing heavily on the earth and the environment.

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Three Ring

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• *VII: Ideas*

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TENSION STRUCTURE.

The foundations of a suspended city.

S I T E
five possible locations of residence
scale: 1: 400

P L A N
scale: 1: 25

OTTAVIA Tree-house.

Questions = Tree Allocation? = Detailed Images of Tree. [Western-most Tree Preferred]
 - Can materials be arranged and delivered to site before our arrival?

On-site requirements;

Tools on site. (Forests to Supply)

- Large - flat work-benches (Tressel tables)
- Battery operated Tools - Jig-saw; Drills; Belt Sanders, Adjustable Builders Clamps (x10+)
- Paint-brushes, Battery operated Circular-Saw
- Sewing Machine ~~Machine~~
 ↳ Walking Foot Machine.
- Big Paddling Pod. → Former

Materials. (

- + (12x(2.4x1.2) Ply) x2 [Bendable Ply]?
- + "equivalent size" - Industrial Cardboard. Reinforced Corrugated Centre.
- + ~~12000m~~ of Orange structural string or ? Hemp??? Orange. Boot-lace cord?
- + Anchor-Foundation - Drill-Pile.
- + Big - Water-proof Bean-bag.
- + Curved Metal Template (same diameter as ring structure)
- + Spandex Volume? Area? [] white.
- + Harakeke
- + Yachting Rope, orange. [Hemp?]
- + Recycling Table for table?
- + Orange paint.
- + 6 x hinges.
- + Door Locking Mechanism

Community Help;

- Fabric ^{Maker} Expert / Seamstress.
- 'Riggers' - people who can work in-trees safely.
- ~~→ Most materials to be brought to site.~~
- Carpenters x2 - To build Tables, Bench, Doors.
-
- Hessian ~~Fabric~~ (Burlap style)

Cotton Duck Canvas 15oz, 425g | White.

MATERIAL CALCULATION WORKING SHEETS

images: author's own

6.5

BUILDING MATERIAL SELECTION

August, 2016

The Octavia design draws its material precedent from the 20th century industrial history of the city of Terni. Hessian fabric, canvas and muslin cloth were all once produced in the industrial area in which this project is sited. These industrially woven, natural fibres of jute, sisal and cotton express a tactile connection to this 19th Century industrial culture.

In the Te Pa Rākau design investigation of thesis book II, the plant material of harakeke flax, native to Aotearoa, is introduced into the second developed design. Traditional Māori methods of weaving the material are incorporated also which give the project a tactile connection to a pre-colonial culture.

MATERIAL QUANTITY ASSESSMENT: PLYWOOD CURVING FORM WORK AND

image: Author's own.

PRE-TRAVEL MATERIAL ORDER

August, 2016

CONSTRUCTION MATERIAL LIST:

37x PLYWOOD SHEETS | *Compensato*

Specification:

- 2.4x1.2m size
- 5mm thickness preferred
- Natural, untreated
- Sustainably sourced
- 'One-side good' (no printing or timber knots)

^ Good side: must have clean surface, ^ bad side will be covered

5x 2.5m 100x50mm TIMBER PIECES | *legno giunti dita*

Specification:

- Rough cut | *legno non levigato*.
- Natural, untreated
- Sustainably sourced

2x 1mx1m FINGER JOINTED WOOD | *legno giunti dita*

Specification:

- 25mm thickness
- Natural, untreated
- Sustainably sourced.

2x 8m RACHET TIE-DOWN STRAPS | *cinghie a cricchetto*

Specification:

- Heavy Duty, 2 tonne working load
- 8m length
- ~50mm width
- Colour: BRIGHT ORANGE (preferably without obvious markings)

Fig. 6.1- 6.5 Construction Material Images
images: bunnings.co.nz

3x 6m RACHET TIE-DOWN STRAPS | *cinghie a cricchetto*

Specification:

- ~600 kg working load
- 6m Length
- 25mm width
- Colour: BRIGHT ORANGE
(preferably without obvious markings)

1000m CLOTHES-LINE STRING

Specification:

- 4mm diameter
- non-elastic
- 630 metres, (ie: 6x100m rolls/ 12x50m rolls)
- Colour: BRIGHT ORANGE (same as straps)
- Ideally hemp or other natural material.
Must be orange however.

7.5m COTTON DUCK CANVAS | *Tele di cotone anatra*

Specification:

- No. 1 Grade : [18oz per linear yard 22inches wide]
- 183cm x 750cm
- White or Natural Cream Colour.

100m MUSLIN CLOTH | *Panno di mussola*

[Otherwise known as 'Stockinette-Cloth' or Cheese-Cloth]

Specification:

- Natural Cream Colour.
- 100m lenth (ie: 2x47m rolls)

Fig. 6.6- 6.10 Construction Material Images
images: bunnings.co.nz

TOOLS AND EQUIPMENT

- 4x LARGE-FLAT WORK BENCHES (TRESTLE TABLES) |
- 1x JIG-SAW (BATTERY OPERATED) | *sega da traforo*
- 2x POWER DRILLS (BATTERY OPERATED) | *trapano elettrico*
- 1x CIRCULAR-SAW (BATTERY OPERATED) | *Sega circolare*
- 10+ x BUILDERS CLAMPS (adjustable) | *morsetti falegnami*
- 4x LARGE PANT BRUSHES
- 1x WALKING-FOOT SEWING MACHINE | *Camminare macchina da cucire piedi*

Fig. 6.11- 6.15 Construction Material Images
images: bunnings.co.nz

EXPERT HELP NEEDED

2x CARPENTERS | **falegname** – People with skill working with wood. >

1x FABRIC MAKER | **produttore di tessuto**
(People who are experienced in operating sewing machines)

2x 'RIGGERS' (People who can work high in trees safely)

Materials:

1. 3. 2 + 6 + 1 Triangles
6 6 6 6 6 RINGS = FORMERS.

Stairs = 0000.
⊕⊕ - Small Rings

3 ply layers x 4.7m
I 250 Central Ribs.

7mm thickness or 5mm. (preferably)

5 x 2.5m [100x50] PINE FOR FORMERS.

1x 1m x 1m square 25mm I
'Finger-Jointed Pine'

thickest available
Cotton Duck Canvas 150z, 425g | White.

183cm (3.75x2)
7.5m.
(doublet).

Ratched - Tie-Downs
"Heavy Duty" - 2 Tonne Working Load 8m length x 2
[50 mm wide] Colour = Bright Orange.

Ratchet Tie Down - 650 kg working load 6m Length x 3
[25mm wide] Colour = Bright Orange

Clothes-Line-String 4mm diameter = 630 metres.
ie 6 x 100 m rolls.
12 x 50 m rolls

100m (Stockinette cloth)
(Muslin cloth)
(Cheese-Cloth.)
(2x47m pack.)

Hessian Fabric (Burlap style) = Wide-Woven Hessian (1.83m wide) = 20m length

COMPONENT DRAWINGS

The following are the original, pre-construction, component drawings (left) and the sketches overlaying them (right) that were made during the construction process as alterations to the design were made in-situ.

COMPONENT SHEET 1: PRE CONSTRUCTION

image: Author's own.

COMPONENT SHEET 1: POST CONSTRUCTION

image: Author's own.

COMPONENT SHEET 2: PRE CONSTRUCTION

image: Author's own.

COMPONENT SHEET 2: POST CONSTRUCTION

image: Author's own.

6.7

COMPETITION OUTCOME

AUGUST, 2016

MESSAGE OF CONGRADULATIONS;

////////////////////////////////////
July 20th 2016:

Dear Jacob
Thank you once more for your participation and for waiting so to allow the committees to analyze properly each project and reach an unanimous decision.

We are pleased to inform you that your project was included in the final selection of the 5 ideas that will be realized to host the artists in residency in Terni during Terni Festival.

We ask you to confirm us your availability to realized the project in Terni within the 7th of September to confirm you will be actually able to build the house as written in the call to propose us a date for a Skype call to discuss the project in details, logistically, technically and financially.

Besides, we would love to disseminate some pictures and notes of your project through our media channels and we ask for your authorization.

Congratulations for the results!
Looking forward for reading you very soon

Kind regards

Foresta Staff

Fig. 6.16 Octavia Treehouse Newspaper Article, August 25, 2016
image: The Wellingtonian

THE HOST TREES

FINDING AN APPROPRIATE TREE ON SITE

TREE GENUS: *TILIA CORDATA* (LINDEN TREE),
AGE 100+ YEARS. FULL HEIGHT: 16M+
HEIGHT OF POLLARDED TRUNK LEVEL: 5.4M

The sculpted appearance of these trees is due to the technique of pollarding which occurred over a majority of these trees' lives. Pollarding is the practice of the pruning of tree branches. Approximately twenty years ago pollarding was stopped and the vertical branches have since grown over ten metres above the branched trunk. This human-engineered tree sculpting has left these trees with an average of 8m² of raised and enclosed space directly above the main trunk. They are perfect specimens for treehouse construction. However, the OCTAVIA treehouse design had very specific requirements, and much thought was put into the selection of the primary host tree. The tree chosen was one of five this author and a volunteer construction team had to choose from. Considerations were as follows:

1. The space within the vertical branches must allow for a spherical structure with a diameter of 2.4 metres.

2. The tree must be in good health and strong enough to take the load of the building intervention.
3. There must exist three openings between the vertical branches wide enough to allow three extruding 'wings' of the building to break out of the primary tree. They must be at least 1000mm wide. These three openings must be located approximately 120 degrees from the centre point of the tree when viewed in plan.
4. To allow the sleeping wing, of 1200mm width at its widest point, to extrude outwards from the main spherical structure an opening must face directly towards the branches of the neighbouring tree (to which the sleeping wing will be connected.)
5. Due to tension-strap length, the secondary tree must be no more than 6.6 metres from the primary tree.
6. A third tree to be located no further than 9 metres from the primary tree and positioned in the appropriate place to allow strings travelling directly outwards from the 'display window' to reach its branches,

THE CENTENNIAL LINDEN TREE | Chosen to become the living backbone of the OCTAVIA Treehouse.

Jacob Dench
image: Author's own

image: author's own

CHAPTER 7

A TALE OF TWO SUSPENDED CITIES: OCTAVIA

DEVELOPED DESIGN

DOCUMENTATION OF THE 12-DAY CONSTRUCTION PROCESS

For the 2016 Terni International

Performing Arts Festival Umbria, Italy.

AUGUST, 2016

This chapter documents the twelve day construction of the suspended artist's residence in centennial linden trees of Terni Italy. *It outlines the process of construction through step by step photography and schematic diagramming.* To conclude this chapter, the many learnings that came from the construction of this prototype construction project will be discussed.

QR CODE LINK
TO CONSTRUCTION VIDEO

*A construction video can be
found by following the QR
code above.*

7.1

SCHEMATIC CONSTRUCTION PROCESS DIAGRAMME FOR PLYWOOD ELEMENT

7.2 - DAY BY DAY CONSTRUCTION DOCUMENTATION

PRE-TRAVEL PROTOTYPE TEST DAY

WORK COMPLETED: FABRICATING A PROTOTYPE PLYWOOD CURVING FORMWORK AND TEST RING

all photographs: Author's own

SCHEMATIC PROCESS DIAGRAM

images: Author's own

Four standard 2.4x1.2m sized 8mm thick pine plywood sheets were cut with hand-held jig saw into arches. These arches made up two rings that were positioned together over a forming-frame made from the waste material. The two rings were then glued together with an epoxy foaming glue. They were left for eight hours and the rest is seen the far right image. From this one-day test prototype for the creation of a curved plywood ring the following was learnt:

- An expanding epoxy foam glue would create a poor finish. Instead a thinner less expansive glue should be used and applied evenly over the entire face.
- Thinner plywood would give a more consistent curve. Three ring-layers of 6mm plywood layers should therefore be used instead (a total of 6 plywood sheets per ring are needed). 18 plywood sheets will be needed in total to construct all three rings.

PLYWOOD CURVING PROCESS DIAGRAMME

images: Author's own

CONSTRUCTION DAYS 1-3

WORKSHOP PREFABRICATION

WORK COMPLETED: FABRICATING A PROTOTYPE PLYWOOD CURVING FORM WORK AND TEST RING

From the learnings made from the earlier prototype the three rings were constructed from 6 individual plywood sheets. Each was cut with a hand-held jigsaw, laid down on the framework and glued with a PVA glue. Blocking and painters tape was applied after all three layers were in place in order to hold the form for drying. The following was learnt from this process:

- Thinner plywood produced a much more consistent curve.
- A rotating sanding tool provides a smooth finish around the ring circumference

all photographs: Author's own

SCHEMATIC PROCESS DIAGRAM
images: Author's own

SCHEMATIC PROCESS DIAGRAM
images: Author's own

CONSTRUCTION DAY 4 WORKSHOP PREFABRICATION

WORK COMPLETED: RINGS ASSEMBLED TOGETHER AND DRILLED

all photographs: Author's own

A total of 36 holes were drilled into the face of each ring. These are holes that strings (that create the building's wing form) will be passed through. The three curved rings created were connected together at mid-height via two 15cm deep 10mm thick bolts at each of the three connection points. The triangular single-layer ceiling pieces were traced out and cut. These were then folded over the structure in place and drilled into place. The following was learnt in this process:

- Where the curved rings meet a thin interior space is opened up. This area is perfect for the holding of small artefacts such as books.
- Each ring has slight differences in curve. This requires the custom tracing of ceiling and ground sheets.

SCHEMATIC PROCESS DIAGRAM

SCHEMATIC PROCESS DIAGRAM
images: Author's own

CONSTRUCTION DAY 5 *WORKSHOP PREFABRICATION*

WORK COMPLETED: FLOORING AND DOORS INSTALLED

Flooring battens were cut to the correct angle and length, These were installed between the plywood rings of the bottom curve of the spherical frame. Triangular flooring pieces were cut to shape. They were bent and double laminated in-situ, held in place by drilled screws. A triangular middle section was cut from 60mm plywood. Locking notches were cut into it so that it sat in place.

all photographs: Author's own

- The spherical form enjoys rolling and needs propping at all times. This will not longer be a problem when it is placed within the tree and held by three points of tension.
- Door sections require hinging along a straight edge, therefore a fully opening circular face will not be able to be achieved.

CONSTRUCTION DAY 6 *WORKSHOP PREFABRICATION*

WORK COMPLETED: SEMI-CIRCULAR BENCH AND BACKREST INSTALLED

all photographs: Author's own

The following was learnt from this process:

- The bench required additional support below as was originally envisioned. Four additional blocking pieces were added in a way this author felt was sympathetic to the original design.

CONSTRUCTION DAY 7 *RAISING THE STRUCTURE TO THE TREE*

WORK COMPLETED: STRUCTURE IS RAISED INTO TREE IN PIECES, THEN REASSEMBLED

all photographs: Author's own

The following was learnt from this process:

- No longer working from a flat surface gave rise to many challenges. By using an electronic leveller and by tensioning the frame into space a level floor was finally achieved.

CONSTRUCTION DAY 8 *WORKING WITHIN THE TREES*

WORK COMPLETED: STRUCTURE IS FULLY RE-ASSEMBLED WITHIN THE TREE. THE FIRST TENSIONED STRAPS ARE INSTALLED

The form is restored to how it was prior to placement within the tree. Tensioned straps are installed connecting the structure to its neighbouring tree. From this process the following was learnt:

- Void spaces in the structure frame interesting views to the surrounding branches and leaves.
- A strong tension-strap connection point can be created by allowing the strap to pass around the exterior of the frame before connecting to the interior bolt that connects each ring face.

CONSTRUCTION DAYS 9 *WORKING WITHIN THE TREES*

WORK COMPLETED: TENSIONED STAIRCASE REDESIGNED AND INSTALLED

The 60mm plywood steps were cut with a jigsaw, then varnished. Tension straps were laid in place between tree and ground soil. The orange straps were screwed into the thickness of the plywood steps but the plywood delaminated when loaded with the weight of a person. Compression bolts were fitted to each side of the steps to prevent this delamination occurring. Each has an individual form and range in size from smallest at the bottom to largest at the top.

- The original angle of the staircase would put too much load on the tree and ground anchors. Therefore a sharper, more vertical was adopted. This turned the staircase into more of a ladder which was not originally intended, but did provide an easily navigable vertical access way.
- Purpose made steel anchor points were found to be the best solution to maintain strong connection to the soil.
- Screws placed vertically through the plywood near the point of connection to tension strap prevents the plywood from splitting under stress.

COMPLETED TENSILE LADDER

CONSTRUCTION DAY 10 *WORKING WITHIN THE TREES*

WORK COMPLETED: STRINGS AND TENSIONS TRAPS ATTACHED. DOOR INSTALLED ALSO

A total of 36 bright orange string lines were strung from each of two ring faces. These were attached at a horizontal level to the branches of two neighbouring trees at nine, and seven metres distance. Each string line was threaded through the 36 holes created of both faces. Strings enclose a spatial environment and will support light-weight muslin cloth. Tension straps to support the hammock surface were secured in place and ratchet tightened. The doors were painted and installed in place.

- Strings can be threaded continuously as per the sketch modelling done in Thesis book II, part I for the 'Te Whai' taonga.
- Strings would ideally been threaded and bundled in place before the framing structure was placed in the tree. Having to do this completely in-situ was very laborious.

STRINGS REMAINING OUT AND
CONNECTING TO NEIGHBOURING

all photographs: Author's own

CONSTRUCTION DAY II

[ADDITIONAL PHOTO DOCUMENTATION]

FIXING TENSION STRAPS IN PLACE

all photographs: Author's own

CONSTRUCTION DAY 12

WORKING WITHIN THE TREES

WORK COMPLETED: HAMMOCK SURFACE SEWN TO FIT AND INSTALLED.
MUSLIN FABRIC INSTALLED

FIXING TENSION STRAPS IN PLACE
images: Foresta, Terni Festival Blog

images: Foresta, Terni Festival Blog

The hammock surface was sewn to fit from a natural canvas material. This process was laborious as it required the provision of specialised sleeves for tension straps along the long edge of the hammock. The two tension straps were taken down from the tree and threaded through the completed hammock in the workshop. Now ready the straps were brought back to the tree and reinstalled. Ratchets were used to tighten the hammock so that it was taut. Muslin fabric was attached using a staple gun to the edges of the large and small rings. The following was learnt from these final days:

- The process of sewing the hammock was very laborious. Finding a ready-made hammock product that fits this shape would save time and cost.
- The hammock dips upon entry. Therefore it was important that the point at which the hammock would attach to the bench for entry is raised slightly to adjust for this and prevent the user from dropping

Fig. 8.1: On site interview with European Parliamentarians

image: Foresta Treehouse Construction Blog.

I progetti

Un arco rigido per sorreggere un «nido»

La falegnameria Fa.Sa. ha costruito «Geo-Desto, il Nido Modesto» (foto). La casa è di forma quasi sferica, è un poliedro non regolare formato da un unico tipo di triangolo che si ripete fino a chiudere l'intero volume. La scelta di tale forma è dovuta alla volontà di ottenere un organismo composto da piccoli elementi standard che, uniti tra loro, danno vita a una casa rigida ma molto leggera. Un solaio in legno che si prolunga lateralmente fino a terra, formando un grande arco, è la struttura portante della casa. Le altre case sono «Cloudster» realizzata da EqualogicalLab; «Lampiride» del gruppo Zapoi; «Ottavia» del collettivo Dench-Sanchez-Pugsley; «Peter Pan» del collettivo Poggiani-Picano.

Il mondo visto dall'alto Gli artisti riflettono nelle case sull'albero

Festival di Terni, esperimento ecosostenibile
Cinque architetture nascono sui tigli centenari

Gli alberi sono tigli centenari. Il luogo dove sorgono è un'area che anticamente accoglieva una ferriera pontificia, poi una azienda chimica. Sugli alberi trovano spazio delle piccole case, che ospitano residenze artistiche. Adesso l'area si chiama Caos, Centro arti opificio Siri, una struttura polivalente nel centro storico di Terni, esempio di archeologia industriale trasformata in una zona che accoglie un museo di arte moderna e uno archeologico, un luogo per esposizioni temporanee, un teatro e poi laboratori didattici, biblioteca e sala video. Il progetto delle case sugli alberi si chiama «Foresta» ed è

Il festival
● L'XI edizione del Terni Festival presenta fino al 25 settembre una serie di prime di spettacoli nazionali e internazionali. Tra gli altri, «Five Easy Pieces» dello svizzero Milo Rau; «La vita ferma» di Lucia Calamaro; «Purgatorio» di babilonia Teatri.

La ragnatela
«Ottavia» è stata realizzata dal collettivo neozelandese Dench-Sanchez-Pugsley. Nella foto, Leonardo Delogu, ideatore dell'intero

allacci di gas e acqua. Per il fessaggio delle strutture è stato rispettato il criterio di salvaguardia dell'albero.

Le case sono state costruite da cinque collettivi di varie nazionalità selezionati da una giuria composta, tra gli altri, da Stefano Boeri, progettista del Bosco verticale di Milano. Sono abitate da artisti che, durante il festival, studieranno il mondo

to che sarà realizzato l'anno venturo.

«Siamo orgogliosi di questa iniziativa — afferma Linda Di Pietro, direttore del Terni Festival —. Il cuore del progetto vive

Le caratteristiche

Le costruzioni realizzate da 5 collettivi sono autoportanti

in un dispositivo architettonico che è in grado di comunicare con l'esterno e ospitare al proprio interno la vita e le idee degli artisti. L'installazione ricrea l'intricato, delicato equilibrio della foresta. Nella progettazione delle case, gli architetti hanno tenuto conto di parametri fondamentali: il rispetto e l'incolumità dell'albero, la sicurezza della costruzione e la sua

CHAPTER 8

FINAL DESIGN

THE REALISED BUILDING PROJECT

SEPTEMBER, 2016

This chapter shows photography of the finished OCTAVIA treehouse building. As it was for the September 2016 opening of Terni International Performing Arts Festival, Italy.

QR CODE LINK

TO POST-CONSTRUCTION
RADIO NZ INTERVIEW

A Radio New Zealand post-construction radio interview can be found by above link.

THE FINAL OCTAVIA TREE RESIDENCE

all photographs: Author's own

OCTAVIA TREEHOUSE SEEN THROUGH
TREE BRANCHES

all photographs: Author's own

SCULPTED APERTURES FROM WHICH TO
VIEW THE OUTSIDE FOREST

BOOKSHELF SPACE CREATED
BETWEEN RING ELEMENTS

SITTING WITHIN HAMMOCK WING

SPHERE FORM AFTER FIRST ASSEMBLY

all photographs: Author's own

RESIDENT ARTIST WITHIN SPHERE SPACE

Fig. 8.3 Artist in Tree Residence
image: Foresta, Terni Festival Blog

FABRICATION OF RINGS ELEMENTS

image: Foresta, Terni Festival Blog

VIEW FROM WITHIN HAMMOCK

image: Author's own

RESIDENT ARTIST
WITHIN OCTAVIA.

SEEN FROM BELOW
image: Author's own.

STRING STRUCTURE BY NIGHT

all photographs: Author's own

all photographs: Author's own

CRITICAL REFLECTIONS

LEARNINGS OF THE OCTAVIA TREEHOUSE

This thesis chapter has documented the design, development, construction and eventual realisation of a radical tree architecture. Through this process of learning by doing I have been able to prove the structural viability of the design for this thesis investigation. Through the construction and post-construction photographs this investigation presents a tangible presentation of how design based on a allegorical connection to Māori taonga can be manifested into built form. The practical experience of building the Octavia prototype led to a number of important conclusions that have enabled this thesis investigation to pursue a final design. This investigation finds the following conclusions;

- The design employs the use of simple affordable materials throughout every aspect of the design. The entire project was completed for 2200 euros. (With the free labour of this author and volunteers). This budget served a valuable means of steering the design towards a highly cost-effective outcome. The design techniques that allowed for this low cost can be replicated to a certain extent in the Te Pā Rākau design for Book II. However, Book II introduces different materiality; another major spatial component to the design; and a need for weather-screening. These will increase cost significantly. Overall material quality must be adjusted too if the final design is to last longer than this very temporary prototype.
- As total building weight was light enough to be fully supported by the primary tree and other supporting trees. The final design must do what the OCTAVIA project only alluded to. That is, to be fully suspended in stable tension through three primary points of contact to the three ancient kahikatea trees of the Papaitonga site. Material lightness is very important therefore. What has been learnt of material weight and strength will be applied to developed design.
- A simple workshop and tools were enough to enable the prefabrication of all building components in this prototype. This maximised the extend to which nonprofessional participants could be involved in construction. The developed design should follow this, such that its construction could utilise impassioned Muaūpoko, or other community volunteers, regardless of formal building training.

all photographs: author's own

9.1 CRITICAL REFLECTION

This built project achieves the following objectives of this investigation:

AIM TAHI: ARCHITECTURE OF LIGHTNESS

The built intervention has been shown to provide habitation free of the ground plane. It does this through a tension ladder, tree-supported spherical frame and bench space, and a suspended hammock. It has been proven to be light enough to be able to be fully supported by living trees. It expresses tension through all major design elements. At every opportunity the design of this building was altered in order to provide for the lightest and also most affordable outcome. This led however to the very enduring temporal nature of the building.

AIM RUA: ARCHITECTURE + HUMANKIND = NATURE

Whether or not the building fostered a stronger connection to nature in its resident artist inhabitant is a very subjective question. This investigation can report that the built intervention allows users to experience environmentally conscious human place within nature. All materials, except for the orange string and strap elements, express natural material colours and textures. All components express temperance akin to that of nature. The design relates to the scale of the human body. Ladder, bench, spherical space and hammock all follow the needs of the human body. The spherical space is 2.2 metres in diameter. This allows most people to both stand and sit comfortably. The interior space created surrounds its user with nature. It does so through sculpted apertures that lead the eye outwards towards the surrounding branches of the trees.

all photographs: Author's own

10. EPILOGUE CLOSING NARRATIVE

INVISIBLE CITIES ITALO CALVINO

ERSILIA, THE RUINED CITY OF STRINGS

In Ersilia, to establish the relationships that sustain the city's life, the inhabitants stretch strings from the corners of the houses, white or black or gray or black-and-white according to whether they mark a relationship of blood, of trade, authority, agency. When the strings become so numerous that you can no longer pass among them, the inhabitants leave: the houses are dismantled; only the strings and their supports remain.

From a mountainside, camping with their household goods, Ersilia's refugees look at the labyrinth of taut strings and poles that rise in the plain. That is the city of Ersilia still, and they are nothing.

They rebuild Ersilia elsewhere. They weave a similar pattern of strings which they would like to be more complex and at the same time more regular than the other. Then they abandon it and take themselves and their houses still farther away.

Thus, when traveling in the territory of Ersilia, you come upon the ruins of abandoned cities, without the walls which do not last, without the bones of the dead which the wind rolls away: spiderwebs of intricate relationships seeking a form.

- Calvino, 1972, translation by Weaver 1997

A tale of

TWO SUSPENDED CITIES

THESIS BOOK II

JACOB DENCH

A TALE OF TWO SUSPENDED CITIES

BY

JACOB DENCH

A 120-point thesis
submitted to Victoria University of Wellington
in partial fulfilment of the requirements for the
degree of Master of Architecture (Professional)

Victoria University of Wellington

School of Architecture

2017

Fig. 1.1: Mita Taupopoki, speaking on Marae, circa 1915
image: National Library of New Zealand

In Māoridom it is said that “*Manu Kōrero, Orators, illuminate topics in the same way that Tāne [god of the forest] brought light into the world when he separated heaven and earth.*”

- Te Ahukaramū, 2007

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An orator’s shelter in a remnant of an ancient forest

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TE PĀ RĀKAU

AN ORATOR'S SHELTER IN A REMNANT OF AN ANCIENT KAHIKATEA FOREST

JACOB DENCH

image: author's own

THE TALE OF TWO SUSPENDED CITIES

BOOK II:

TE PĀ RĀKAU

THE TREE VILLAGE OF THE MUAŪPOKO

PART I

CHAPTER I:

INTRODUCTION

TALE II Te Pā Rākau

The little known true story of the Muaūpoko people of Horowhenua Aotearoa and their suspended tree village in an ancient kahikatea forest.

Te Pā Rākau of the Muaūpoko people represents a unique story in the cultural history of Aotearoa that is intimately connected to an ancient forest landscape. The Muaūpoko are the only known iwi in Aotearoa to have lived in villages high above the ground - suspended in the trees. Today, only Te Papaitonga Reserve, a tiny remnant of the once immense lowland kahikatea forest of this iwi remains. Their unique architecture once demonstrated a human connectedness with this forest. This second design investigation takes stage within the Papaitonga forest. It seeks an architecture of allegorical narrative for which can restore a people's connectedness to a once vast indigenous forest.

This design-led investigation proposes a new kind of architectural space for Whaikōrero, oral narrative storytelling. This design investigation seeks a means of creating an inspiring context for, and preserving the oral tradition of the Muaūpoko people - and the knowledge and understanding of that comes with it.

The design takes stage within the ancient kahikatea trees of the Papaitonga forest remnant, Horowhenua, Aotearoa.

TE PĀ RĀKAU

THE LOST TREE VILLAGE OF THE MUAŪPOKO

In former times, the lowlands of the Horowhenua region, like 90 percent of the rest of Aotearoa, supported a vast and ancient temperate rainforest (C. Knight, 2010). The Muaūpoko, the children of Kupe, were the tangata-whenua, the people of these vast forested lowlands. Their region was bordered on the west by Te Tai-o-Rē-Hua, the Tasman Sea, and on the east by Ngā Maunga Tararua, the Tararua Ranges (E. Best, 1893).

The name they gave to their region, Horowhenua, translates to “shifting/rippling earth”. (Te Ara, 2016). This could be seen as referring to the distinct foundations of this land. (Adkin, 1948). The region is a dune landscape. Here the ground rises and sinks constantly and a high water table feeds emerging wetlands (Te Ara, 2016). Here a village of Muaūpoko people chose to free their architecture from the ground plane entirely.

Fig. 2.1 - MUAŪPOKO TRIBAL AREA TODAY, image: Te Ara: The Encyclopedia of New Zealand.

Fig. 2.2 - HOROWHENUA - A RIPPLING LANDSCAPE OF SAND image: Google Earth satellite imagery. Edited by author.

Fig. 2.3: Kahikatea Tree Specimen, The Tallest Native Tree of Aotearoa, Pirongia Forest Park image: Derek Bao ©

The kahikatea provided a means for Muaūpoko to do this. Kahikatea are the tallest growing and most ancient tree species of Aotearoa. These trees once dominated this landscape, towering up to 70 metres above the forest floor. An individual tree could live over 2,000 years. These trees are an ancient survivor from the Jurassic Period, evidenced by geologists' discoveries of its pollen and leaves in Jurassic rocks, some 160-180 million years old (C. Knight). Dinosaurs walked amidst the ancestors of these trees on the supercontinent Pangaea, their berries likely feasted on by pterodactyls (C. Knight, 2010).

Within the kahikatea trees of Horowhenua resided the only known people of Aotearoa with a culture of living suspended in the trees, at a clearing named Whakahoro...

As a means of defence, and to ensure the safety of their Tamariki, their children, the Muaūpoko of Whakahoro constructed a suspended fortified tree-village [a 'pā-rākau'], in the tops of the immense Kahikatea trees.

The Muaūpoko people here were often attacked by the war parties of Ngati-Tiapa and the Ngati-Kahungunu of Wairarapa who reached these lowlands via the old war trails over the Tararua Mountains.

Beams were laid from fork to fork of the trees, and upon these was suspended a platform, upon which the houses were erected. A fence encircled the whole stage, and stores of food and water were always kept in this aerial pā.

-E. Best, 1893

Upon the approach of taua, war parties, the Muaūpoko would retreat to their pā-rākau, pulling up the ladders with them. There they would find safety as the smooth branchless trunks of the Kahikatea cannot easily be climbed without rope or ladder (C. Knight, 2010).

Fig. 2.3: Kahikatea Tree Specimen
The Tallest Native Tree of Aotearoa
Pirongia Forest Park
image: Derek Bao ©

Upon the platform were piled heaps of stones, which could be hurled down upon the enemy when he approached the trees - and the besieged might well defy their enemies as long as their food and water held out. – For in those days guns were unheard of.

When, however, Te Rauparaha arrived in the district with firearms, the days of the [pā-rākau] were numbered. The children of Kupe could then see that their position was untenable, and therefore they declined to remain aloft to be shot down – “Me he pupuhi Manu” - to be shot down like birds.

- E. Best, 1893

Today the Papaitonga Forest remnant is all that remains of this lost way of life and the great kahikatea forest that provided for it. Recent mass deforestation has reduced the ancient kahikatea tree to tiny isolated forest remnants. One of these remnants is the Te Papaitonga Forest Reserve, near the town of Ohau, Horowhenua, shown in figures 3 and 4 below.

Figure 3:
PAPAITONGA RESERVE

image: Google Earth, author edited

Figure 4:
WIDER GEOGRAPHICAL
CONTEXT

image: Google Earth,
author edited

This particular remnant is special. Its trees are the closest remaining to those that in which the Muaūpoko lived. This forest gives context to this unique lost way of life about which few people today have heard. It holds the environmental history of this landscape.

‘Me he pu-puhi Manu’

To be shot down like the birds

Whakatouki Māori Proverb (B. Keane, 2017)

Specimen of Extinct Huia Bird.

Image: Te Papa Archives.

Fig. 2.3: Kahikatea Tree Specimen,
The Tallest Native Tree of Aotearoa,
Pirangia Forest Park
image: Derek Bao ©

2.1 UNSEEN AND UNHEARD

A CATALOGUE OF AOTEAROA NOTABLE EXTINCTIONS ALONGSIDE REMAINING SPECIES

CIRCA 1300 - 2016

[data: nzbirdsonline.org.nz]

It is said in Māori oral histories that Aotearoa could be heard by ear by seafarers long before it was seen by eye. Joseph Banks on board James Cook's expedition to New Zealand in 1770 writes of the birdsong he heard,

"Their voices were certainly the most melodious wild musick I have ever heard, almost imitating small bells but with the most tuneable silver sound imaginable". (J. Banks, 1770)

Figures 2.4.
[data and images: sourced from NZ Birds
Online, nzbirdsonline.org.nz]

The close relationship which the Muaūpoko had with these special trees is largely forgotten today - but it is not yet lost. The oral narratives, ngā whaikōrero, are still remembered by the elders of the Muaūpoko iwi, passed down to them by their elders.

This investigation proposes a suspended shelter for this forest remnant. Its purpose is to provide a place where whaikōrero oratory of this place can be preserved, passed down from tīpuna to mokopuna, from grandparent to grandchild, and from orator to apprentice.

This design that stems from this research offers a place of inspiration, and a means for the tamariki of Aotearoa today to experience a lost way of life within a remnant of their lost wilderness.

CHAPTER 3

SITE AND CONTEXT

TE PAPAITONGA RESERVE,
HOROWHENUA

REMNANT OF AN ANCIENT FOREST

3.1

SITE IN CONTEMPORARY AND HISTORIC CONTEXT

The two mapping diagrams pictured shown here depict the geographical relationship of the Papaitonga site to its wider cultural context. The modern day Muaūpoko tribal area is shown adjacent in blue. Over the page, the iwi's two existing marae can be seen situated at opposite ends of Lake Horowhenua near the town of Levin.

Cultural events of the iwi are currently centred around two marae sites. The two existing marae, Ko Kohuturoa and Ko Kawiū, are located amidst a farmland environment. Near to both marae lies Lake Horowhenua. This lake, like Papaitonga, was once a highly prized body of water for Muaūpoko - two open bodies of water in an otherwise densely forested plain. Today Lake Horowhenua lies exposed, its forest long since removed. It is heavily polluted with farming runoff, named 'Lake of Shame' on the cover of The New Zealand Listener in March 2013, seen in figure 3.2 below.

The map in figure 3.1 shows that Te Papaitonga Forest Reserve contains the area's only significant remaining indigenous forest after the rapid deforestation that occurred from early Pākehā colonisation (C. Knight, 2010)

Having a publicly accessible cultural meeting place within the Papaitonga site would provide the iwi with a place for intimate-scale cultural events within the forested environment in which their culture developed. It would also centre cultural activity around the less polluted of their lakes, and a far less damaged ecosystem.

Fig 3.1: MUAŪPOKO TRIBAL AREA TODAY

image: Te Ara

- Muaūpoko Tribal Area
- Area shown left page map.

Fig 3.2: ARTICLE ON LAKE HOROWHENUA WATER QUALITY

image: New Zealand Listener, March 2-8 2013

- Original Native Forest
- Pasture Land
- Urban Area of Levin
- Lake
- Waterway

Fig 3.3: SITE CONTEXT MAP

image: NZ Topographic / Author Edited

THE COLONIAL MEETING HOUSES OF MUAŪPOKO MARAE

Fig. 3.4 : KAWIU MARAE WHARENUI (1921)

Muaūpoko Tribal Area,

Taitoko | Levin

image: Muaūpoko Tribal Authority.

FIGURE 3.5 : KOHUTUROA MARAE WHARENUI, (1928)

Muaūpoko Tribal Area

Taitoko | Levin

image: Muaūpoko Tribal Authority.

3.2 CRITICAL ANALYSIS:

CURRENT PLACE FOR ORATORY IN MUAŪPOKO TRIBAL AREA

The whaikōrero, Māori oral narrative tradition, has lost its place as traditional marae, and their wharenui meeting houses are less frequented by an urbanised Māori population.

The post-colonial wharenui, meeting houses, - an architecture that has its roots in both the vernacular typology that has existed within Aotearoa forests for half a millennia and the colonial architecture of Pākehā. The two existing Muaūpoko wharenui of the Kawiū and Kohuturoa marae, seen in the two figures, left.

The architecture of these two existing marae, is more heavily influenced by early colonialist architecture than they are by the unique architectural history of their people. Like their location within pasture farmland, these buildings express a great disconnection from the precolonial forested world of the Muaūpoko culture. These buildings are a response to Māori architecture I will refer to, as I did when describing the standard back country bivvy in thesis book I, 'conformity and camouflage'. The following features of these buildings show this.

- Simple rectilinear form and pitched roof
- Traditional Pākehā colonial style weatherboard timber expressed.
- Natural materials are hidden behind a coating of white paint.
- The building is more reminiscent of the colonial church or cottage, than of the unique architectural heritage of Muaūpoko.
- Sited within a farmland context far from the pre-colonial forested condition of the land.

These buildings do not provide an inspirational space for the practice of contemporary whaikōrero oratory. These buildings represent Muaūpoko assimilation into colonial New Zealand. They do not represent or celebrate their own culture's rich architectural history. The architecture of these wharenui does not communicate the iwi's rich historical relationship to their indigenous forest homeland either. These buildings are not providing environments rich enough to inspire the continuation of their practice of oral narration - Te Whaikōrero.

The sites of the two existing Muaūpoko wharenui centre offer no connection to the pre-colonial condition of the land in which the Muaūpoko culture developed. These sites speak nothing of the temperate rainforest that existed here, or the abundant in bio-diverse flora and fauna that lived within it.

Site of three ancient kahikatea trees is 25 minutes walk from the reserve entrance.

Site in relation to its wider environmental environment.

THEN: Part of a dense forested land that reached from the Tararua Mountains to the Tasman Sea. NOW: A remnant forest in a pasture farmland setting.

Fig 3.6, 3.7: SITE CONTEXT MAPS
image: Google Earth / Author Edited.

SITE SIGNIFICANCE

Te Papaitonga Reserve can provide an inspirational site for the kind of architectural intervention proposed through this investigation. It is a site which is culturally and environmentally significant for Muaūpoko and relevant to the history of their pā-pakau.

BIOLOGICAL SIGNIFICANCE

This reserve is an important refuge for birds that depend on wetlands or lowland forests for their survival. Within the reserve is the only intact sequence from wetland to mature dry terrace forest in the Wellington and Horowhenua regions (C. Knight, 2009). The wetland is part of the wider dune landscape of the region. The wetland forest associations of kahikatea/pukatea, tawa and pukatea-tawa-swamp maire trees are now rare - as most lowland indigenous forests ecosystems of Aotearoa have been reduced to pastures (C. Knight, 2010).

MUAUPOKO HISTORICAL CONEXT

Not only is it of great ecological significance, Papaitonga also has been the scene of much dramatic history for the Muaūpoko people (C. Knight, 2009). The last recorded Muaūpoko settlement in the area was during the early part of the 19th century (C. Knight, 2009). In 1820 Muaūpoko built an artificial island, Papawhārangi (the smaller eastern of the two islands in the lake) as an extension of their lakeside pā. On this island visiting chief of Ngati-Toa, Te Rauparaha, narrowly escaped death at the hands of the Muaūpoko in an incident that claimed the lives of his son and daughter. In 1822, retaliation, Te Rauparaha led a firearms-fuelled taua, war party, to seek revenge. The Muaūpoko at Papaitonga took refuge on the island but were not safe. Hundreds of Muaūpoko were killed by the taua who swam there. The Muaūpoko who survived were driven from the entire area.

RELATIONSHIP TO THE SITE OF ORIGINAL TE PA-RAKAU.

This reserve is the only remaining ancient lowland forest in the Muaūpoko tribal area in Horowhenua (C. Knight, 2009). Therefore it is the nearest remaining environment to that in which Te Pā Rākau was built. It is less than five kilometres from the estimated site of the original Pā Rakau.

3.5

MODELLING A LANDSCAPE

Based on the contours retrieved from a Department of Conservation survey I was able to create a topographic site model of the site focus area. The circular focus area selected is positioned between the mainland and Papaitonga Island. The area has a radius of 200m.

I cut horizontal sections through the digital model and produced sections. I printed these sections at a scale of 1:400 (by which the diameter of the circular area is 1m.) These printed paper strips I glued to the side of forty individual recycled matai timber weatherboards. Using the printed sections as guides I was able to individually cut the ground contour line of each timber section using a handheld jig saw. The resulting landscape model is shown below.

PLAN VIEW

Scale: 1:4000

ISOMETRIC VIEW

Scale: 1:4000

images: Author's own.

images and model's depicted: Author's own.

NGĀ TAONGA

AN ALLEGORICAL PĀ-RĀKAU FOR ORAL NARRATIVE.

TAONGA ARTEFACTS AND ELEMENTS INFORMING A NEW
ARCHITECTURAL TYPOLOGY

Fig 4.1-4.4 NGĀ TAONGA
image: Te Ara.

This thesis chapter works towards the articulation of a contemporary Muaūpoko treehouse typology. This chapter deals with the need for such an intervention to express itself as a contemporary reinterpretation of the original Pā-Rākau of the Muaūpoko - to tell that important story. It does this in accordance with my aim Toru,

TORU: AN ALLEGORICAL ARCHITECTURE FOR ORAL NARRATIVE.

[Embodying storytelling symbology within an orator's shelter]

- AIM: *To incorporate storytelling design elements into architecture to encourage the telling of oral histories; and to re-imagine the tale of suspended cities through contemporary architectural intervention.*
- OBJECTIVE I: To create a suspended space for intimate cultural gatherings within the remnant trees of an ancient indigenous forest.
- OBJECTIVE II: To create a spatial environment relevant to its cultural context and narrative that could inspire the contemporary practice of an oral narrative.
- OBJECTIVE III: To derive a new typology tree-architecture from the spatial qualities of indigenous trees in order to communicate meaning.

Firstly this chapter briefly introduces the existing architecture of Muaūpoko marae in order to highlight the need for a new typology capable of celebrating the iwi's rich architectural history. This chapter then introduces Māori taonga, artefacts of allegorical narrative, that act as a mnemonic devices to aid in the telling of oral histories. It investigates their symbology and embodied meaning. From the formal qualities of these taonga it begins to derive a new suspended tree architecture, to reinvent the architectural typology of the Muaūpoko. This chapter experiments with form derived from these taonga which leads to spatial conditions that might inspire oral histories to be told within them - and within the context of the Muaūpoko's ancient indigenous forest.

4.1 TAONGA I:

TE WHAI WAWEWAWE A MAUI

A MNEMONIC DEVICE FOR THE ORAL NARRATIVE STORYTELLING

Te Whai Wawewawe a Maui, or simply whai, are complex string pattern games played between the fingers. The origin of te whai is accredited in Māoridom to the atua (god or ancestor) Maui. The forming of the many varied patterns provided amusement during long winter nights, and in former times the game was practised by young and old. The more intricate patterns were taught to the children by the elders, the simpler ones they learned from one another (J. Andersen, 1927).

Figure 4.5 WHAI STRINGS - TANE MAHUTA - ATUA, GOD OF THE FOREST
images: Te Ara - Encyclopedia of New Zealand

This image depicts Tāne Māhuta, god of the forest, during one stage in a Whai string game narrative. The narrative, of which this stage is a part, tells of the separation of Ranginui, sky father, and Papatuanuku, earth mother, resulting in the emergence of the primordial children into the world of light or Te Ao Marama. It is said that Tāne Māhuta, holds back the sky and earth through his great forests (Te Ara 2013).

The different forms were said to represent scenes in mythology, such as Hine-rii-te-po; mother night bringing forth her progeny; Maru and the gods; Maui fishing up the land; Tawhaki ascending to the heavens; the fall of Karihi, and so on. Other shapes represented people, canoes, stars, houses, parts of houses, and so on. Most of the figures were set up by one person; some required two, three, or more to set up the completed figure. Some figures ran in series, one figure proceeding from another (J. Andersen, 1927).

There are waiata, songs, that would accompany the making of some of the figures. These would explain the symbology of the forms created. Some forms allowed specific movements to be shown at the finish. These movements add to the allegory of accompanying storytelling (J. Andersen, 1927).

Attributes that could inform architectural design;

- > Held in Tension
- > Dynamic, changing.
- > Architectural spaces can be perceived between string lines

These attributes of the string forms of Whai informed the string models and sketches that follow.

SKETCH EXPERIMENTS

EXPERIMENT 1: EMBRACING THE CURVES OF TENSILE MEMBRANES

image: Author's own.

Tensile design leads to elegant formal outcomes; the curves that are achieved when tensile wires or membranes come under the force of gravity. The straight line is translated through gravity into a curvilinear line. This leads to formal outcomes more in keeping with the forms of a forest landscape.

EXPERIMENT 2: TE WHAI STRING STRUCTURE SKETCH *Exploring the spatial potential of tensile structure*

image: Author's own.

4.3

LEARNINGS

From these three sketch experiments shown I gained a greater understanding of tensile structure. I began to understand how I might construct an architecture of lightness that incorporates the mnemonic narratives of te whai.

From the physical string model I learnt valuable techniques of continuous string modelling that had influence over the construction method of the Octavia project in Book I, part II.

CRITICAL REFLECTION

This research does not go so far as to accumulate a great understanding of whai forms and the narratives that correspond to their forms. The forms that I have created here strings a part of a sequence of forms that could be understood as a mnemonic pattern for the telling of particular narratives. More simplistically, I have used the formal techniques of whai in order to allude to the practice itself.

The forms that have been created offer many opportunities for architectural spatial environment. I imaged membrane faces between the lines of each sketch and designed the iterations for the shedding of water.

1. Strings arrayed from three points.

2. Central element connects strings and forms a central architectural space.

3. Strings follow the curves of a tensioned membrane material

4. A spatial environment is created within the strings.

EXPERIMENT 3: TENSIONED STRING SKETCHES

images: Author's own.

EXPERIMENT 4: TE WHAI TENSIONED STRING SKETCH MODEL

Tensile string model strung within cardboard box.

4.4 TAONGA II:

HARAKEKE RARANGA FLAX WOVEN ARTEFACTS

Figure 4.6: Harakeke Plant
images: Te Ara

Figure 4.7: Fresh Flax Weaving
images: Te Ara

Figure 4.8: Korowai kiwi, kiwi feather cloak
with harakeke flax woven base. image: Te Ara

Figure 4.9: Tukutuku
image: Te Ara

The harakeke (flax) plant is used a metaphor in Māori culture for the whānau, family. The rito, shoot, is seen as the child. It is protectively surrounded by the awhi rito (parents). The outside leaves represent the tūpuna, grandparents and ancestors (Te Ahukaramū, 2007). Like the family blood line, if the rito (children) are lost the plant will die. Only the awhi rito and tūpuna therefore are traditionally allowed to be harvested. (Te Ahukaramū, 2007). The harvesting of harakeke is done in a ritualistic way. In this author's own experience with harvesting harakeke in ritualistic manner, any leaf matter remaining after harvesting is commonly returned to the soil of the plant as a sign of respect and care.

Figure 4.10 Harakeke Whanau Metaphor
image: Te Ara, artist: Bruce Mahalski

Such was the importance of harakeke for Māori that there existed an Atua, god, of harakeke who's story forms a part of the Māori mythology of the creation of the world. Her name was Pakoti. Pakoti is said to have slept with Tane Mahuta, god of the forest, in order to bring resources to the world (E, Shortland, 1882). One common Māori narrative for the creation of the world, in which the god of Harakeke forms an intricate part, is told in this sequence:

Io Matua and Whaea Rikoriko
Ko Te Ao and Ko Te Po
Ranginui and Papatuanuku
Tane Mahuta and Hine-i-te-repo
Pakoti
Hinerauamoa

- D. Hemana, 2008

First there was Ranginui (male - the Sky God) and Papatuanuku (female - Earth Mother or God - female). When Ranginui and Papatuanuku separated, Te Ao Marama (the world of Light) came. Then came Tane Mahuta (God of the Forests and bush), along with three female gods. Pakoti was once of these Gods. She was the god of Harakeke (flax). Tane had children with the female gods including Pakoti, and from their births were born the world's resources (D. Hemana, 2008).

Figure 4.11: Harakeke Spiral Flower woven
from single leaf.

Figure 4.12: Hinaki - Traditional Harakeke Flax Fibre Fishing Nets
image: Te Papa Online Archives

Harakeke was traditionally vital in the creation architecture, clothing, tools and artworks. Tightly woven flax lined the interior of houses to stop airflow and maintain heat. The Muka, flax fibre was extracted and woven together to very fine and a very strong materials, rope or netting. Harakeke was used to make korowai, cloaks, also. Today harakeke's application remains highly diverse. It continues to be used in tool making, architecture

SKETCH EXPERIMENTS + LEARNINGS

Figure 4.13: Hinaki - Traditional Harakeke Flax Fibre Fishing Nets
image: Te Papa Online Archives

Continuing from the understanding of string forms under tension gained from the the first 'Whai' experiments, here I show further iterative development of a suspended architecture. Here I use the forms of traditional hīnaki harakeke flax fishing nets to form interior spatial environments. I incorporated the circular opening elements of these woven forms in order to test their formal appearance in my design. From these iterations I learnt that circular ring compression elements create interesting spatial environments at their meeting points. These iterations showing the connection of three rings and their out trailing nets form the basis for perhaps the most important formal element of my preliminary design.

CRITICAL REFLECTION

Netting forms used in this way create flat floor areas. Instead the spatial environment inside would be tubular. The area created between the netting is a void, and this area requires greater consideration.

The area between these rings elements is developed further through the study of the last taonga introduced, Te Poi.

EXPERIMENT 1:
TENSILE WOVEN NET ITERATIONS

1. Triangular spaces to match scale of human body at rest.

2. Nets encase triangular spaces

3. Solid rings elements introduced

4. Solid rings come together at centre

images: Author's own.

EXPERIMENT 5:
WOVEN NET SPACES HELD IN TENSION

Incorporating compression ring elements.

images: Author's own.

4.6 TAONGA III:

TE POI

Figure 4.14: Contemporary Te Poi Performance
image: flowartsinstitute.com

Te Poi is a percussive device. It is a lightweight, spherical ball attached to a cord that is spun with the twist of the wrists in combinations of movements, around the hands. Poi are used as visual and rhythmic accompaniments to Māori cultural song and dance performances. Performers might use a single poi or a pair (Te Papa Archives). These devices were used prolifically by pre-European Māori - men, woman and children - in games and physical exercises to sharpen reflexes, increase flexibility and improve coordination (D. Hemana, 2008).

Poi are thought to originated from the ancient “ki”. These were small woven harakeke baskets used to carry a single giant egg of the giant extinct Moa. To ease carrying, two (or more) ki would be joined by a length of plaited flax rope and slung over the shoulders or around the neck (D. Hemana, 2008).

The example shown in figure 4.15 is a very rare type woven in muka fibre with a technique called knot-less netting. It is known as ‘poi awe’, a *powerful poi*. It is adorned with intricate patterns and kuri, dog, hair. (Te Papa Archives).

Attributes that could inform architectural design;

- > Spherical form
- > Dynamic movement spun in tension

Fig. 4.15: TE POI AWE
Origin unknown, circa 1800
image: Te Papa Archives Online

4.7

SKETCH EXPERIMENTS

Tensile structure can be implemented into all scales of a project. Project reviews have suggested tensile structure working from the micro scale of the spider's web - right through to the mega-scale of suspended cities.

The following are working sketches for a the integration of a tensioned spherical framing structure influenced by Māori taonga, Te Poi'. This spherical framing structure forms a solid framework from which tensile cables extend outwards. The design found through this experimentation becomes a crucial central element to the Octavia design of Book I also. The challenge with this element is to create a compression connecting device for the greater tensile building which itself also expresses tension also.

TE KI: SKETCH EXPERIMENT 2
INTERIOR FURNITURE HELD IN TENSION

image: Author's own.

Exploring the practicalities for tensile-supported furniture within the framing structure. Sketches below show a wire suspended table and the possibility for the table surface itself to be made up of a surface of tightly tensioned ropes.

TE KI EXPERIMENT 1:
SPHERICAL FRAME CONSTRUCTED OF FLAT CARDBOARD

Exploring the possibilities of supporting circular forms through flat material

image: Author's own.

TE KI: EXPERIMENT 3:
CIRCULAR ELEMENTS THROUGH TENSION

Hanging spherical forms through tensile ropes

image: Author's own.

TE KI: EXPERIMENT 4:
SKETCHING A COMPOSITION WITHIN THE TREES

Adapting the 'te ki' form for suspension between trees
or placed within a single pollarded tree.

image: Author's own.

CHAPTER CONCLUSIONS

LEARNINGS

From the physical modelling and sketching experiments of this exercise of I learnt that a spherical spatial environment can be created through the curving and connecting of flat rings. In the 'modelling experiment 4' I combined the design developments learnt from the previous analysis of taonga to create a lightweight tensioned model that incorporates the ring elements of harakeke nets, hīanki, and whai strings. In this exercise I begin experimenting with flat ground surfaces and hammock bed platforms. These experiments show that these forms derived from taonga can form stable spatial environments.

Working at this small scale these sketching and modelling experiments offer only an indication of the strength and durability of materials held in tension in this way, and how connection points would be detailed. The void spaces seen around the hammock and the side cables in this model would allow users falling. This aspect needs further design resolution. This issue was not resolving through these experiments. In thesis book I, part II this investigation takes these small scale experiments to a 1:1 scale through the built treehouse project Octavia. With the hindsight of the Octavia construction project this investigation can confirm that the fundamental forms proposed here hold up very well at a 1:1 scale, real world condition.

The 'te ki' spherical framing form derived from these experiments became a principle building element to both the Octavia and Te Pā Rākau design investigations.

CRITICAL REFLECTIONS

The spherical form achieves an abstract formal relationship with 'te poi awe'. It is designed to be held in tension not just from above, as is the poi awe, but from three directions corresponding to each of its circular faces - which were shown in the preliminary design in Book I, part II. The spherical void created in its centre offers another interpretation relevant to the ancient origin of this taonga, 'te ki', the single moa egg carrying basket. The void could be read as the missing single moa egg and the frame its empty basket. In this way the symbology of this building element reaches into both Māori culture as well as speaking to the human-led mas extinction event of Aotearoa.

As well as symbology the design adheres to the other objectives of this investigation. It expresses natural materiality and tension. The 'te ki' element is designed for construction from simple standard laminated plywood sheets. All faces are held in curve by tension. This element provides for an intimate interior space that expresses timber materiality and creates wide apertures to view the outside forest.

'Te ki' is the only major solid part of the design presented thus far. It expresses a weightedness counter to the other building elements and counter to the aim *tahi* of this investigation: creating an architecture of lightness. However, this author feels that this level of solidity for the central element of the building is necessary in order to appreciate the lightness of the tension rope and membrane structure which stretches out from it.

*Exploring circular elements, within tensile string model.
Developing a design for a spherical plywood framed space
made from standard plywood sections*

image: Author's own.

THESIS BOOK II:

TE PĀ RĀKAU

AN ORATOR'S SHELTER IN A REMNANT OF AN ANCIENT FOREST

PART II

I think the first step is to give up this illusion of opposites, of nature versus technology, and see them as being just two ends of a continuous spectrum. Then we can start imaging how we could form new relationships.

— Liam Young, 2015

Dag Anderson writes of the place that the human technology of architecture has within nature, in his interpretation of nineteenth century theorist, John Ruskin's perspective.

Architecture shows [...] more than any other art, how human work is connected to natural forms. Architecture can avoid any endeavour to obtain certain effects because it can be considered 'an essential part of landscape'

- D. Anderson, 2014

Anderson's understanding is in opposition to the commonly accepted ethos of 'wilderness as a place apart from people' (and apart from architecture) introduced by Abbott in Chapter 4 of Book I. Instead this chapter will introduce a built project of allegorical architecture which tells of architecture's place within landscape.

This chapter begins with the introduction of two storytelling narratives that paint an image of what has been lost from the Aotearoa forest environment. Through this narrative it introduces the concept of an anthropomorphic architecture symbolising and telling the narrative of the significant wildlife of Aotearoa forest. It analyses a building project by architect, Santiago Calatrava, to establish protocols for the formal expression of an anthropomorphic architecture of flight.

WHA: ANTHROPOMORPHIC ARCHITECTURE OF FLIGHT

[An allegorical narrative of extinct megafauna told through built form.]

AIM: To create an anthropomorphic architecture that expresses itself as a living part of the forest; and to express, through built form, the narrative of the vibrant wildlife that once existed in this environment.

OBJECTIVE I: To create architectural form that plays with anthropomorphic qualities; to use form, composition, colour, and materiality to blur the boundary between human-made structure and living entity.

OBJECTIVE II: To create an architecture symbolic of flight.

FALL OF ICARUS 1995 BILL HAMMOND

Fig. 5.1
image: Christchurch Art Gallery

BILL HAMMOND

THE FALL OF ICARUS

A MYTHOLOGY OF SITE ENVIRONMENTAL HISTORY

Artist Bill Hammond tells a narrative relevant to the Papaitonga site and this design research. Through his artwork *The Fall of Icarus* Hammond tells another story of Papaitonga: the narrative of the decline of the avifauna from the forests which occurred quickly alongside the human deforestation, mammalian pest introduction, and deliberate hunting in postcolonial Aotearoa. The Fall of Icarus, sets the tone for a history of native habitat loss, extinction, as well as the loss of the Muaūpoko people's land that occurred at Papaitonga.

The artwork depicts the last stand of an ecosystem of abundant bird life at the edge of extinction. The Christchurch Art Gallery describes the painting and its founding in Greek mythological narrative:

In a green, almost primordial, world of dripping forests and smouldering volcanoes, bird-like creatures stand as sentinels, looking out to sea. Sleek and enigmatic, wearing lustrous fabrics rather than feathers, they suggest New Zealand's early history as a land occupied almost solely by birds, before the arrival of humans. The threat posed to the natural environment through use by humans is suggested by Hammond using the Greek legend of Icarus, who flew too close to the sun, melting his wax and feather wings and plunging to his death in the sea.

- Curator's description, Christchurch Art Gallery, 2005

Günther Feuerstein in his book titled *Biomorphic Architecture* writes of the Greek mythological narrative of the Fall of Icarus. He interprets this story of the human flight and its relation to the architectural discipline. He explains that the expression of flight through the built form has long been a desire of architects - that in fact, he says, "*the history of architecture could in fact be told as a fairy-tale of flying*" (G. Feuerstein, 2002. p125).

There is a deeper meaning to be found in the fact that a skilful mythological architect, Daedalus, soars successfully in a flying machine, while his arrogant son Icarus crashes. Since then architects have repeatedly dreamt of flying or rather that their buildings could take off, that they could become immaterial and thus weightless.

- G. Feuerstein, 2002 (p125)

5.2 - PROJECT REVIEW V

SANTIAGO CALATRAVA

GARE DE L'AÉROPORT DE LYON | 1994

Fig. 5.2, 5.3: Santiago Calatrava, Gare de L'aéroport de Lyon

images: Santiago Calatrava Archives

Feuerstein writes of a seemingly weightless architecture and the desire of architects to want to defy gravity and express flight with through their buildings. Feuerstein explains that conceptualising architecture through an expression of flight can lead to elegant outcomes of form. He writes that; “*flying knows no gravity, and so it knows no top and bottom either, nor is it familiar with right angles and rational geometry*” (G. Feuerstein, 2002. p127)

Feuerstein explains that as architecture has rarely achieved this will to fly, the bird has become a popular anthropomorphic metaphor in the form of some of the most elegant contemporary buildings. “[The bird] is the animal that contradicts the basic principal of weight in buildings most intensively.” (G. Feuerstein, 2002. p125).

In contemporary architecture, a formal expression of flight exemplified in the incredible grace and elegance of the work of Santiago Calatrava. The first project review of this thesis investigation is his 1994 building, Gare de L'aéroport de Lyon. This airport train station terminal in Lyon, France, exemplifies an architecture with an expression of a potential for flight.

Fig. 5.4: BIRD SCULPTURE, Santiago Calatrava

image: Santiago Calatrava Project Archives

Describing the building, Feuerstein writes;

Its external appearance strongly suggests an association with taking off, with wings, with flying. The symmetry that Calatrava always prefers reinforces this impression if we place ourselves at the axis of symmetry. Then we can even make out that body of the flying creature, and the enormous wings seems to end of the edge of light, transparent feathers.

- G. Feuerstein | 2002 (p.105)

In *Santiago Calatrava: the Poetics of Movement*, Alexandar Tzonis writes of the work of Calatrava's architecture and the anthropomorphic, the sense of lifelike movement it possesses.

In searching to develop a morphology of movement, [Calatrava] draws dramatic significance from the body's acrobatic action. [...] Gravity-defying gestures – to capture the shape of change and immerse it in a world of flux.

A. Tzonis, 1999

Fig. 5.5: Bird Form Sketches, Santiago Calatrava
images: courtesy Santiago Calatrava archives

Through the gravity defying gestures its two enormous arched 'wings', the building expresses a potential for uplift and movement of a bird poised before flight. The symmetry of the building adds a dimension of life to the building. Calatrava's building offers a precedent for the expression of flight in an architectural intervention for the Papaitonga site. This anthropomorphic architecture expresses, through the form of living entities, a symbolic relationship with the living world.

5.3

SKETCH STUDY AND CRITICAL REFLECTION

SKETCH STUDY 1

Exploring a wing-like architecture produced created through tensile structure

Calatrava uses anthropomorphic forms to give a sense of life to his building. The building, however, does not tell a story specific to its site and cultural context as I aim to in this design investigation. Instead Calatrava's work falls in line with what Christian Norberg-Schulz describes as *Symbolisation* as an approach to architecture in a natural landscape. Symbolisation means "using architecture as translator of the immediate experience of nature into a built medium that might be understood by other cultures and generations." (Norberg-Schulz, 1980).

In the sketch study above I have tried to learn from the symbolic gesture of Calatrava's anthropomorphic architecture of flight. Here I begin to use tensile architecture to create a similar formal outcome with minimal use of solid structure - to create a new architectural element of lightness in line with the design development throughout this thesis Book I and II.

image: Author's own.

CHAPTER 6

A TALE OF TWO SUSPENDED CITIES: TE PĀ RĀKAU

PRELIMINARY DESIGN

A TENSILE ANTHROPOMORPHIC SUPERSTRUCTURE

An Early Design Experiments For A Large-Scale Intervention For Papaitonga

As an parallel development in this thesis investigation, Far from the later commitment to the small scale of a grove of kahikatea trees this early work explores the possibility for a large-scale tensile intervention for the Papaitonga site. An ephemeral tensile intervention was conceived to be supported by raised pylons that would be positioned throughout the wider site.

This exploration of sketches, digital and physical models is draws influence from the anthropomorphic forms of Calatrava and combines it with the tensile superstructures of Takis Zentos. Through this experimentation I derive a tensile expression of flight to be incorporated into the final design development. This preliminary design introduced a large spherical truss structure specific to these large-scale studies.

SKETCH STUDY 1

Exploring a language through tension structure.

image: Author's own

image: Author's own

6.1
DESIGN DEVELOPMENT

image: Author's own

SKETCH STUDY 2
Pilon Structure Supporting netted tensile web forms within

PARALLEL CONCEPT I
Exploring a language through tension structure.

PLAN
SCALE: 1:1000

image: Author's own

PARALLEL CONCEPT I
Exploring a language through tension structure.

PERSPECTIVE VIEW

image: Author's own

6.2

CHAPTER CONCLUSIONS

It is from this concept of a large scale tensile structure within a spherical truss that the tension 'wing' form of this investigation's second developed design is derived.

LEARNINGS

Using line-based digital modelling I was able to derive this form as 'an architecture of lightness', adhering to the aim *Tahi*. Membrane surfaces are shown in this design between tension cables which form a semi-circular anthropomorphic wing-like form between a large circular truss. From this experimentation with anthropomorphic architecture and the expression of flight I derived a formal wing form capable of achieving the objectives of this chapter.

CRITICAL REFLECTION

The wing form that has been derived through this formal experimentation could, on the far more intimate scale of three specific trees, provide an design of metaphorical narrative of for the environmental history of the Papaitonga forest. This form could carry the allegory for the bird life of Aotearoa forests.

On reflection the heavy circular truss frame, to which the wings attach, appears overly engineered and heavy in comparison to the lightweight tensile structure within. This truss would not be necessary if this design is to be applied to far more intimate scale of three trees. The trees themselves will provide the matrix from which the tensile wings can attach.

VIEW FROM BRIDGE PLATFORM
PERSPECTIVE RENDER

DEVELOPED PARALLEL CONCEPT 2
Exploring a language through tension structure.

image: Author's own

THESIS BOOK II:
TE PĀ RĀKAU
AN ORATOR'S SHELTER IN A REMNANT OF AN ANCIENT FOREST

END OF PART I

Part II of thesis Book II shows design development and final design of this design investigation of a tale of two suspended cities.

THESIS BOOK II:

TE PĀ RĀKAU

AN ORATOR'S SHELTER IN A REMNANT OF AN ANCIENT FOREST

PART II

CHAPTER 7

DEVELOPED DESIGN

TE PĀ RĀKAU

This chapter shows an iterative process of developed design and final design that has been lead by the three research questions of this two-tale thesis investigation.

1. Can an architecture of allegorical narrative aid an inhabitant's understanding of indigenous forest - and help foster a culture of custodianship for it?
2. How can architecture express an allegorical narrative to reawaken the tale of a lost or imagined suspended city for two unique cultures on opposite sides of the planet?

How can contemporary architecture encourage the telling of oral narratives, and safeguard the knowledge and understanding communicated through them?

image: Author's own

image: Author's own

7.1:

PRACTICAL DESIGN CONSIDERATIONS

This investigation has placed a lot of emphasis on the formal outcome of the intervention. The reason for this is the need express allegory through architectural form that reads both as being of Māoridom and of nature. As well as the four aims and their objectives that govern this thesis investigation, the hindsight of the Octavia construction project offers the following additional considerations to advance this developed design for the Papaitonga site.

MATERIALITY

Working from the successful prototype of the Octavia treehouse, I developed a contrasting mixture of both humble and natural materials - and bold engineered tensile products for this final design. The material and colour palate of this final design resulted through the following considerations;

- Raw materiality should be expressed.
- Materiality should allude to the palate of Māori artefacts.
- Like the Octavia project it is important that no materials carry a great cost.
- Materiality should express humbleness - and not monetary wealth.
- Materiality should express weightlessness

In this final design I have worked to find a palate of standard affordable materials - and to use them together in a innovative new way. Through such design decision making I want to make the point that the a richness of the Muaūpoko culture stems not from monetary wealth, but rather a wealth in connection and understanding of nature.

FORM AND STRUCTURE

- Formal outcomes must allude to the form of Māori Tāonga artefacts.
- Tensile structure should guide form.
- Structure must be exposed for users to see and understand.
- To adopt the biological principle of symmetry in order that the building might take on an anthropomorphic character.
- The building must be balanced such that it is stable under three points of tensioning. Form should express flight.

CONSTRUCTABILITY

Important in this final design, as per the Octavia treehouse prototype, is its build-ability. This is important in the enabling of community involvement in the project's construction. It is also important to note that the site of the intervention is located 25 minutes walk from the Papaitonga Reserve road access [through a forest walking track].

- Like in the Octavia construction project, all building components are lightweight and small enough such that they are able to be individually carried into the forested site and erected by hand.
- The pine timbers of the suspended platforms; tensile stairway and timber and cable truss are designed to be able to be cut and fashioned by hand or with hand-held tools off site.
- The curved plywood timbers of the spherical meeting space, 'te ki', can be constructed by hand using the same techniques that I laid out in the construction process the prototype.
- The hand-woven harakeke linings of the interior are also foldable and would be woven together into the final shape in-situ. ETFE waterproofing membrane is lightweight and foldable.
- With the help of professional riggers, the tension strap connections would be made to the three host kahikatea trees. After these connections have been made the building components would begin to be attached and elevated into place.

7.2

ITERATIVE DESIGN DEVELOPMENT

'TE WHAI KOROWAI' RAIN SCREEN CLOAK
EAST ELEVATION
SCALE: 1:100

image: Author's own

'TE WHAI KOROWAI' RAIN SCREEN CLOAK
EAST ELEVATION
SCALE: 1:50

image: Author's own

ITERATIONS OF 'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
NORTH ELEVATION
SCALE: 1:50

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
ITERATION 1:

NORTH ELEVATION
SCALE: 1:50

image: Author's own

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
ITERATION 2:

PERSPECTIVE IMAGE
SCALE: 1:50

image: Author's own

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
ITERATION 3

PERSPECTIVE IMAGE
SCALE: 1:50

image: Author's own

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
ITERATION 4

image: Author's own

PERSPECTIVE IMAGE
SCALE: 1:50

image: Author's own

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
ITERATION 4

PLAN
SCALE: 1:25

image: Author's own

'TE KUPENGA RARANGA' INTERIOR WOVEN WALLS
FINAL ITERATION

EAST ELEVATION
SCALE: 1:50

image: Author's own

CHAPTER 8

FINAL DESIGN PRESENTATION

For the 2016 New Zealand Institute of Architects

Student Design Competition

Left: 1:1 Section model of 'te ki' space

Right: 1:25 Model of project, and kahikatea tree sapling.

Fig. 8.1: 2016 New Zealand Institute of Architects Student Design Competition

image: NZIA

scale: 1:250 EXPLODED DIAGRAM

Ko te hunga ka eke ki ngā taumata ahakoa ngā
pōrearea ka whakaritea ki te iti rearea korimako e
eke ana ki te kāuru o te kahikatea.

*Even the smallest of birds, even the Korimako can stand proud
and tall on the mighty shoulders of the Kahikatea tree.*

Whakataukī Māori, (Māori Poverb)

[Keane, 2007]

FINAL DESIGN INTRODUCTION

The vast knowledge that remains in storytelling memory of Muaūpoko elders must be passed down to a new generation if their unique cultural connection to nature is to survive. My design research illustrates that tree architecture, within the context of the ancient forest of Papaitonga could facilitate the passing-down of this knowledge.

Te Pā Rākau is a vehicle for the perpetuation of memory and the retelling of whaikōrero Māori oral histories - and a vehicle for the understanding of the forested world of Aotearoa in which these oral narratives took place.

The allegorical architecture provides a small-scale performance environment within the context of this rare indigenous environment. This shelter represents a remnant of a lost way of life of the Muaūpoko people - and a new chapter in this tale.

8.2

BUILDING DESCRIPTION

Lightweight traditional and modern material elements are held in tension and form wings; suspended timber flooring forms a suspended platform; and suspended in the shelter's centre is the spherical meeting space from which all else is attached and travels outward radially.

WEST ELEVATION
scale: 1:100

image: Author's own

PLAN
[horizontal section cut at 1m from floor platform]

scale: 1:100

image: Author's own

image: Author's own

8.3

1:1 SECTION MODEL OF THE 'TE KI' SPACE

Model demonstrates one of three symmetrical tension strap connection points.

LIMITATIONS OF MODEL

This 1:1 section model produced for this developed design offers only an indication of the structural viability of the tension strap connection of the central spherical 'Te Ki' structure as it as was been tested under full load.

image: Author's own

8.3

1:25 SCALE MODEL

DEMONSTRATING TENSION STRUCTURE

Red string and bamboo model with beach driftwood as representational of Kahikatea Matai Floorboard base landscape.

Laser-cut, steam curved, glued, and needle threaded.

LIMITATIONS OF MODEL

The 1:25 model produced for this developed design offers only an indication of the structural viability of the intervention. The anthropomorphic wing structure is not included in this model.

all images: Author's own

image: Author's own

image: Author's own

image: Author's own

WEST SECTION ELEVATION

scale: 1:50

images: author's own

SECTION PATH THROUGH PLAN

images: Author's own

WEST ELEVATION WIREFRAME
scale: 1:50
Jacob Dench

8.5

COMPOSITION + MATERIALITY

ELEMENT I: TE WHAI KOROWAI STRING FORM CLOAK
TRANSPARENT WEATHERPROOF FILM MEMBRANE

DETAILS:
ETHYLENE TETRAFLUOROETHYLENE (ETFE)
+ ULTRA VIOLET (UV) LIGHT FILTERING.

Te Kākahu, the building cloak is unique in the shelter's design. Te Kākahu (along with the tension straps which hold the building in tension) is the only building element that utilises highly engineered contemporary building products. The 80 percent transparent film, juxtaposes the otherwise naturally occurring materials within,- while protecting them from rain, wind and UV light,

ETFE is a film commonly used as an alternative to structural glass. A single layer membrane is specified for this building element. Te Kākahu provides the suspended shelter with a weatherproof barrier to insure the protection of the shelters precious interior structure, (constructed of more delicate timber and traditional woven fabrics.)

The cloak comprises of 19 ETFE triangular sections which are seamed over a stainless steel cable frame. Stainless steel cables have a diameter of 20mm.

At no instance does this form connect to the suspended building which in envelopes. It is independently connected to the three kahikatea trees via a series of 10 30mm stainless steel cables. These run from the centre of the cloak outwards upwards and downwards and connect at six different heights on the trees trunks. The principle tree, to which the main wing of the form faces, has four of these connection points; each providing connection to two cables.

Fig. 8.2: Rope Attachment
image: Diba Eco Tech

Fig. 8.3: ETFE UV Membrane Material
image: Diba Eco Tech

scale: 1:250 EXPLODED DIAGRAM

ISOMETRIC DRAWING
scale: 1:100

Fig. 4.5 image: Te Ara

COMPOSITION
+ MATERIALITY

ELEMENT 2 : NGĀ KUPENGA RARANGA
TRADITIONALLY WOVEN TUKUTUKU PANNEL WALLING

DETAILS:
HAREKEKE FLAX LEAF

Ngā Kupenga , ‘the nets’ comprise of woven harekeke flax traditionally woven walls that wrap around and envelope the three interior wings of the shelter.

In principle wing of the building, the woven walls are held by tension in a folded pattern held in place by their attachment to two semicircular timber and cable trusses. This produces light and shadow effects reminiscent of traditional Māori tukutuku panels. These nets are suspended in tension, pulled in place by industrially woven, harakeke fibre rope. This rope is dyed bright red and highlights the strong axial perspective of the space. In the two smaller spaces all ropes lead to a single point on their connecting kahikatea trees; in the principle wing ropes splay in the vertical axis outwards to nine connection points along the height of the trunk.

Rendered Building Interior
image author's Own

Fig. 4.7 Freshly woven Harekeke Flax

Fig. 4.9: Tukutuku Panels
images: Te Ara

scale: 1:250 EXPLODED DIAGRAM

ISOMETRIC DRAWING
scale: 1:100

images: author's own

COMPOSITION
+ MATERIALITY

ELEMENT 3: NGĀ WHA HAREKEKE FLAX LEAVES
HINGE-JOINTED TENSION SUSPENDED TIMBER PLATFORMS AND
TENSION STAIR
MATERIAL DETAILS:
+ 12x 2500KG STRENGTH RED TRUCK-TIE DOWNS.
+ 50x100 TIMBER PINUS RADIATA TIMBERS

PLATFORM AND SEMI-CIRFCULAR BENCH FLOOR AREA: 9.89M2

The three taut suspended platforms extrude outwards from the centre, coming to single points as do harakeke flax leaves. It is as these outmost points that connection is made to the kahikatea trees. The two upper wings depicted below are enclosed low sitting spaces. The larger platform below is the floor for a much higher 4.5 metre space. Views outwards face connecting kahikatea trees.

BUILDING PLAN SECTION
scale: 1:100

scale: 1:250 EXPLODED DIAGRAM

Harakeke Leaf Form Precedent
image: author's own

NGĀ TAONGA HOAHOANGA
BUILDING ELEMENTS

3. NGĀ WHĀ HAREKEKE
FLAX LEAVES

THE SUSPENDED TIMBER PLATFORMS
AND SUSPENDED STAIRWAY

ISOMETRIC DRAWING
scale: 1:100

Stair based on that constructed in Octavia built project.
[Here photographed under construction.]
image: author's own

images: author's own

COMPOSITION
+ MATERIALITY

ELEMENT 4: NGĀ PUNGA ANCHORS

HANGING ANCHOR STONE CAIRN

DETAILS:

DRILLED RIVER STONES, ROPE THREADED AND HUNG

“Upon the platform were piled heaps of stones, which could be hurled down upon the enemy when he approached the trees”

- E. Best

Industrially fabricated harakeke flax fibre rope. Dyed red. Rope is tensioned between two connection points to outer weather screen cable system. Knots in the rope maintain the suspended position of the river stones.

This suspended cairn is emblematic of the piled stones documented for use as defence my the Muaūpoko in their pā-rākau. They are the metaphorical anchor stones, floating in a floating structure without connection to the ground plain.

Alternative Design - Single Carved Punga Stone.
1:1 Model - constructed for NZIA Competition.
image/model depicted #?: author's own

Harakeke Fibre Rope
image: Author's own.

scale: 1:250 EXPLODED DIAGRAM

NGĀ TAONGA HOAHOANGA
BUILDING ELEMENTS

4. NGĀ PUNGA
ANCHOR STONES

HANGING CAIRN WEIGHTED BUILDING ELEMENT

Rendered artist's impression
image #?: author's Own

ISOMETRIC DRAWING
scale: 1:100

COMPOSITION
+ MATERIALITY

ELEMENT 5: TE PAEPAE ORATORS PLATFORM
TENSION ROPE SUSPENDED LECTERN

DETAILS:
+ RECYCLED SWAMP-KAURI TIMBER LECTERN AND FOOT
PLATFORM SURFACE: HAND CUT.

+ HARAKEKE FIBRE ROPE INDUSTRIAL 2500KG STRENGTH

Te Paepae lectern is suspended in stable tension at 1100mm from the height of the floor platform below. The lectern is attached at four spread points by harakeke ropes knots. The ropes are hung from a single attachment point to the truss connection above. Below the table two primary ropes connect the lectern in tension to the bottom of the truss structure below. An additional nine support ropes attach directly to the foot platform below. They act to minimise movement of the lectern and enclose the opening of the stairway below.

Te Paepae | Oritor's Platform
Artistic impression Oritor's delivery
image: author's Own

Te Paepae | Oritor's Platform
Isometric showing rope connections.
image: author's own

scale: 1:250 EXPLODED DIAGRAM

NGĀ TAONGA HOAHOANGA
BUILDING ELEMENTS

5. TE PAEPAE ORATORS LECTURN

TENSION SUSPENDED LECTERN.

ISOMETRIC DRAWING
scale: 1:100

THE MOA'S EGG BASKET: CENTRAL SPHERICAL SPACE

3X CURVED LAMENTED PINUS RADIATA PLYWOOD RINGS

RING DIAMETRE: 2400

8x 1.2x3.4M PLYWOOD SHEETS USED FOR EACH RING

12MM THICKNESS EACH

HI.2 TIMBER TREATMENT

SURFACE VANISHED WITH OIL-BASED EXTERIOR VANISH

3X CURVED PLYWOOD TRIANGULAR FLOORING PANELS.

UNDERLAID WITH 50X100 TIMBER FLOORING JOISTS.

PINAS RADIATA

HI.2 TIMBER TREATMENT

SURFACE VANISHED WITH OIL-BASED EXTERIOR VANISH

Te Ki is the central meeting space and heart of the suspended building. With its timber framing, the sculptural form is the most solid of spaces within the shelter, yet it opens in three directions outward into larger enclosed spaces.

Connecting Hanging-Load Point
1:1 Scale Model constructed for NZIA
Competition.

image/design depicted: author's own

View upwards from within Poi Awe.
Design based on construction of
prototype; Octavia treehouse.

image/design depicted: author's own

scale: 1:250 EXPLODED DIAGRAM

NGĀ TAONGA HOAHOANGA
BUILDING ELEMENTS

6. TEKİ

THE MOA'S EGG BASKET.

SUSPENDED SPHERICAL SPACE

AT THE HEART OF THE SHELTER

Design based on construction of
prototype; Octavia treehouse.
[Here photographed during construction]
August 2016.
image/design depicted: author's own

ISOMETRIC DRAWING
scale: 1:50

images: author's own

CONCLUSION

DISCUSSION

In the Horowhenua, Aotearoa and in Terni, Italy there exists today a disconnection between people and the ancient forest environments from which their cultures developed. Deforestation has led in the Horowhenua to the survival of only a tiny remnant forest of a once vast forested land. In Terni, Italy, the trees of the ancient forest exist only in a very different form: they have been pollarded, manipulated through by humankind such that they no longer resemble the trees of the ancient Italian forests to which they are related. In Terni the unique cultural relationship the people had with their forested environment was lost long ago. Today in Aotearoa the Muaūpoko people of the Horowhenua are at risk of losing this cultural relationship also. The oral narratives of the Muaūpoko iwi that keep ancient knowledge of the forest alive are no longer being told. The unique history of a tree architecture of Aotearoa, and the culture that lived within it, is now little known.

This investigation has proposed that architectural intervention may be able to foster a human connection to the remnant trees of lost ancient forests. It has offered two distinct design outcomes that show how a tension suspended tree architecture of lightness might be capable of addressing distinct cultural narratives. An allegorical architecture of embodied storytelling elements has been presented as a means of enhancing architecture narrative.

Through incorporation of the anthropomorphic qualities of trees and the expression of flight through structural elements, the final designs of this investigation communicate the environmental narrative of the ancient forests of Aotearoa and Italy.

image: Author's own

CRITICAL REFLECTION

This design-led thesis has investigated creating an intervention that fosters a human relationship with nature while encouraging the traditional practice of oral narrative storytelling. This has led to the design of two unique suspended spaces that can highlight a physical connection between architecture and living ancient trees.

This investigation has explored ways that a tension suspended tree architecture can coexist in a forested environment without damaging the trees. The design could be applied to other larger scale projects, as explored in the preliminary design section of book II.

The design outcome of the Octavia construction project provides a tenile design framework than can lead to a design of more complex symbology. Te Pā Rākau final design has built upon discoveries from the Octavia project and heightened the portrayal of allegory through the embodiment of storytelling artefacts and the unique programme requirement of oral narration of the Muaūpoko people.

CONCLUSIONS AND RESEARCH LIMITATIONS

This investigation offers users an opportunity to visualise the trees and architecture as one, by presenting them with apertures which frame view shafts to the outside forest. The designs produced through this investigation attempt to demonstrate that architecture might help reconnect people to the roots of their culture while understanding our connection to nature.

The Octavia tree residence demonstrates the objective of being fully suspended in the trees through the successful building prototype Terni, Italy. However, this investigation was not able to test the design of Te Pa Rākau through the same prototype construction process. The two models produced for this developed design offer an informed indication of structural viability. Several important architectural issues in the Terni project were discovered and resolved on-site; likewise, it would be expected that the construction of Te Pa-Rakau would have similar unique variables to address during the construction process. Variables might include: the unique site condition and trees of the design; the design's fully suspended nature; the provision of additional structural elements; and use of traditionally woven material rather than traditional Italian manufactured textiles. A built Te Pā Rākau project would also have a need for longer durability, though ultimately it too is conceived as a temporary intervention designed of natural materials that can return to the earth.

The author hopes to construct Te Pā Rākau in the coming months, as the Octavia design was, and in so doing, the design would undergo the same process of learning-by-doing that informed the design development of Octavia.

Fig. 9.1: Coastal Kahikatea Forest, [as the Horowhenua may once have appeared.]
image: © Oliver Strewe Photography

KI TE KAHORE

Without a remembrance of the past

HE WHAKAKITENGA

or vision of the future

KA NGARO TE IWI

the people will be lost

- Whakatouki
Māori Proverb
(B. Keane, 2017)

CHAPTER 10

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