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Architecture and Textiles
Master Thesis Explanatory Document
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An explanatory document submitted in partial fulfilment of the requirements for the degree of, Master of Architecture (Professional).

ABSTRACT

This proposal develops a design for a textile museum and gallery. The design has been produced as a result of an indepth analysis of textile arts and the information that can be derived from their application in architecture. The research is based upon the theoretical influence that Gottfried Semper specified in his writings on the topic of textiles and their relationship in architecture. The design explores the application of textiles in architecture in various ways; from translating textile inspired structures into tectonic materials, to the incorporation of textile materials with traditional building construction, all with the aim of exploiting textiles and all that they can offer to the development of a New Zealand contemporary architecture.

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1. Introduction

Research Question

How will the use of textile methods and materials influence form, structure and skin?

1.1 Project outline

The project will involve the research and design of an architectural proposal that has been generated from textile arts and their application in architecture. These influences will include historic and theoretical information, contemporary practices and techniques, and exploration through the crafting of design models.

1.2 Research Objectives

- To gain a thorough understanding of the influence that textiles have had in the development of architecture.
- To apply a theoretical and historical understanding of the relationship between architecture and textiles and use this information to inform a local contemporary architecture that makes use of developments in materials and digital technology.
- To understand the structural behaviour of textiles and express this structure tectonically and successfully in a structural system using both conventional building materials and textile materials.
- To demonstrate how the use of textiles in architecture can provide alternatives that are simultaneously sensual and technically charged.
- To design a building that incorporates textiles, landscape (topography of the site) and a contemporary expression of the vernacular of the area.
- To demonstrate possible current and future relationships between textiles and architecture.

1.3 Definitions (Textile Terminology)

In this research project, I look at two textile practices in detail: the knot, which is the basis for the craft of crochet and macrame, and the weave, which is used commonly in other textile crafts such as weaving rugs and fabrics.

Knot Definitions

Gottfried Semper described the knot as being, “the oldest technical symbol and an expression of the earliest cosmogonic ideas, symbolising the primordial chain of being.”¹

‘Knot’ is a common word that has a number of meanings. To define these meanings creates an insight into architectural possibilities;

- Knot: a fastening made by tying a piece of string, rope or something similar.
- A complex and intractable problem.
- A hard mass formed in a tree trunk at the intersection with a branch resulting in a round cross-grained piece in timber when cut through.
- A hard lump of tissue in an animal or human body.
- A tense constricted feeling in the body, e.g stomach full of knots.
- A unit of speed equivalent to one nautical mile per hour, used in ships, aircrafts and winds.

The above definitions contain metaphors of the ‘knot’, and these can be used as a starting point in the design process.

One possible architectural definition is the joining together of systems, the connection of more than one element intersecting with another element. The knot also implies tension when used metaphorically, such as knots in the stomach, or a knot of hard tissue in a muscle. This supports the structural behaviour of the knot, which is always acting in tension, but fails to have any compressive qualities

Weave Definitions

- Weave: Form a fabric item by interlacing long threads passing in one direction with others at a right angle to them.
- Weaving: Make fabric in this way, typically by working at a loom
- Weave something into: include something as an integral part/element of (a woven fabric.)

¹ Mari Hvattum, *Gottfried Semper and the problem of Historicism* (U.K:Cambridge University Press, 2004), p67

Textile Processes: Processes used in the making of textiles, such as weaving, knotting and knitting.

Double Curvature: The ability of a surface to curve in more than one direction.

Crochet: The interlocking of loops from a single thread with a hooked needle. Crocheting can be done either by hand or by machine.

Cartesian Space: Also known as Euclidean Geometry, is derived from two-dimensional planes into three-dimensional space. This produces orthogonal spaces where walls are at right angles to the floor, consists of horizontal planes.

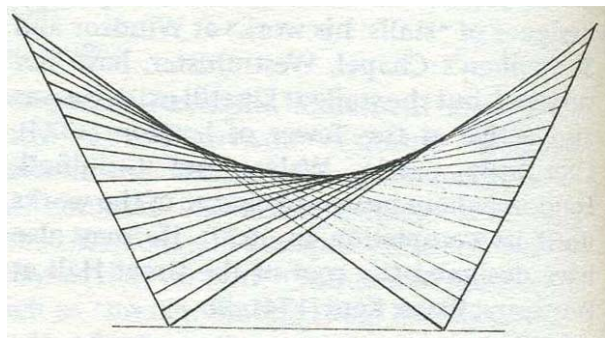
Architextile: a term used to describe the use of textile techniques, materials and ideas in architecture

Contemporary: belonging to or occurring in the present.

Contemporary Textiles: Textile materials that have been developed with the use of new materials and technologies.

Hyperbolic Space: space or structures designed with hyperboloid geometry. Hyperbolic structures have a negative Gaussian curvature, meaning they curve inward rather than being straight. Hyperboloid structures are superior in stability towards outside forces than “straight” buildings.

Hyperbolic Parabola: Continuous flowing double-curved form. Wing-like in elevation, starting from a parabolic arch and progressing to an upside down parabola of similar size. Its geometry, although seemingly complex, is actually very simple, and its construction is largely dependent on straight lines.²



² James Steven Curl, *Oxford dictionary of Architecture*, (UK:Oxford University Press 1999), p 330

³ Ibid, p330

1.4 Justification for research

The design of architecture and the making of textiles encompass many significant theoretical, historical, contemporary, technological and creative aspects. The application of textiles in architecture has enormous potential, from the use of new materials with impressive structural and thermal properties, to the development of advanced technologies that can digitally create and build the complex geometries that textiles may possess.

“[Textiles]... provide protection from heat and cold, absorb noise, and give control of the amount of light entering the view. Their manifold characteristics and application potentials make textiles a highly interesting architectural material. Textiles further possess very special, sensually tangible often poetic aesthetics.”⁴

Within this research area I have investigated architecture and textiles within the New Zealand context and their application in the development of a contemporary vernacular. Maori architecture has been largely neglected as a source of inspiration in the development of contemporary New Zealand architecture. By revisiting our earliest forms of architecture were before the arrival of Western architecture the development of New Zealand's own architectural identity may progress.

Without realising it, New Zealanders are very familiar with “textile architecture” because it surrounds us in our everyday life. Most Kiwi families spend their summers holidaying in tents or in winter use an umbrella to protect themselves from rain. Whether building site protection, awning or festival tent, textile structures fulfill a wide range of functions in our everyday environments.

1.5 Scope and limitations of research project.

-Limitations:

- The way that structure responds in textile lattices depends heavily upon scale, materials, and size of structural members. The actual structural performance of textiles in architecture requires specialist engineering knowledge. My project was limited by a lack of this specialist knowledge as I was unable to test more abstract concepts with regards to performance of the structures at full scale.
- I had limited access to recently developed materials to perform experiments and tests.
- The topic that I have chosen is at the cutting-edge of developments in contemporary architecture. Although I do not possess the high level of technical ability needed to digitally model the complex geometries and understand the woven structural lattices, exploring these structures pushed me to find ways to express my intentions with the knowledge and skills that I do possess.

⁴ Sylvie Krugër, *Textile Architecture*, (Berlin:Jolvis, 2009), p6

2. Methodology

2.1 Introduction

The methodological approach of this project has been a combination of two methods of research and design. The first is the systematic research of theoretical literature, site analysis and program. This method informed the rational requirements such as, spatial requirements, and orientation. Another strand that had greatly impacted my design was the construction of models, particularly textile models to test design decisions and understand the form, structure and skin of my building.

2.2 Primary research questions

This document intends to answer or suggest possible resolutions to the following:

1. Is it possible to use the form of the weave and the knot in both construction and formal qualities in a building?
2. Would the marriage of Maori building methods and contemporary textile materials and techniques create a highly crafted building that references the poetic qualities of the textile and Maori architecture that has a sense of place in Matakana, New Zealand?

2.3 Problem found in the process of answering questions

Structure and construction are the issues most relevant to my project. Because textiles cannot perform under compression loads, many forms that can be produced through knotting and weaving are not structurally viable if actually constructed with textiles. The forms require the textile to be translated into a tectonic material, such as steel tubes or timber or bamboo lattices to be constructed. How does such a structure then successfully reference the original textile and express its quality?

2.4 Method of data collection

-Research (Literature)

A significant body of literature must be critically analysed to understand the impact of textiles on the development of architecture. This body includes a large number of theoretical writings that interpret this impact.

-Model Making

Crafting textile models helps one understand the spaces that knotting and weaving may potentially create. Because these spaces are often very complex- for example characterized by double curvature- model making was especially important in this project.

-Computer Visualisations and Digital Fabrications

Using digital modelling software to model various investigations provided a clearer understanding of the spatial qualities of forms created.

3. Review of current Knowledge

In this section of the document I will discuss the theoretical writings of Gottfried Semper and his analysis of textiles and architecture. I will also discuss the Maori use of textiles and techniques in their early architecture in an effort to uncover the influence that textiles have had on New Zealand architecture. To conclude this section, I reference contemporary architects and practices with examples of contemporary textile architecture.

3.1 Introduction:

The unification of architecture and textiles is not a recent development. The fusion of textiles and architecture, including the processes, techniques and materials involved, has a long and winding, but largely neglected history. Only in recent times have theorists, architects, engineers, textile designers, material scientists and artists⁵ expressed a renewed interest in the possibilities that the combination allows.

3.2 Historical analysis and theory:

The German architect and theorist, Gottfried Semper wrote extensively on the significance of art and architecture. The origins of architecture, according to Semper, did not originate from the primitive hut but from the arts: the first structure, the original “abode of man” required not just structure, but the weave, the knot, the textile and the tangible.

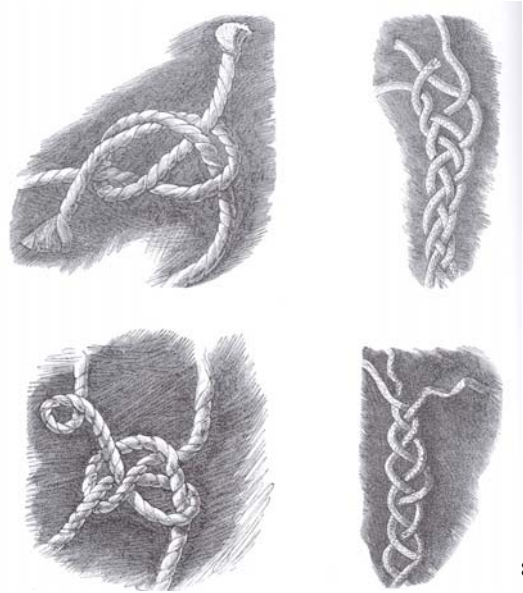
“The primitive hut, then was not the first and ‘natural’ artefact sprung from the unadulterated needs of man, but rather a complex product of a long historical process.” When Semper, despite his criticism, kept returning to the topic of origins, he clearly had in mind something other than the Vitruvian hut. The origins of architecture, he insisted, must be sought not in architectural form itself but in the precondition which shaped it: “the constituent parts of form that are form itself, but the idea, the force, the task and the means”. It was Semper’s lifelong ambition to find and define the ‘constituent parts’ - and he found them, not as archaeological facts but as a creative principle”⁶

Semper explains that through ritual, man captures the creative law of nature. “When seeking the simplest translation of ritual into tangible form, Semper turned to textile art. This was the *Urkunst*, he explained, a primordial embodiment of the ritual act of joining parts into a whole. The **knot** was a privileged example of this: “perhaps the oldest technical symbol and an expression of the earliest cosmogonic ideas,” symbolising “the primordial chain of being.” Being simultaneously a functional technique and a symbolic means of representation, the knot was a mediating figure between the ritual act, the technique of making, and the actual work of art or craft. In time, the motif of the knot

⁵ Mark Garcia, ‘Architecture + Textiles = Architextiles’, *Architectural Design* vol 76 (2006):p6

⁶ Mari Hvattum, *Gottfried Semper and the problem of Historicism*, (U.K:Cambridge University Press, 2004), p65

was developed further in the more complex techniques of the braid, the wreath, the seam, and the weave, all constituting primordial symbols of ordering.⁷



Having identified the original motifs of art, Semper sought to map their development and inclusion in architecture. A key link in this development was the motif of the wall, which he traced back to the technique of weaving. The original enclosure, he argued, was not the solid wall of stone or wood, but rather the primitive fence, woven by branches and grass: “Wickerwork, the original space divider, retained the full importance of its earlier meaning, actually or ideally, when later the light mat walls were transformed into clay tile, brick, or stone walls. Wickerwork was the essence of the wall.”⁹

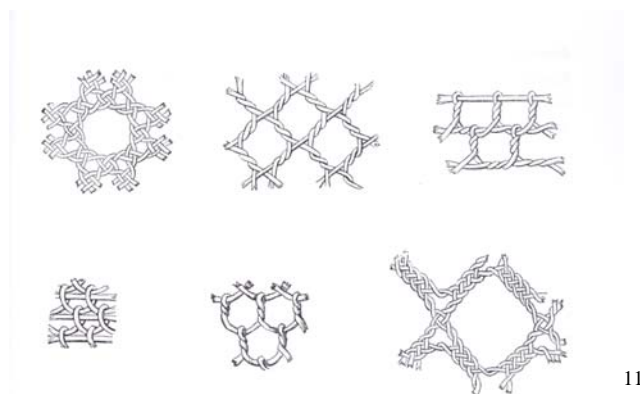
Textile art therefore, itself an imitation of ritual, rhythm, and dance- is the source not only of the practical arts, but also of architecture: “The beginnings of building coincide with those of weaving,” Semper declared. The first volume of *Der Stil* was meant to provide substantial documentation for this assertion. Tracing the motif of enclosure from the primitive fence to textile draperies, Semper found the principle of “Bekleidung” (clothing or dressing) to be intrinsically linked to spatial enclosure, a use that preceded even the clothing of the human body.¹⁰

⁷ Ibid, p67-68

⁸ Ibid, p68

⁹ Ibid, p70

¹⁰ Ibid, p70-71



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In his drawings above of crochet and knitting, Semper clearly illustrates the potential for structural arrangements and space-defining qualities that textile crafts possess. Textile art according to Semper, had a significant influence on the development of architecture. However in contemporary architecture, these historic techniques are very rarely expressed. The majority of contemporary architecture is made of inflexible materials that are very un-textile like in character. Perhaps it is time that we as architects reassess the relevance for textile-inspired structures that can fulfil the growing desire for the non-cartesian space that society has a growing appetite for.

3.3 Semper and Early Maori Architecture

*“The Maori race, dominant in some other fields, had little architectural influence. They have it is true, a native architecture interesting and valuable from a historical point of view, but it served a way of living entirely opposed to the British civilization. Apart from some influence in detailed ornament it could have little effect upon contemporary design”*¹² This was a view shared by many architects and academics in New Zealand. In 1976, Mike Austin in his thesis, *“Polynesian Architecture in New Zealand”*, proved that the Maori did in fact have architecture and were very much aware of their architectural interventions. This was a significant moment in New Zealand’s architectural history, when for the first time, Maori architecture was given its due recognition. I am also attempting to highlight the sophistication of Maori architecture, by focusing on its use of sophisticated textile techniques.

Early Maori architecture supports Semper’s argument regarding the impact of textiles on architecture. Within Maori architecture the architectural elements and features that possess Semperian qualities are the wall, the roof and the plan.

Any analysis of the history of New Zealand architecture must begin with the buildings of the Tangata Whenua, the people of the land. *“The first inhabitants of Aotearoa were groups of Polynesian explorers who discovered and settled these islands in the period*

¹¹ Ibid, p71

¹² Mike Austin, *“Polynesian Architecture in New Zealand”* (Phd diss, University of Auckland, 1976) p10

A.D 800-1000.”¹³ Using the resources available to them the Maori developed an architecture that used textiles and textile methods of construction. Following is a description early Maori architecture made by Jean Roux, an ensign on board the French ship *Mascarin* in 1772.¹⁴

“Among other things their houses prompted our admiration, so skilfully were they made. They were rectangular in shape and varied in size according to need. They were coated on the outside with a layer of moss thick enough to prevent water and wind from getting in and this layer was held up by a well- constructed little lattice. The interior was woven with a matting of sword grass (flax) on which there were at intervals, by way of ornament as well as to support the roof, little poles, or more accurately, planks, two or three inches thick and rather well carved. In the middle of the house there was also a big carved pole which supported the weight of the roof (together with two others at the two ends.) What surprised us still further was that the whole construction was mortised and very strongly bound together with their sword grass ropes, and the houses are roofed with reeds.”¹⁵



This description reveals that the simple textile techniques of the weave, and the knot constitute the joining techniques of structural elements in early Maori architecture. These techniques stood in complete contrast to the building techniques of early European explorers. By 1772, European architecture was highly developed, with the Gothic, Renaissance and Baroque movements having already passed. Yet, the Frenchman, Jean Roux, “admired”, the Maori architecture as “so skilfully was it made.” These skills that the Maori possessed in crafting their architecture, was heavily derived from textile techniques. This type of construction involves a high level of skill and craft that is extremely different to the European techniques of construction.

¹³ Peter Shaw, *New Zealand Architecture, From Polynesian beginnings to 1990*, (Hodder and Stoughton Ltd, Auckland, 1991),p10

¹⁴ Ibid, p10

¹⁵ Ibid, p10-11

¹⁶ Images from Te Papa Museum, Wellington, photographed by student (myself)

The Wall in Maori Architecture

Semper directly refers to the cultures of the “south sea ” (Polynesia and New Zealand) in *Der Stil*. “*Semper outlined the development of the “Bekleidung”(clothing or dressing) motif, starting with the primitive cultures of the south sea, where the woven wall appeared in its original state.*”¹⁷

Sempers writing, states the original enclosure was not the solid wall, but the primitive fence, woven of branches and grass. This fence was a characteristic of early Maori fortified Pa sites, where enclosure and space were defined by woven fences for protection and battle.

*“Building forms and techniques used in Central Polynesia would have had to have been quickly and significantly adapted to suit the cooler climate and new construction materials. Roofs remained thatched, although they may have been lower in height and pitch to retain warmth. Open sided buildings were no longer practical in this environment. It is thought that the practice of using mats and thin vertical stakes to enclose the openings of Pacific buildings was replaced in Aotearoa New Zealand with fixed exterior wall thatching, of the type also used on the roof, as well as lattice wall linings, which were the precursor of later elaborately stitched tukutuku (lattice) panels.”*¹⁸



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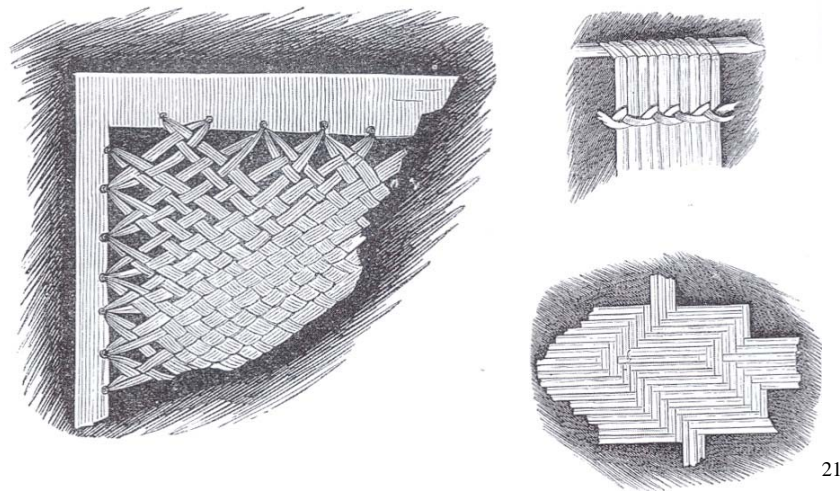
The above image made by Louis de Sainson in 1833, illustrates a Maori village and the adaptation of the Polynesian architecture to a cooler climate.

¹⁷ Mari Hvattum, *Gottfried Semper and the problem of Historicism*, (U.K:Cambridge University Press, 2004)p73

¹⁸ Deidre Brown, *Maori Architecture: from fale to wharenui and beyond* (Auckland:Raupo, 2009)p26

¹⁹ *Ibid*,p31

Semper also explains that the wall, “*springs directly from acts of gathering and enclosing, acts expressed both practically and symbolically in the motifs of the textile arts,*”²⁰ This is evident in Maori architecture, where the exterior deals with weather protection and shelter, but where the interior is layered with symbolic meaning and mythology that is traced through the textiles. The Tukutuku panels, are decorative wall panels that were created by people working in pairs from either side creating intricate and artistic patterns. These panels were not only ornamentation but also were an integral part of the Whare construction as the panels created a warm and insulated decorative wallboard.



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Above is another Der Still illustration of weaving techniques. The similarities with both Maori architecture and arts are astounding, especially considering that Semper did not actually visit New Zealand to make these observations.

²⁰ Ibid, p71

²¹ Ibid, p70

Maori Plan

*“Maori Architecture is structured differently to European architecture, which is based on the grid of squares, rooms and walls. Maori architecture is organised around sheltering roofs and open space. It has taken a long time for the existence, let alone the organization of this architecture to be appreciated, in spite of the frequent assertion of its importance by Maori. It would still be difficult to say that Maori architecture is acknowledged in Aotearoa New Zealand.”*²²

While Maori planning appears simple, typified by the rectangular plan, it displayed an acute understanding of three-dimensional volume. The roof volume, interior and exterior spaces are considered, designed and highlight the sophistication of the Maori as architects. While Maori and European architecture differ in their rationale, Semper highlights spatial and textile similarities between them in his analysis of the early Roman house; *“This building type was in its earliest form characterised by a rectangular plan, and an open, colonnaded atrium. The spaces between the columns were equipped with woven partitions, which subdivided the peristyle into different zones. The partitions had both a functional and a symbolic task, differentiating the space for various domestic purposes while at the same time constituting a symbolic enclosure of the hearth, gathering the family together as a sacred community.”*²³

Both the Whare and the Roman house have a rectangular plan with the porch or the colonnaded atrium at the front of the building. Columns are used in both buildings to support the roof and define the interior spaces. Also, both have strong symbolic representations with the sense of Whanau, or family. This provides evidence of a wider connection of early architecture with textiles.



Takitimu Meeting house

²² Deidre Brown, *Maori Architecture: from fale to wharenui and beyond* (Auckland:Raupo, 2009)p15

²³ Mari Hvattum, *Gottfried Semper and the problem of Historicism*, (U.K:Cambridge University Press, 2004), p72

²⁴ Deidre Brown, *Maori Architecture: from fale to wharenui and beyond* (Auckland:Raupo, 2009)p94

Maori Roof

There is no doubt that the roof is the most significant physical and symbolic element in Maori architecture. The architect Michael Austin has recorded Polynesian ancestral stories that claim houses were upside down vessels and vice versa. The narratives recount a debate as to whether a house or a boat should be built first. He writes;

*“In the Samoan version of the story a house was built first and thus it was that sennit (or coconut fibre) was used in constructing canoes. In a Tongan version of the story it was decided to build the canoe first and when this was done it was turned upside down on poles to provide shelter for the night. In Mangareva (Tuamotu region) there is a story of Rata who rescued his parents by turning his grandparents house roof upside down- using it as a canoe and returning it to use as a roof at night. Certainly the construction methods, the skills and the decorations of the two fundamental artefacts are connected and water and boats affect this architecture in many ways from structure to construction to detail ornament. Sails become floor mats (and vice versa), old boats are used as storage structures, and both buildings and boats are held together by weaving and tying.”*²⁵

In the Whare, the roof is gabled with eaves projecting over the front entrance forming a porch. The ridgepole is the most significant link to the ancestors; it is carved and the Whare is named after the ancestor.

²⁵ Brown, *Maori Architecture*, p 25

3.4 Contemporary analysis and theory, (Architectural Precedents)

*“I am not attracted to straight angles or to the straight line, hard and inflexible, created by man. I am attracted to free-flowing, sensual curves. The curves that I find in the mountains of my country, in the sinousness of its rivers, in the waves of the ocean, and on the body of the beloved woman. Curves make up the entire Universe, the curved Universe of Einstein.”*²⁶ Oscar Niemeyer

In recent times there has been an increased interest in creating architecture that has dynamic curved forms, resulting from advancements in digital technologies that now make it possible to engineer these complex but soft geometries. Structure plays an integral part in textile architecture as the geometries that result are predominantly curved forms. Creating forms that curve and bend in ways different from typical Cartesian buildings means that complex structural systems must be custom designed to achieve the desired architecture. At the cutting edge of these textile structures are internationally renowned architects and designers including, Lars Spuybroek of NOX, Dominique Perrault, Shigeru Ban and the Advanced Geometry Unit (AGU) at Arup.

Lars Spuybroek of Rotterdam based firm, NOX describes his own brand of textile tectonics or ‘soft constructivism,’ in which textile techniques- weaving, bundling, interlacing, braiding, knitting or knotting- effectively build structure through softness and flexibility.²⁷ The interest that NOX has in textiles stems from the in-depth exploration of both Frei Otto and Gottfried Semper. Semper introduced textiles into architecture through the physical realm of engineering and Otto through the symbolic realm of style.

NOX are internationally recognised for their research on the relationship between architecture and computing. Working with computed curves, or splines- has always required a mixture of analogue and digital techniques, as Spuybroek states below, *“One is always pervading the other: textile techniques become computing techniques, surface becomes structure, and structure becomes geometry. It goes beyond a pure transmutation of textile techniques into design techniques; it is, a completely ‘textile way of thinking’ in architecture.”*²⁸ Textile architecture is not just a surface/ skin proposition, but a structural one.

NOX also highlights the way in which ‘architextile’ may be defined. Architextiles may function at the purely aesthetic level, (undulating surfaces), or at the structural level, (weaving and braiding of steel members) or at the methodological level, (using techniques ‘instead of ideas’ to generate architectural form.)²⁹

²⁶ Oscar Niemeyer, *“The curves of Time, the memoirs of Oscar Niemeyer”*, (London Phaidon Press Ltd, 2000), p3

²⁷ Maria Ludovica Tramontin, “Textile Tectonics, an interview with Lars Spuybroek.” *Architectural Design Architextiles vol 76* (2006): p52

²⁸ Ibid, p53

²⁹ Maria Ludovica Tramontin, “Textile Tectonics, an interview with Lars Spuybroek.” *Architectural Design Architextiles vol 76* (2006): p53



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In NOX Maison Folies Cultural complex in Lille (2001-2004), the spectacular glimmering façade is an eulogy to Semper's *Bekleidungsprinzip* a supple ornate surface draped over a tectonic volume.



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Using digital techniques for NOX later projects such as the Jalisco Library, in Guadalajara Mexico we find a fully Semperian notion of textile becoming architectural style.

Spuybroek's reference to Semperian 'textile tectonics' refers to Semper's adoration of the textile and his four elements of architecture: earth for the foundation, wood for construction, textile for enclosure and fire for climate.

*"It's such a beautiful way of ordering, from heavy to light, not being a pure materialism of built forms, but more like the Greek, earth, water, air and fire. The constituent elements that make up all the other materials and life forms."*³²

³⁰ www.nox-art-architecture.com

³¹ Maria Ludovica Tramontin, "Textile Tectonics, an interview with Lars Spuybroek." *Architectural Design Architextiles* vol 76 (2006): p53

³² *Ibid*, p53

Another architect that has advanced the research into contemporary applications of architecture and textiles is Paris based architect, Dominique Perrault. Perrault is famous for his explicit and extensive textile-based architectural urban designs. For more than 16 years he has been researching the relationship between textiles and architecture as part of his broader project on the contemporary city.

*“The qualities of textiles for Dominique Perrault ‘represent a real expansion of the feeling of architecture’. Through the application of highly innovative meshes, Perrault has realised ‘synthetic landscapes’ that introduce an entirely new type of public space. Ultimately, Perraults vision is to apply textiles to a more democratic, human and pleasurable type of urban space”.*³³

Perraults first architextile scheme was his competition entry for the new Bibliotheque Nationale in Paris, which propelled his textile-based approach onto the international scene. Since then, his research has explored the structural, functional, emotive and atmospheric effects of textile-based architecture. In comparison to Spuybroek, Perrault is more concerned with spatial potential of textile meshes than with ‘tectonic textiles’. Perrault works are described in phenomenological terms, referring to fleeting effects and to ‘speed’, liquidity’, ‘softness’ and other characteristics of textiles in space.³⁴ *“The excitement, for Perrault, is in the use of the mesh to protect people with the architecture and to encourage them to reconsider their use and sense of the city, ‘to stop and experience another ambience, another quality. It’s neither in nor out, it’s more subtle than that. It’s an emotional attitude”.*³⁵



³³ Mark Garcia, “Impending Landscapes of the Architextile City, An interview with Dominique Perrault”, *Architectural Design Architextiles* vol 76(2006):p28

³⁴ Ibid, p29

³⁵ Ibid, p30

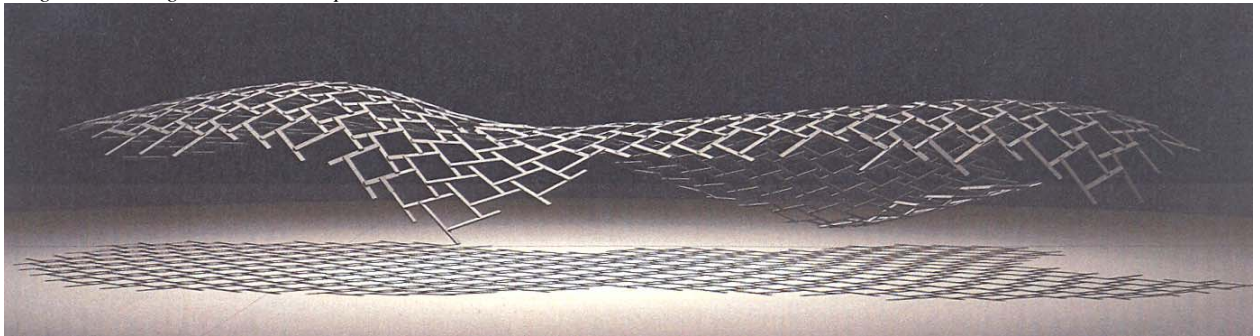
³⁶ Ibid,p30

Timber Fabric:

Contemporary architextile techniques make use of woven or knotted structures. Research into such structures has been led by the Advanced Geometry Unit (AGU) at Arup, founded by Cecil Balmond and Charles Walker. The AGU's work is characterized by a highly mathematical, topological approach, as is evidenced by their research into knot diagrams. AGU has also studied the topology of the weave and its application to large scale structural systems. This technique called, macroweaving is the discrete bending or compression of shell elements, rather than the microweaving of fabrics to form tension-only surfaces.³⁷

Several of AGU's projects use materials that do not easily bend, such as wood planks and bamboo, (to weave curved surface). These projects use different structural arrangements, such as reciprocal beams, to allow compression, tension and a degree of bending, and to mix synclastic, (having a curvature at a given point and in a particular direction that is of the same sign as the curvature at that point in a perpendicular direction) and anticlastic, (having a curvature at a given point and in a particular direction, that is of the opposite sign to the curvature at that point in a perpendicular direction). Examples of this include The Forest Park pavilion, St Louis, Missouri 2005, by Shigeru Ban and Arup AGU which employs a reciprocal timber roof. Another example is the Serpentine Pavilion by Alvaro Siza and Eduardo Souto de Moura with Cecil Balmond.

Image below: Shigeru Ban and Arup AGU, Forest Park Pavilion, St Louis, Missouri, 2005



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³⁷ Tristan Simmonds, Martin Self and Daniel Bosia, "Woven Surface and Form." *Architectural Design Architextiles* vol 76 (2006):p87

³⁸ *Ibid*, p86

3.5 Structural Analysis of Textiles and Architecture: (Tectonic Textiles)

The structural complexity of many contemporary architextile buildings requires closer collaboration between architect and engineer. It is the perfect marrying of the arts and science. *“A new model in architectural production is resulted in which architects and engineers work together in a higher level of collaboration. The structural engineer is no longer the fixer brought in during the late design stage to make a design work, but integral to the earliest generative stages. Design is no longer wholly dictated by form with structure following behind; structure becomes integral to form-finding.”*³⁹

Digital technologies have greatly assisted in the development and the resolution of the textile-inspired architectural forms. *“With the onset of digital technologies, existing parameters have shifted. The old order of standardised design and its established processes no longer hold sway; contemporary architectural design can now be characterised by irregularity, and an appetite for producing customised non-standard, complex curvilinear forms.”*⁴⁰

A very recent project that has broken technological boundaries and really pushed the notion of ‘woven architecture’ is the Spanish Pavillion at the Shanghai Expo 2010. The pavilion is a complex basket-like structure woven from lightweight steel and wicker. It is the result of a unique collaboration between architects EMBT (Enric Miralles and Benedetta Tagliabue) and MC2 Structural engineers. *“Its complex geometry and light weight “virtual volume” generated by a steel framework and a wicker covering creates a fresh interpretation of the concept of the pavilion. Its objectives were to blend the primordial craft quality of weaving with the networks structure, non-linearity and complex spatial vision of the future. Thus on ‘weaving architecture’ became a motif of this project that also seeks to weave the past into an architectural vision of the future.”*⁴¹



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³⁹ Julio Martinez Calzón, Carlos Castañón Jiménez, “Weaving Architecture structuring the Spanish Pavilion, Expo 2010” *Architectural Design, The New Structuralism vol 206* (2010) p:52

⁴⁰ Ibid, p52

⁴¹ AD Magazine, “The New Structuralism” July/August 2010, Issue 206, p55

⁴² Ibid, p59

Computer software was essential in the development of the Spanish Pavilion. The form was first devised as geometric NURBS (non-uniform rational B-splines) surfaces in Rhino software, then surfaces were cut by vertical and horizontal planes which resulted in curves that defined the axis of the corresponding structural tubes. *“Current interest in the structural properties of complex meshes led to the search for means to accommodate new techniques in a mesh structure of such a high level of formal complexity. Woven architecture became a prerogative for weaving structure.”*⁴³

Future Fabrics

The Spanish Pavilion it clearly illustrates the possibilities to build complex structural systems. The other area that must be acknowledged in the use of textiles in architecture is the recent developments in textile technology. As Matilda Mc Quaid states, *“In the last century there have been extraordinary advancements in materials used in textile making that have had, and will continue to have, an enormous impact on architecture.”*⁴⁴

The architectural potential of recently developed fabrics is mainly limited not by choice, but by available design techniques. There is great potential in the combination of multiple materials to form bespoke architectural ‘fabric’ that delivers structural strength, stiffness, weather proofing, insulation, power, heat and light to exactly where it is required. Another material that offers enormous potential is rope. *“Ropes made from synthetic fibres as aramids, high-modulus polyethylene and vectran have a diameter similar to steel wire, but at one-tenth its weight. They have break loads that exceed 1.8 million kilograms (4 million pounds), and may one day hurl satellites into deep orbit.”*⁴⁵ These extremely strong composite ropes, used by the marine, industrial and military industries, have amazing architectural potential. The flexibility of rope creates increased potential for the use and expression of tension in architectural structures.

⁴³ Ibid, p55

⁴⁴ Matilda McQuaid, "Tectonics and Textiles". *Architectural Design Architextiles* vol 76(2006):p99

⁴⁵ Ibid, 99

“As architects begin to explore alternative construction materials such as carbon fibre and other advanced composites, more architectural possibilities will emerge in terms of form, process and maintenance. The combination of innovative thinking, problem solving and reimagining the external surface of a building led Testa and Weiser to seriously study the potential of actually weaving a building. The technology exists, and it will take only one client to shift the carbon tower to the realm of reality. The future of design lies with these models of innovation as textiles push boundaries, eliminate borders between traditional disciplines and continue to be a foundation of our physical world.”⁴⁶

Testa and Weiser’s 2004 Carbon tower design constitutes one of the most ambitious examples of a contemporary fusing of textiles and architecture. The carbon tower is a 40-storey office building constructed from carbon fibre and composite materials. The structure is woven together, rather than assembled from a series of distinct parts, as in traditional construction methods, and has a double façade of transparent and translucent membranes. The structure is made up of 40 helical bands of carbon fibre each hundreds of feet long and winding in two directions around the cylindrical volume. Instead of a rigid internal core and a series of columns for stability, the thin bands run continuously from the bottom to the top of the building and take the entire compressive load. The 40 floor plates, each 38 metres in diameter, are tied in to the external structure, acting in tension. The floors prevent the helix from collapsing while the helix supports the floor. Quite remarkably, a network of sensors monitoring the integrity of all structural members is woven into the matrix of the building. The bands comprising the helix are constructed by robotic devices working in tandem. The robots weave simultaneously, moving up the steadily rising building floor by floor.⁴⁷



This project, although still unbuilt, has solved major problems in the use of textiles in architecture and has made ‘weaving a building’ a potential reality.

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⁴⁶ Matilda McQuaid, “Tectonics and Textiles”. *Architectural Design Architextiles* vol 76(2006):p101

⁴⁷ Ibid,p101

⁴⁸ Ibid,p101

Knot Structure

Because the knot acts purely in tension, it is almost impossible to design a building composed solely of knots. This structural understanding helped significantly in clarifying my design process. Earlier crochet models, (see design process) supported both tension and compression loads: hyperbolic curve models supported themselves (compression) and maintained their form (tension). However these models were knotted together using thin cotton at a small scale. Once the building was studied at 1:1 the cotton thread has to be translated into a tectonic material, such as the steel tube used in the Spanish Pavilion and create a grid structure where each structural member is woven into the entire lattice.⁴⁹

3.6 Conclusion of Literature Review

I have drawn two conclusions regarding the cross- fertilisation of architecture and textiles: The first application of textiles in architecture, is using textiles as building materials. Textile meshes, and tensile membranes in architecture provide sensual qualities of space that only textiles can offer, their ability to control light, be semi-transparent, flexible and create a ‘soft’ architecture, as evidenced in Perrault’s architecture. The second way in which textiles inform a contemporary architecture is the translation of textile geometries, techniques and forms into tectonic materials. For example, my crocheted models cannot be constructed out of textiles at a large scale. Through digital means these complex curved forms can be translated into tectonic form. This is evident in the work produced by AGU Arup, Shigeru Ban and Lars Spuybroek.

I am interested in both Perrault and Spuybroek, and their techniques of expressing the architextile. The two different methods of expression offer qualities to my project that will strengthen the connection to the textile. Using textile materials and translating textile geometries into tectonic forms the project engages with textiles on many different levels.

⁴⁹ (2nd June: Meeting with Unitec professor Regan Potangaroa, Engineer)

4. Project Development

4.1 Site History (See appendix A for more information from site analysis)

My site is located in Matakana, a growing town less than one-hour North of Auckland. Matakana is located in the Rodney District, which is the fastest growing region in the North Island. This growth is largely due to the new Northern Motorway decreasing travel time to Auckland, and encouraging more permanent residents in Omaha, Point Wells, and Matakana.

Matakana has become a popular destination for both tourists and Aucklanders wanting to enjoy a day in the country. With a strong arts community along with many successful vineyards and the world famous farmers market, the area continues to grow. Founded in 1862, Matakana was an early trading port, with one of New Zealand's first water-powered sawmills supplying timber to local shipwrights. Today, the tourist trade is based on natural attractions and man-made attractions, both of which provide 'a day in the country experience'. My project consists of a textile museum and gallery for Matakana that will attract more visitors to the area and encourage the preservation and growth of the textile arts.

The balance between new development and preserving natural qualities of the area, is essential to the tourism industry. The village is evolving into a strong tourist centre, and a strong local centre.⁵⁰ The scale of which Matakana develops depends largely on whether the Matakana markets create a stronger focus on a week-round and year-round basis for tourists.



Map showing location of Matakana and its relation to the growing coastal centres, Omaha and Point Wells.

Figure 4.1.1

⁵⁰ Rodney District Council, *Sustainable Development Plan* (2006), p6

4.2 Maori Settlement and Architecture in Matakana

Matakana and its surrounding coastal areas are rich in Maori history with the tribe Ngati Manuhiri occupation of the area tracing back over 600 years, to before the coming of Toi.⁵¹ The well known ancestor of the Mahurangi people, Maki, conquered the islands of the Hauraki Gulf north to Hauturu (Little Barrier Island), the Kaipara district north of the harbour entrance, as well as the east coast from Takapuna to Te Arai. The ancestors of the son's of Maki held rights to the east coast as Ngati Manuhiri. Ngati Manuhiri held ahi kaa (exclusive rights) in the area of the coast of the main ridge extending from Paepae o Tu (Bream Head) to Matakana. Manuhiri maintain ahi kaa in the area today.⁵²

Ngati Manuhiri also seasonally occupied the Tawharanui Peninsula, located 10 kilometres east from Matakana. Archaeological and traditional evidence indicates intensive settlements at Tawharanui for both food storage and Pa settlements. At Tawharanui, immediately above the outlet of the Mangatatawhiri stream is an extensive defended settlement site known as 'Pa -hi', or the 'lofty fortified settlement'. The Pa extends for nearly half a kilometre along the ridge and includes a minimum of 24 terraces and 15 pits. It is defended at its eastern extremity by two transverse ditches each 60 metres in length. Above the western end of the bay is another major defended settlement site that contains at least 25 terraces and 31 pits and is defended by a double ditch at its Western extremity.⁵³ These Pa sites illustrate the extraordinary ability of the Ngati Manuhiri to excavate the landscape through manual labour and their intense desire to protect the land.

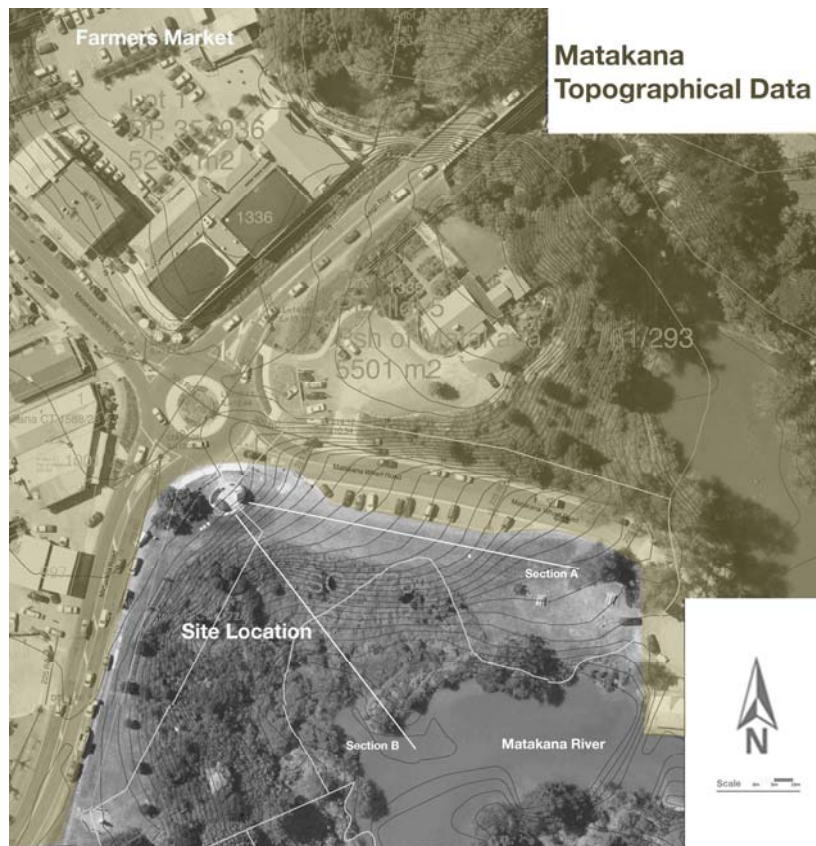
4.3 Site features

My site in Matakana has a strong connection with the landscape and it is important that my architecture reinforces this connection. The Matakana area is typified by several landscape features important in maintaining the identity and character of the area. Surrounded by large ridgelines to the West, North and East, Matakana's landscape is dominated by views of these features. The Matakana River, (which runs through my site) is largely ignored and to restore and reconnect the village with its initial heritage would be of great gain to the village of Matakana. The river was in fact responsible for the creation of Matakana, connecting it to the sea and establishing Matakana as a Market town, which it continues to grow as today. Barely visible from street level the site slopes down towards the Matakana River. This makes possible an architectural journey passing through the site like the action of a knot to the river below. An important aspect of the site is its close proximity to the already established Matakana markets, which are located adjacent to the river, to the North, this already has a popular reputation with tourists and through pedestrian connections adjacent to the river visitors can be led between the two attractions.

⁵¹ Rodney District Council, *Sustainable Development Plan* (2006), p72

⁵² Ibid, p72

⁵³ Auckland Regional Council, *Maori History: Tawharanui Regional Park Management Plan* (1992), p2



Dominique Perrault speaks of the connection that textile architecture can have with the site; *“My strategy or concern is how to link the disposition of a volume in space with its context. I manage the presence of the context around the building, with another element. This element has become the fabric. With this flexible, supple material, this tissue, it is possible to develop, around a very functional box, a special in-between space that also connects the box to the geography of the site. I have been interested in the Land/Art approach because I am constantly investigation new relationships between architecture and landscape.”*⁵⁴ As part of my design the textile material will engage directly with the contours of the site, not only for aesthetic and spatial reasons, but also for structural requirements. The site is the surface that the textile roof is connected to, keeping the roof in tension.

⁵⁴ Mark Garcia, “Impending Landscapes of the Architextile City, An interview with Dominique Perrault”, *Architectural Design Architextiles* vol 76(2006):p29

4.4 Brief Development:

Introduction:

Textiles are an integral part of New Zealand's history. They are present in our earliest architecture, and are used daily in our marine industry. They also constitute the basis of one of our most successful industries- the wool industry which has led to the development of internationally renowned fashion and textile labels. New Zealand is also home to many textile artists, and the world famous wearable arts show. The museum and gallery intends to recognise, exhibit, educate, and encourage this significant part of our culture.

The brief/ Programme

The Museum is made up of permanent collections:

-Early Maori textiles and costume	Area = 90sqm
-Early Colonial New Zealand textile crafts	Area = 70sqm
-New Zealand Wool industry	Area = 70sqm
-New Zealand Wearable Arts	Area= 60sqm
-New Zealand Fashion	Area = 60sqm

Total Area= 350sqm

-The Contemporary Gallery will have rotating exhibitions of various artists and designers

Total Area = 250sqm

- Other Programmatic Spaces:

Workshop Rooms	Area= 80sqm
Shop	Area=40sqm
Café	Area=30sqm
Toilets	Area= 40sqm
Circulation	Area= 80sqm
Outdoor Space	Area =200sqm

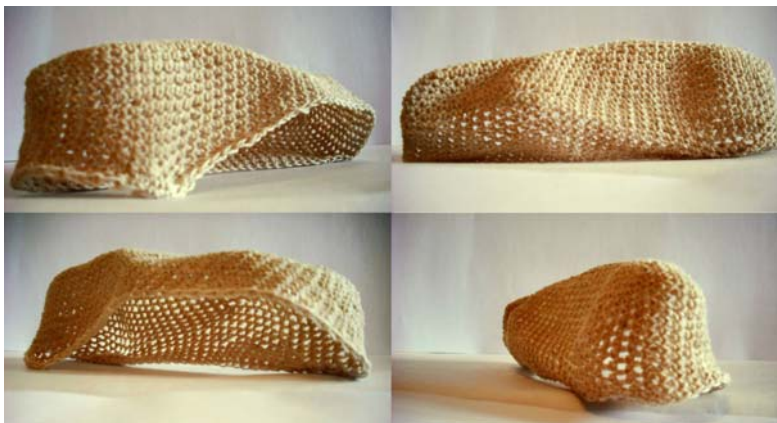
Total Area = 470sqm

Combined total area = 1070 sqm

4.5 Design process *(See Appendix B for extra documentation from the design process.)*

The design process involved with architecture and textiles is unlike the design process where conventional building materials, methods and forms are used. The essential part in my process was the determination of the form. In this case, it was an intuitive process searching for form through making and crafting. Also, the determination of the form depends largely on the type of textile construction desired; for example the design intention may be to translate the textile-generated form into tectonic materials in a lattice arrangement using, timber, steel or bamboo. Or, the design intention may be to use a textile expression of construction and materials with the use of textile meshes, membranes and materials. Throughout my design process I wanted to incorporate both of the above options. This was a ‘collage’ approach, of form within form, and ideas within ideas, but insisting on both expressions has given my design strength and credibility.

Stage one of my design process began with crochet model making, researching literature texts, analysing the site and drawing conceptual diagrams. Crochet has several characteristics that give it architectural potential. The first is the structure. Crochet is a craft that is made up of hundreds of knots, which are constructed using a crochet hook and twine or wool. It is continuous construction where there is an infinite thread that continues to be passed through the chains and stitches, row upon row. (This is what gives crochet its compressive and tensile structural potential and its space and form making properties.



Images are of an early crocheted exploration model. Created using a basket pattern, which creates space and form. Once the model was completed, I applied a thin layer of resin to make the construction rigid.

*Figure 4.7. 1
Concept Model 1*

From this model I was able to derive the following information with the respect to formal, structural and spatial qualities:

- **1: Materiality:** The use of thin cotton gives high density of the structural members allowing minimal light to penetrate the form. The only part where you can see into the form is where the model curves allowing the holes to be pulled apart in tension opening their aperture.
- **2: Scale:** The model creates the form, but does not provide an appropriate method of construction. This model cannot be constructed at 1:1 scale out of textiles in this example. The reason for this is at the small scale of the model it is possible as the thin cotton is coated with a layer of resin, thus making it rigid and preventing movement in the knots, causing them to become stiff acting in compression.
- **3: Formula/Pattern:** The form was derived by following a basket pattern. The way that this pattern creates space is that it continues to increase the amount of stitches producing more material around each end of the starting chain, thus making it curve at each end, resembling a basket.
- **4: Translation into tectonic materials:** This model can be translated into a lattice, possible options are timber, steel or bamboo.



Figure 4.7.2 Concept Drawing of Basket Woven form on site section B

In the next model I experimented with light and density of material by using stitches with varying apertures and a bigger crochet hook, with thicker twine to create a looser weave that allows more light penetration.



Figure 4.7.3
Concept Model 2

As the model illustrates, the thicker twine used gives the construction a heavier surface. It also allows more light through the construction with the stitches starting dense at the beginning chain of the model which is located along the top of the 'roof' and becoming more open as the model touches the ground. It also allows more light through the open portion of the structure at the end of the chain, (near the edge).

The next model in the design phase was crafted using hyperbolic crochet. For a long time people thought that hyperbolic space was just some mathematical abstraction. We now know that there are many things in nature that exhibit this geometry; lettuce leaves, kelp, coral and various kinds of sea creatures, sea slugs, flat worms, and nudibranchs.

In 1997, Daina Taimina, a mathematician at Cornell University, made the first useable physical model of the hyperbolic - a feat many mathematicians had believed was impossible - using, of all things, crochet.



Figure 4.7.3 Concept Model 3

The adjacent models I crafted following a hyperbolic crochet pattern. This structure is different to the basket pattern in that the number of stitches is always increasing according to a simple mathematical formula.

The significant surplus of material that results causes it to curve. The curves become the structure on which the form rests. The spaces produced by this method of construction are dynamic and light: they in theory rest on a single point, providing a unique spatial experience. However, they lack the sense of enclosure that is required for the programmatic functions of the textile museum.

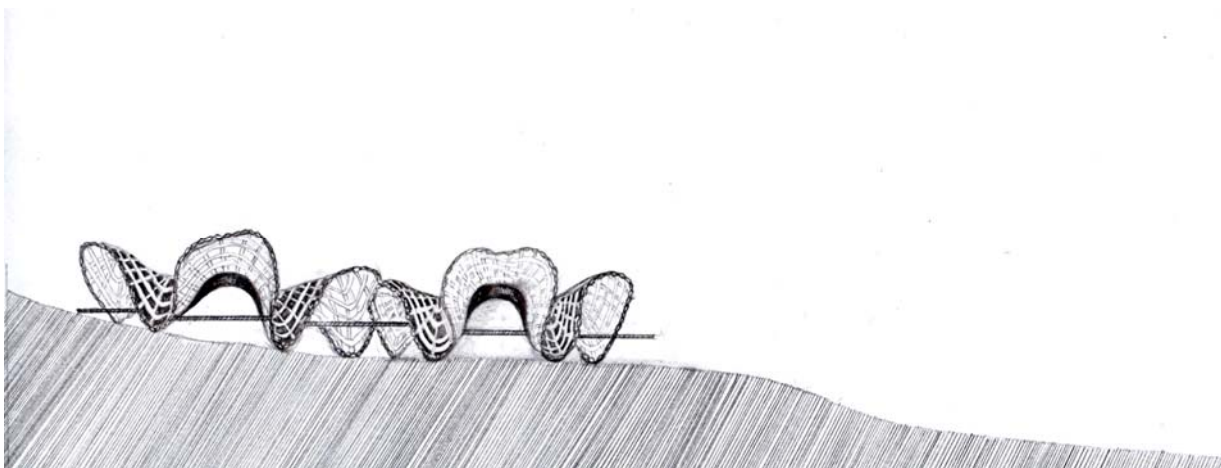


Figure 4.7.4 Concept drawing of Hyperbolic Forms on site section A

Finally in this design phase I was interested in zooming in on the structural element that composes many textile crafts, including crochet; the single knot. I was also interested in occupation of the knot itself. I explored digital means of form finding using knots generated in three-dimensional computer software.

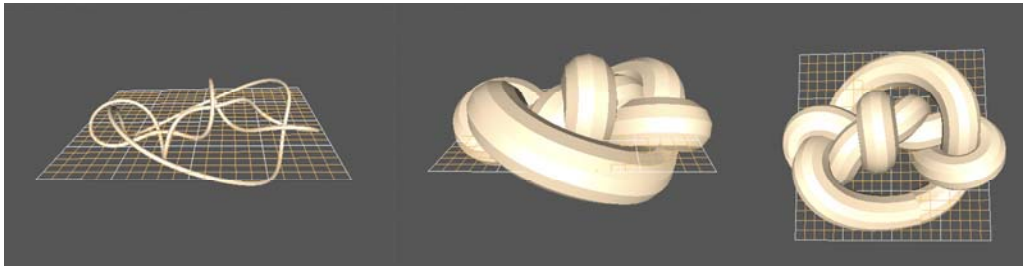


Figure 4.7.5 *Concept Model 4, computer generated*

The above demonstrates an investigation into the thickness of the knot's strands. On the left hand side, the strand that makes up the knot is thin, providing occupiable space between the strands. The image next to it on the right is the same knot, however the strand has been significantly thickened suggesting potential occupation of the strand itself. The above form can be comprehended at various scales, including the scale of a building. Also what I also find very interesting in this investigation is the scale model of an architectural joint, the knot. The spatial properties are continuous, which is what makes textiles very unique in architecture as continuous forms, spaces and construction are rarely investigated.

Conclusion of design process one:

In this initial design phase I exposed significant structural, spatial, material and formal issues inherent in the fusion of architecture and textiles. While the models were essentially form-finding exercises, they also suggest the qualities of interior spaces. They were not, however, particularly useful in suggesting a form specific to New Zealand history and culture. Each model had its own strengths, the basket model created useable space and had control of light variations. The hyperbolic created an open, flowing space that blurred the interior and exterior boundaries. Lastly, the knot model enclosed space successfully creating an internal closed off environment. Within these models there still needs to be adaptations to solve structural issues, this was explored in the second design phase.

4.8 Design Process Part Two:

The first design process produced some very interesting propositions but through the research process it became apparent that a structure that is completely woven or knotted requires an incredible amount of material and technology. My initial models were therefore adapted to incorporate a portal frame that carries compression loads. The bracing and tension structure expressed textile qualities.



Figure 4.8.1 Digitally laser cut portal frames

The image shows one possible portal frame arrangement. In this particular example the idea of knotting the frames together is explored through the lateral beams crossing through each other.



Figure 4.8.2 Digitally modelled design proposition

This adjacent illustrates the portal frame structure on site with the woven lattice providing tension bracing and creating a woven interior inspired by Maori architecture and Sempers writings.

Through my research into early Maori architecture, I attempted to understand the principles behind early forms of Maori architecture and express these ideas in a contemporary manner. I wanted to revive the elements that were significant in Maori architecture such as rectangular planning, emphasis on the roof and the interior volume, ornate interiors, crafted structure and carefully designed exterior spaces. While this design investigation resolved some issues it did not push the textile surface with respect to curvature and flexibility, far enough.



Figure 4.8.3 Concept model of next design iteration

This led me to the next design iteration that also incorporated a portal frame. In this instance the frame creates a 'portal thread', like a crochet hook or knitting needle left in the textile, giving it form, shape and primary structure.

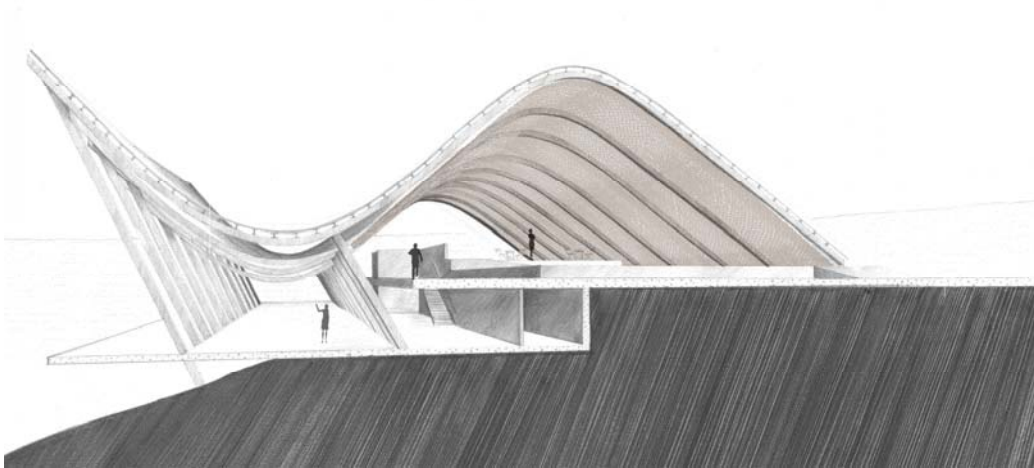


Figure 4.8.4 Perspective Drawing showing portal thread arrangements and the resulting gallery and exhibition spaces .

In this design I increased the number of portal threads to give a sense of rhythm similar to a textile, which has row upon row of pattern and structure. I also changed the curves of the portal threads to bring the textile roof closer to the occupants. It still exhibits the qualities of Maori architecture, the ornate woven interior and the emphasis on the roof volume, with the planning following simple rectangular planning.

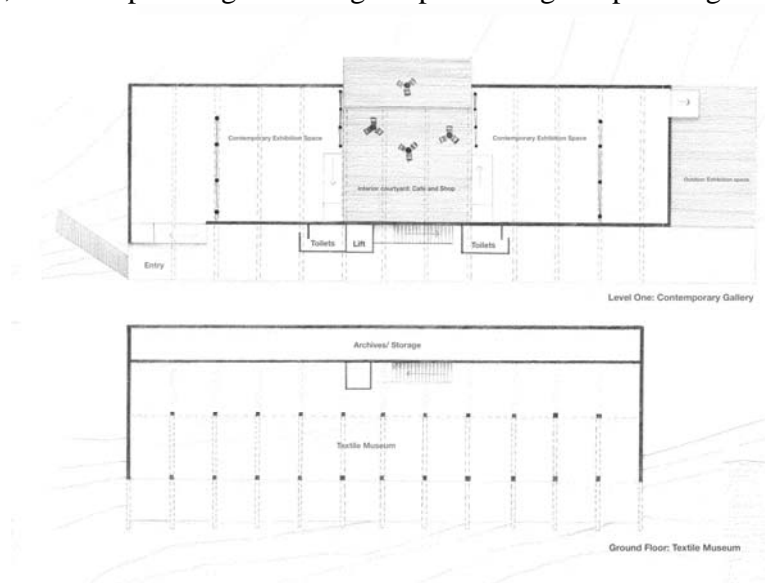


Figure 4.8.5 Plan

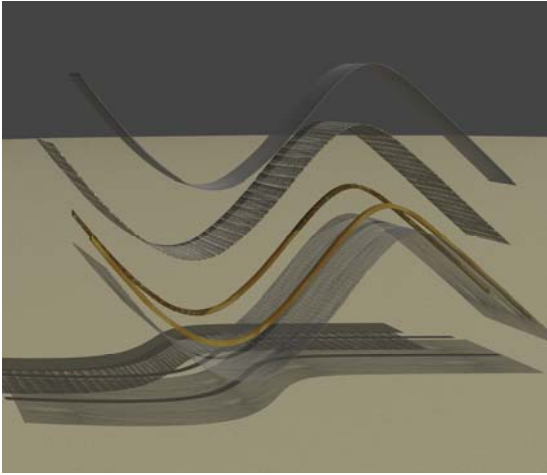


Figure 4.8.6 Exploded axonometric of roof structure

This axonometric drawing illustrates the textile materials that compose the roof sandwich.

Starting from the exterior, these include:

- Outer roof layer: Sheds water off the building, made of smooth polyester coated with aluminium.

- Tension Mesh Structure: Vectran Fibre rope, machine woven into panels, extremely strong composite rope, stronger than steel cable.

- Laminated timber Portal frames: compression structure.

- Interior textile surface: woven cotton or wool mesh, acoustic, thermal, light filtering and moisture absorption properties.

4.9 Final Design Process

After many different design iterations I was still faced with the same problems, most of which were the management of the structural requirements of the compression and tension structure in the right manner; too add to the architectural intention, not take away from the initial concept. With the introduction of the portal frames in the second design phase a lot of the textile qualities in the building had been lost. These textile qualities and ideas were stronger in the models I had crafted in the first design phase. At the end of the second design phase I felt the building I was designing looked like a conventional building with little reference to the textile forms that had inspired it.

Ultimately, I returned to my initial models as a solution. These models included the crochet hyperbolic form, the woven basket form and the digitally modelled knot. I wanted to include these forms in the final design and express them as the compression structures. All of these models directly resulted from my investigation into the materiality and structural potential of textiles. They all express in different ways, the potential of textile construction and textile form as surface, structure and space-defining tools. These objects house the various functions, they are the compression structures. Constructed out of tectonic materials, their forms are all directly derived from the textile, the galleries become objects on display themselves.

Another important aspect of the design is the woven roof, derived from Maori architecture. In the roof, the woven textile and tension structure is expressed. Also the simple gable portal frame acts as both a link to the Whare while also providing a visual frame for the textile derived compression structures that sit within it. There is something fascinating about translucent materials. They give architects scope for handling light

sensually and creating an exciting interplay between interior and exterior. The kind of atmosphere that used to be achieved with stained glass windows in church, or paper coverings is reinterpreted for today with innovative textile materials. The portal frame roof defines the space, and creates the sense of enclosure, framing the artworks that are the buildings and beautifully casting a woven shadow over the buildings. This I feel is a great achievement, and something that I only discovered as I was constructing models of the design. As I placed the knot under the woven 'whare' frame the shadow of the textile mesh was cast strongly onto the objects below. In a beautiful irony what was created by the textile but cannot be built out of textiles can have a woven grid cast upon it accurately mapping the structure of the form as the shadow distorts following the curves of the forms underneath it.



Figure 4.9.1. Images of model with woven shadows cast on the buildings

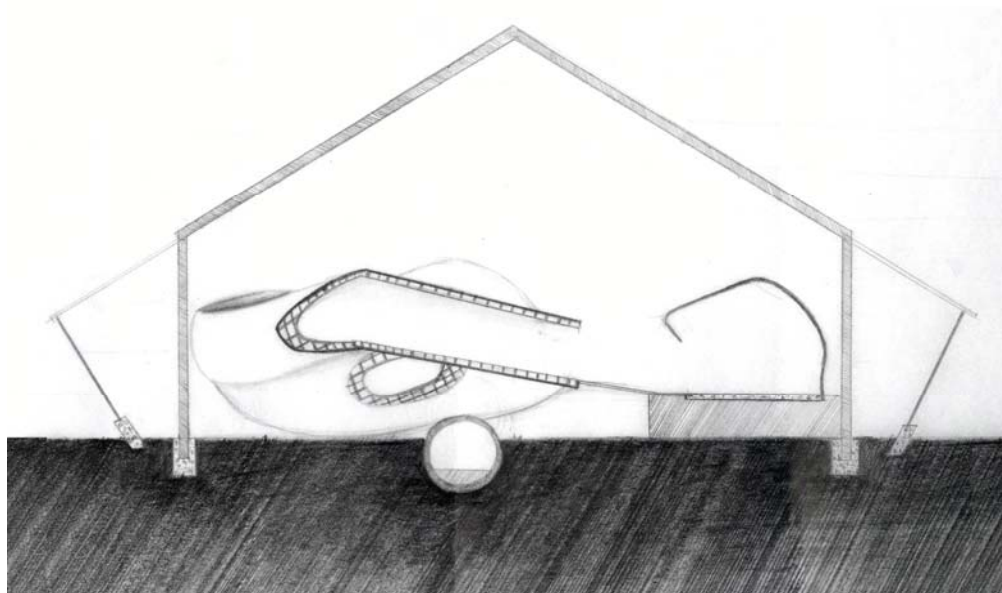


Figure 4.9.2 Section of portal frame, textile museum (left) and contemporary gallery (right)

As the site has a strong connection with the surrounding landscape, it was important to create an environment with a strong indoor/ outdoor relationship, where people can enjoy the site whether or not they visit the museum. The architecture is the opposite to the Cartesian box gallery many are familiar with. Instead the galleries are metaphors, symbols and cultural references to create a dialogue between the building and the subjects presented. The architecture has returned to the origins of architecture in a textile manner.

In the final design there are three different buildings, each derived from the knot. The first building that the visitors will experience has its form derived from the hyperbolic crochet models. This building hosts the non- exhibiting program such as the reception, café, shop, workshop rooms and toilets.

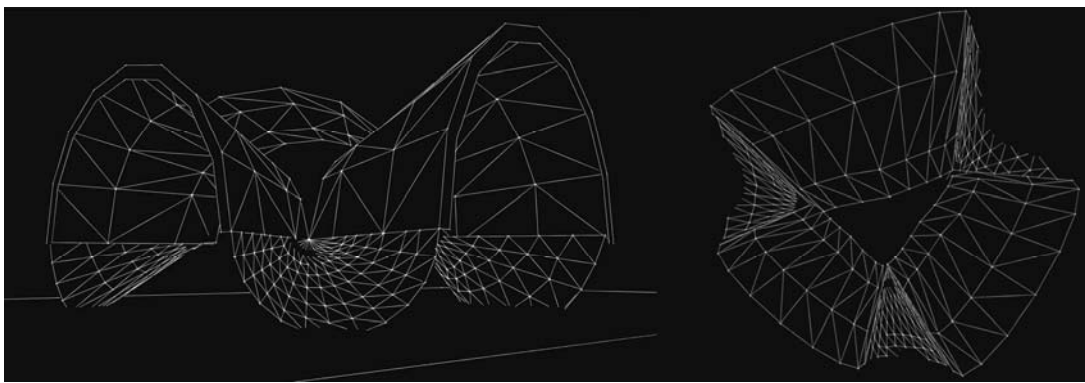


Figure 4.9.3 Digitally modelled hyperbolic building, perspective and birds-eye view

As the first building that the visitors will experience, it aims to stimulate the interest in all that the textile inspires, giving the occupants a unique spatial experience. As this building hosts the café, shop, entrance and workshop rooms, the functions compliment the indoor/ outdoor flow of the building. In the above image the geometries that construct the form are visually engaging, arousing interest in both the interior volume and the exterior form.

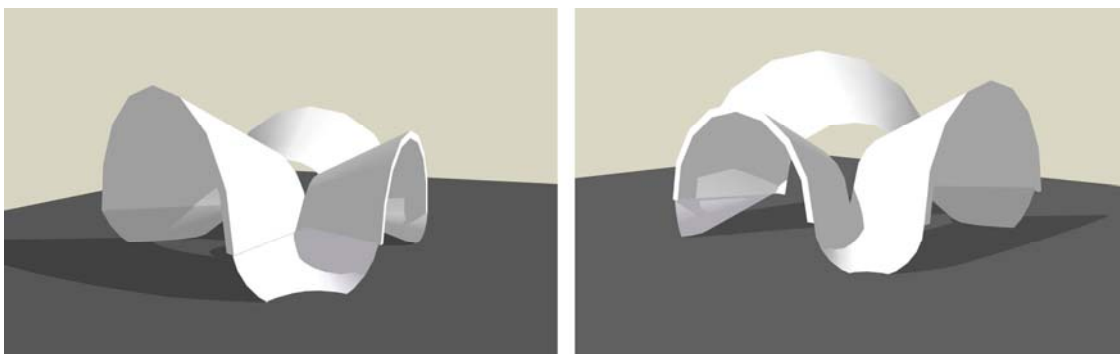


Figure 4.9.4 Digitally modelled Hyperbolic forms with rendered surface

The second building that the visitors experience is the ‘knot’ building, where the form is a direct translation from the simple knot. In this building the textile museum is located, housing the New Zealand textile artefacts.

For Semper the knot was the very first joint in architecture and turning this joint into an entire structure becomes a perfect typology for a museum. Knots have an entirely different organization of space, they give rise to highly complex forms of space and structure, they also create complex non-orientable surface where the traditional notions of floor, ceiling and wall are displaced by a form where no Cartesian reference system applies. Knots also control direction extremely well, which is perfect for a museum that follows a path, revealing the artefacts as the architecture reveals itself. Within the interior of the building, which is ramped throughout, the visitors obtain different vantage points viewing the artefacts as they move through the constant changing gradient of the strands. This gives the ability to view the artefacts and exhibitions, overhead, at eye level or looking down on the artefacts below, providing variety in the way that the artefacts are exhibited, (as textiles have the ability to curve there is no disadvantage in having curved walls.) Also the ability to control light in this very internal architecture is necessary as UV light damages older textiles.

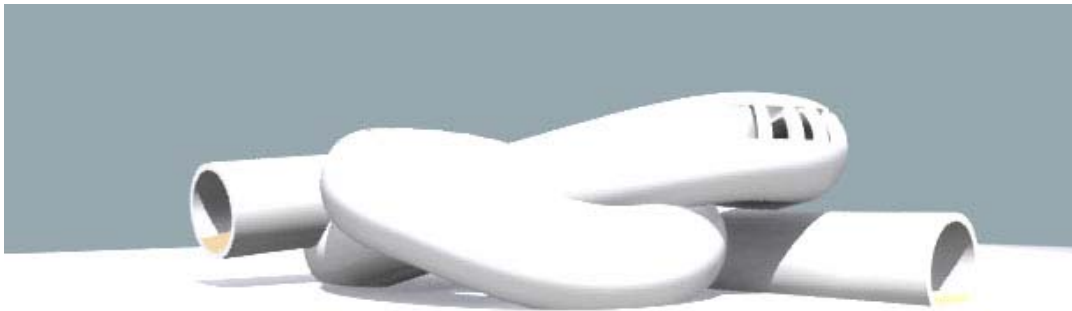


Figure 4.9.5 Digitally modelled knot building, housing museum artefacts



Figure 4.9.6 working plans of Knot building

The final building that the visitors experience is the contemporary gallery where the form has been derived from the basket crochet models. (see fig 4.9.1. and fig 4.9.2) The contemporary gallery will exhibit works from New Zealand textile artists. The form allows light through the tectonic lattice (the crochet lattice has been translated into a timber lattice) and gives the occupants a sense of being in a woven space. Also the structural lattice provides opportunity for the artists to exhibit their works freely. Textile installations can be hung from the structure itself.

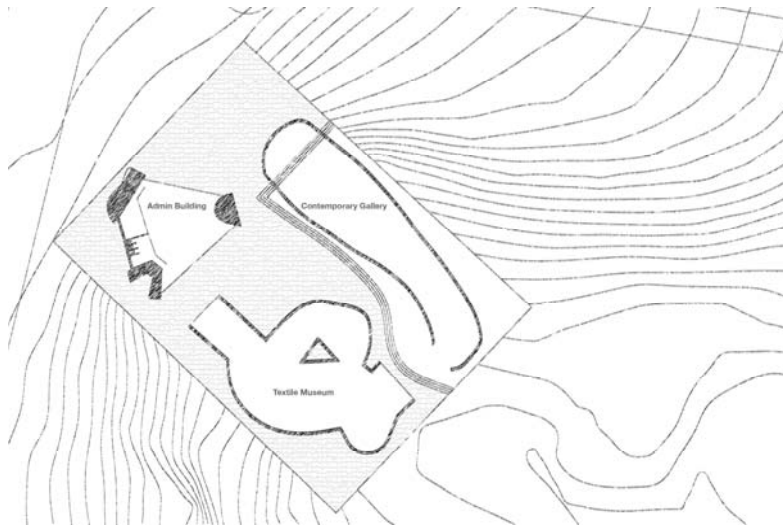


Figure 4.9.7 Sketch site plan of final design

In my research of Pre-European Maori architecture, I have described the significant modification that the first inhabitants/ architects had on the natural landscape. To achieve the objectives I indicated at the beginning of my document would be to incorporate techniques used by the early Maori. By excavating the site as I have done I am fulfilling the goal to create a vernacular architecture and a sense of place. I am replicating the way in which the Maori were not afraid to modify the landscape for their settlements and dwellings. The houses in some examples were dug in to the landscape with only the roof to be seen and this is a parallel with my project where the emphasis is on the woven roof that becomes the main façade of the building. Also textiles are very present in the Matakana area. The vineyards are covered row upon row with machine woven textile nets that cover the grapes, ensuring they can ripe without the threat of birds devouring them. The imagery of these vineyards is striking, with a topography that has been extruded from the site in the form of the vines, covered with nets that terrace down the hillside. From this imagery I wanted to replicate in some sense the experience that it feels to be under this netted canopy, descending down the site. The main features of the final design are the woven roof, forms within forms, the interior volume, crafted structure and carefully designed exterior spaces.

5. Critical appraisal of finished work

The resulted architecture of the final design is successful in the way that it is true to the textile. Each design phase had positive aspects, but did not fulfil the architectural intention completely so I continued to push the architecture until I found an architectural solution that satisfied my intentions of my project. In this final design, the success is that each building can provide the control required for each particular gallery function, while the textile roof adds the poetic qualities of the textile to the space. As the Museums intention is to encourage the interest in textile arts and architecture, it is fitting that the architecture is a little playful and daring. The occupants should be stimulated and inspired by the architecture arousing interest in textile arts for the coming generation.

My passion for architecture and textiles will continue at the conclude of this project. This research project has progressed my understanding of the discipline of the architextile significantly and the knowledge I have obtained is invaluable in my future career.

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Appendix A: Site analysis and context

Site Photographs:



Panoramic view of the intersection that borders the site.



Photographs of the site showing location and topography in relation to the Matakana village



Images from a Matakana vineyard: The grapevines are covered in textile nets to prevent birds from eating ripening grapes. Very picturesque imagery of the vines clothed in textile nets row upon row of vines terrace down the sloping site.



Images of two different types of nets. The first on the left is pulled in tension and only covers half of the grapevine, this creates interesting forms and the vine pushes the textile net to its shape. The second net on the right is draped loosely over the vine and touches the ground with a wire running over it pinning it to the ground. In this example a more fluid form is created as there is not as much tension in the net.



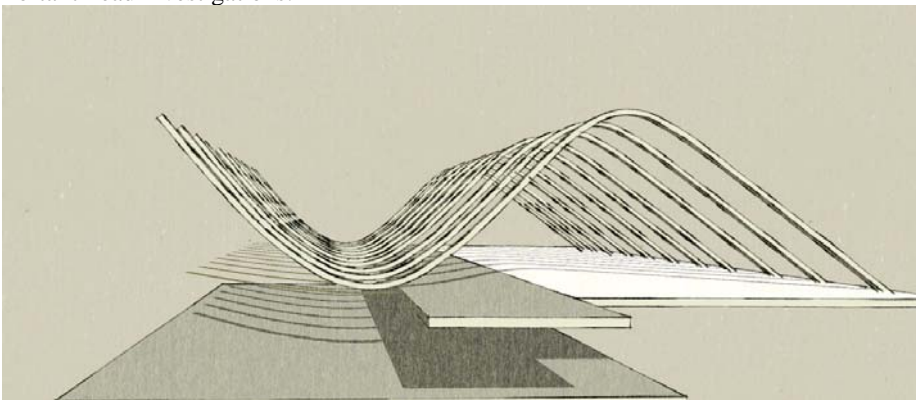
Images from the Matakana Farmers Market, illustrating the simple tent and umbrella structures that host the Markets every weekend, year round.

Appendix B surplus drawings and images from design processes

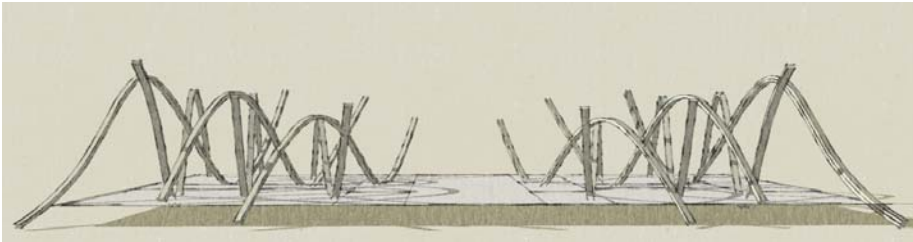


Concept Model of woven Roof form

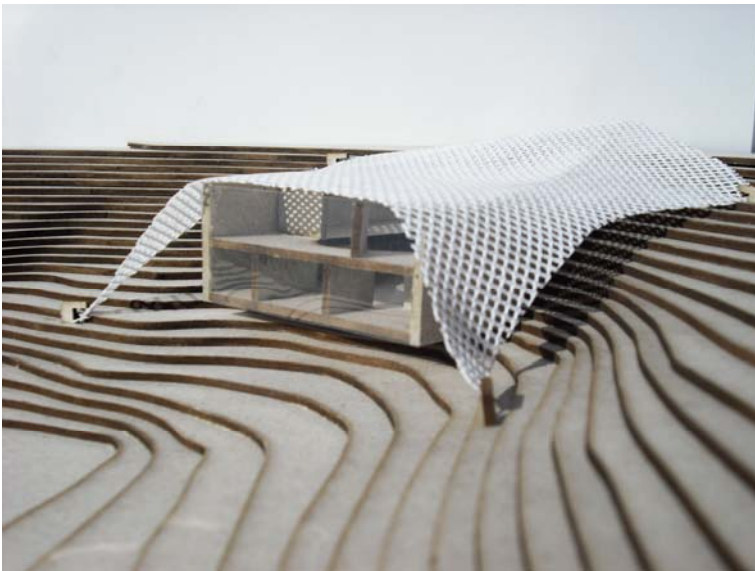
Portal thread investigations:



Drawing of portal thread arrangement from the second design process



Another investigation into 'weaving' the portal thread structure

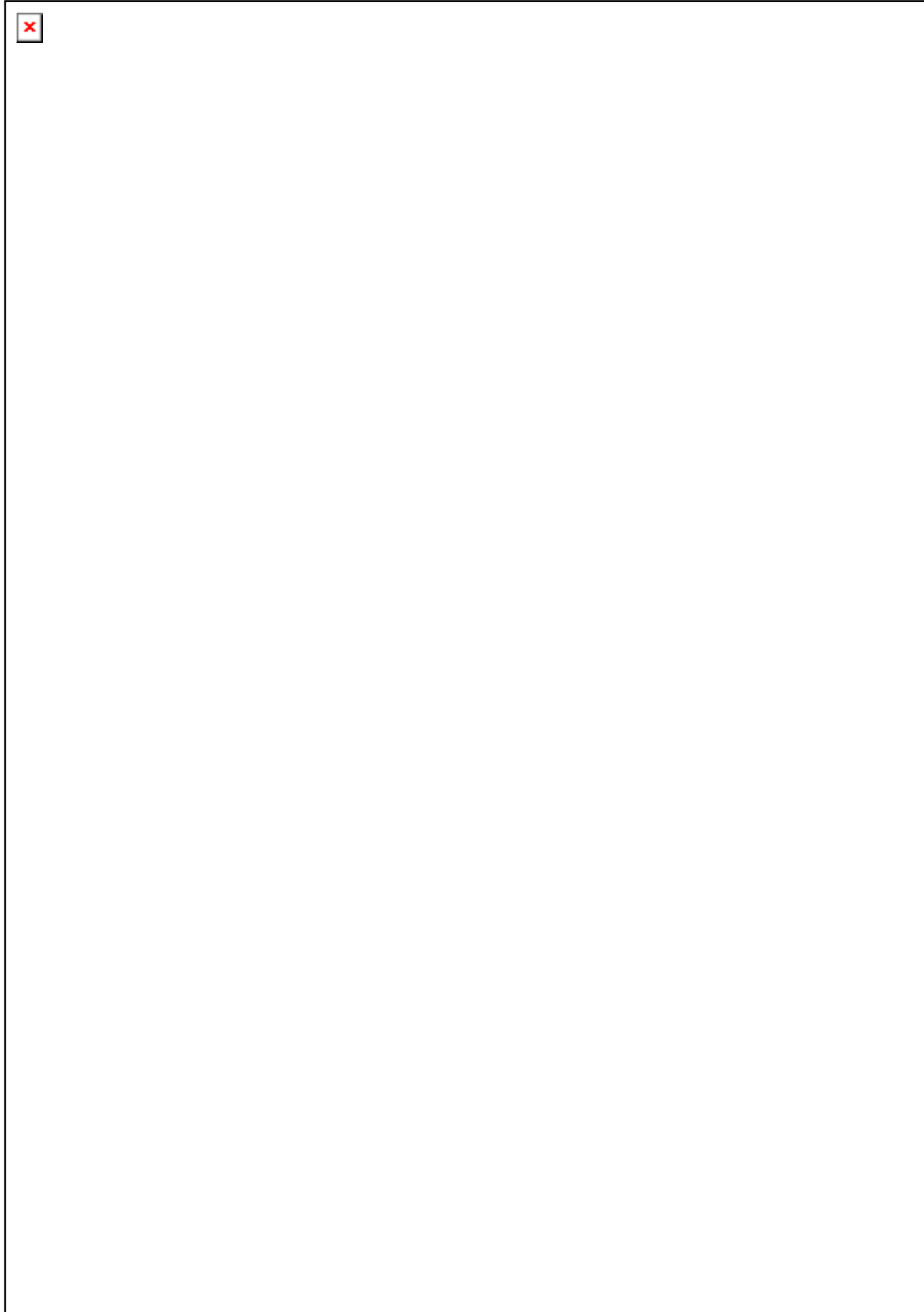


Working model, excavated into the site, with the removal of the portal threads

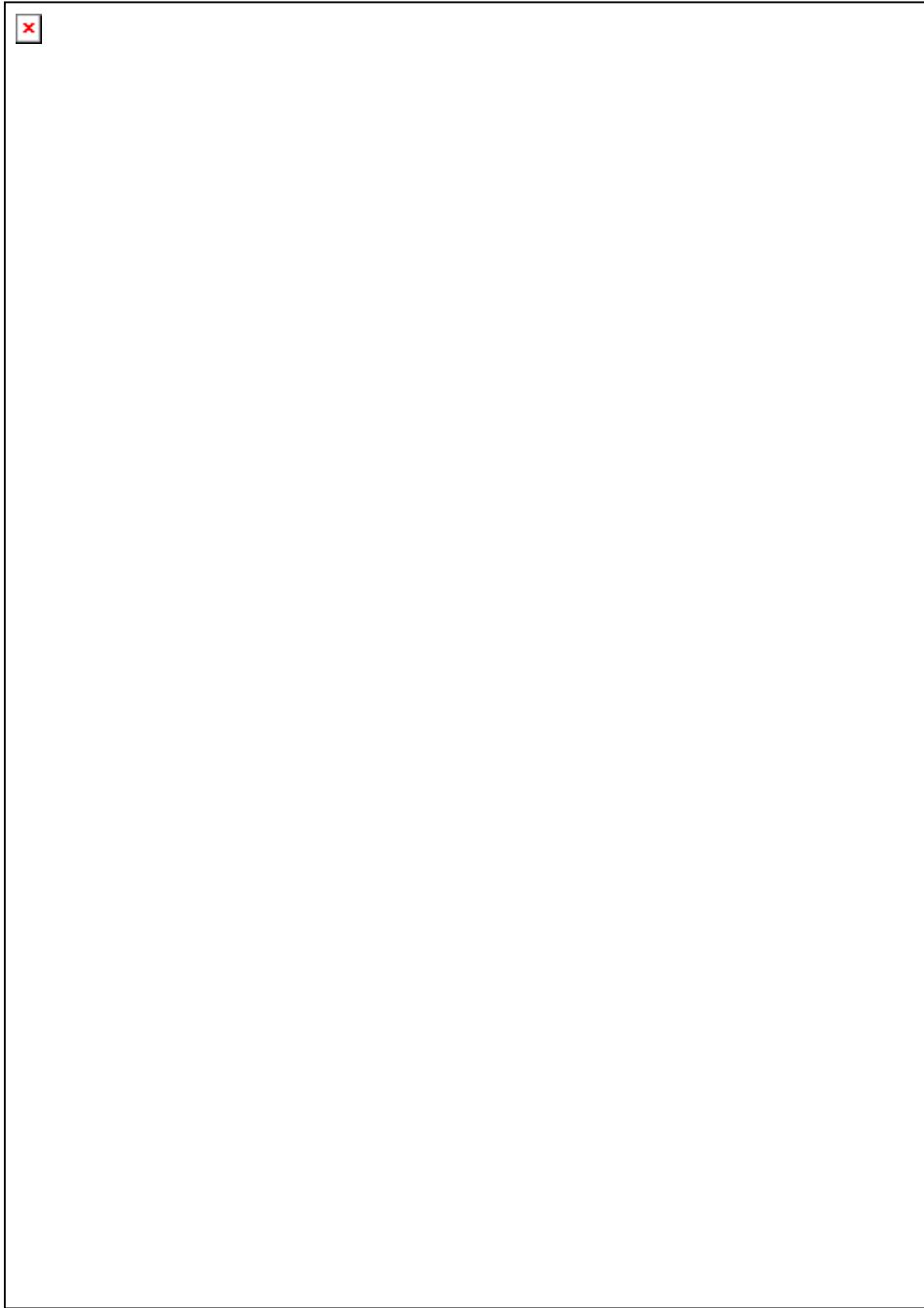


Working model showing entrance from the street descending into the museum

Appendix C: Final Drawings



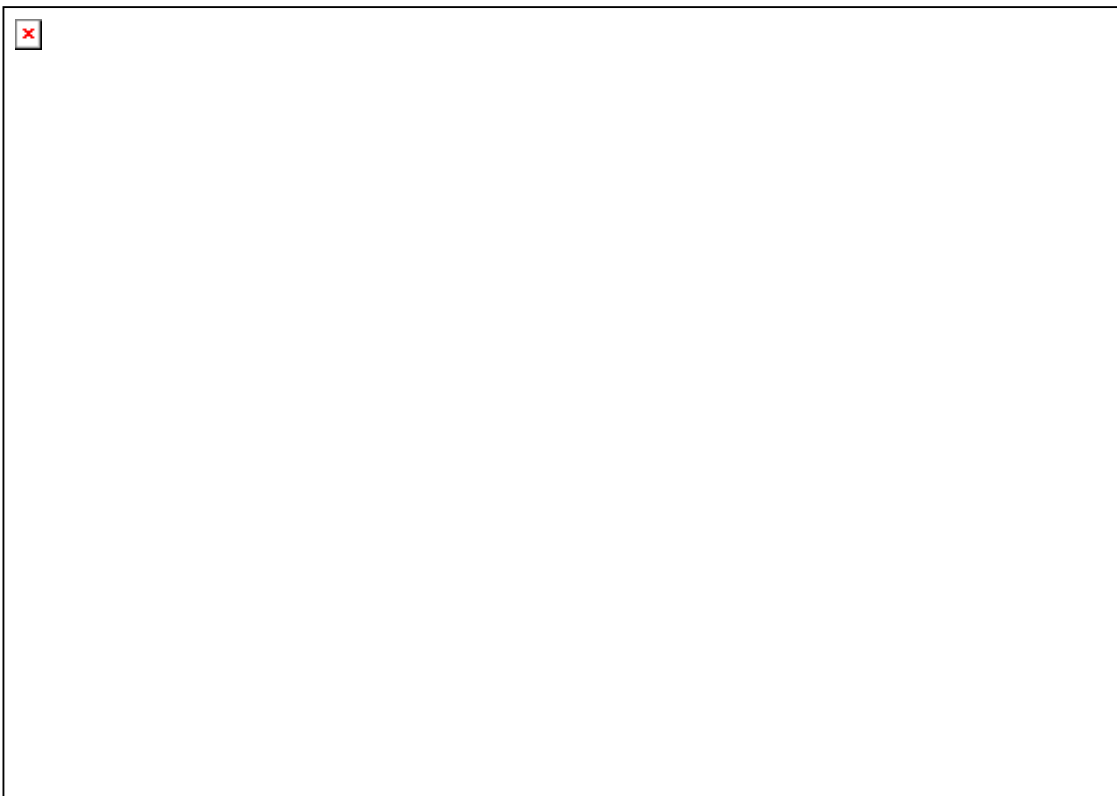
Final Site Plan



Final Plan



Final Long Section



Final Short Section

