“Strengthening Ha’apai”

An Architectural research project exploring the history of Pangai’s fish market and port, proposing a working outcome to strengthening the Ha’apai island group.

Master Explanatory Document

With supervision from:
Jeanette Budgett
Michael Austin

A Research Project submitted in partial fulfillment of the requirements for the degree of Master of Architecture.

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Juan Blas Pedreira
1353012
A concern for the rural islands of Ha'apai and its community was my motivation for this explanatory document. My childhood was largely spent around the ocean. My family and I would spend our summers sailing the coast of New Zealand. Soon a lifelong dream to sail the world became a reality and for the last 10 years I have voyaged on numerous trips to the islands in the Pacific.

Having travelled around Tongan islands I became attached to the people, and the copious, untouched, captivating islets that make up the landscape of Ha'apai. When deciding on the topic for my research document it became apparent to me that I could deliver an architectural project to help the current situation in the Ha'apai Islands, in an attempt to create something meaningful for the community.

The production of this document has broadened my knowledge of Tonga's history, and the influence ofanga fakapalangi has had on their architecture and daily way of living.
Many people are to thank for assisting me in the development of this research project. Firstly, thank you to my supervisor Jeanette Budgett for your guidance and support. This document would have been very different if it weren’t for your valuable opinions.

To my family, mum and dad, who supported me from day one. Thank you for always being there, your caring thoughts helped fuel my determination.

Thank you to my fellow Unitec students, this journey has bound beautiful friendships.

Lastly to Hannah, for keeping me sane when I couldn’t see the light. For being in my corner all these years.

ACKNOWLEDGMENTS

This research project focuses on the marketplace and the existing port structure in Pangai. Once the primary market place in the whole of Ha’apai island group, its destruction caused from the cyclone has had a serious impact on the community and their economy. With no place for trade, the community’s future on the Ha’apai island looks bleak.

With natural disasters increasing in frequency, every day, more and more people leave the islands, diminishing the possibility for a brighter future.

Having traveled there, there is an evident opportunity for architecture to achieve a unity through building, while also benefiting from the influence of climatically responsive Pacific architecture, as a solution to connecting its rich heritage.

With vast ocean coasts, there is an opportunity for Pangai and the Ha’apai islands to become the primary source of the eco-tourism and fishing industries in Tonga. En-richening the people to a healthier and prosperous future.
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1.0 INTRODUCTION
1.1 RESEARCH QUESTION

How can a waterfront architectural proposition uplift the current socio-economic problems in Ha’apai, while providing a cyclone resilient solution?

1.2 PROJECT OUTLINE

Nature has the capacity to produce an overwhelming feeling of joy. We take nature for granted; but what if nature fought back? What if the welcoming gentle breeze on a hot day turned into a storm? Would you be prepared? For life in the Pacific Islands, nature isn’t always kind.

In the past 10 years Tonga has faced 7 high category tropical cyclones.1 “List of Tropical Cyclones that have affected at least a part of Tonga from 1960-Present,” accessed April 2, 2018, http://www.met.gov.to/index_files/TC_list_update.pdf

This project addresses the effects that various tropical cyclones have had on Tonga, Ha’apai. Each cyclone adding damage to an already bruised economy and its infrastructure in Ha’apai. It has affected financial security and brought uncertainty for the future.

In order to ensure a positive future for the Ha’apai Group locals must understand how to build to withstand the harsh tropical conditions. Western influenced architecture is not the solution.

As the world becomes more accessible the core values and traditions of countries like Tonga are becoming vulnerable. An essential intent for the architecture and its programme is to create a hub where anga fakatonga (‘the Tongan Way’) is expressed and celebrated. Additionally, this project will explore how an assimilation between traditional Tongan architecture and modern technologies can produce resilience against the harsh tropical climate.

Explicitly, this research project will focus around revitalising the existing wharf and waterfront, in an attempt to strengthen Ha’apai’s main income sources - tourism and fisheries - analysing mechanisms to integrate an interactive public precinct into Pangai’s waterfront.

The new waterfront will play an active role in providing the people a place to sell their produce that they gather from the land and sea. It will also become a new place where tourists and local inhabitants can interact. Making the Ha’apai islands more appealing to the tourists, while also giving locals the opportunity for a financial gain.
1.3 AIMS AND OBJECTIVES

The focus of this project is to produce a realistic, responsive design solution that will create opportunities for the community in Ha’apai. The proposal will enhance Pangai’s waterfront. This can be achieved by engaging the locals and tourists in a marketplace where locals can trade their goods resulting in a financial benefit to the community. As well as a space where Tongan ceremonies can be celebrated and shared.

The following goals are to be achieved:

• Celebrate Tongan culture, informed in the design
• Combine modern and traditional building techniques to showcase how they can work well together.
• Incorporate locally sourced materials, so the building can be independently built and maintained by the community
• Understand why Ha’apai has a declining population and create an architectural project that urge people to stay.
• Investigate an approach that can maximize the financial value that tourism brings to the islands.

Preserving Tongan architecture is a key driver: the intention is not to criticize the Western culture, but to propose a solution that can benefit from the attributes that each culture has to offer. Currently in tourist destinations such as Ha’apai, Pacific architecture is the common typology in holiday resorts, exhibited as a form of grandeur. Yet, this desirable structure is rarely seen in local communities, instead adopting foreign techniques. This project will present an opportunity to discover an acceptable architectural method in the Pacific.

1.4 METHODOLOGY

This research project incorporated the following two frameworks; research ‘for design’, and research ‘by design’.

Research ‘for design’ is explored through extensive precedent and literature - based on the history of Tonga, climate, natural disasters, Tongan architecture, Western influence overall and in architecture, and exploring further into the reasons why outer islands like Ha’apai group are struggling for survival. There is limited published literature on traditional Tongan architecture, however information from other South Pacific Island, such as Samoa, will aid where lacking. The majority of this material was sourced from academic papers, corresponding published studies, including local and international websites, as well as information obtained from the site visit.

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The questions raised through initial research were resolved using various methods, such as 3D and 2D diagramming, sketching,测量 in context, and modeling. 3D physical modeling was the most effective method to explore design ideas and further understood the cultural significance. The project was critiqued by supervisors, as well as students, often leading to further exploration, or evaluation of different alternatives.

Ultimately, this lead to a responsive architectural design that contributes to enhancement of the Ha’apai community and an increased understanding of cyclone resilient buildings.

Figure 2: Objectives Diagram
"We should not be defined by the smallness of our islands, but by the greatness of our oceans."

- Epeli Hau'ofa

The Pacific Ocean covers one third of the earth’s surface. The vast and seemingly empty expanse of ocean harbours thousands of islands, in which many inhabitants view the Pacific as ‘a sea of islands’.

Situated in the heart of the South Pacific Ocean, the ancient Polynesian Kingdom of Tonga is one of the most scenic and unspoiled of the Pacific island nations.

Tonga is part of the Pacific Island Countries (PICs). The Pacific Island Countries are categorized into three island districts:

- Melanesia (Black Islands)
- Polynesia (Many Islands)
- Micronesia (Small Islands)

Polynesia, in which Tonga lies, is shared with countries, such as Samoa, The Cook Islands, Nuie, and New Zealand; as illustrated in Figure 4.

Tonga archipelago comprises of two geologically different parallel chains of islands that make up 176 limestone and volcanic islands. Due to its location within the Pacific Ring of Fire, Tonga can experience volcanic activity; the most frequent eruption was in 2009, on Hunga Tonga - situated 11km away from Tongatapu. Tonga’s western islands make up the Volcanic Arch and are all volcanic in origin.

The eastern islands are non-volcanic limestone, or coral formations, and sit above the Tonga ridge that runs parallel to the Volcanic Arch and Tongan Trench. Located east of Tonga, in the depths of the ocean, is the Tonga Trench - the deepest trench in the Southern Hemisphere, succeeded only by the Challenger Deep site in the Mariana Trench. Its deepest point, called the Horizon Deep, plunges 10,882m below the surface of the water.

Climate in a tropical country like Tonga experiences two distinct seasons: a ‘dry’ season and a ‘wet’ season. The hot, rainy season falls in December-April, with temperatures rising up to 33 degrees Celsius. The six months between May and November are considered the cool dry season, with temperatures ranging between 17°C-22°C. It is during the rainy season that Tonga experiences tropical cyclones; an average of two annually. Big cyclones, however, only occur every 10-15 years.

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Tonga, "to" (to plant) and "nga" (a place), also means ‘south’.

Tonga; one of the most beautiful, but volatile environments on Earth. Tonga is an archipelagic nation of some 176 islands (36 of which are inhabited), representing a collective area of about 750km², distributed over 700,000 sq km.

Such dispersion means water is a principal component in the Tongans lifestyle, be it culturally, or economically. The core islands are divided into three main groups; outlined in figure 5.

1. Tongatapu - The main island of the Kingdom of Tonga, and the location of its capital, Nuku'alofa. Almost two-thirds of Tonga's population live on the main island Tongatapu.

2. Ha'apai Islands - A combination of small islands in between Tongatapu and Vava'u.

3. Vava'u - Located farthest north, Vava'u group contains 55 islands, including the second biggest island of Tonga.

Poor connection between the three main groups has meant they ultimately function independently. Tonga, like many other Pacific nations, rely heavily on the ocean; for food, transport and economic development. The expansive space between islets provides large areas for their fisheries industry to develop, however the water also acts as a hindrance. Excessive traveling distances discourages distribution and allocation of produce.

The smaller islands struggle with the involuntary autonomy, as they do not have sufficient skilled workers to sustain their population, nor jobs to keep people on the island. The impending lack of prospects is increasing the likelihood of poverty to occur and consequently abandonment. This pattern can be seen in figure 6 showing a depleting population in the Ha'apai islands, with the number of residents moving to Tongatapu increasing every year.

Ha'apai islands suffer the most. Small, narrow landmasses restrict the towns potential size, consequently limiting economic and educational opportunity for most Tongans living in the outer islands.
Ha'apai is comprised of 62 islets. The islands include barrier reefs, coral shoals, shallow lagoons, and active volcanoes, but most are small low-lying coral atolls. Only 17 are inhabited, with approximately 8,000 people settled in 20 villages. The main group consists of 5 islands running along a strip on the eastern side, which act as the prime settlements in Ha'apai, and the only islands with electricity. The sketch adjacent shows the main group.

The Ha'apai island group is divided into 6 main districts (Figure 9 and 10):
- Lifuka - Mu’omu’a
- Foa - Ha’ano
- Lulunga - Ha’ano

Subsistence income is primarily from agriculture, fishing and tourism, however, like much of Tonga, a large source of income is remittance from family members living abroad. Pangai is the main village and administrative centre in Ha’apai, located in the island of Lifuka.

Although Ha’apai is the smallest Island group of Tonga, the deep blue water and reefs make it the ideal location for fisheries and eco-tourism. The close proximity to the Tongan trench has developed strong reef environments and marine life. As a result, fisheries have developed to become one of the biggest industries in Ha’apai.

Access to Ha’apai group is by either a 12-hour boat ride from Tongatapu, or Vava’u, or a short plane flight, where an airstrip was created to increase tourism. Once a strong settlement, Ha’apai has deteriorated over the years, due to recurring cyclones and the population migrating to larger cities. Most of the remaining inhabitants are in the Pangai and Foa districts where a new road has been developed to link the two main islands together.
Like all their Polynesian relatives, the Tongans did not have a written language to record their early history; but anthropologists estimate that it was first inhabited around 1500-1000 BC, about 3,000 years ago, by Lapita people from Southeast Asia. Facing the natural hazards of the region, including devastating storms and having ocean floor with its volcanoes and earthquakes, they persevered to achieve new communities in the idyllic tropical setting.

Tonga was not immune to the overtures of the European powers that interfered in other Pacific Island groups. Tonga’s first contact with the Western world began when early European explorers set off to discover new land. Initially Dutch navigators Jakob Le Maire and Abel Tasman arrived at Tonga, in 1616 and 1643, however effective European contact dated from Captain James Cook’s visits between 1773 and 1777. Prompted by this contact, Tonga was not immune to the overtures of the European powers that interfered in other Pacific Island groups. Tonga’s first contact with the Western world began when early European explorers set off to discover new land. Initially Dutch navigators Jakob Le Maire and Abel Tasman arrived at Tonga, in 1616 and 1643, however effective European contact dated from Captain James Cook’s visits between 1773 and 1777.

By 1845 a crucial action to identify Tonga took place. Taufa’ahau Tupou united all of the Tongan islands under his leadership, as the first undisputed Tu’i Tonga (“king of Tonga”), who took the name King George Tupou I. In 1901, the kingdom became a British protectorate, under the “Treaty of Friendship,” allowing the Europeans to settle and trade. Tonga remained part of the British Empire until 1970, the nation declared independence, however Tonga remains a member of the British Commonwealth.

Although Tonga was part of the British Empire, it never lost its indigenous governance. To this day the patrilineal mode of succession continues; remaining an influential and powerful entity in the modern Kingdom. Tongan monarchy is the longest, uninterrupted hereditary monarchies from one family of any country in the world. A fact most Tongans are proud of.

Current King George Tupou V, has introduced concessions to accommodate a more democratic state, however withholds the undemocratic ability to elect the Prime Minister. Evident corruption, shaped to benefit the select instead of the many, has often lead to short term outcomes rather than long term factors. The consequences for this immediate appetite will be explained later in the document.
Anga fakatonga (‘the Tongan way’) is exhibited every day. It is Tongan identity and as the values and behaviours that comprises to be a Tongan. The core values in anga fakatonga are:

- 'ofa (love)
- 'tauhi va (gratitude)
- faka'apa'apa (respect)
- fakato ki lalo (humility)

These values that Tongan culture is built on are expected to be upheld in society. For kings, Anga fakatonga has respectively been passed onto succeeding generations, and a strong national and cultural identity. With other cultures there are multiple interpretations and historical transformations.

European missionaries had a powerful influence on the social and political transformations. The ‘true Tongan custom’ was established. An “early, stable complex of institutions, ideas, and practices, which integrated Tongan culture with a version of European culture.” As elsewhere in Polynesia in terms of the indigenous and the foreign, Tonga is an intrinsically hierarchical society. Rank and status are integral to Tongan identity. The Tongan diaspora often contrasts with anga fakatonga, the Western way, in terms of the indigenous and the foreign.
Tonga is a dispersed community, and Tongan identities are evolving in response to exposure to new environments. However, the underlying ancient rituals and art forms outlined are still critical to Tongans identity. The project must instill anga fakatonga into the design. Incorporating Tongan values in the design, will aid in the overall success of and integration into the local community.

TONGAN DANCING

Traditional dancing is an important part of national ceremonies and local village festivities. Traditional dances include: me’etu’upaki, the paddle dance, soke, a stick dance, kailao, a war dance, ‘otuhaka, lakalaka and the ma’ulu’ulu, dances performed by standing and seated groups, respectively, and accompanied by densely polyphonic singing; and the tau’olunga, an individual dance accompanied by singing. Lakalaka practiced nationwide.24


TAPA CLOTH

Tapa cloth, or Ngatu, is a barkcloth, made from the bark of the mulberry tree, known locally as hiapo. Ngatu is of great cultural significance in the Kingdom of Tonga. Only men can tend hiapo, but once harvested, only women may create a tapa cloth. The social function of Ngatu is a gift, given at special occasions like, births, weddings and funerals. Women gather in their homes or at the fale kautaha (the village’s communal tapa house) to assist each other in tapa making.25


CULTURAL CONTEXT

MATS

Like tapa making, mat weaving is an everyday part of Tongan life. Women weave the mats from several varieties of pandanus leaves. Mats are the most treasured possessions in Tongan households, and are traditionally presented at births, weddings, funerals and other special occasions. Tongans also wear mats known as ta’ovala around the waist, the most respectful form of dress in the Kingdom.

KAVA

The elaborate ritual of drinking kava is associated with both social and ceremonial function, also common in Fiji and Samoa. The widely consumed drink, prepared from the root of a piper plant, has the properties of a mild narcotic.26 The ceremonial drinking of kava is an ancient custom, during which commensality is important, and is still an integral part of Tongan life. Kava represents the virtues of anga fakatonga and plays a vital role in maintaining the Tongan way. Nicholas Thomas writes in his book ‘Islanders’ “kava was more than a refreshment and mild narcotic for these Islanders. In a double sense it was integral to the social life, admittedly not of the population as a whole, but that of high-ranking men. It was never simply prepared and drunk unceremoniously. It was ritually offered to the person of highest rank present. It was received, blessed and shared.”27 Even with Western influence, kava has remained an important tradition in Tongan culture. Kava is embedded in tourism, with tourists offered kava ceremonies upon arrival as a sign of respect (faka’apa’apa) to both parties. The anga fakatonga kava represents presents an opportunity to include the tradition into the design, as a way of giving a greater sense of ownership to the people of Ha’apai.


27 Thomas Nicholas, Islanders (London: Yale University press, 2010), 36.
Traditional, or indigenous architecture, could be defined as an architectural style based on specific localities, devoid of authors. Traditional architecture is strongly influenced by climate, local materials, cultural factors and typically built from manual processes without industrial components. Every culture expresses a unique knowledge of construction and design techniques, evolved from 100's or 1000's of years.

Traditional Pacific architecture varies between the three Pacific groups; Micronesia, Polynesia, Melanesia. Many micro-societies have their own traditions and rituals, therefore it is difficult to generalize about architecture in the Pacific, except in the similarities with climate, which dictates the materials available and building techniques that have been developed over time.

The close connection with water has had a major influence on the islands culture and design. We see this in their arts and crafts with smooth carvings co-relating to nature and water. In architecture the same influence occurs. There is a close connection between boat construction and buildings. Particularly, Polynesian architecture, as they are the major pacific island group that migrated vast distances through island hopping.

Architect Dr Mike Austin describes the correlation between Pacific canoes to architecture: “As with the canoe, the Pacific building strives to achieve stability through lightness and tension”. This contrasts to the Western approach, which generally adds weight, even nautically, were mass is applied to keels with lead to keep the boat balanced, while in the Pacific two hulls would be used to achieve balance. In general, Pacific method is lighter, faster and more stable.


2.3 PACIFIC ARCHITECTURE
FEATURES IN TYPOLOGIES OF THE PACIFIC

Majority of villages are located by the seashore, with each family occupying their own house or fale. Polynesians are known to have a close connection to the sea. Hence why their typology resembles an inverted canoe.

The fale is typically round or oval shaped, where the roof is the dominant feature. Walls are porous or nonexistent. If used, they are suspended from the roof to provide shading. The unicellular pavilions are free standing with differentiation of spaces is not achieved by walls but by space, or va, much like how the islands in the Pacific are separated by sea. The floor is typically a raised platform to allow ventilation, however can also be dug into the ground for insulation (like Maori did in New Zealand).

Traditionally the toilet and the kitchen were in separate shelters. This housing structure was useful in keeping the vermin out of the sleeping house.

Oldest group in the Pacific. Archaeological studies show that they can date back to 800 B.C. The long history and isolation between islands in Melanesia means the architectural expression is varied.

Typical typologies have walls to create privacy; however, the front is always open, facing towards the prevailing winds or sea. Walls are made of thatched patterns with loads being carried by columns. Heavily thatched roofs (pandanus, or palm leaf) to protect from the humid wet environment. The structure is simple and unadorned, lashed together with coconut sennit. The structures sit on a bed of leveled rocks with mats inside to provide a cool temperature.

Unlike the Polynesian and Micronesian, the Melanesian reside inland (central highlands of the islands) instead of close to the coast. Only fishermen and sailors settle by the coast.

Lightweight structure creating minimal distribution towards strong winds. They have beautifully patterned wall and floor coverings displaying the artistic handcraft developed from weaving and lashing techniques.

The roofs are designed to be easily lifted off the posts to prevent damage from cyclones or ease of repairs where the structure is commonly elevated from the ground on raised platforms due to rising water level. Some are elevated above the sea.

The Maneaba (meeting house) is the center of village life; a sacred shrine for the community. An imposing structure with coral bedrock supporting a large thatch roof formed from coconut wood. Its importance is evident in the detailed craftsmanship, with the whole community involved in construction.

Over the islands long settlement history architecture in Tonga has gone through a process of evolving, using different construction methods, materials, outside influence, and spatial organisations. From the monumental langi structures and royal pyramidal tombs built from massive stone slabs, to the Western style that has influenced the obsequeous Tongan today.

Traditional Tongan architecture is in the form of a fale, consisting of the main architectural component, a curved roof, which governs the aesthetic. The house stands on a raised platform on ground of stones and sand, oval in shape, with walls as woven palm tree screens. A contrast to Western architecture, where walls take an important role in the structure and visual aspect. The fale is ever-present throughout Tonga in the form of homes, churches, and other public buildings.

The warm wet climate generates lush vegetation, used for the framework, thatch roofs and mats. The sustainable buildings are built from local materials, such as pandanus or coconut leaves for the characteristic rounded thatched roof, resting on the supportive pillars, called pou, made of vesi trunks. The structural use of the pou alternates the need for load bearing walls. The possibility to detach walls maximises natural ventilation, while reducing the wind forces acting on the building. Locally sourced materials are within economic reach of most of the population who obtain apprehensible building knowledge. Using these materials does have its weaknesses. They decay rapidly, due to the weather and insects, giving the architecture temporary quality. The temporary nature of the materials used bodes well with the unknown climatic nature of Tonga. Extreme tropical weather inflicted on Tonga enforced unique architectural techniques to help inhabit their natural surroundings. The traditional fale had strong cyclone resilient solutions. In the event of a natural disaster, if the winds threatened to shred the walls and overturn the roof, the inhabitants could remove the screens and disconnect the roof from the main structure. The roof and its structural components that help define its shape would be disconnected and lowered to the ground, while the main structure would remain intact. Roofs create immense uplifting forces, therefore detaching the roof maximises strain on the fale's structure and reduces the damage and rebuild post disasters. The curved roof form responds well in cyclones as the wind blows over, reducing the uplifting forces generated.

The response and relationship the fale form has with its surroundings, in terms of resilience, will be considered in the design process.
Beyond environmental advantages, the traditional Tongan fale also incorporated strong cultural identity and social values. Owners took pride in their fale, as they defined the family’s status amongst the community.

The structural components that make up the fale are named according to their function, as well as having a culturally significant meaning. Tongan sculptor Viliami Tolutaʻu mentioned, “The impact of the word is the backbone and foundation of Tongan Tradition.” These words help us understand Tongan architecture, together with its culture.

The most widely recognised structural component is the pou, or post, which acts as the main structure to the fale. Pou means ‘to support and hold’ and was typically made of local trees, such as Koka, Toi and Toa. Coconut trees were not used, as they rot if connected with the ground. Independent from the wall systems, the fale typically had a series of 4 pou. Lalango, the supporting beam of the fale ran from pou to pou. Lalango means ‘uphold or elevate’ and would be made of coconut trees due to its strength and long spanning capabilities.

The Toka was then placed above the Lalango, like rafters, running perpendicular to the Lalango. The toʻofufuloto, is defined as fufu meaning ‘hidden’ and loto meaning ‘center or inside’. It rested on the center of the tokas and became the central beam connecting the Toka to help support the roof. Teke means ‘to push or support’, the longer the teke, the higher the roof would become. The teke supported the tauʻolunga and the tuʻungahoka.

The roof shape was determined by the kauta, feleano and taʻopatu. All made from coconut trees or whatever tree that was available in the area. The kauta would determine the bottom of the roof while the feleano would contour the roof shape and add structural support. After the roof structure was created the ‘apai would be placed on top acting similarly to purlins in a Western house. The ‘apai was where the thatching was then lashed.
When analysing the volume of building a sectional drawing aids in highlighting different aspects. In the fale it is evident how different the building is divided. There is a clear difference between the roof space and the ground floor. The roof, cluttered with various structural components, allows the ground floor to be unobstructed and maximise the floor usage area. The volume of the roof space almost matches what would be the floor to ceiling height. Opposite to Western architecture where low pitch roofs are used, and visual dominance is mainly directed to the walls.

The roof's large size isn't just for aesthetic, but also for function. The large volume allows hot air to rise, ultimately keeping the ground level cooler.

In plan view there is a division of spaces, outlined by the 4 main pous that support the roof. These pous define the central space of the fale. It would be the centre of the home where a greater sense of privacy and security would be achieved.

In a sense, the fale is a home within a home, needing to go through layers to slowly transition from the outside world into the secluded world. This takes effect in all directions of the building. Unlike Western architecture, which usually achieves division of spaces with walls, the Tongan approach is much simpler, while still achieving a division and a connection to the outside world. Also, in Western architecture not necessarily is the center of the home the most private area. Often bedrooms and living areas are at the corners to maximise the views and openings. The Tongan fale has a heart right at the center similarly to how Frank Lloyd Wright's typically positioned the heart at the center of the house, often represented as a fireplace.

Fale's were traditionally located by the coastline, above the beaches. They would be placed in no particular order or orientation, however where small villages were created, the chief, or highest rank fale would be positioned in the middle, with relatives fale's around him.

The cluster of fale's around the chief, or heart of the village, is similar to the effect of how the center of the fale is the most secure part of the structure. Figure 26 illustrates the small urban planning. This method links all the fale's together and therefore makes the village work together as a whole instead of stark individual families. It is quite common for Tongan's to share with their own. Even today many families join together on a Sunday and indulge in a Tongan feast, catered by everyone for everyone.
When one envisions a Pacific Island like Tonga, one imagines idyllic weather, picturesque islands, white beaches with palm trees dotted along the coast and over the water fale accommodation. But these seemingly perfect islands are more than just a holiday destination. They have had their fair share of conquest and colonization over the past few centuries that has shaped the architecture we see today.

The arrival of the Europeans substantially changed Tongan architecture. The standardisation widespread of Western dwellings began when the first wave of missionaries arrived in 1979, made up of tradesmen eager to teach the Tongans construction skills in an attempt to gain their trust before pursuing conversion. Impressed with the capabilities to produce gas-western-fale/architecturenow.co.nz/articles/building-ton- architecture now, accessed January 15, 2018, http://gas-western-fale/ western customs, though more practical modern than on the function that they importance is given to items that appear durable and affluence. In cases more influential, Western building materials are seen as modern, despite the natural ventilation advantages that the latter can provide. In a short time-frame, Western architecture has become prominent in architecture in the Pacific.

The traditional approach is to provide a light structure that would not obstruct the forces of the winds. Joistty joined together, instead of fixed with nails, to allow movement and flexibility in the building. Locally sourced materials for ease of distribution, and economic advantages. Post cyclone, a simple affordable rebuild. All these values are not seen in Western architecture. WAY FORWARD: Technology has and is advancing at such a rate that it is expected of buildings. The harsh climate is not sympathetic to the island dwellers, nor their buildings. It is not about designing a building that can withstand the chaotic events but designing so it can be easily reconstructed, so the public can rebuild, using resources from the land.

Advancements in technology has provided a platform that, with careful consideration and cohesion between Tongan and Western architecture, can be developed to find a resilient solution for Tongan society.

The aim in this research project is to find the balance between the two types of architecture. It presents an opportunity to strengthen the culture, improve lifestyle and wellbeing, and act as an educational tool for current and future generations.
Natural disasters are becoming an ever-preserving global issue, and according to recent studies the number of natural disasters is only going to increase. This presents a challenge to produce and establish resilience in small communities like Ha’apai, before they are damaged beyond repair. The increasing occurrence of extreme weather events: cyclones, hail storms, flooding, are considered to be a result of El Niño. This is caused by global warming and the effects of warming the ocean and surrounding areas. Such extreme events are expected to become cyclical in frequency. Consequently, increased pressure on already strained communities will cause farming and agricultural businesses to become economically unviable.

Tonga is highly exposed to natural hazards. This vulnerability is heightened by the community’s lack of resilience. Undeveloped countries, like Tonga, have a higher fatality rate in natural disasters than developed countries, since developed countries are more prepared with resources and can recover faster. Developing countries however, do not have such a strong economy, which impacts their preparation and slows down the recovery process.

The 2016 World Disaster Report concluded that Tonga is the second most disaster prone country in the world, behind Vanuatu, revealing a strong exposure to natural hazards and owing to their poor economic and social situations. Even though emergency relief response has increased over the years, it is the permanent damage which requires more attention. Emergency relief organisations focus on the temporary shelters, the immediate effect, however it is the rebuilding process after the support has gone which is lacking. Education on building resilient architecture must be provided, so locals are not so heavily reliant on outside help.

Unfortunately for the people of Tonga nature cannot be controlled. Whether the cause of an influx in natural disasters is due to the increasing global population and the pressure people are putting on the earth’s resources, does not help the Tongan population. However, there are ways to prevent a natural event from becoming a disaster, starting with the built environment.

The current western influence on the built landscape has no design consideration to the climatic conditions and is therefore ill fit for withstand cyclone disasters. This project will focus on using design methods that reflect the environmental conditions. Looking at the long term solution, rather than the immediate effect.
Tropical cyclones are a common occurrence for most countries in the Pacific Islands, usually occurring during the summer season. In the last 10 years Tonga has had over half a dozen cyclones.

The most recent cyclones were Cyclone Ian in January 2014, Cyclone Winston in February 2016 and Cyclone Gita in February 2018. Cyclone Ian was particularly destructive for Ha’apai island. The category-five storm destroyed more than 70% of residential homes and rendered half of the commercial buildings inhabitable. Additionally, 13 out of 17 schools were ruined and most of their agricultural produce was left tarnished. In Ha’apai alone, it is estimated that the cyclone caused a physical loss of US$49.5 million (or about 11% of the country’s GDP).41

Of the 4,000 people in Ha’apai who were displaced by the 2014 storm, just 50 new houses were built one year on.43 The apparent poor recovery effort left mass amounts of people homeless and living in tents, years after their homes being destroyed. The failure to rebuild, not just residential, but commercial buildings left those able no other option, but to leave.

4 years on and the destruction wrought by cyclone Gita has been labeled as the worst to hit Tonga in 60 years. This time causing chaos on the main island of Tongatapu.

**No matter what and no matter how dire people’s situation seemed, they still laughed and smiled. I think that shows the resilience of the Tongan people.**

If more effective post disaster solutions are not presented to Tongan communities, the mental resilience still apparent in the Tongan people will soon dwindle.


AFTERMATH

The decreasing population in Ha’apai and Vava’u, due to migration to Tongatapu over the recent years has become a developing problem in Tonga.

With lack of planning, Tongatapu is having to erect a large number of housing to accommodate the migrating people from other islands. To cater for the influx of people large forestry areas are being cut down to make room, meanwhile the city’s infrastructure is failing.

The lack of jobs in Tongatapu is resulting in increasing crime, riots, nabish and suicide deaths (particularly the youth). Suicide is a familiar situation shared by most Pacific island countries. “A decade ago there were an estimated 33,1000 annual suicides in the region, accounting for 18 percent of the world total.” 45 A number Anne Rasch, development advisor of Fiji Alliance for Mental Health, says is significantly higher. 46

The key cause for the growing rate of suicide lies with the high rate of unemployment. It is estimated that for every 8 school leavers, only 1 formal job is available. To make things worse the Pacific islands are increasing in youth population, with currently 54 percent of people under 24 years of age. 47

The challenge facing the Pacific youth is poor prospects of employment combined with aspirations generated by Western lifestyle exposed through mass media. Greater access to education should be translating into better opportunities of gaining paid employment, to a prosperous future. If not, Tongans will continue to leave the country in search for a better life; the others without that option; crime and suicide will seem their only choice.

An extreme example of the frustration felt by the community is the 2006 Nuku’Alofa riots. Just two months after the death of King Tupou IV, citizens of Nuku’Alofa engaged in frenzied riots, looting and arson. Figure 36 showcases the aftermath which left 60 percent of the central business district destroyed, with an estimated $123 million in damages. 48 8 bodies were found in the charred ruins. 49

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**Figure 36: Rubbish on Side of Street, Nuku’Alofa**

**Figure 37: Aftermath of Riot**

**Figure 38: Riot in Nuku’Alofa**
Tonga’s economy is reliant on tourism, fisheries and agriculture.

Uninhabited islands, world class snorkeling, whale encounters, caves, and diving, it becomes obvious why tourism is the strongest industry in Tonga, achieving greater than 50% of the GDP of the workforce. Secondary industries, agriculture and fisheries, contribute to a combine total of 37%; all crucial for the country’s wealth.

As a solution to the shortfall of revenue due to cyclone’s damage, fishing licenses were sold to overseas vessels for the right to tuna fish in their waters. Licensing has been justified by fisheries official’s “as better to get something out of fisheries, than nothing at all.”

Although this may seem an easy alternative to get money fast for their fisheries it is not an ideal solution. The short term effect might appear positive, but the long term will be a decrease to an estimated 70 percent of fish in Tonga in only 3 years.21 This will not only affect the fisheries industry, but also have a big impact on their strongest industry, tourism. Most of tourists come for the marine life that Tonga has to offer. Such a cut in the tuna population will drastically unbalance the marine ecosystems, hindering the very tourism that people travel the world to see.

Additionally, the sale of rights to fish to overseas has unmotivated local fishermen to fish, as their competition can fish far greater quantities than a local fisherman with a small craft. For example, in 2013, a total of 24 tuna fishing boats were fishing in Tonga’s 460,355 square kilometers. Twenty two of these boats were foreign fishing boats.22

With no fishing rights reserved to local fishing companies, the locals are ill-equipped to contend with such fierce competition. The loss of jobs continues to increase, with little hope for redemption when The Ministry of Agriculture, Forestry and Fisheries consider the industry dead. A decision that has greatly impacted the Ha’apai islands.

A short term gain, long term downfall. The government has not considered the impact such a decision would have on the nation. The population graph, shown previously in figure 6, perfectly outlines the direct relation in declining fisheries industry is having on Ha’apai islands. The only group of islands with a decreasing population.

2.5 INDUSTRIES OF TONGA

Tonga’s Tuna Fishing License Fees

Fishing for tuna is a great source of revenue for Tonga. However, the controversy surrounding the sale of fishing licenses has brought concerns about the sustainability of the tuna industry.

Figure 29: Tuna Fishing Boats in Suva
Figure 30: Tuna Fishing Boats in Nuku’ Alofa
Figure 31: Traditional Tongan Fisherman in Ha’apai

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Figure 30: Tuna Fishing Boats in Nuku’ Alofa
Figure 31: Traditional Tongan Fisherman in Ha’apai

2.5 INDUSTRIES OF TONGA
Ha’apai’s economy is a small consumption economy, largely relying on remittances given from overseas family, or foreign aid. It is hard for industries to be able to support themselves, as cyclones damage investments in agriculture, tourism and fishing.

Although Ha’apai’s small scale has made it hard for a strong economy to develop, a prosperous economy is possible. Their resources are some of the richest in Tonga. The 4 main industries in Tonga are the following:

- **Agriculture**
- **Fisheries**
- **Tourism**
- **Weaving Crafts**

### Agriculture

Agriculture in Ha’apai is done mainly at a subsistence level. Most of the produce that is harvested is Taro which is commonly used in all island countries of the Pacific. Tongan’s use their leaves as well as using it to wrap their meat when cooking their traditional Tongan feast, ‘Umu.

Ha’apai has rich soil and possible areas for larger farmlands to develop. Tonga’s main agricultural exports are copra (dried coconut meat yielding coconut oil), bananas, squash and vanilla beans.

If houses were to incorporate natural materials (emulated in traditional buildings) in replacement of western materials an avenue of agriculture for new homes could be explored.

### Fisheries

It is around the Ha’apai islands that Tonga’s fisheries are the richest. As a result of their vastly spread tropical islands being near the Tongan Trench, large reef barriers were formed surrounding great ocean depths. It is there, at the drop off that rich marine life is born with large schools of high grade tuna and snapper to feast upon.

Often commercial fishing vessels make weekly voyages to the Ha’apai group and return to Tongatapu to unload their catch and return.

Small fishing vessels leave from Ha’apai and use it for themselves or sell to the local resorts on the island.

### Tourism

Eco-tourism, more specifically, Humpback whales, is one of the most popular and vital attractions that enriches tourism throughout Tonga, offering, with only a handful of other countries, the opportunity to swim with the whales.

The whales are largely found in the islands of Vava’u or Ha’apai, arriving every winter in their hundreds. Travelling the long journey from Antarctica to give birth there. They are often encountered close to the islands within the reef barriers playing with their young.

Due to their arrival, commercial whale watching tours are located in the islands running many trips daily due to their proximity to the shore line. The struggling that Ha’apai is having has intensified since the tropical cyclone that hit early...
RE ESTABLISHING HA’APA’I

Challenges

The struggles that Ha’apai is experiencing has intensified since the tropical cyclone that hit in early 2014. Even though years have passed there are remains of the ruins that cyclone Ian left to fight with. As a result, the island has not been able to recover, as it cannot function without most of its infrastructure.

The priority is to re-establish a future for Ha’apai by re-developing their main industries - tourism and fisheries, consisting of a marketplace and port in Pangai, allowing citizens to establish themselves in Ha’apai rather than migrating. The objective is to set Pangai as the precedent for all the islands in Ha’apai Group. With the ultimate goal for Ha’apai to increase in population.

How can architecture solve these problems?

By providing necessary infrastructure that is currently lacking. Said infrastructure will provide incomes, which in turn will give the ability for people to stay. Additionally, the design will be in response to traditional Tongan values and act as a precedent for cyclone resilient architecture, in the hopes to educate locals on the topic.

The ‘Ha’apai Development Master plan’ outlines steps towards re-establishing Ha’apai.

HA’APA’I DEVELOPMENT MASTER PLAN

The developing problems inflicted throughout Tonga, mentioned previously in ‘aftermath’, forced the Government to react. The Ha’apai Development Master Plan was issued in 2010, proposing a plan for the next 10 years. Its main purpose was to investigate the social and economic problems experienced and address the needs of the people of Ha’apai.

The master plan was funded by AusAID, along with similar proposals issued for Vava'u and ‘Eua.

Two consultants, Sione Tu’itupou Fotu & Sinaitakala Tu’itahi, traveled and met with the communities from the 6 main districts of Ha’apai. A total of 187 people participated in the consultation process and from there the needs of each island community were able to be recorded and prioritized.

The master plans main objective is:

“To provide a Master Development Plan to prioritize projects that can further enhance the development of the Ha’apai Group to improve the living standard of its people and contributes to the economic growth of the Kingdom.”

The aim of the master plan is to focus on developing the infrastructure of Ha’apai in the period of 10 years. To do so, the infrastructure needed to operate, for example electricity and water, will be provided. Additionally, the design will be in response to traditional Tongan values and act as a precedent for cyclone resilient architecture, in the hopes to educate locals on the topic.

The ‘Ha’apai Development Master plan’ outlines steps towards re-establishing Ha’apai.

The following diagram (Figure 45) summarizes the infrastructure to be developed in ranking of importance. The first improvements were the Ha’apai fish market building which was opened 2014 and subsequently closed in 2016 due to severe damage.

There are number of overarching ideas outlined in Ha’apai’s master plan which will be useful for developing the brief. Key points taken from the master plan’s vision to establish a strong Ha’apai Group which will be useful for developing the brief.

Firstly, to strengthen Pangai as the stable capital city of Ha’apai. To establish Pangai as the centre piece by developing an inter transit ferry system that accommodates and branches out to other districts.

Secondly, to promote sustainable management of resources.

Lastly, the power of collective individual action. The cumulative effect of individuals contributions makes a difference. Individually and collectively all are responsible for determining the future their surroundings and community.
2.6 PRECEDES

In order to present a clear understanding within which this research project is positioned, three precedents have been selected, eachone demonstrating a different aspect of architectural design relevant to this project. Whether they are an architectural ideology, or the functioning purpose of the building, it is beneficial to research negative and positive outcomes from similar projects.

These precedents are all community driven, with a purpose to serve their community. Differing locations means they all function according to their climatic conditions, culture and materials.

The analysis will consist of their functioning aspect, integration of their culture, and how they become an architectural representation of the communities they serve.
NEST WE GROW
Kengo Kuma & Associates
Hokkaido, Japan
2014

Nest we grow is the result of an international design competition focusing on new California driven architecture new to Asia. It is an open public structure where its intent is to bring people together with the involvement of storing, preparing and enjoying food in Hokkaido.

Architecturally, there is a beautiful balance between the new technological advancements in material selection and the more traditional Japanese crafts. This is evident in the usage of rammed-earth walls and straw bale construction, foreign to Japan, however when inside the grid like structure of composite columns reminds us of the beauty in Japanese timber construction.

The purpose of having these foreign methods in such a communal building was to express how these solutions could work in Japanese buildings. It was to become a building that “would introduce renewable building techniques to an area of Japan that could take advantage of these concepts.”

The program of the building acts as a life cycle of their food. Growing, harvesting, storing, cooking/dining, and computing which then restarts the cycle. All the members of the community help to complete the stages. The building becomes a platform for community learning from the experience, while also benefiting from gathering and cultivating resources through the whole year.

What works well is not only the architectural aspects of the building, but fundamentally its connection to the involvement with the community. It isn’t a marketplace or a farm, but becomes the whole process, from start to finish. This makes it an integral learning experience to the people on how to produce and live off their own produce. It is a never ending process and passes on to the new generations.

One negative would be the long term outcome. Being a community building with open access, one could see problems with ownership of their produce. It would be easy to see select people doing most of the work, while others benefit from the outcome.

Although on the outside we find near to no architectural connection to Japanese Design in the interior is the opposite. Dominated by the wooden column grid structure and the use of precise Japanese carpentry joinery techniques. A nice balance between new and traditional methods for Asia.

New materials such as the clear corrugated plastic cladding and rammed-earth walls brought a spark of new to the community. Acting as an example or precedent to the community of new building techniques and how they can be incorporated to their buildings.
Figure 54: Cycle of Nest We Grow

- CORRUGATED PLASTIC CLADDING
- GRID COLUMN STRUCTURE ALLOWING CLADDING TO BE NON LOAD CARRYING AND SUSPENDING FOR BETTER CIRCULATION OF AIR
- WATER CATCHMENT TANK
- ROOF OPENS TO ALLOW WATER CAUGHT BY ROOF TO FLOW INTO TANK
- RAMMED EARTH WALLS
- COOL AIR FROM ALL DIRECTIONS TRAVELS FROM THE UNDERSIDE OF THE CLADDING TO THE ROOF OPENING

Figure 55: Cross Section Nest We Grow

- Growing
- Harvesting
- Storing
- Cooking / Dining
- Composting
The Besiktas fish market project was commissioned by the community to GAD architecture with the aim of revitalizing the neighborhood.

Besiktas is one of Istanbul's most populated and diverse neighborhoods with a rich history and old village atmosphere, currently in process of renewal and preservation. 56

The design direction is heavily influenced by the triangular site that it sits on. Due to the location being in a busy commercial district, GAD wanted to benefit from its exposure as much as possible, with the intent of making the market as welcoming as possible from all directions to the public.

As a result, “the surface was pierced along its periphery. This technique created a hollow, porous form allowing program and circulation to easily mix and flow”57 – Gozde Nur Deniz.

The structure is a simple yet unique steel seashell-like covering with large openings at ground level. The sturdy structure rests on three points at the end of the triangular shaped roofs, thus allowing a column free interior space. This optimizes the project’s programmatic needs, a dramatic market place.

The interior volume is divided into 6 sections using locally made stainless steel cabinet stands. These sections are all intertwined with pathways that links them together while also extending them to the larger urban fabric outside the marketplace.

The use of materials and building techniques is something that contrasts with its surrounding building fabric. The only connection to the past or traditional markets in Istanbul is with the hanging bulb light bulbs which are commonly found in Istanbul bazar type marketplaces.

57  Ibid.
The project, led by Architect Ken McBryde and Nev Hyman, was an experiment in using recycled plastic waste and wood composite to make affordable housing for Pacific nations that could be erected quickly with ease. Initially it was aimed to be for Papua New Guinea but following the Cyclone Pam in March 2015 they redesigned the Nev House to withstand tropical winds and shifted their attention to Vanuatu.

The house was designed to be culturally appropriate as well as strong and affordable. Their aim was to listen to the people and design a house they’d want to live in. Low level louvres help control privacy while also allowing ventilation to occur as needed. The materials consist of wooden columns that help support the wooden rafters that hold the corrugated roof. The large overhangs provide good shade while also a shaded entrance porch is created. The walls are made of the recyclable plastic waste with specially manufactured wall cladding sheets.

The idea of being flatpack was so that the houses could be manufactured in advance in Australia and then be shipped to Pacific nations and erected where needed. This allows for a quick solution, if the initial manufacturing the structures was done before the natural disaster hits.
Though a well considered design, there are concerns worth noting. Producing in another country may be an advantage for efficiency, but adversely this means locals are relying on other people for help. Also, the very specific material narrows its scope. The specialised material means locals would not be able to maintain the building, should a disaster occur again. For example, if a portion of the external walls are damaged Vanuatu would not have the necessary materials to repair the structure. A new sheet would need to be shipped from Australia taking more time and resources than it would have taken if locally produced materials were used.

If the buildings intent is in fact temporary solution for a disaster struck country, the act of shipping and re-shipping to different countries is not very sustainable.
Potential sites were filtered by considering sites only on the main island of Lifuka, relative to the water. Analysis of the environmental, physical, and social context was completed for further understanding.

Their suitability was judged by a table of criteria, namely, existing public and commercial infrastructure, accessibility to outer islands, current community engagement, and potential to achieve the key proposals mentioned in the Ha’apai master plan. A site located in Pangai was ultimately chosen. The reasoning for this site selection will be explained in the following pages.
Pangai presents the best opportunity to make the most impact, as it is the center point of all Ha'apai. The site fits well with the vision that was created in the Ha'apai master plan, 2010, to establish Pangai as the center point of Ha'apai.

Key attributes of the site:
- Proximity to main road (allows easy connection from airport, port, all Litufa’s settlements & Foa island).
- Located near farmlands for easy access for local farmers to bring their goods.
- Easy proximity to Port, vehicles are a luxury item and some fishermen may not have access to one.
- Within the town center to achieve maximum exposure.
- Existing infrastructure destroyed in Cyclone Ian, and in need.

Figure 62 Site Analysis
The adjoining image highlights the towns in the Ha'apai islands shown shaded in red. It is immediately clear that the more populated areas are in the Islands of Litufa and Foa, which are connected by an elevated bridge.

Pangai is considerably the largest. The main ferry terminal is in Pangai, that connects to all the secondary islands. In social context, this location has the potential to benefit the majority of towns in the Ha'apai islands, as there are direct infrastructure connections to where the potential project is to be located in. The ability to cater for a wider audience, rather than restricting to one local community, strengthens the reasoning for choosing this site.
The port facility in Pangai serves as the main port for the Islands of Lifuka and Foa. It is the largest in the whole Ha'apai group and serves the ferry arrival from Tongatapu and Vava'u.

Having the largest port has given Pangai an importance in Ha'apai and now acts as the capital city of the islands.

After the master plan was issued in 2010 the port became more usable, as the natural channel and lagoon were dredged to facilitate larger vessels to dock.

It's protective natural reef barrier acts as a natural entry channel and makes the water very calm, even in windy weather. This enables larger boats to maneuver with ease. Various light beacons were added to mark the path for the inter transit ferry to arrive at night from the other main islands in Tonga.

The 2014 Cyclone 'Ian' cause chaos to the Ha'apai Islands including devastation to Pangai. The damage to the port itself was not substantial, as the hard concrete and low profile port was able to withstand the strong winds and therefore the core structure remains functional until today. The majority of the damaged impacting the buildings located at the port.

The port is still being used as the main port for Ha'apai in its wounded state. With careful planning and thinking there would be opportune outcomes to come from it the structure remains with the possibility for a waterfront to develop on the existing foundation.
The fish market building in Pangai was constructed in conjunction with the development of Ha'apai Master plan. It was one of the donations provided by King George Tupou V to aid in the possibility of a renewable income to develop in the distant islands.

Although there were markets before which often took place in schools, or any large community halls, this was to be the first large-scale building to be built to serve that purpose.

Initially the market was built solely as a fish market, however increasing demand for a variety of produce from the locals altered the building's intent. The communal building served all fishermen of Ha'apai, as opposed to a private business.

Its close location to the port and docks made it easy to transport their catch without the use of any vehicle as it is a commodity that not everyone can afford in the Ha'apai islands.

Cyclone Ian damaged the relatively new building soon after the 4 years of construction. The cyclone caused substantial damage to the roof, pulling most of the corrugated steel structure apart. The front facade of the building is still mostly intact however the rear wall collapsed on itself and is being held by temporary timber framing.

The market remains in the same condition as it did in 2014. Figure 66, taken in 2016 shows the building in its current state, which looks like the cyclone hit recently.

With no other place to relocate, every Saturday the unfit, dangerous building hosts a fresh produce market for the community. Mainly filled with locals to sell their produce to tourists and locals.
A limitation to the project is accessibility to the site. However, a site visit before this project commenced was achieved. A selection of photographs that were taken at the port in Pangai are shown.

Ideally it would be beneficial to inspect the site numerous times, to develop a stronger understanding of the site’s physical and social context.

Figure 78: Figure Marking Site Visit Images
Figure 79: Coils in Port, Pangai
Figure 80: Street View South
Figure 81: Road to Port
Figure 82: Street View North, Fish Market at Background
It is a common site seeing these types of small docks for local fishermen around Tonga. They are often erected with wooden deck structures with floating devices to support them underneath. The low cost solution has expanded over the years, and it fulfills the purpose for what they are used for.

Marketplaces are often erected by the street fronts of villages, although sometimes there are allocated marketplaces, like in the adjacent figure. It is common that insufficient room is allocated, making the sellers push their produce to the sidewalk to remain by the street frontage. Sellers return every weekend to the market developing a friendly relationship with the locals and tourists of the area.
4.0 DESIGN PROCESS
Initial thoughts on the design scope was to focus on creating a market place. However, upon further understanding of the situation and needs in Ha’apai, the development of this project increased in scale. The project is the establishment of the Pangai waterfront in Ha’apai using a fusion of traditional and modern techniques. The project consists of an amalgamation of four interrelated programmes; a market place, a marina, a weaving and restaurant building, and a boat shed. These facilities will be developed around a walkway. The walkway will become the connection from the existing ferry terminal towards Pangai township, a connection that is currently non-existent. The overall proposal will enhance the Tongan culture by providing a place to work, while also allowing tourists to observe and learn their methods.

In 2010 the Ha’apai Development Master Plan was released outlining a 10-year strategy. The overarching key message; “developing the tourism sector is the best way forward for Ha’apai’s development” 59 mentioned in the strategy is useful for developing the brief.

The success of the waterfront revitalisation is reliant on engagement with the local community. In a pragmatic sense, success will be achieved by providing facilities evidently lacking in Ha’apai, with the intent to develop industries towards tourism. Ideologically, an emotional connection with the newfound community precinct will be based on the inclusion of anga fakatonga (the Tongan way).

A brief is provided to ensure all components of each of the above elements are considered from the beginning of the design process. 59 Ha’apai Development Master plan, pg 49.

1. Experience
The primary aim is to create a path that connects the tourists to the locals, thereby creating potential economic growth. The path will be formed as an interactive walkway, starting at the Ferry terminal and wrapping around the waterfront, with local businesses coiled off it. Additionally, the intention is to strengthen ‘anga fakatonga’ by providing spaces to educate locals and tourists on traditional crafts, whether it would be in boat building, or weaving, to avoid ancient art forms from fading away to Western solutions. This project will strive to establish an understanding of Ha’apai land and resources by enabling an experience that encompasses the following values:

• Relation to the environment
• Connection to Tongan culture
• Interaction (Tourist vs Locals)

The design is intended to provide facilities to advance Ha’apai’s industries, while portraying a cyclone resilient model that brings the locals and tourists together through various forms of interaction.

2. Aesthetic
The aesthetic and building elements shall respond to traditional Tongan architecture, with the appropriate incorporation of modern techniques. Emulating a celebration of Tongan culture.

Figure86 Bubble Diagram
3. Function/Programme

The project will include areas and facilities which cater for:

**Market**
- Open space
- Access to road for deliveries
- Allocated delivery space
- Openings from multiple directions
- Fixed display areas
- Area for additional removable stands to cater for future influx
- Area separation between fish and fresh produce market

The Market building should have a capacity for 80 people to account for local sellers and tourists. A generous outdoor area must be provided for public to encroach onto in case of an increase in numbers.

**Marina**
- Multiple marinas to cater various size boats
- Accessibility to Waterfront project
- Secured

**Restaurant**
- Kitchen + dining
- Indoor and outdoor sitting
- Washrooms facilities
- View

The restaurant should accommodate for at least 30 guests. This is taken from an average in tourist numbers in the Ha’apai islands and locals.

**Boat shed**
- Proximity to sea for easy launching
- Large open space to accommodate different boat sizes
- Indoor area to work in a shaded environment while allocating outdoor areas due to height restrictions

**Weaving House**
- Open area for tourist to observe how the Tongan women create their crafts
- Medium size open space

Although the weaving house will only be used by Tongan women it could serve as a variable space for special events. For example, tapa cloth workshops and dancing events.

**Ferry Terminal**

Existing terminal will be used as it is currently in service. Development of connection to proposed waterfront.

**Marina**

The marina will be used to accommodate private yachts while allowing easy access to the marketplace and restaurant facilities.

Local fisherman will get to construct or maintain their boats in order to maintain the demand of the marketplace. Would be placed by the natural lagoon to launch boats with ease.

**Transport Stop**

Area allocated to facilitate means of transport for locals and tourist.

**Ambient**

Platforms walkway to observe landscape.

**Small Dock**

Existing small dock to be used by fishermen to unload and head to marketplace. Also can be used for dinghies or small crafts to be tied in.

**Weaving Deck**

Platforms walkway to observe landscape.

**Weaving House**

Alfresco area for tourist to observe how the Tongan women create their crafts.

**Transport Stop**

Area allocated to facilitate means of transport for locals and tourist.

**Marina**

The marina will be used to accommodate private yachts while allowing easy access to the marketplace and restaurant facilities.

**Ferry Terminal**

Existing terminal will be used as it is currently in service. Development of connection to proposed waterfront.

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Local fisherman will get to construct or maintain their boats in order to maintain the demand of the marketplace. Would be placed by the natural lagoon to launch boats with ease.

**Transport Stop**

Area allocated to facilitate means of transport for locals and tourist.
Previous research showed that traditional Polynesian architecture was derived from their methods of boat construction. It is often described that the fale is an inverted canoe, where the hull becomes the roof. Building form is one of the only similar attributes, but also structural methods and choice of material.

Polynesian boats are very light and so are their buildings. Their design isn’t to fight the tropical conditions, but rather they become flexible, not obstructing the wind like a thin palm tree is able to withstand the winds. Tongan architecture and boat building follow similar attributes.

The approach is then to take influence from their boat manufacturing methods and incorporate them into the design proposal, with a combination of tension, lashings and weaving. The positioning of the project close proximity to the water, which naturally influences the buildings design, a suitable location to incorporate the traditional aspects.
Before site and programme specific design can begin, a concise understanding of basic design principles when building in cyclone prone areas needs to be achieved. The following are selected principles for safe construction methods against cyclones:

**Site Location:**
Building position is important, however there is often little choice on site location, perhaps because of financial constraints. It is essential, therefore, to recognise when a building is in a more vulnerable area and to build accordingly. Do not build at the head of a valley, or on the top of a hill due to the wind speeds being much higher. One can take advantage of naturally protected areas due to rocks, banks, and strong shrubbery. A tree can shield 8-10 times the height of itself, however it is important to keep a distance of 1.5 times the height of the tree away from the house, to avoid any damage to the house should the tree fall in a disaster.

Cyclonic storms always approach from the sea towards the coastline, however during the cyclone the wind direction, relative to a building, remains random, due to the rotating motion of the high velocity winds. Therefore, we can’t necessarily predict what would be the most advantageous orientation of the buildings to combat wind direction during a cyclone.

**Building Form + Planning:**
The physical geometry of a building is an important factor in determining a building’s performance in cyclones. Simple, compact, symmetrical shapes are best. The best shape to resist high winds is square. If other shapes are desired, recognition of the implications of design decisions must be considered to counter any negative features. For example; strengthening the corners.

Rectangular configuration is a strong resilient shape provided that the length to width ratio does not exceed 3:1.

When considering a group of buildings, a random clustered arrangement is preferable instead of a grid layout, explained in figure 93. This avoids a wind tunnel effect to be produced when buildings are arranged in a row format.

Figure 93 shows the effect of wind circulation through the building form with black and red arrows that display different wind directions.

No concentrated wind tunnels can be formed as buildings break up the wind flow.
A common way for buildings to be destroyed in a storm is wind acting on the roof surfaces of a building that creates lifting forces due to negative pressure. heavyweight roofs are designed to fly off in high winds. To minimize uplift the upper structure should be securely attached to the foundation with the use of columns or walls.60

Solid roof sheathing materials, like corrugate, can provide fast roof covering solutions, but often become hazardous during heavy storms. They are the most common area of failure during cyclones.61 Other roof coverings, such as the traditional thatched roofs are safer options during a storm, as they create minimal risk of damage in comparison to a corrugated metal sheet. Used from local materials, the thatched roofs would then be easily repaired after the cyclone has passed from local materials.

The ideal roof shape is categorised in the figure below, in which form best to worst. The ideal shape for a roof is a dome structure. Traditional building structures in Tonga use this form. If a pitched roof is constructed then the hipped roof provides the strongest form due to its similarity to a dome, as there is less area facing the wind, therefore reducing the negative suction pressure created. Gable roofs can also be used, but need good quality building materials and should be a minimum pitch of 22°, ideally 30°, to mitigate the effect of the splitting forces on the roof.62

Roof Shapes

Large overhangs should not be used, ideally they should be kept at least five half a meter long. If a sheltered outdoor area is desired, it is better to make an individual veranda construction. This is done so that if any wind is trapped under the veranda then the individual veranda structure will break keeping the roof intact, shown in Figure 99.

Figure99 Verandas and Overhangs

Openings: Openings weaken the building susceptible to collapse by high wind pressure, creating debris. Conflictingly, they are essential for light and ventilation. Openings must be securely closed during a cyclone, i.e. with shutters. In a Westernised era, today glazing is an obvious inclusion in a home. Yet, glass is precarious in the event of a disaster. Smaller openings and thicker glass could be incorporated, as well as adding pasting thin film to help hold the debris of glass panes from flying. Glazing isn’t a common way for buildings to be destroyed in a storm as flying timber, corrugate sheets, or shards of glass, are dangerous. The pride locals associate with owning a fale Tufitfi, or home with western materials, is detrimental to creating a resilient home. Although Tonga may consider western materials modern, not all are available in their environment. Locally sourced materials are safer in storms, and are readily available, making the resilient homes. The challenge is to find the balance between modern and traditional.

Connections: All structural members should be securely connected, to ensure the rigidity of the building is evenly distributed.

SUMMARY: The pride locals associate with owning a fale Tufitfi, or home with western materials, is detrimental to creating a resilient home. Although Tonga may consider western materials modern, not all are available in their environment. Locally sourced materials are safer in storms, and are readily available, making the resilient homes. The challenge is to find the balance between modern and traditional.

Construction Quality: Poor construction and workmanship are a major cause of damage. Educating the local workers is essential in creating better built structures in the future. Less reliance on outside help.

Figure98 Roof Shapes

Walls: Walls must be strong enough to prevent openings blowing walls inwards, and the joints must be strong enough to resist the uplift on the roof. Interior walls can be used to help external walls resist the direct horizontal pressure of the wind, they help brace external walls and are necessary every 6 meters.63

Figure98 Roof Shapes

Material: The greatest danger to people in a storm is flying debris. Flying timber, corrugate sheets, or shards of glass, are dangerous. The pride locals associate with owning a fale Tufitfi, or home with western materials, is detrimental to creating a resilient home. Although Tonga may consider western materials modern, not all are available in their environment. Locally sourced materials are safer in storms, and are readily available, making the resilient homes. The challenge is to find the balance between modern and traditional.

Connections: All structural members should be securely connected, to ensure the rigidity of the building is evenly distributed.

SUMMARY: The pride locals associate with owning a fale Tufitfi, or home with western materials, is detrimental to creating a resilient home. Although Tonga may consider western materials modern, not all are available in their environment. Locally sourced materials are safer in storms, and are readily available, making the resilient homes. The challenge is to find the balance between modern and traditional.
The proposal comprises of a walkway, marina, boat shed, restaurant and weaving building, and a marketplace. These entities have their own prerequisites, in accordance with the overall brief.

As displayed in the adjoining master plan, the project is categorised into 5 sections: 1. walkway, 2. marina, 3. boatshed/workshop, 4. restaurant and weaving building and 5. market.

Each section will be explored as an entity. All sections will be looking at cyclone resilient architecture, and incorporating traditional techniques, before a master plan will be outlined at the end of the design process.

1. WALKWAY
2. MARINA
3. BOAT SHED/WORKSHOP
4. RESTAURANT & WEAVING BUILDING
5. MARKET
The first component of the master plan is the walkway. The walkway will act as the spine of the project, linking all the programmes together. Consideration of the natural surroundings will be in place to ensure the walkway doesn’t just connect the user to abutting facilities, but also experiences to the land and sea.

Similar waterfront examples were researched in order to achieve a deeper understanding. The following boardwalk in Auckland City and its connection between Westhaven to the City Centre was analysed.

The collection of concept sketches to the right is an initial analysis of various shelters. Exploring their use, whether it be for people waiting for a ferry, a landmark for pop up shops - such as bike rentals, or simply a resting spot for users of the walkway.
Wynyard quarter, highlighted in figure 103, is a transition area in the Auckland city boardwalk. It offers a pedestrian walkway along the docks with many restaurants fronting the public space, allowing immediate connection with outdoor seating, providing a place to sit down and enjoy the atmosphere.

The width of the walkway allows for different points of engagement, whether it be passing through, various forms of seats to take in the surroundings, or playful sculptures for a more tangible interaction.
Figure 105 Waterfront Walkway

The Westhaven Promenade, highlighted in figure 102, is a 2 km walkway + cycleway that connects the Westhaven Marina with Wynyard Quarter.

The 5m wide path along the water's edge is a shared space for both pedestrians and cyclists to enjoy. The Promenade is a step supporting the vision of Auckland having a 10km public waterfront walkway and cycleway connecting the Harbour Bridge Park in the west to Teal Park in the East, where it then continues to the walkway and cycleway towards Tamaki Drive.

The Promenade directs and engages people to an area that was previously designated as unwelcoming. The surge of interaction in Westhaven can only be a positive in spurring interest to existing activities like the water sports clubs.

The design consists of simple neutral materials; timber, steel and concrete. This provides a cohesive aspect and becomes consistent with materials used in Wynyard Quarter. Certain sustainable design principles have been adopted:

• Constructed of sustainability hardwood timber
• Recycled Westhaven pontoons
• Provides native planting along the route
• Been designed to withstand sea-level rise and flooding from storms.

In the middle of the walkway above the bay is a view point platform that comes off adjacent to the walkway. This creates a defined resting area while enjoying the view.

As the path transitions briefly from the water to land there is a more secluded area where lounges are placed. Note change in surface material from wood, to more permeable stones.

At the end of the bay there is a sculpture that represents the Wikato that beached in that bay. A gesture to the history of the area.

Figure 106 Site Visit Photos

In transitioning back from land to water, stainless steel shells in the concrete create a point of difference. Creating a relation between land and sea in a man-made manner.

The walkway varies in material, wood above the sea and concrete on land.

The Westhaven Promenade, highlighted in figure 102, is a 2 km walkway + cycleway that connects the Westhaven Marina with Wynyard Quarter.

Certain sustainable design principles have been adopted:

• Constructed of sustainability hardwood timber
• Recycled Westhaven pontoons
• Provides native planting along the route
• Been designed to withstand sea-level rise and flooding from storms.
The walkway will commence at the ferry terminal building and end at Fanga Road. As tourists, and locals, depart the ferry they can meander along the path, encountering allocated spaces for cultural activities, such as Kava ceremonies. The highlighted area in green (Figure 110) designates where such ceremonies can take place. The courtyard could be used for other activities, like dancing. Central in its location, the proposed facilities are close in proximity, and has direct visual connection to the water. Traditionally Kava ceremonies would be held on the beach as it acts as the threshold from water to land.

The walkway will act as a playful connection to the water’s edge, with a change in transitions in between spaces. It will highlight specific ocean views, while also dedicating areas for small temporary stalls to be allocating along the walkway. Shading structures will be included to provide shelter for anyone not along the walkway. The objective is to draw people from every direction and lead them to the newly built facilities.

Like in Maori culture, where the Karanga takes place when visiting a new Marae and songs are sang to call the spirits to the new arrivals, Tongans too have their rituals. The walkway could act as a response to the welcoming ceremony that Tongans have.

Also, the walkway could be used to display artwork/sculptures of Tongan designs. Semisi Fetokai Potauaine is a Tongan architect and artist whom has featured in Headland Sculture on the Gulf. His pieces represent Polynesia Moana which would suit well due to the proximity to water. Pieces such as this one would also act as a beacon and clearly display the start of the walkway.

The marina is to be a Mediterranean style berthing. Mediterranean style berthing is the most space efficient method of berthing. It requires a single pier on the stern of the boat allowing boats to be much closer together. This method means only one pier is needed making it significantly cheaper; due to less structure being needed. Boats are secured on the stern by two points while the bow is simply using the boat’s anchor to prevent any swinging. Another advantage of this style of berthing is that it can cater a variety of boat sizes due to no specific marina size being created.

Negatives are that it does not provide as many anchoring points for the boats and require a well protected area to maneuver, as there is more room for human error.

Due to the site location and the proposed building shielding the marina from the prevailing winds this method of berthing could be of benefit to the town of Pangai.

The marina would then be accessible by close proximity to the restaurant and the marketplace allowing the tourists a better chance to use them.

The design approach for the new structures will derive from the fale technique that was looked at in the literature review. A series of central post columns will support the roof structure, while additional non-loading columns around the roof edge will be used to create walls by wrapping thatching sheets.

The center of the structure is the private more intimate area, while the outer edges act as the semi-private entry points and transition areas from the outside to the inside.

Every proposed structure will consist of this structural approach but will vary in size to accommodate the functional requirements of the building type.
Initial concepts were derived from boat designs, where tension through ropes and mast type structures are used. These masts could then support movable walls that could be held open and close as needed. The masts would fit well on the site, due to the proximity to the sea, but could be too radical to the locals, as it may differ too much from Polynesian typology. Additionally, the masts resilience is a concern.

Due to the differing function of each programme, the corresponding building form will need to respond accordingly. For example, the weaving house needs to be more private than the marketplace building. Standardizing all the structures to have outer columns allows the possibility for modular panel type walls to be placed. These panels can vary. Some that are louvers, swinging doors, etc, to adapt best to the purpose of the building.

Modularity also allows for easy manufacturing and replacement. These panels will be simple to remove from the building and be replaced if damaged, a nod to the traditional fale approach. An example of the indication towards resilience is if a storm arrives these panels can be removed and stored underneath the floor before the cyclone hits. This would eliminate the lateral forces that cyclones cause on buildings, as no walls will obstruct the wind forces.

4 different modular panels have been explored. Materials will be locally sourced timber and woven palm tree screens thatch together. No glass will be used to eliminate potential danger in the event of high winds.

The following pages outline the 4 panel modules in further detail.
The model above demonstrates how the panels can be removed and stored flat underneath the floor boards. These can then be strapped down to the ground. In the event of a cyclone minimal to no damage would be done to the walls.

The restaurant and weaving will be close together, separated by an outdoor deck. The deck also acts as a thoroughfare to the marketplace, increasing exposure to foot traffic, in the hopes that tourists get tempted to go to the restaurant afterwards.

Locating the weaving house close to the restaurant instigates a curiosity in customers who are dining opposite, creating deliberate observation of the crafts by Tongan women, with the intent to increase a purchasing opportunity.

The marketplace will be adjacent to the road to allow deliveries to occur without impeding the new waterfront.
The boat shed will be located close to the existing boat ramp. This boat ramp is not used as much now due to the construction of the newer and bigger ramp that was made during the Ha'apai master plan in 2010.

The boat shed and workshop will be used for locals to repair and construct small vessels in order for larger amounts of locals to fish in order to consume or sell their catches.

Different boat sizes will be able to be fitted due to the grid structure chosen, the following figure explains how it can be used to accommodate different working areas. The design of movable walls means the locals can easily use any panel as a door to easily move boats in and out as needed.
5.0 DESIGN OUTCOME
This research project presents one example of how architecture can be used as a mechanism to enhance vital industries in Ha’apai, through the revitalisation of the Pangai waterfront, and therefore strengthening the economy in Ha’apai.

The literary content provided a historical understanding of traditional Polynesian architecture, and Tonga’s cultural practices before Western arrival. Analysing the effects Western influence had on Tonga and considering the underlying beliefs and traditions still prevalent in Tongan society, led to an understanding of the key values to incorporate in the design.

Once an understanding of the present architecture, and traditional fale typology was achieved the next step was to look at resilience in tropical climatic conditions. The destruction caused by the frequent cyclones developed into a mass social, and economic problem, largely due to the buildings lack of cyclone resilience. Exploring necessary methods to achieve increased resilience helped inform the modular typology of the design. Analysing Western and Tongan traditional knowledge to address the realities of climate change, informed a stronger, responsive solution. Taking note of traditional techniques in the fale, like movable walls, and utilising locally sourced materials, while positioning and forming in such a way that influences from Western styles.

The aim was to re-establish Ha’apai, to provide a solution to the social-economic problems that are currently taking place. To provide a social hub to display and celebrate Tongan culture, to locals and tourists. The design was not for financial opportunity, but also the potential to hold ancestral celebrations that are vulnerable in today’s Western age. In order for the locals to feel associated with the new waterfront, cultural traditions from the literature review were incorporated in the design. The walkway represents the idea of the Ana’i ceremony, it guides new tourists arrivals into a story telling pathway where they are greeted by the ceremonial traditions that Tongans are so proud of.

The relevance of this project has hopefully indicated a new direction of hope to Ha’apai. At minimum this research has outlined the importance that re-establishing and embracing traditional values can have on a small entity, like Ha’apai, both in terms of livelihood (architectural resilience), and survival of a culture.

Upon reflection, undertaking a broad design scope directed a large amount of time on the master plan, and therefore limited the amount of detail attainable. If the process were to continue, regular site visits would be arranged, to delve further into the micro environment, these discussions could include; a typical day of a Tongan, talking to the locals, recognising where infrastructure is lacking, analysing the current mixture of typologies and culture, being amidst the environment and the lifestyle - anaga fakatonga. Such observations would provide sound understanding of what is needed and allow the design to not be solely based on what records show, but from sympathetic encounters and considerations.
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