“Tangible Architecture”
Proposal for a natural experience in a manmade environment

A Research Project submitted in partial fulfillment of the requirements for the degree of Master of Architecture Professional
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New Zealand appears to me to be one of the few places in the world that still has a strong sense of untouched nature. And people who live in this amazing environment should do their utmost to preserve it. My previous occupation as a scuba instructor has given me unforgettable underwater experiences. I want to use this experience to reproduce it architecturally and share it with the majority including children and elderly.

During the struggle and accomplishments of this project, there are many people who have supported and helped me, without whom this project will never be possible. First of all I would like to thank my parents who love and support me unconditionally, and my mentor Mr. David Chaplin whose encouragement, guidance and support from the start to the final stage that allow me to develop a better project.

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My best wishes to you all.
ABSTRACT

Nature provides the environment for all lives including people, and allow us to compete and survive. Most would agree that, for healthier and happier lives, people should know more about nature and the natural environment. The natural world as we know it is declining. And irresponsible human activities should be stopped, or at least restricted. Although there are people and organizations that strive to protect the natural environment, the majority's knowledge about nature is limited. Through the study of natural environments and architectural precedence, this project proposes to develop a design for a series of spaces in order for people to intimately experience the natural environment – the marine environment in particular – in constant changing conditions. By experiencing nature closely, people may gain more knowledge and understanding about the natural world. And hopefully, because of this experience, they will have more respect for the surrounding natural environment.
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1.0 INTRODUCTION

1.1 Research Question

How can architecture allow people to experience the natural world in its most authentic and primitive condition?

1.2 Aims and Objective

The design or the research of this project aims to showcase and demonstrate the provision of architectural spaces that, to a considerable extent, engage us with the surrounding natural marine environment. The research project is expected to result in a series of "Experimental Laboratories" that are open to the public and will open the public objectively to the natural environment. By monitoring and experiencing the changes of the natural world from these spaces, people might develop more respect for the natural environment.
1.3 Outline of Project

The core of this design project seeks to allow people to experience natural environment in an intimate relationship. This requires the architecture, which is the medium between people and the natural environment, to extend the human environment into the core of nature. Nature, which is an enormous living organism, is always changing. To achieve an intimate relationship, the architecture needs to adapt to the natural movement and do its best to encourage people to engage and get involve with this movement so that people might have a better understanding of nature. To be precise, the project will connect with the marine environment that it will demonstrate the power of architectural form and space to interact with natural movements.

The research will study and analyze architectural precedents including projects by Tadao Ando and Peter Zumthor, which have achieved a harmonious relationship with the natural environment. This background helps to develop the design methodology and the architectural language. The project will also look into existing aquariums and their exhibition programmes to create sufficient functionality to allow public involvement. Learning from these precedents, the design of the “Experimental Laboratories” developed a cluster of blocky spaces that accommodate both public visitors and research professionals. Its functional spaces include offices and laboratories for the researchers, exhibition, and gallery spaces for the visitors.

1.4 Scope and Limitations

The project focuses on developing and exploring formal and functional arrangement of the building complex to sufficiently serve its objective.
2.0 CURRENT STATE OF KNOWLEDGE

2.1 Ando’s Architecture

The architecture of Tadao Ando is known for its use of simple geometry, light, shadow, and connection with the natural environment. His works and philosophy are the main inspiration of this project.

Born in Japan in 1941, Ando grew up in a traditional Japanese home, from where he gained his first sense of architecture. At the age of twenty-four, Ando left everything behind to travel the world. The travel experience did not only help to increase his architectural knowledge, but also gave him an intuitive sense of the Earth and nature.\(^1\)

After nearly four years of travel, Ando began his own practice of architecture in Osaka. Influenced by the modernist movement, his work employs simple geometries and modern construction techniques, which often result in plain and minimalist boxes and walls. However, unlike other modernists, Ando’s works are often considered highly regional not because of their external appearance, but rather that their architectural quality illustrates his deep and unique interpretation of traditional Japanese architecture, which is really about an intimate relationship with nature.

His geometry

Especially in rural areas (similar to this project) the general geometry of Ando’s architecture usually follows the natural forms of the landscape. He uses simple geometry, which people could easily perceive and understand to mould and shape the seemingly chaotic landscape. It is an abstracted interpretation of the existing landform. One example of Ando’s design of geometry is the Children’s Museum in Himeji, Hyogo. It is a multifunctional cultural facility for the artistic education of young people. The facility consists of one main museum building complex, a two-storey workshop at the back of the hill and a long walkway connecting the two.\(^2\)

As shown in the site plan, the building sits comfortably on the hill overlooking the lake as its geometry carefully follows the shoreline. Ando uses geometrical forms like rectangles and arcs to mark the two major

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locations on the site. He then uses long and elegant walkways between the two buildings to join the complex as a whole. Also shown in the sketch, he uses small circles as pivot points at the junctions between the walkways, which make the whole building geometry looks like a moving mechanism. It looks like the heavy building structure is rotating around the pivot point until it snaps into a perfect location on the hill. The building form then becomes a part of the landscape.

The simplicity

In his article, Ando wrote, “It seems to me that, at present, concrete is the most suitable material for realizing spaces created by rays of sunlight. But the concrete I employ does not have plastic rigidity or weight. Instead, it must be homogeneous and light and must create surfaces. When they agree with my aesthetic image, walls become abstract, are negated, and approach the ultimate limit of space. Their actuality is lost, and only the space they enclose gives a sense of really existing.” Ando’s formal simplicity creates a strong architectural character. There is no particular element of the building that is visually dominant or noticeable. The nothingness he strives for in his architecture is to remove the attention from the building.

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Figure 2.1.3: Aerial view of Children's Museum

Figure 2.1.4: Children's Museum
and material and focus only on the space and everything in that space. In this way, "Universal geometric forms clearly determine spaces and elevate the entire piece of architecture in a single direction. People living in spaces formed on the basis of this principle gradually lose superficial awareness of them. The forms transcend their nature as forms and become invisible except in certain instances. The space is the only thing with power to stimulate emotions."4

Enclosed Nature

Raised in a traditional Japanese row house, Ando strives to bring back the intimate relationship with nature to modern Japanese houses. To achieve this, he looks into one of the most successful architecture styles in Japan that forms balance between people and nature: the Sukiya architecture, which was developed to provide spaces for the tea ceremony. Ando believes this type of aesthetic awareness and emotion is fundamental to all things Japanese.5 And instead of reproducing the form of the Sukiya architecture he aims to discover the deeper quality that would affect people emotionally. This is the access to nature in an enclosed manmade environment. The simple geometrical forms and the homogeneous quality of Ando’s architecture are the tools he uses to pull natural elements inside. And the nothingness generated efficiently affects people emotionally. In other words, "it is an architecture reduced to the extremes of simplicity and an aesthetic so devoid of actuality and attributes that it approached theories of mu, or nothingness."6 To this extent the connection between people and nature is affected by subtle changes caused by light and shadow, wind and rain.

Nature is never absent, and architecture, as spaces created by man to cope with the natural environment, is the medium between the manmade environment and nature. “There is generally less tension in the act of acceptance than there is in rejection. To accept is to affirm and with this one tends to put down one’s guard. However, if everything is allowed to penetrate into the interior, the internal world disintegrates and its centrality collapses. I believe therefore that tension should be as present in acceptance as in rejection. In architecture this tension signifies an intense confrontation between the inside and the outside. Thus, those places where the internal order meets the external order, that is, the areas of fenestration in a building, are of extreme importance.”7

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4 Ibid.
5 Ibid, 9.
6 Ibid, 11.
Azuma Residence (1976) is one of Ando’s first projects that can perfectly illustrate his architectural philosophy. He called this house “the prototype of my image of architecture” because of its enclosed expression, and the way light and nature enters the daily-life spaces. The residence, also known as Row House, is a simple concrete box that silently slots into a row of traditional Japanese houses in a central part of Osaka. From the street view, the white concrete wall is almost invisible. The two-storey concrete box is divided into three equal segments. The central part of the three is dedicated to an enclosed courtyard that opens only to the sky. On the ground floor there is the living room, kitchen and bathroom, which are on either side of the courtyard. The master bedroom and a spare bedroom are on the first level, and can be accessed from a staircase and a concrete bridge in the courtyard. The court acts as the focal point of the daily family life. It is surrounded by glass, concrete and slate that accept and reflect light and shade to enhance the simple composition of the space.

With limited site area, instead of chasing the maximum “useful” floor space, Ando dedicated one third of the site to a light court, which creates the essence of the architecture. In the centre of an urban context, Ando uses the simple form and a homogeneous space to capture a piece of nature into this small courtyard. Surrounded and isolated by uniform materiality, the condition of the court changes according to the natural environment. “Such things as light and wind only have meaning when they are introduced inside a house in a form cut off from the outside world. The isolated fragments of light and air suggest the entire natural world.”

8 Ibid, 9.
Figure 2.1.5: Azuma residence, View from the bedroom

Figure 2.1.6: Azuma residence, In the courtyard under the skywalk
Above, figure 2.1.6: Azuma residence, First floor plan
Middle, figure 2.1.7: Azuma residence, Ground floor plan
Below, figure 2.1.8: Azuma residence, Isometric

Figure 2.1.9: Azuma residence, Courtyard
2.2 Thermal Bath, Vals, Switzerland

Peter Zumthor is an architect who is well known for his achievement of harmony between architecture and the surrounding natural environment. The project looks into the Thermal Bach at Vals in particular to study the architect’s design process and achievements.

Sited in the beautiful basin-shaped valley of Vals, the Thermal Bath (1996) is one of Zumthor’s most memorable buildings. It is a replacement of the old bathhouse with an underground passageway leading from the existing hotel complex. The building structure resembles one large, permeable stone projecting out of the slope in the southwest corner of the hotel. The green roof smoothly fuses into the landscape, hiding the building perfectly within the sloping hill. The architect described the form of the architecture as resisting “formal integration with the existing structure in order to evoke more clearly – and achieve more fully – what seemed more important role: the establishing of a special relationship with the mountain landscape, its natural power, geological substance and impressive topography.” He believes the appearance of the building should be older than the immediate building context to enhance the linkage between the architecture and the landscape.9

The interior of the building is like a manmade cave. As shown in the floor plan, the hollow stone blocks act like great columns, while supporting the building structurally, they sub-divide the internal space into a continuous circulation space leading to the pools and an outdoor courtyard. The hollow stone blocks accommodate functional spaces ranging from hot and cold baths, massage rooms, Turkish baths, shower boxes, changing rooms and toilets. Walking in the spaces and between the blocks, people’s perception changes from the dark and narrow caverns by the mountain to bright spaces at the front of the big openings, through which the magnificent view of the Vals valley comes inside the dim stone cave. The section and profile of the structure is a series of natural stone strata quarried 1,000 metres further up the valley. The uniform stone laying is used on almost every surface of the building including circulation areas, pool floors, ceilings, stairs, benches, door panels and so on. The uniformity and homogenous stone mass may appear orthogonal and technically ordered, yet the architecture has retained a clear sense of the original design idea, which was to hollow out the hard mountain rock and create the sunken spring water basins. Similar ideas were used to cut out strips from the roof to bring in natural light. Strips of sunlight that bounce between the dark

stone and steaming water have created a natural spatial experience.\textsuperscript{10}

“Not by forming preliminary images of the building in our minds and subsequently adapting them to the assignment, but by endeavouring to answer basic questions arising from the location of the given site, the purpose, and the building materials – mountain, rock, water – which at first had no visual content in terms of existing architecture.”\textsuperscript{11} As described by the architect, the architecture is a result derived from responding to the surrounding natural environment. The building form appears to be rigid and orthogonal, yet the minimalist architecture has tied in with the natural environment using simple geometry and organic materials. The stone blocks appear heavy and permanent, and yet they gives the impression of silence. Similar to Ando’s “nothingness”, Zumthor believes that “good architecture should receive the human visitor, should enable him to experience it and live in it, but it should not constantly talk at him.”\textsuperscript{12}

\textsuperscript{10}Ibid, 141.
\textsuperscript{11}Peter Zumthor, \textit{Thinking Architecture}, 3\textsuperscript{rd} ed. (Basel: Birkhauser, 2010), 31.
\textsuperscript{12}Ibid, 33.
Figure 2.2.1: Thermal Bath, Floor plan
Above left, figure 2.2.2: Thermal Bath, Plan sketch
Above middle, figure 2.2.3: Thermal Bath, Plan sketch of a inside pool
Above right, figure 2.2.4: Thermal Bath, Section sketch of a inside pool
Below, figure 2.2.5: Thermal Bath, Section A
Figure 2.2.6: Thermal Bath, Front facade

Figure 2.2.7: Thermal Bath, Interior pool
Figure 2.2.8: Thermal Bath, Interior view

Figure 2.2.9: Thermal Bath, Courtyard
2.3 Tangible Nature

Places like aquariums could provide hands on experiences and information about the undersea world. Such places could be interesting and interactive. The following section introduces two considerably successful and popular aquariums. Through analysis and comparison one can discover the reason for their success, and how their programme can benefit this project.

2.3.1 Okinawa Churaumi Aquarium

The Okinawa Aquarium is the biggest and considerably the most popular aquarium in Asia. And it is undoubtedly an underwater wonderland. The reinforced concrete building complex occupies approximately 10,000 square metres of land. It has seventy-seven exhibition water tanks that totally hold a total of 10,000 cubic metres of water. Amongst these tanks the Kuroshio Sea is the biggest, which has a capacity of 7,500 cubic metres.\(^{13}\)

As shown in the map, the whole exhibition in the building complex follows a specific route that passes through different themes on different floor levels. After arriving at the entry area, people go down to the tropical sea section. On this level people see a full tank of tropical fish in the Coral Sea, live coral reefs in The Coral Reef Gallery, and numerous species in a fresh water tank. The next level down is the famous Kuroshio Sea. The biggest seawater tank opens its one side completely in full height to the visitors through an eight metre tall acrylic wall. The tank is constantly supplied with fresh seawater from a location twenty metres deep and three hundred metres offshore. The tank’s large capacity is able to accommodate large marine animals such as whale sharks and manta rays. The next section of the exhibition is the Deep Sea World containing mysterious marine life that normally inhabits 100-700 metres below the ocean’s surface.\(^{14}\)

The experience in the aquarium is impressive, especially when standing in front of the Kuroshio Sea. Being able to see the largest fish in the world along with millions of other marine species in motion is truly spectacular. However, even though it looks realistic, the underwater environment in the tank is not real. In fact, it is far from the real marine world. It is a collective animated presentation that introduces rare marine species. Surely the size, colour and movement of the marine species are impressive, and visitors will gain knowledge about sea lives. But it is difficult for them to connect


\(^{14}\)Ibid.
Above, figure 2.3.1: Okinawa Aquarium guide isometric
Below, figure 2.3.2: Okinawa Aquarium guide map

Above, figure 2.3.3: Okinawa Aquarium, Aerial view
Below, figure 2.3.4: Okinawa Aquarium, Front entry
this information with the constant changing natural environment. Not only discovering the disconnection with the real marine world, some visitors even had negative comments. In a personal weblog, one of the visitors wrote, “One entire wall was taken up with the thick glass of the tank. Inside there were smaller fish, massive mantas, and a couple of the huge sharks. When they swam low enough, it was truly impressive to see how large they were in comparison to the people in front of the glass. We stood for quite a while to admire them, and then went down to get a closer look. It was pretty sad to think how small the tank was, how like a prison it must feel to them. I suppose whale sharks often have to endure this sort of cruelty.”

Like many aquariums, the Okinawa Aquarium spent an enormous amount of money and resources to create an efficient artificial environment, whose purpose is to contain as many rare marine species on display as possible. Visitors admire the unknown species in the unknown world and take pleasure in the alienated environment. However, the surrounding environment changes as soon as people exit the building. And since everyday life is so different, people only remember the visit as a nice encounter with the underwater wonderland. The building complex is located near the coastline, yet it is a totally different experience inside the building. One can hardly connect the calm and sunny beach (which is the view people will have outside the buildings) to the numerous marine animals displayed inside the tank.

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2.3.2 Monterey Bay Aquarium (MBA)

This aquarium is located on the beautiful northern California coast. Designed by EHDD Architects, the Monterey Bay Aquarium is widely acknowledged as a public, non-profitable, and research based facility, which focuses on the unique ecology of Monterey Bay. The building complex was converted from an old sardine cannery between 1980 and 1984. Chief architect Charles M. Davis says that the new building will reflect “the nature of Cannery Row itself – seemingly chaotic, a hodgepodge of roofs”. The new building kept the original style of the site and enhanced it with additional circulation and exhibition spaces for public visitors. The factory style and the wharf-like front yard provide the architecture with a strong relationship to the local context.

One of the major features of the MBA is the 10-metre tall Kelp Forest tank, which was the first in the world to sufficiently grow live California Giant Kelp. With numerous species live around the kelp forest, and the natural lighting provided by the glass tank top, the kelp tank correctly reproduces the local underwater ecology. And because of the realistic copy of the natural environment, it allows people to have the sensation of being underwater. In March 1996 the Monterey Bay Aquarium opened the Outer Bay galleries to the public. Features a 4.5 million-litre tank, the sea life on exhibit includes stingrays, jellyfish, sea otters and other marine species that are mainly native to the local ocean environment. Situated in the centre of a National Marine Sanctuary, which extends approximately 13,700 square kilometres from near San Francisco to south of San Simeon, the Monterey Bay area is the home to over 30 species of marine mammals and other wild species. Visitors inside the building complex and the front courtyard have good chances of spotting wild creatures that live in the bay including seals, brown pelican and dolphins in the distance. Maintaining a close relationship with the Monterey Bay Aquarium Research Institute, the MBA supports and even conducts numerous field researches and projects that aim to preserve the local natural environment. This has resulted in achievements such as saving white sharks and sea otters, and revealing tuna secrets.

Unlike many other aquariums, the MBA mainly focuses on the native species in the local marine environment. By displaying marine animals and plants from the local water, and publishing research projects that involve native marine ecology and biology, the MBA creates an underwater environment that is amazingly close to us. People might find it convincing that those marine lives need more attention and


\[^{17}\text{Ibid.}\]
Figure 2.3.6: Monterey Bay Aquarium, Guide map

Above, figure 2.3.7: Monterey Bay Aquarium, View of the courtyard

Below, figure 2.3.8: Monterey Bay Aquarium, Aerial view
Above, figure 2.3.9: Monterey Bay Aquarium, The Tide Pool
Below, figure 2.3.10: Monterey Bay Aquarium, Native stingray in the Touch Pool
Figure 2.3.11: Monterey Bay Aquarium, The Giant Kelp Forrest
2.3.3 Comparing the two

As mentioned above, many aquariums aim to capture large or rare species to attract tourists. In these types of aquariums, even though the original intention is good, it is not sufficient to either sustain the business or educate the public. As the unchanged universal exhibition usually will quickly lose the public’s attention whenever there is a new tourist attraction nearby. The Okinawa Aquarium has one of the biggest tanks in the world and contains the largest fish species. It is their main attraction. People who have seen this will probably only admire the size of the tank and the variety of the animal collection. Even though visitors will learn facts about the underwater environment, it is difficult for people to connect the animals inside a glass box to their daily natural environment. The MBA on the other hand is a successful educational facility because the entertaining exhibitions are supported by research projects and reflect the local natural environment. This way people will more involved.

Based on a critical assessment of the two aquariums, this project tries to develop an appropriate building programme that will allow people to learn more about nature and the natural environment, especially the local marine ecology.
3.0 PROJECT DEVELOPMENT

3.1 The Site

3.1.1 Criteria

The success of this project depends heavily on the selection of an appropriate site. The most important feature of the site should allow for a natural movement that can be easily perceived and understood by onlookers. It is important that people can observe and engage with the movement from within the confines of the architecture. Also, the natural habitats in the surrounding context area should be kept in their original conditions or improved to preserve and attract wild animals.

3.1.2 Site information

Cape Rodney Okakari Point Marine Reserve (also known as the Goat Island marine reserve) is New Zealand’s first marine reserve established in 1975. As shown on the map, Goat Island sits approximately one hundred meters from the coastline within the general reserve area. During the 1950s, the area was popular for spear fishing activity, which depleted that area’s marine life quickly. By the mid 1960s, much of the crayfish, snapper and paua had disappeared. Due to its uniqueness (clear water, exposed coast, proximity to Auckland), the area not only attracted fishermen, divers, but also scientists. Through the initiative of Professor John Morton, Auckland University purchased a coastal site and then opened the Marine Laboratory in 1964. In 1965 Professor Val Chapman suggested creating a marine reserve to protect the research effort. The reserve was officially opened in 1977. As a “no-take” marine reserve, set aside for scientific studies, the marine life is fully protected. It covers a coastline of about five kilometres and extends out to the sea by eight hundred metres. The total area of the reserve is approximately five square kilometres. In the ten years after the official opening, the reserve had already become a rich ecological area teeming with fish and other marine life.\(^\text{18}\)

Figure 3.1.2.1: Location plan, showing the great Auckland area

Figure 3.1.2.2: Location plan, Goat Island in the general Leigh district
Figure 3.1.2.3: Site plan of the Goat Island area
3.1.3 Site analysis

The reserve is situated near Leigh, which is approximately 89 kilometres or about one hour north of Auckland. Arriving at the destination, the visitor’s car park is on the hill to the left of the main road. From the car park people can see the main beach right below the hill and, in the distance, the Leigh Laboratory on top of another hill across the Whakatuwhenua Stream. Because of its rich history, Goat Island (nowadays when people mention Goat Island, they usually mean Goat Island and the surrounding area instead of the actual island) attracts lots of tourists, divers, and snorkelers. For a remote location it is a rather crowded place.

Today, Goat Island is famous for scuba diving and snorkelling due to its prosperous marine ecology and underwater biodiversity. For people who have dived in this area, the underwater environment is wondrous and exciting because of frequent encounters with a variety of marine species including large fish, crayfishes, stingrays, and sometimes even large marine mammals. Another significant feature of this area is the great flat rocky reefs that cover most of the coastline. The marine life on these rocky platforms and in rock pools is just as rich as the underwater environment. On a fine day, the platform acts like an enormous natural aquarium left behind by the tide. It allows people to see what lives in the sea without diving into water.

...
3.2 Methodology Approach

This project is heavily design based. The most important aspect of the project is to create an appropriate building geometry. It needs to reflect and respond to the surrounding natural environment. It also needs to appear to be part of the landscape.

Design between the space and within the buildings along with suitable functions that would enhance people’s experience of nature.
Figure 3.1.2.6: View from Hormosira Flats, Goat Island is to the right of this photograph. The photo was taken during low tide.
Figure 3.1.2.7: View from the Entry beach looking Goat Island. The photograph was taken during low tide.
3.3 Design Concept

For this project the architecture is the medium for people to experience nature. People perceive nature differently when they are inside a manmade structure. And it is the architect’s responsibility to ensure the experience is adequate by creating good enough architectural spaces that agree with as well as enhances the experience of the surrounding natural environment.

Figure 3.3.3 shows a conceptual model that reflects the initial architectural impression of the site in an early design stage. It was created as a manmade structure extending out from the familiar area (land) to the relatively unfamiliar territory (sea) using simple graphical geometry to build walls, rooms, walkways and platforms for people to go further into unfamiliar nature (in this case, the sea). The model represents a heavy artificial structure on the reefs. It is a romantic gesture to exaggerate the edge between two very different natural conditions. Even for people who are comfortable with the marine environment, it is normal to expect natural materials to change gradually from land to sea. It is important that people are aware of this change and the architecture allows them to progressively adapt to the surrounding conditions. In this case, the natural experience changes from the visitor’s car park to the lawn, the sandy beach, the rocky reef, and then to the cold seawater. A sharpened edge (caused by the structure) between the land and the sea could enhance the experience of nature and generate excitement. People could choose to jump into the sea from this artificial edge or observe nature inside this safe yet provocative manmade environment. To further explore this experience, the structure will be extended to some areas where people cannot usually go (for instance underwater and on to small isolated rocky islands). This way most people, including children and the elderly, have the opportunity to observe the marine environment closely.

“Ultimately our understanding of nature configures the way we approach both the environment that we create and the environment in which our creations reside. Thus our quest for understanding what we call ‘beauty’ in architecture and cities must become an inquiry into the intrinsic idea of nature as well.”

In the quote above, Crowe expresses an idea of the origin of architecture, which is created by people while they try to learn from nature and use

Above, figure 3.3.1: Site plan of the conceptual model #1
Below, figure 3.3.2: Photo of the conceptual model #1
Figure 3.3.3: Photo of the conceptual model #1 showing the plan view
this knowledge to build the manmade environment. For this project, it is important to understand and learn from the surrounding natural environment and movements, and design the buildings that look as though they belong in the natural landscape. An analysis of the existing land geometry is the starting point of the design.

The conceptual model has been generated by attention to the form of the landscape and attempts to find a correspondence with the rocks and the surrounding environment geometrically. It was derived from several geometrical axes of the landform and contexts. For instance, the existing building form, guidelines drawn between the flat rocky reef on the Goat Island side and the rocky shoreline of the mainland, and guidelines drawn at right angles to the above axes. The actual location for this conceptual model is between Hormosira Flats and Pumphouse Reef as shown in the drawing.

Further in the drawings, the general geometry of the model opens to the northeast, which is the main direction of the wind and wave movement. The gesture suggests that the whole building complex is exposed to the extreme and unstable natural environment. The upper leg of the building reaches out to the sea as if it would bring more seawater into the central courtyard. The purpose of this geometry is to enhance the natural impact and to expand the natural experience. The northern part of the building sits completely in the water. Its internal space is totally sealed and beneath the water level to allow people to see the underwater environment through glass. The intention is to expand people’s natural experience to an extra-ordinary level of engagement with nature as mentioned earlier.

Referencing the Thermal Bath by Zumthor, the second conceptual model inserts “block spaces” to identify important internal spaces within the general form. These blocks represent confined and sealed spaces that are feasible for occupation in this particular environment. Like the previous model, the predominant space is the central courtyard, which is generated by the building form. The bridges and walkways that connect the blocky spaces are not weatherproof. So when the actual courtyard is filled with water and constantly receiving waves from the open sea, these walkways will also be flooded especially during the high tide period. As the condition of these spaces is constantly changing, it forces people to use the building according to the weather and other aspects of nature. And hopefully, with the unique and intimate natural experience, people could be more considerate of the natural environment, which will in turn improve the public’s awareness of ocean conservation.
Above, figure 3.3.4: Blocky plan drawing of the conceptual model #2
Below, figure 3.3.5: Photo of the conceptual model #2

Figure 3.3.6: Photo of the conceptual model #2 showing the plan view
3.4 The Critique of the Conceptual Models

Placing the conceptual model mentioned above on a real location has generated interesting ideas. And through explorations, the design was developed to a point that proved that these ideas could be achieved. However, the design process encountered difficulties that hinder any further developments. Primarily, it was designed from the plan view, and largely ignores the elevations. This is evident especially in the second model, as all the blocks are simply extrusions from the plan. Secondly, the location is not suitable for the project due to its proximity to the entry beach. As the artificial structure would cause an excessive impact on the natural scenery, and it would make the already crowded area even busier. The ideal experience for approaching the building should be lasting and enjoyable. People would first enter the busy car park and then the entry beach where visitors could explore the natural landscape. After a time of wandering around, people will find and set out on a journey on a directed route to the architecture that is well hidden when viewed from the entry area.

A further reason is that the natural condition of the current site is not adventurous enough, thus reduces the excitement of the project. For instance, this particular location is relatively calm due to the protection from Goat Island, and the water is too shallow for the underwater exploration. And as mentioned earlier, the architecture on the second site should allow people to have an extreme natural experience.

The design attempt of the first conceptual models was ineffective because it ignored the actual site condition. It concentrated on discovering the possible geometry and spaces that might belong to the landscape. However, it was a mistake made in an early design stage, but at the same time a basis for future developments. The subsequent design should start by trying to duplicate the valuable qualities of the previous design.

3.5 The New Location

To respond to the difficulty of the design process, the project needs a new location that allows for an extreme natural experience. As shown in the drawing, the new location is not far from the main entry beach. However the conditions here are very different, because it is at the doorway of Goat Island Channel that opens to the Pacific. The new location receives
stronger wind and waves from the sea, and the water depth here is up to six metres (to the north of the Surge Rock). There is an existing walking track climbing up the hill to the laboratory, which is mainly used by the research personnel. Looking at the site from an aerial view, the geometry of the landscape is amazingly regular. As the result of the sea erosion, the overall geometries of the Surge Rock, Pennys Reef and the cliff form almost perfect parallel shapes. This unique natural condition will be the foundation of the geometry for the architectural form to respond to the existing landscape.
Figure 3.5.2: View looking north-east towards the open sea. This photograph was taken on the Pennys Reef
3.6 Further Exploration of the Geometry

Like the previous process, the following design process involves drawing guidelines and axes on the site plan to relate the building form to the surrounding landscape. As shown in the drawings, by using straight lines along the slightly curving contours of the land and extracting some of these lines to create solid blocks, the general building geometry starts to form. Even looking only from the plan view, this drawing successfully duplicates the positive qualities of the previous conceptual models. And with further development, it should be possible to recreate similar sensations. Only this time the design will be processed with higher regards for the general site orientation and conditions.
3.7 Functions

The initial purpose of the project is to allow the general public to intimately experience the natural environment, especially the marine environment and raise the awareness of marine conservation.

The most common way to educate the public without losing their interest is to build museum-type aquariums, which try to mimic the underwater environment. Traditional aquariums are interesting and even educational in some cases. However, due to various restraints such as locations and technical limitations even in the most successful aquariums fail to demonstrate the true marine environment. Standing in front of the Kuroshio Sea, which is one of the biggest aquariums in the world, people should have a realistic sensation of being underwater. In fact, the image created is so wonderful that it is even misleading. Despite the size of the water tank, it is a manmade wonderland that only aims to please people instead of showing the real marine environment.\(^{21}\)

The Leigh Marine Laboratory, which is located right above the proposed building site, has many interesting research projects. And the researchers

\(^{21}\) Kuroshio Sea is the main tank in Okinawa Aquarium. The tank is about 8 metres in depth and big enough to hold large marine species such as whale sharks.
are interested in sharing their knowledge with the general public. This was evident when they decided to open an interpretive centre right next to the laboratory. The centre is designed to present scientific information of the underwater environment to educate the community. And because the interpretive centre is part of the marine laboratory, the information it presents seems academic and convincing. Apart from the centre, people can explore other parts of the campus, and even visit the laboratories by arrangement. However, the presentation inside the interpretive centre is mainly two-dimensional. And it will lose the public’s interest quickly because a simple presentation is most likely not enough to make powerful impressions.

The two types of presentational facilities described above share similar purposes, which is to provide marine information to the public. However, to leave a more powerful impression, and to showcase a research project in a laboratory, this project seeks to invent a new type of facility that accommodates both public visitors and research personnel. And it could be called “The Experimental Laboratory”.

For the visitors, it is unusual and interesting to be able to interact with scientists and researchers, and have the opportunity to witness the latest findings of marine ecology. To allow the public to understand the marine ecology and other scientific knowledge, the information needs to be presented through interactive and innovative media that are educational as well as entertaining. With input from the researchers the visitors would have the privilege of seeing some of the latest research findings, which is an experience that is not possible at many other places.

To ensure the privacy of the researchers, there are only certain spaces that are open to the public including:

- An underwater gallery space that is located about five metres below sea level. Its main purpose is to allow people to observe and learn about the real marine environment through the glass. Through the high glass wall, people should be able to notice the differences between the underwater conditions at different water depths.
- A secure courtyard that becomes a seawater pool during the high tidal period.
- A multifunction conference room, which is to hold small to medium size conferences and exhibitions.

Spaces that are dedicated to the research department are
- Offices and laboratories with separate circulation spaces.
- A water tank that keeps marine animals for research uses.
- A boat shed, a scuba workshop and storage spaces.

Many of the research projects carried out in the Leigh Laboratory are practical. And for some of the research projects, its success will usually depend on whether will it benefit the society. Thus, it is to the researchers’ advantage to work closely with public visitors, as they could choose to test some of their ideas and gain feedback from the public to improve their projects. And as for the visitors, visiting an innovative research facility and being able participate in some research projects would be a rare and exciting experience.

As for the research professionals, it is beneficial to work close to the coast to directly monitor and study the change of weather and marine environment because many of their research projects are involved with the actual condition of the sea. The project aims to provide the researchers with provocative working space that is surrounded by a constantly changing natural environment. Also, with their knowledge and experience of the local weather conditions, the researchers should be able to notice more clearly any sudden changes of the natural environment, which might provide an advantage for their research assignments. The research department in the proposed Experimental Laboratory would have the full control of the facility. According to the local marine condition, this department would decide on the public visiting times and whether to close the building during storms and other severe weather conditions. Additionally they would be responsible for acknowledging the visitors of the time and height of the tides in order for them to use the facility correctly. The researchers would also need to organize the conferences and exhibitions.

- An innovative cafeteria that provide leisure for both visitors and research professionals.
- Changing rooms and an indoor hot water spa pool.
3.8 Diagrams and Geometries

The bubble diagram shown is a graphical presentation of the relationship between the functions. And the sizes of these bubbles represent floor areas, which at this moment are only provisional and flexible. The diagram was then used to produce a series of diagrams, which were based on the block and line drawing shown earlier. These are experiments to discover a suitable relationship between each function. The process from diagram one to eight describes the action of connecting the functional program with the geometry obtained in the earlier design process. And because the geometry is only conceptual, it can be changed to suit the requirements of the building programme.

Figure 3.8.1: Exploration of building programs
Figure 3.8.2: Overlaying the bubble diagram with the land geometry
In diagram one, the geometry was drawn based on the bubble diagram and the block drawing. Its intention is to discover the best relationship between the functions while following the form of the landscape (by following the block drawing). In this diagram, the purple colour represents the research facilities; the pink is public spaces as listed previously; and the green area indicates spaces that accommodate the interaction between the two user groups. The principal rule in the development from diagram one to eight is to interweave different functions, as the interlacing spaces would encourage interactions and communications between different user groups. For instance, for visitors to get to the underwater gallery space from the entry, they need to travel through the building complex. And during this short journey they may encounter researchers while passing through the cafeteria. If the design separates the functional spaces, such interactions as this could not happen.

Here is an explanation of the development from diagram one to two as an example. In diagram one, the pink area (visitors) and the purple area (researchers) are not exactly interwoven. People who walk within the pink area do not necessarily pass through other spaces, which mean there will be hardly any interactions with people working in the purple area. This situation in diagram two is improved as the different spaces interlock closely with one another. However, the purple in this diagram is overpowering the other colours. And the green area (interaction spaces) should be repositioned and enlarged, which will lead to diagram three. And so the development goes on.
Using this diagram-drawing practice, the project is developed both geometrically and functionally. As shown in diagram eight, it is the most developed result of this process. There are several qualities in this diagram that are considered suitable for the project.

- The general geometrical plan is aesthetically pleasing.
- The total floor area is considerably reduced from the first diagram, which would cause less impact on the site.
- The shape of the lower leg is better in terms of responding to the geometry of the hill.
- The form and the arrangement of functions has achieved the interwoven of functions, which would encourage interactions between the two user groups.
- The form has suggested long, narrow walkways and bridges that connect the “knots” in the building complex. Many of these walkways are to be shared between visitors and research professionals, which also encourage people’s interactions.

Based on the Leigh Laboratory’s official website, there are in total 53 research professionals and staff members. Based on this number the project proposes to provide an adequate working spaces for 15 research professionals and 20 staff members. Furthermore, to provide a relaxing atmosphere in the building complex for people to enjoy the natural environment, it should not be more than 100 visitors in the whole building complex at the same time. There should not be more than 20 people allowed in the underwater gallery space at the same time. During a busy day, people should queue on the main building side of the bridge.
Figure 3.8.3: A series of 8 diagrams showing the exploration of the best combination between the functions and the landform
To repeat the previous design process, the following photos show the block models derived from diagram seven and eight. This exploration aims to determine important spaces both internally and externally.

Figure 3.8.4.1 to figure 3.8.4.4: Photographs of block model, exploration 1

Figure 3.8.5.1 to figure 3.8.5.4: Photographs of block model, exploration 2
4.0 DEVELOPMENT OF SPATIAL EXPERIENCES

4.1 Coping with the Flood

One of the strong features of the project is its involvement with the tidal movement. There are two high tides and two low tides every twenty-four hours. The average height of the tidal differentiates is between two and a half metres and three metres. The ground floor of the building complex sits on the reef, which is about one metre above the low tide level, so it will be flooded during the high tidal period. The project’s involvement with nature forces people to use the building differently, therefore they must pay close attention to the surrounding natural environment.

There are two entries to the building complex. One is on the rocky platform used mainly by visitors during the low tidal period. And researchers and staff members will use the other entry from the top of the hill next to the marine laboratory. It will also open to public during the high tidal period. In the main car park, there will be a notice board showing the exact tidal period for the day and directions to both entries. During the low tides in a calm weather, people will approach the building on a walkway built on top of the rocky reefs. After a short and entertaining journey, people will arrive at the entry space between the conference theatre and the offices. After a few turns in a narrow and dark alleyway-like space, people will arrive at a bright courtyard surrounded by four building blocks. In here the visitors can pause and choose to go to the changing room, the conference room or follow the ramp going towards the bridge and the underwater gallery. During the high tidal periods or on a windy day, the entry on the hill will open to visitors. People will still need to park their cars in the main parking space and walk up the hill. The entry foyer is in a freestanding building that includes administration offices and a small library. Visitors will then be required to walk down the hill in a semi-enclosed walkway and arrive in the building complex on a platform that sits directly above the changing room. On this arrival platform, the visitors will have an overview of the central courtyard, which becomes a seawater pool during the high tidal periods. They could then carry on walking around the research water tank to the bridge. The platform is elevated three metres above the ground floor, which would be above the high tide level most of the time. However, in case of a great flood or in a storm situation, the building would be closed to visitors. The researchers and staff members would also share the hilltop entry and the walkway with the visitors during the high tides. Yet in contrast,
Above left, figure 4.1.1: Researcher professionals spaces
Above right, figure 4.1.2: Visitors spaces
Below left, figure 4.1.3: Spaces for interaction
Above, figure 4.1.4: Circulation spaces for visitors, the dark blue area indicates spaces used during the low tide, the light blue colour indicates spaces used during the high tide.
Above right, figure 4.1.5: Visitors' circulation spaces
Below right, figure 4.1.6: Circulations spaces for researchers
the researchers would go directly into the second level that is six metres above the ground level. The entire second level could then be sealed so that the research professionals could still use the space even in severe weather conditions.
4.2 The Perception of the Architecture

Inspired by the Thermal Bath in Vals by Zumthor, the design adopted the idea of using large building blocks to identify spaces both internally and externally. The blocks appear as solid objects from the outside and together they assemble into an organic form at a significant junction between the hill, the rock, and the sea. It is important for the buildings to be strong, as it is exposed to unpredictable weather conditions. The assemblage of the building blocks is designed to create a sensation of being part of the landscape. It looks like a cluster of large stones on the foot of the hill. Inside the cluster people will feel like they are inside a cave while the spaces between the blocks varies from dark and narrow walkways to a wide courtyard; and from a dim platform that hides deep inside the cluster to a bright ramp that opens towards the sea. The reason for the variety is to create different spatial experiences that are complex and playful. In addition to that, some of the detailed design aims to manipulate the natural movement, from which people will perceive the natural world looking out from several different levels in the building complex. Inside the entry building on the top of the hill, and during the walk in the hillside walkway, people will see the whole building complex, Goat Island, and the islands in the distance. And it is hoped that with the overview of the vast ocean, people will feel amazed. On the wide platform on the roof of the changing room, people will see fragments of distant views through openings between the building blocks. They will see and hear the waves pounding on the front building blocks further out to sea, but in here, people feel protected. The central courtyard will be flooded during the high tidal period. Swimming in the seawater while playing with fish, while doing this people might feel fascinated. Between the laboratory block and cafeteria, there is a ramp that slopes down to the sea, which will receive strong wind and waves. Standing on the ramp, people will feel exposed to nature. The underwater gallery parallels in front of the Surge Rock to protect the rock from the wave and make it habitable for more marine species. The south wall of the gallery is made of thick and transparent plastic to allow the visitors to observe the vertical side of the rock and the native marine inhabitants. The wall is about five metres high and leans towards the Surge Rock to allow clearer views. The plastic could also be used as a big screen, on which staff members would project or write scientific statistics and information to help visitors understand the marine environment.
5.0 CRITICAL APPRAISAL

This explanatory document has described the purpose, precedent knowledge and design procedure of the research project. Through numerous explorations of designing geometry and functional programmes, the project has resulted in a preliminary building structure that cuddles around the foot of the hill where the existing Leigh Laboratory is located. With an acceptable form that corresponds with the landscape, the proposed building provides unique spaces for people to intimately experience nature. By visiting and engaging with the marine research department, the visitors will have a better understanding of the local marine environment. Later after people have been to the building, hopefully they will develop a better understanding of the natural environment and pay more attention to it.

Some people would disagree with a heavy construction on a rocky reef because it will partially destroy habitable rocks, which is an important part of local marine ecology. But one can argue that the new building, built in environmental friendly material, will only alter the geometry of the rocks and create more opportunities for the native marine species.

For instance, in a few months time, it is possible that the underside surface of the buildings would grow a thick layer of algae because the building envelope will have direct contact with the seawater, and thereby permit such a growth and further interact with nature.

The success of the project will also be based on the actual exhibition, which will determine how interesting and how related it is to the local ecology. It will be interesting to find out how exactly the visitors and researchers interact. Based on the fact that most research professionals need personal space and quiet environment, the project attempts to link the proposed building with the existing Leigh Laboratory spatially through a courtyard on the top of the hill, so the researcher could have a place to retreat from the crowd. Lastly further development will be possible if this project is successful in attracting large number of visitors.
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