INDIGENOUS NARRATIVES IN PARAMETRIC DESIGN

RECONNECTING WITH MĀORI IDENTITY THROUGH THE DEVELOPMENT OF SCULPTURAL CARTOGRAPHY AS ARCHITECTURAL INTERVENTIONS

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VICTORIA UNIVERSITY OF WELLINGTON

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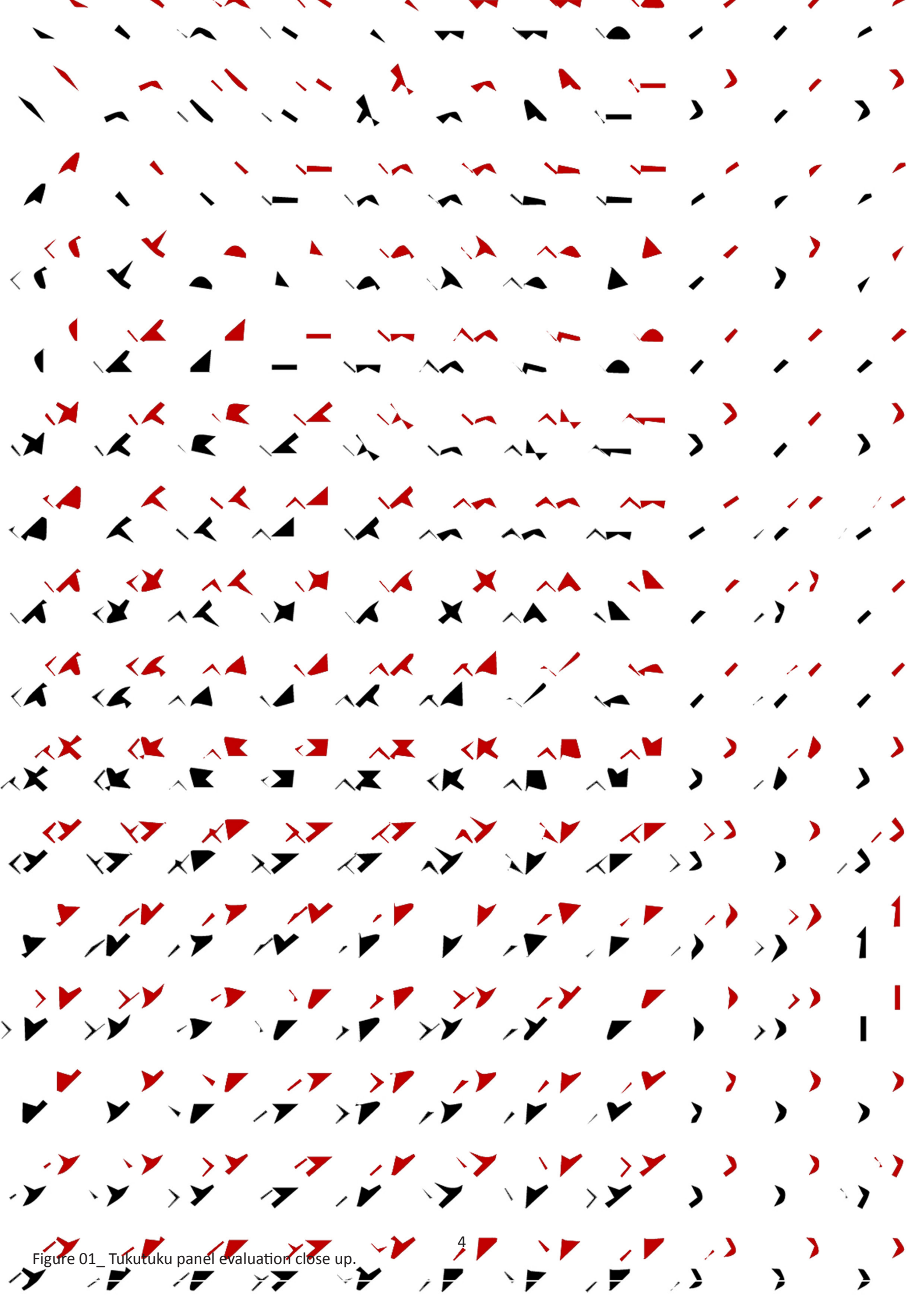


Figure 01_ Tukutuku panel evaluation close up.

Nga Pēpeha

Ko Kahuranaki te maunga
Ko Poukawa te waiu
Ko Ngai Te Whatuiapiti te iwi

Kahuranaki is our (sacred mountain),

(Lake) Poukawa is the source of our sustenance,

Ngai Te Whatuiapiti is our tribe.

Ko Kahuranaki te marae
Ko Te Hāpuku Ika Nui O Te Moana te tangata

Kahuranaki is the marae

Te-Hāpuku-Ika-Nui-O-Te-Moana is the chief

Haere koe i mua i te tuara o Te Hāpuku,
kia kai koe nga kai whakairo i te rangi.

Go forth under the mantle of Te Hāpuku

and you will eat of the food of gods

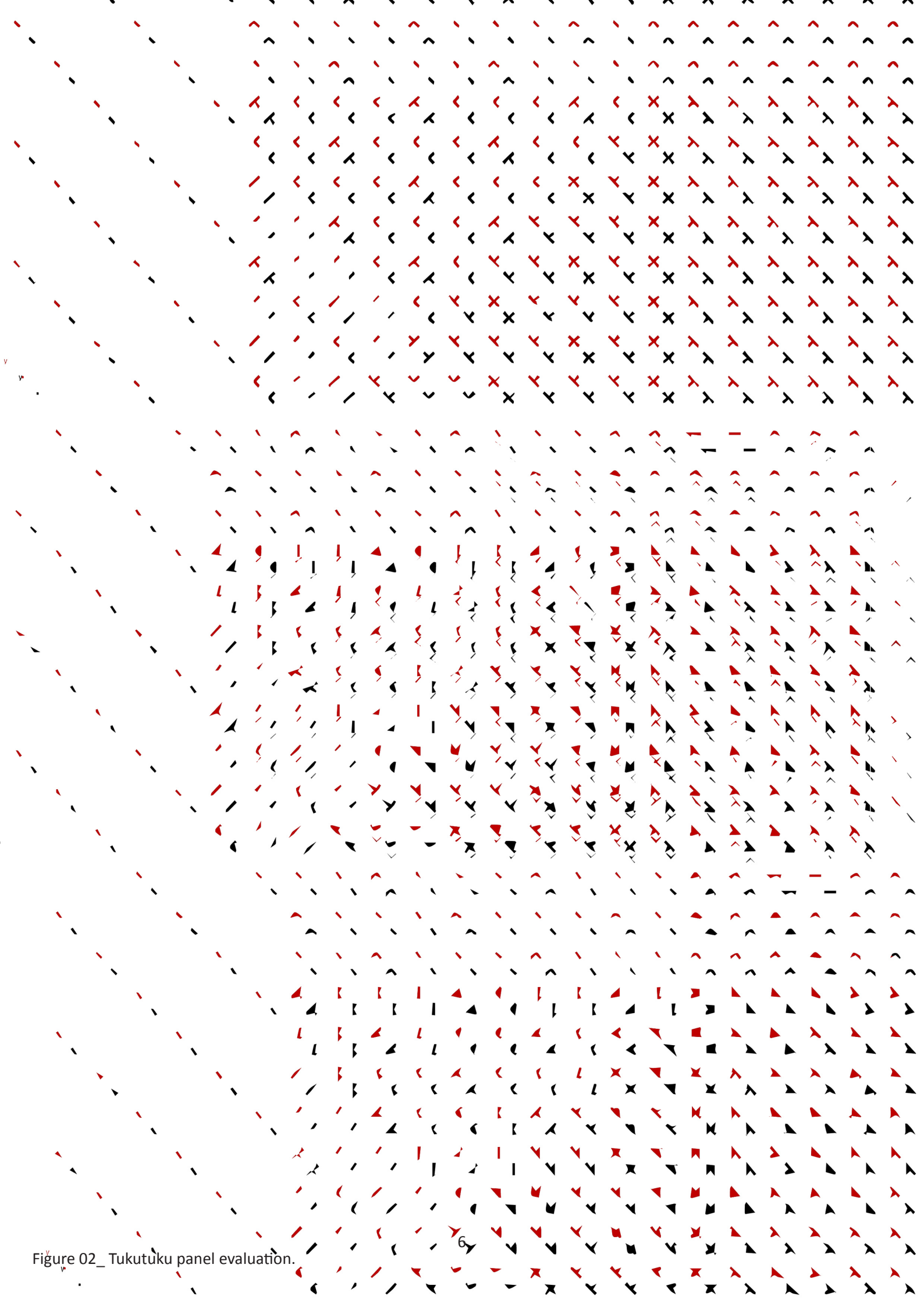


Figure 02_ Tukutuku panel evaluation.

Abstract

Re-connecting with Māori identity through parametric design has been investigated through this body of research by focussing on mātauranga Māori (Māori knowledge). Ultimately asking:

“There is a place for parametric design to help translate Māori narratives, values and procedures into architectural form”.

The designer’s intent through this body of research was to re-enforce old ties with local iwi, re-learn one’s whakapapa (stories/narratives), and re-connect with one’s sense of self through embedding this knowledge into a coded design. The objective was to achieve a design output that is fundamentally built on mātauranga Māori and cultural practices of Ngāti Kahungunu (iwi in the Hawkes Bay that extends down the East coast of New Zealand’s North Island). When a design begins with such an intent, the generated output is unexpected, surprising and changes perception of what a particular structure is meant to be or do.

The ideas touched upon in this research is merely a seed to what can be achieved when using parametric design to produce a culturally significant design. Finding one significant cultural aspect, in this case the power of loci, is one of the most important steps in building the design tikanga (protocols/scope) that will find its way into all aspects of the designs produced. This informed the reasoning for the parameters used, the range of variation and how one step progressed to the next.

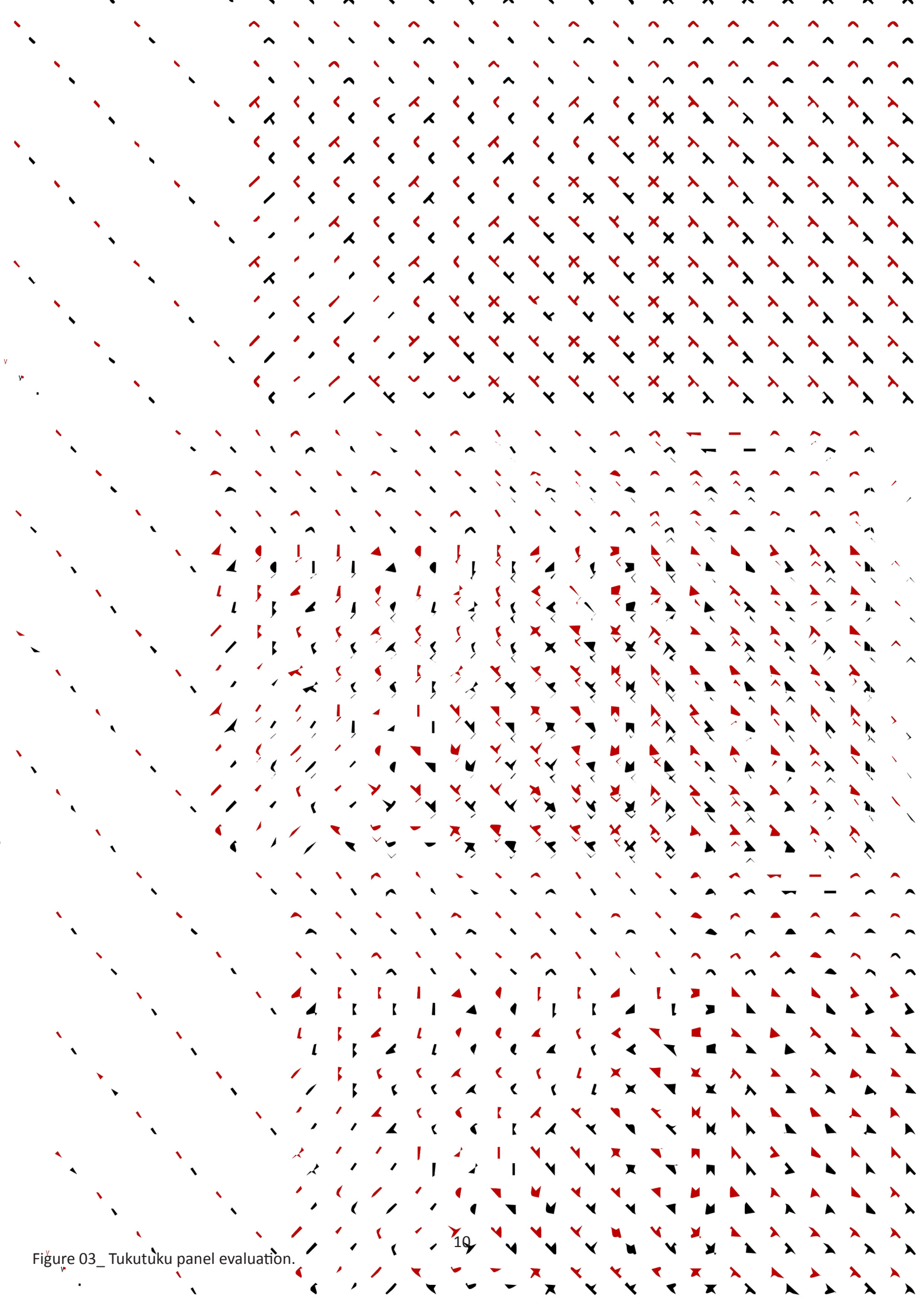


Figure 03_ Tukutuku panel evaluation.

Mihi

This thesis has taken me on a very turbulent journey; throughout I have had to struggle with a lot of personal loss and some of the most difficult times of my life. I had lost a large part of who I am during the process and through this thesis, I attempted to reconnect with all that I had lost along the way; to find myself again.

I wish to thank all those who have helped me along my journey to completing my studies.

To Ngāti Kahungunu Iwi Trust for believing in my research and providing me with the resources to pursue my research. To my parents and family for always allowing me to follow my passions and trusting me in my endeavours over the years.

My friends, all of whom have had a hand in getting me through this year. To my fellow students who were always there for a laugh, a helping hand and a means to get through everything, you know who you are.

To James, thank you for everything.

But most of all, thanks must be given to my amazing supervisor, Tane Moleta. Throughout this year you have guided me into uncharted territories and helped me stay strong and motivated when I most needed it. You will continue to inspire me and your passion for teaching was everything that I needed to get me through it all! Thank you.

Introduction

Cultural identity is an important concept to Māori. It is what connects Māori to their past through tipuna (ancestral ties), Māori to others through whenua (land), and to the country as a whole (H. M. Mead and Grove, 2001). Through this body of research, investigations will be made into the mātauranga Māori (Māori knowledge) and how these can be depicted through parametric design in order to produce culturally meaningful architectural design.

Historically, the carving and weaving of solid materials and fibres was a key component of the New Zealand's māori architectural vocabulary. Till this day, these design and construction activities are held in high esteem with many contemporary practitioners continuing to practice these skilled traditions (S. M. Mead, 1984).

By contrast, parametric design implies a series of contemporary and highly iterative processes. Potentially due to this this newness, parametric design has grown in popularity amongst the architecture profession. Parametric design can be found in a wide variety of design spaces, not excluding, the ability to operate tools of manufacture. CNC (computer numerical control) machines and 3D printers have allowed a number of additive and subtractive procedures to be undertaken in the architectural construction of space.

In this context, this research asks:

"How can parametric design to help reconnect Māori narratives, values and procedures into architectural form?"

This body of research sets out to investigate the potential of parametric architectural design for the future of Māori built environments. Through analysis of traditional Māori narratives and designs through the lens of mathematical logic, the data will be fed into a scripted algorithm to generate a series of outputs that have originated from a cultural seed. As opposed to contemporary use of Māori motifs in cultural buildings of New Zealand, this study will push the use of mātauranga Māori (cultural knowledge) further from the superficial use of geometric Māori patterning to the integrated logic of the buildings design.

Problem Statement

“Māori identities continue to evolve and adapt as a result of social and environmental changes Māori experience”
(Te Huia, 2015)

For many years now, Māori have moved from their ancestral land to cities in search for a better life; me being one of them. However, in pursuit of this so called ‘better’ life many young Māori, including myself, have found that something has diminished from within themselves. Therefore, this body of research is intended to be an exercise of rediscovering my lost identity as Māori, re-learning my whakapapa and reconnecting with my iwi; Ngāti Kahungunu.

“… as individuals, we have no identity except by reference to [our ancestors]. We are beings only because they prepared the way for us, gave us a slot in the system of human relations, a place in the whakapapa lines, and membership in a whanau and in an iwi”
(H. M. Mead, 2003, p.206)

Scope

Whenua (land) has a powerful connection for Māori to their identity. Mead (2003) expands on the meaning of the word whenua; which includes ‘placenta’, ‘ground’, ‘country’ and ‘state’ (p.269).

“Whenua, as placenta, sustains life… This fact of life as a metaphor for whenua, as land, and is the basis for the high value placed on land”

(H. M. Mead, 2003).

This body of research took a purposeful approach to focussing on land and landmarks and their association with Māori. The researched data offered itself for re-interpretation by way of meaningful parameters to be generated with the use of Rhinoceros and Grasshopper3D. In doing so, the research done gave each set of parameters a whakapapa, story, that was used to facilitate a direct connection between the foundations of the parametric design and the ideas used to generate them.

Pēpeha, tribal saying or proverb, can be used as a method of introducing oneself. Within the introduction, a series of physical landmarks are usually stated; such as maunga (mountain), awa (river), and marae (ceremonial courtyard) just to name a few (H. M. Mead and Grove, 2001).

“The mountain that stands day after day… has been given special significance by us [Māori]. We have added words to it, or in the Māori sense, clothed it, and covered it with words. Some would say that we have hung or pinned words to it not merely by giving it a name which then becomes summary of all that it stands for, but by creating stories and singing songs about it, and memorializing it in long-lasting compositions such as proverbs”

(S. M. Mead ,1984).

These landmarks are not only just important its local iwi (tribe), but because of the stories associated with it, other iwi can link them to their own through ancestral connections; thus, furthering the connection between land and identity. Through focussing entirely on whenua, this research aims to tie cultural narratives, that are associated with the physical landmarks, with the parametric designs generated.

Proposition

In attempt to reconnect with Māori cultural identity, research has been made into various scales of Māori history. From the Great Migration of the Pacific Ocean, tracing the voyage our tipuna (ancestors), through to the local iwi whakapapa (narratives) of Ngāti Kahungunu and the great chief, Te Hāpuku.

Parametric design tools, such as Rhinoceros' plugin Grasshopper, have played an instrumental design role in recent years at the school of architecture and is continuing to grow in popularity amongst both students and professionals alike. As such, this will be the key tool in investigating the role of Māori narratives in the design outputs for this body of research; utilising the latest technologies to facilitate the foundations of cultural design.

Taking lead from American cyberneticist, Ron Eglash, analysing how imbedded cultural knowledge can be viewed as a code or mathematical equation in order to decypher how a community operates. This cyclic thought revolving around mātauranga Māori is what will draw me back to reconnecting with cultural identity while gaining insight into how this knowledge can be utilised in a manner similar to that of Ron Eglash's approach to understanding the complex nature of African settlement patterns (Eglash, 1998).

The result of this research will be a beginnings to understanding how one can approach design for Māori in a manner that is culturally seeded in the base of the parametric script. Ultimately, the desired oputcome of these scripts will ideally produce designs that "new" that will challenge the perseption of what Māori architecture and design is.

Methodology

As the main method of investigation, this body of research will make use of the three-dimensional modelling programme, Rhinoceros, and its visual coding plug-in, Grasshopper. With the use these programs, this body of research will investigate how designs can be imbedded with the knowledge gained from the research into Māori narratives. This will in turn generate designs leading towards architectural interventions that promote mātauranga Māori. This will be investigated through a series of iterative designs; from two-dimensional mapping, to three-dimensional prototyping (with the use of UpBox 3D printer and Modella CNC machine), and finally accumulate in a final designed structure that will focus on a lake side intervention.

As an evaluation tool, the designed outputs were given to a group of select individuals, mainly those from my iwi, who reviewed the designs in terms of the desired outcomes. If any deviation or misinterpretation of the outputs were observed the parameters would be adjusted and outputted again to further refine the developed designs. By performing such a process, the research is adhering to the tikanga of research as outlined by Hirini Moko Mead (2003):

“Researchers must seek permission from a tribal authority to enter the authority’s territory and carry out research among their people… Processes, procedures and consultation need to be correct so that in the end everyone who is connected with the project is enriched, empowered, enlightened and glad to have been part of it”

(H. M. Mead, 2003, p.317).

However, interpretations of an output may be swayed with the accompaniment of a written document or discussion outlining the design intent. Understanding the intricate detailing of the numerous carved panels that adorned various whare tipuna (ancestral house) was always more clearly understood when a member of the tangata whenua (people of the land) or a well-informed tohunga (skilled expert) were present. They explained how the various artworks that adorned the whare tipuna were configured and the events that had taken place, with a strong connection to their ancestors, to establish settlement of their hapū in a particular location. All of which added to the local community’s cultural identity and their connections to the past.

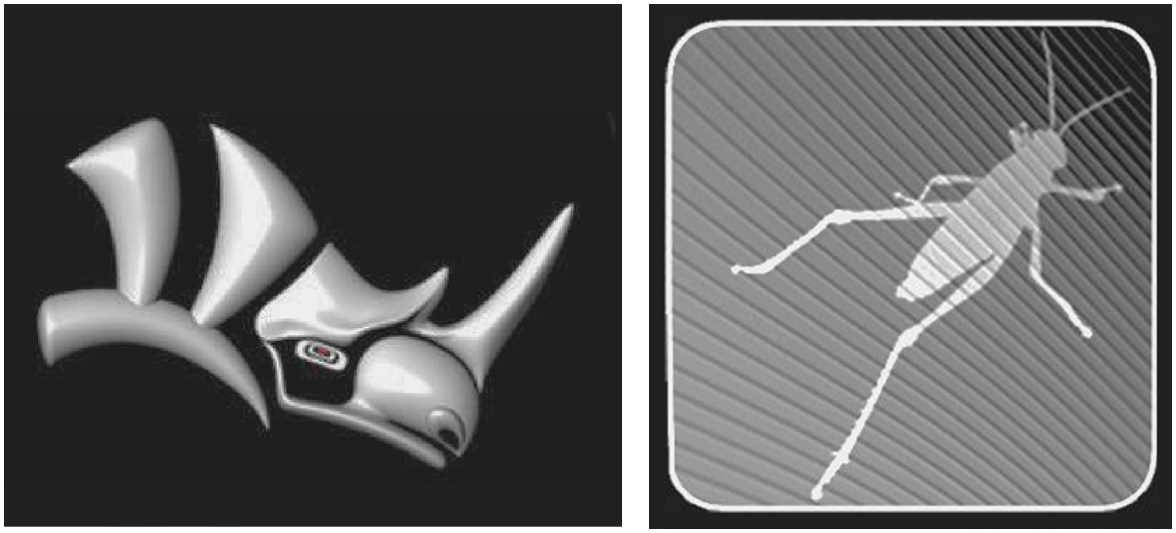
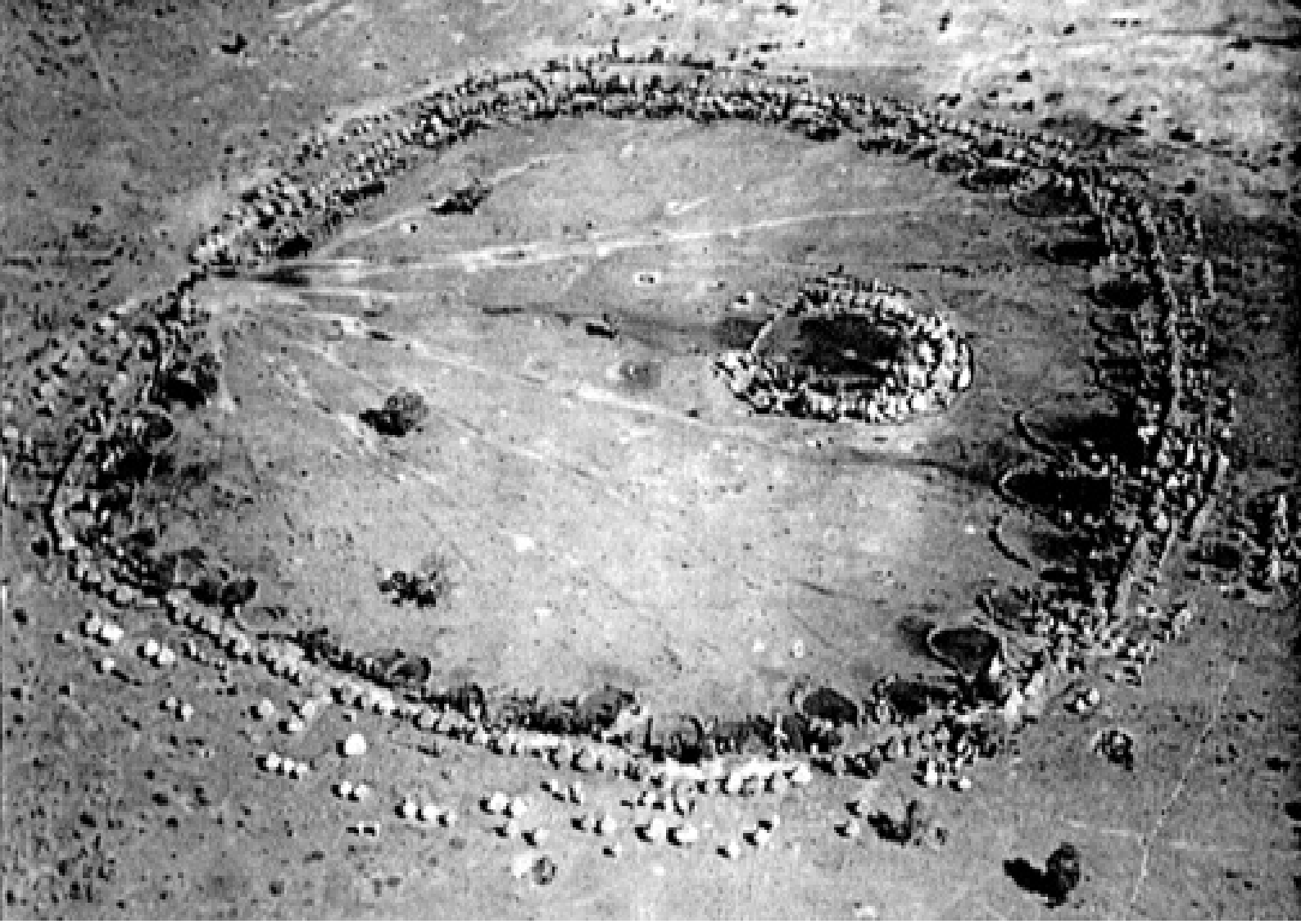


Figure 04_ Rhinoceros & Grasshopper 3D



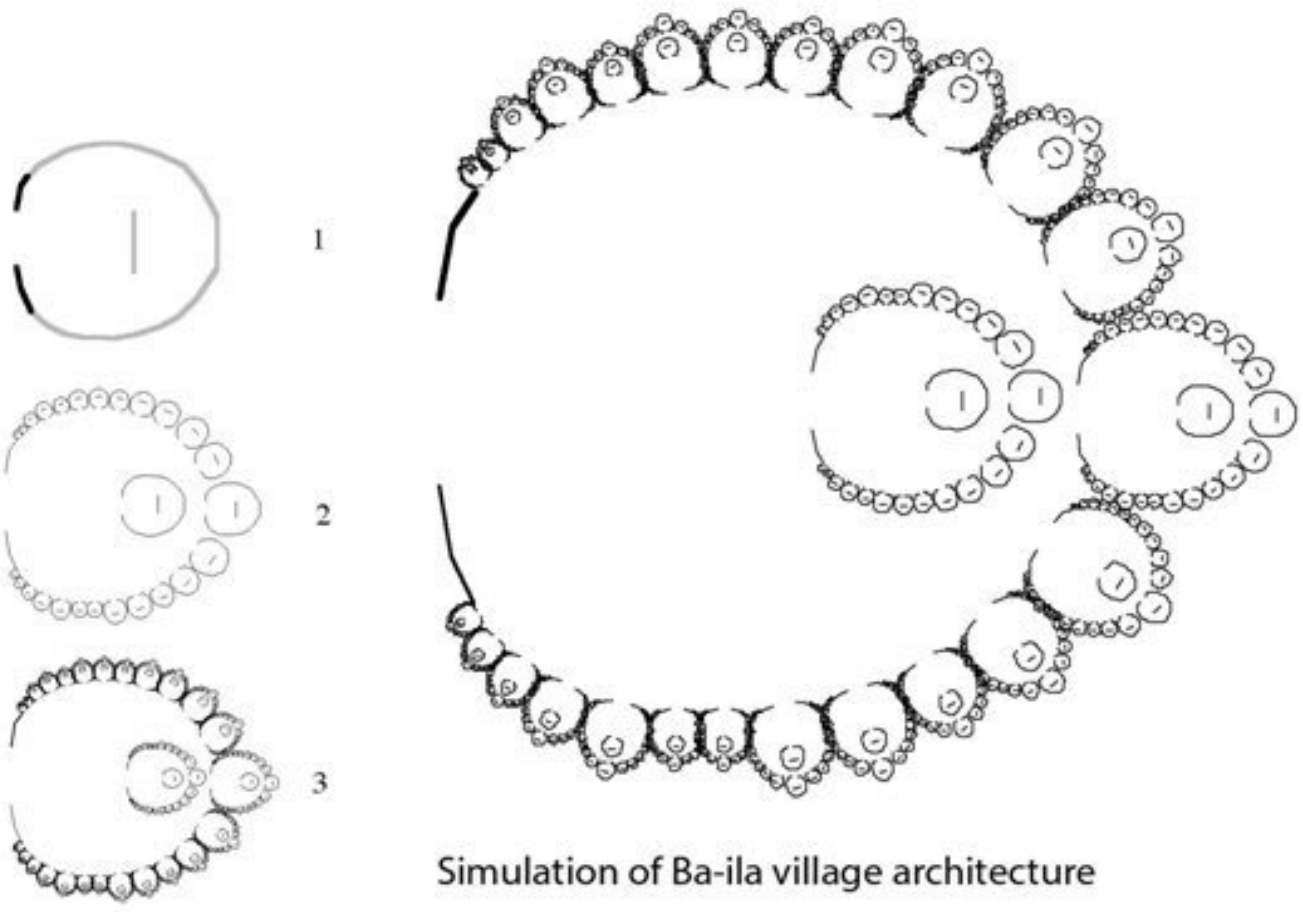


Figure 05_ Ron Eglash analysis of African settlements patterns.

Ron Eglash_ Fractals in African Settlements

American cyberneticist, Ron Eglash has analysed African indigenous designs through parametric analysis; one of particular interest is how African tribal settlements are observed as developing through self organising fractal geometries (Eglash, 1999).

What was taken from this example is the idea of cultural analysis through mathematics. This linked my subjects of cultural designs being analysed by an approach that could be rationalised into a language capatible with parametric modelling.

“Traditional African settlements typically show this “self-similar” characteristic: circles of circles of circular dwellings, rectangular walls enclosing ever-smaller rectangles, and streets in which broad avenues branch doen to tiny footpaths with striking geometric repitition”
(Eglash, 1998).

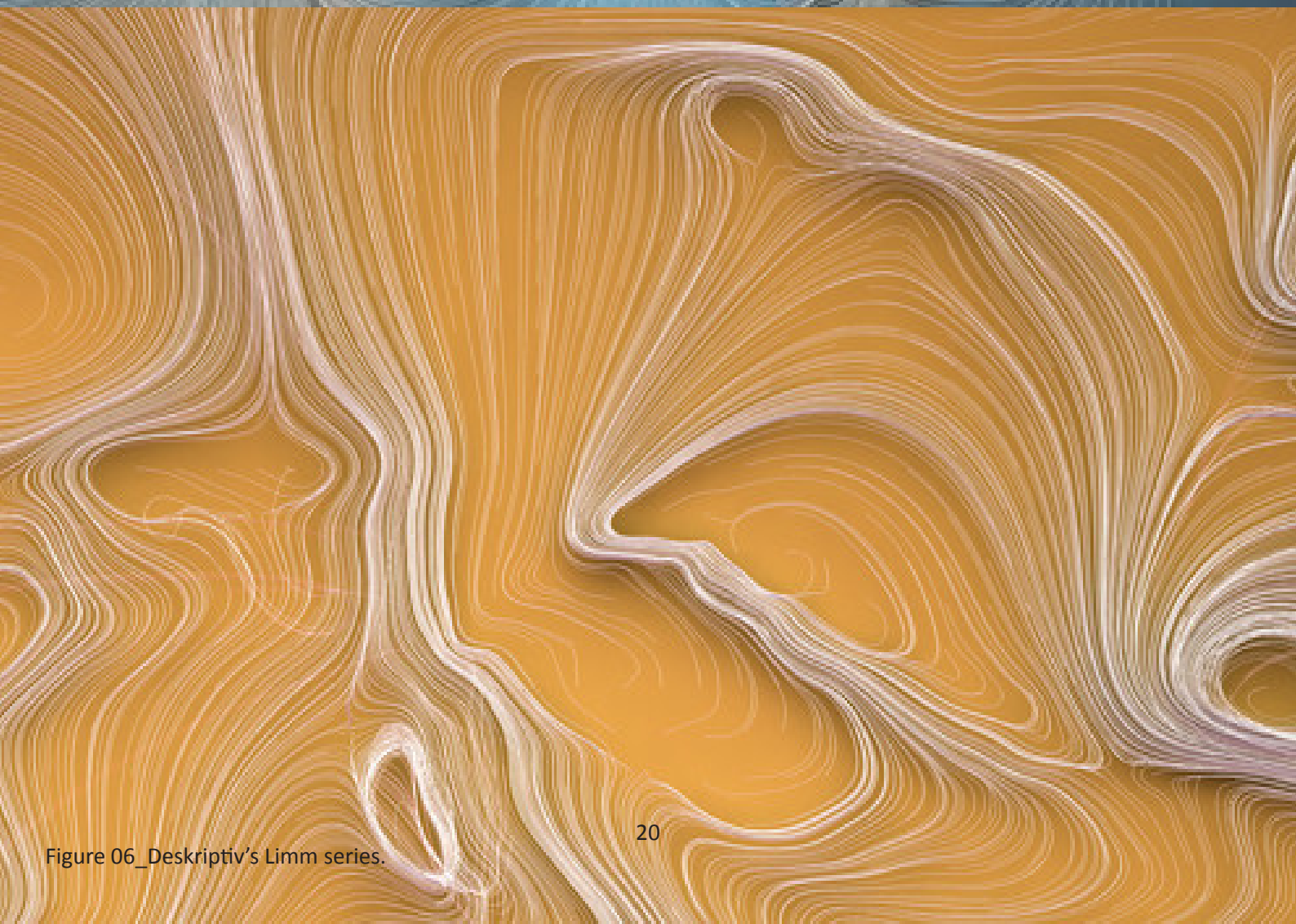


Figure 06_Deskriptiv's Limm series.

Deskriptiv_ Limm Series

Limm is a digital art collection by German based duo, Christoph Bader and Dominik Kolb, known as “Deskriptiv”. It explores the complexity of forms through processes subjected to varying parameters. The series uses a complex programming device that provides the “Limm” series with a genuine commendation to digitally produced artefacts as a wireframe reminiscent wind map.

The script designed for this series uses a cluster of trailing points originating from a variety of sample positions that are enclosed within a vector field (Gupta 2013). With the use of the appropriate algorithms and processes, these trailing points generate their patterns based on a number of attractors.

The Deskriptiv add that:

“the processes that produce shapes are a central theme of their work, so basically it is a switch from a product oriented thinking to a process oriented way of working.”
(Mansour, 2010)

The Limm series offers a means to communicate cultural knowledge that was embedded in the seafaring ancestors who used natural phenomenon, such as wind, tidal currents and water dispersion to navigate between one set of islands to the next. This is a valuable precedent as it graphically communicates intensity and subtlty through wireframe imagery.

Figure 07_ David Hakaraia’s Papatuanuku table.

David Hakaraia_ Contemporary technologies and Māori narratives

David Hakaraia's thesis delves into the contemporary practices of Māori art in conjunction with the use of non-traditional tools and materials. Tikanga Māori is highly regarded in all forms of Māori art and the negotiation between tohunga (artist/designer/skilled expert) and those cultural protocols are adapted to the new technologies and materials used is discussed throughout Hakaraia's work. The driving force behind his work revolves around Māori narratives and these stories dictate a lot of what takes place in terms of design intent.

Hakaraia's approach to designing with contemporary technologies is a valuable asset to this body of research as it has established a relationahip between traditional craft and contemporary technologies and mediated the tikanga involved in the process.

"Traditional craft was, and still is skilled work and involves the function of a technique and application of a human intellect that usually requires the application of the human hand. We would not attribute a high level of craftsmanship to a machine which produced thousands of Hei Tiki in an hour; this type of mass production usually falls into the categories of industrial design and mechanical technology. Craft is not a word that is usually associated with digital technologies but this need not be the case. The human mind still plays a part in the development of a product, regardless of the tools that are used."

(Hakaraia, 2011)

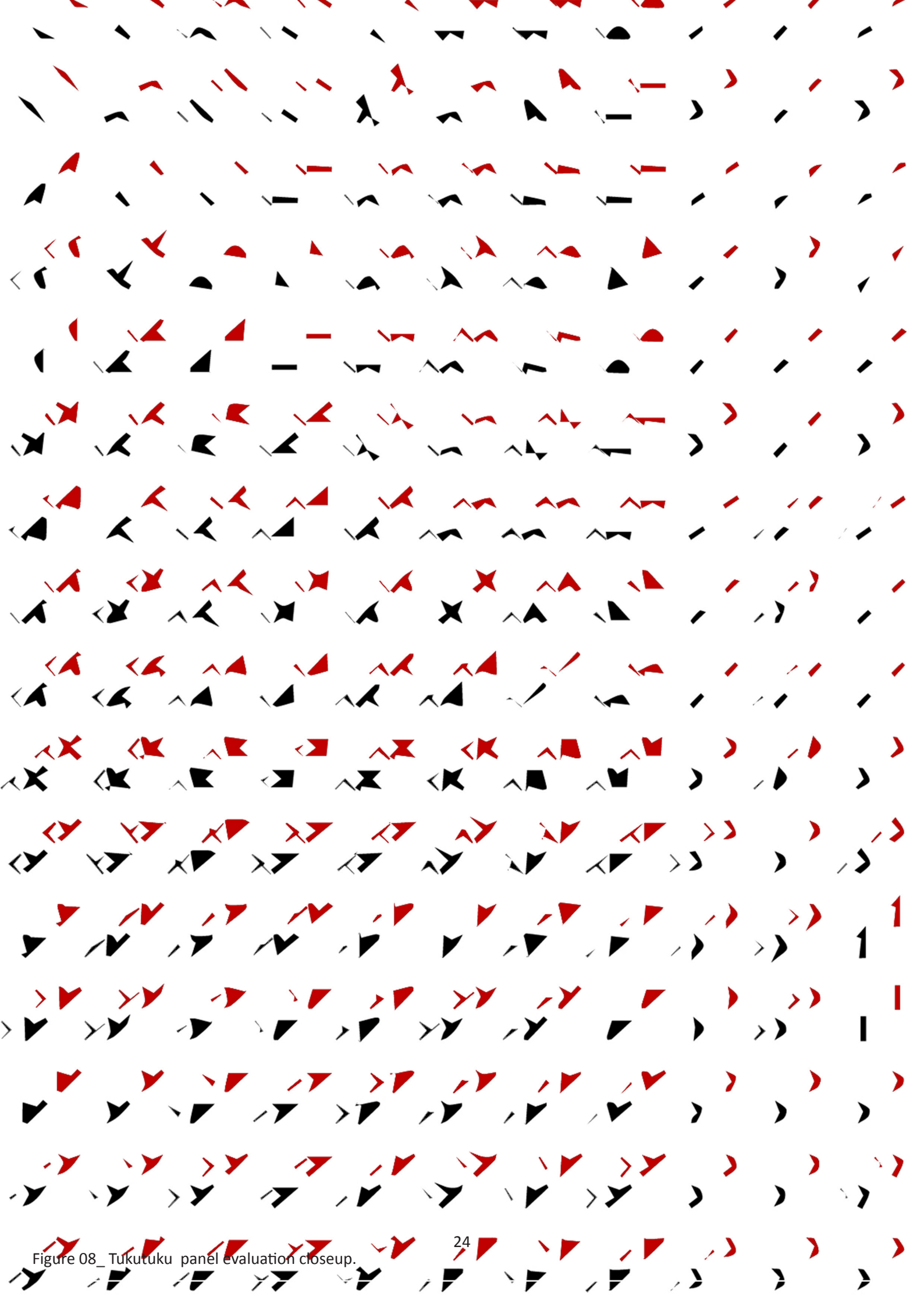


Figure 08_ Tukutuku panel evaluation closeup.

Chapter One

Stage One_ Preliminary Design 1

The Journey of our Tipuna

“Voyaging along the well-travelled ara moana (ocean paths) between known islands, the chance to voyage on the open sea would have been hard to resist. The hunger of chiefs keen to expand their personal domain and power, and the sailors’ desire to increase their personal mana and prestige, would be a powerful mix that must surely have inspired many voyages”

(Evans 1988).

Initial research investigates the patterns of Māori ancestors during the Great Pacific Migration, as deciphered from contemporary theories of our origin: from South East Asia to Aotearoa (New Zealand). Through the thought process of visualising cultural knowledge, the 2-dimensional patterning exercise looked into the techniques used to navigate the vast streches of the Pacific Ocean.

There were many factors that influenced the tohunga’s, expert practitioner, decision making during the voyages. These included, but not limited to, the location of the sun in the sky and its movements, starmapping, the prevailing wind direction, even the inhabitants of the sea itself. However, the one main factor that was chosen as an analytical subject for parametric modelling was how the water behaved; in particular wave, diffraction, reflection and refraction.

This is can be seen in the navigational stick charts of the Marshall Islands. “The chart is less a literal representation of the sea, but more an abstract illustration of the ways that oceans swells interact with land” (Romm 2015).

In attempts to emmulate a similar output through Grasshopper, with the precedent of Deskriptiv’s Limm series, component’s called “Spin Forces” were used to progress the design iterations. Spin forces work but establishing an influencing node (point) that has a series of parameters associated to it. These nodes in turn influence surrounding nodes and generates a series of lines (curves) that are affected by the strength and radius of a particular Spin Force. Using these nodes as reference to a particular island or cluster of islands in the Pacific region, imagery was generated to simulate weather and oceanic phenomenon that were used by the ancient seafarers as a guide to neighbouring islands; which ultimately lead to the settlement in Aotearoa New Zealand.

Critical Reflection

Generating Spin Forces in Grasshopper is easy to understand and predict when dealing with minimal influencing nodes. However, once there a number of these acting simultaneously in the same script, complications arose and control of the design output was difficult to predict. Evidently, this became an exercise in releasing the design intent to the algorithms used in Grasshopper. Through this experiment, the idea of embedding data (mātauranga) into each node with intent became imperative to the success of the design outputs. As the outcomes can be rationalised with the original information fed into the original script.

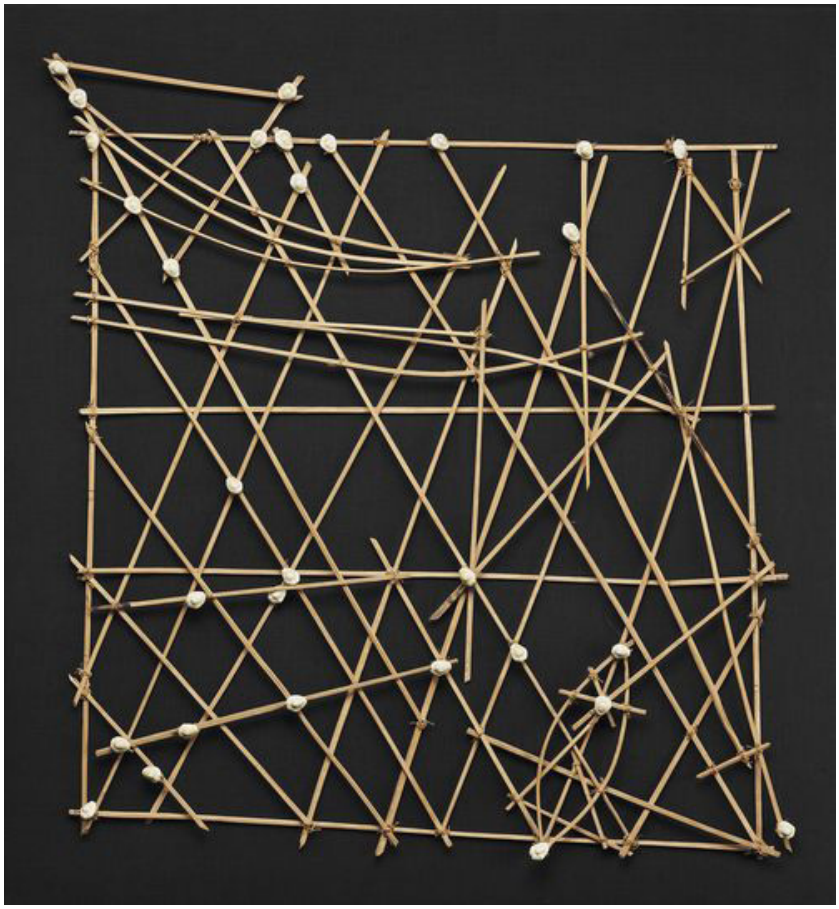
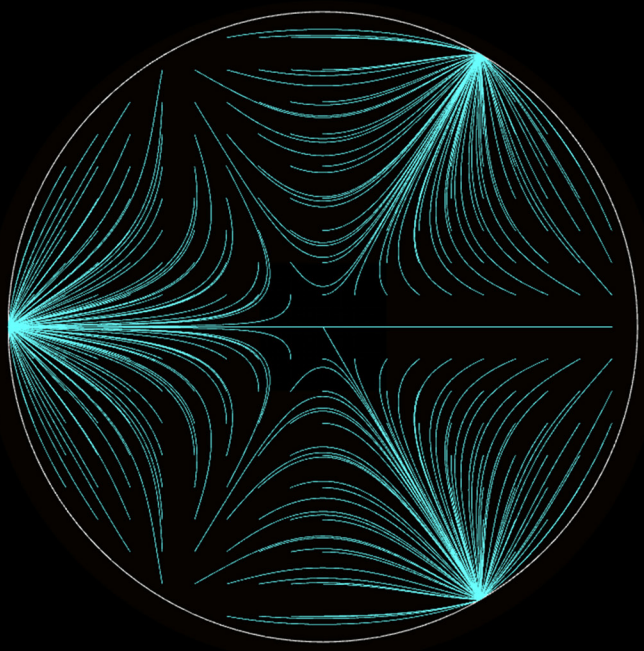
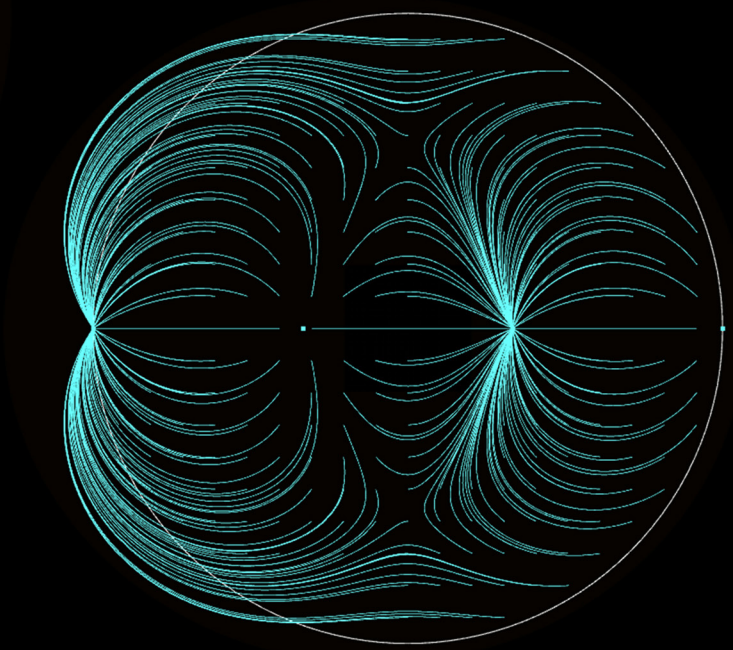
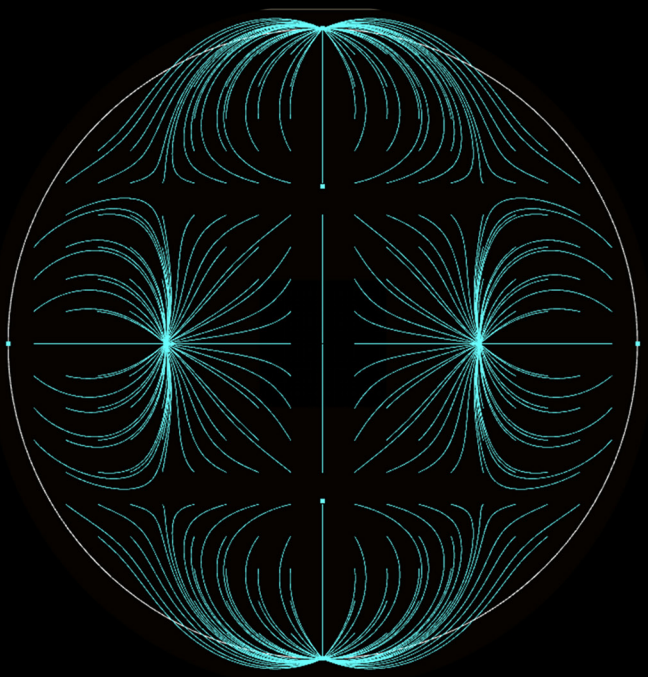
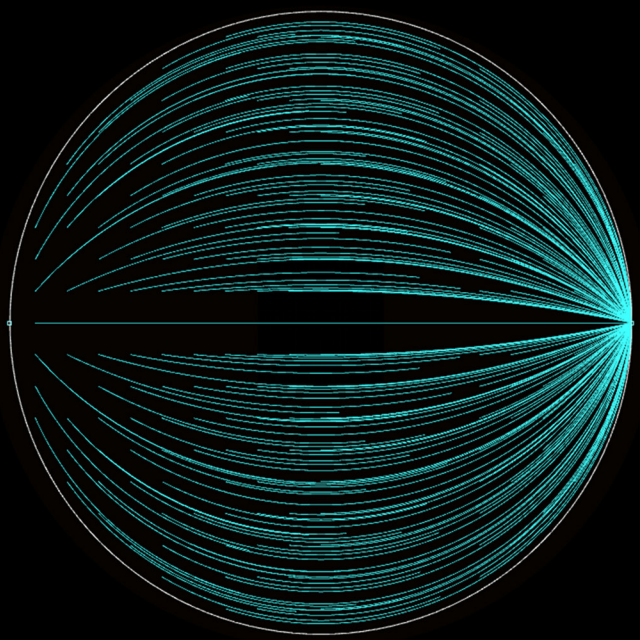


Figure 09_ Marshall Island Stick Chart.









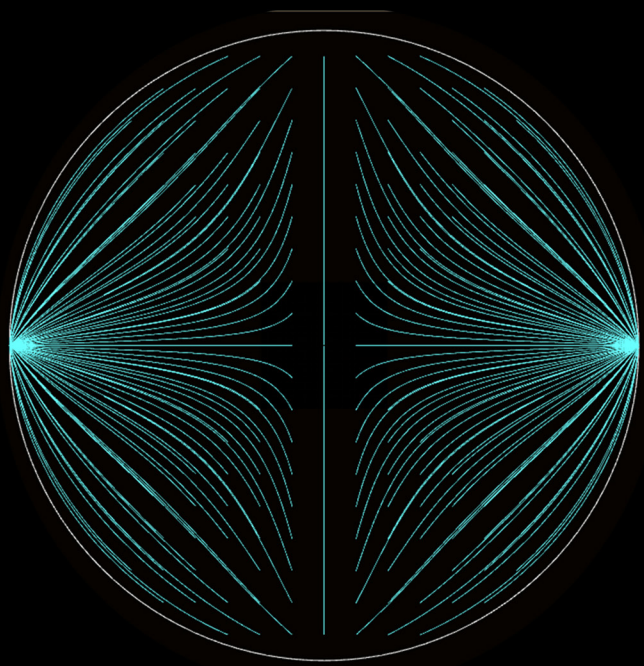
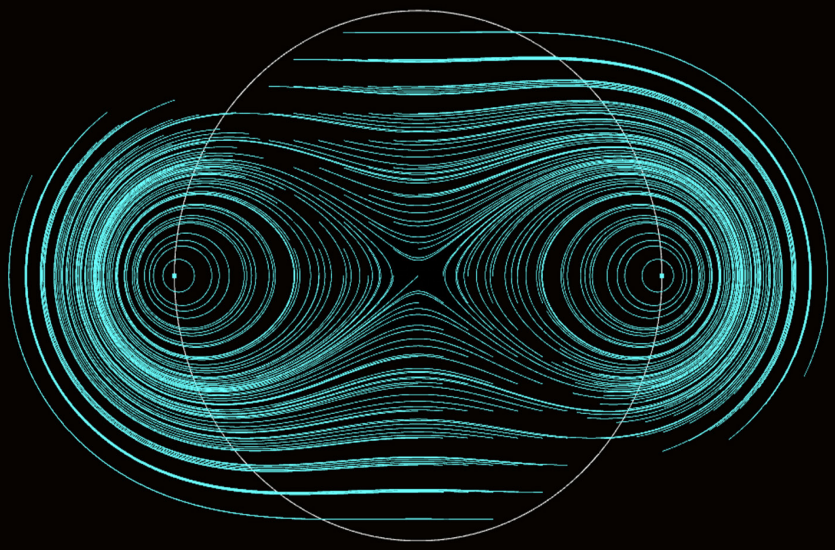
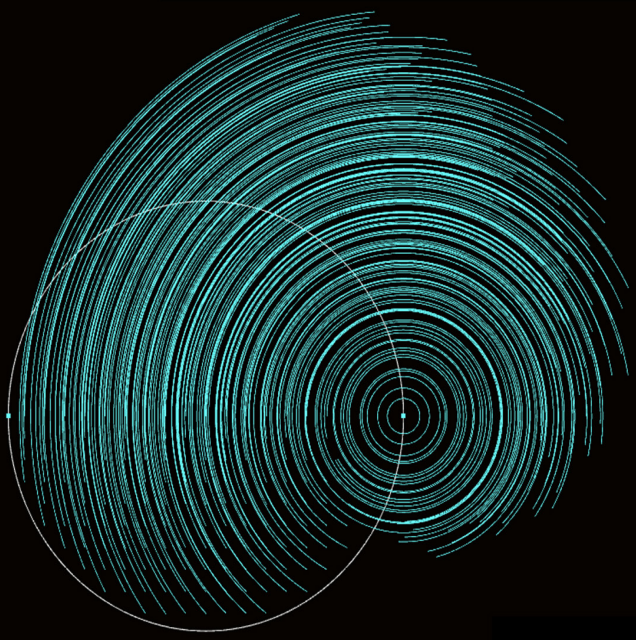
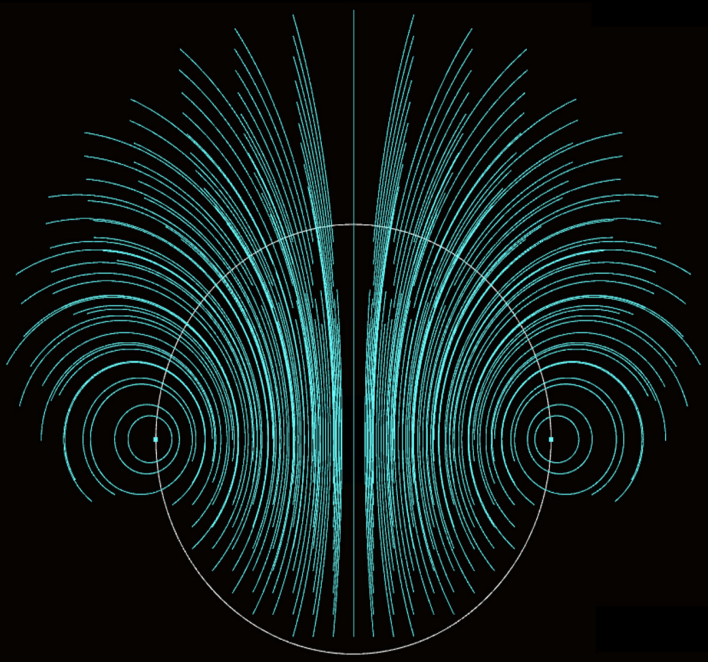


Figure 10_ Vector force evaluation trials.







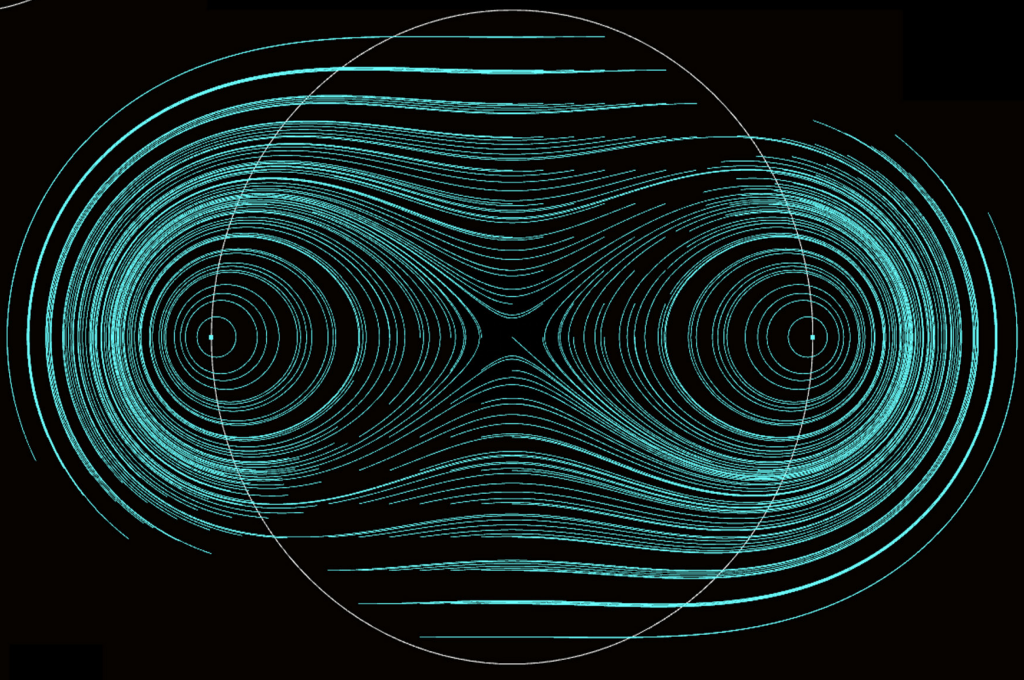


Figure 11_Spin force evaluation trials.

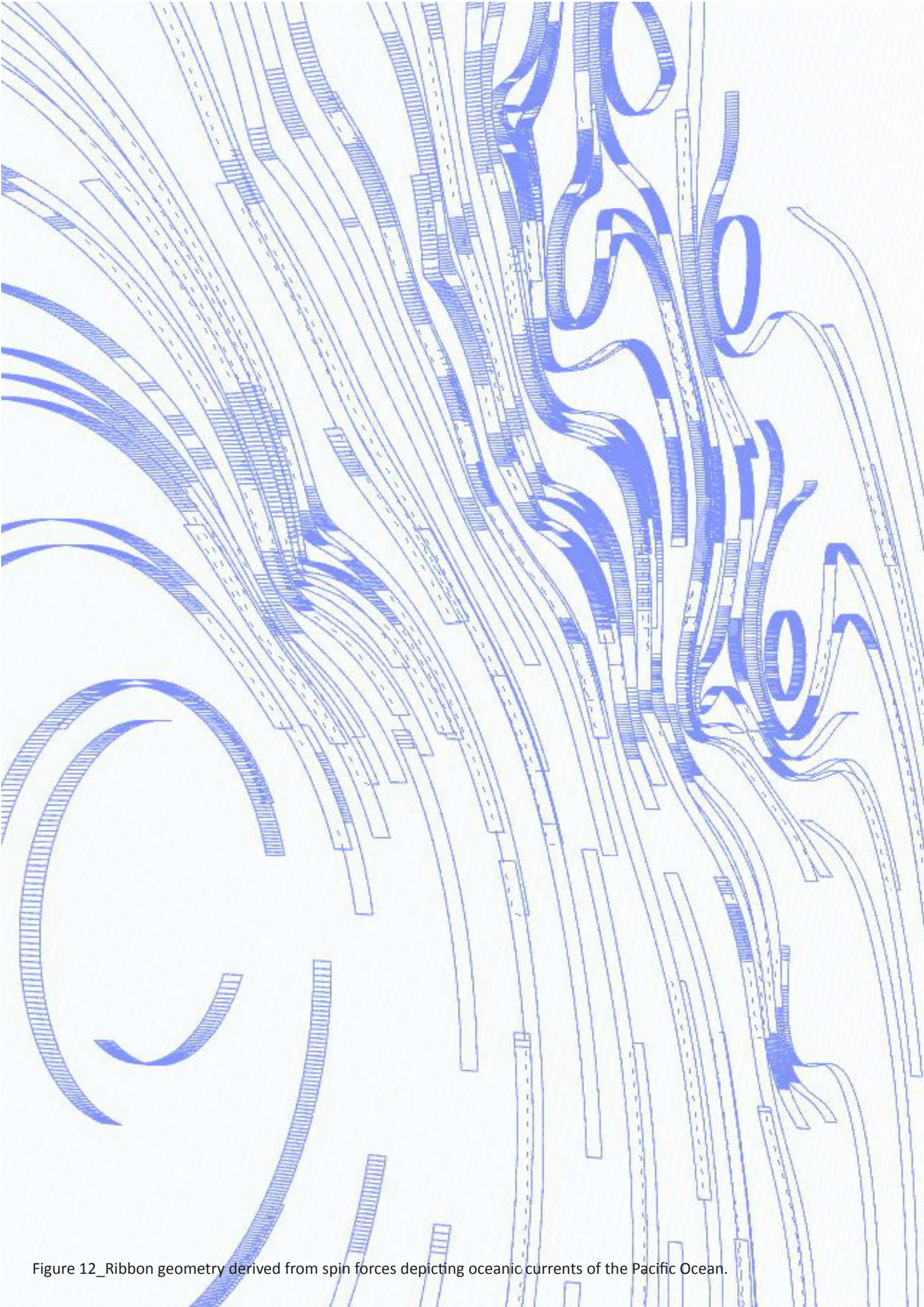
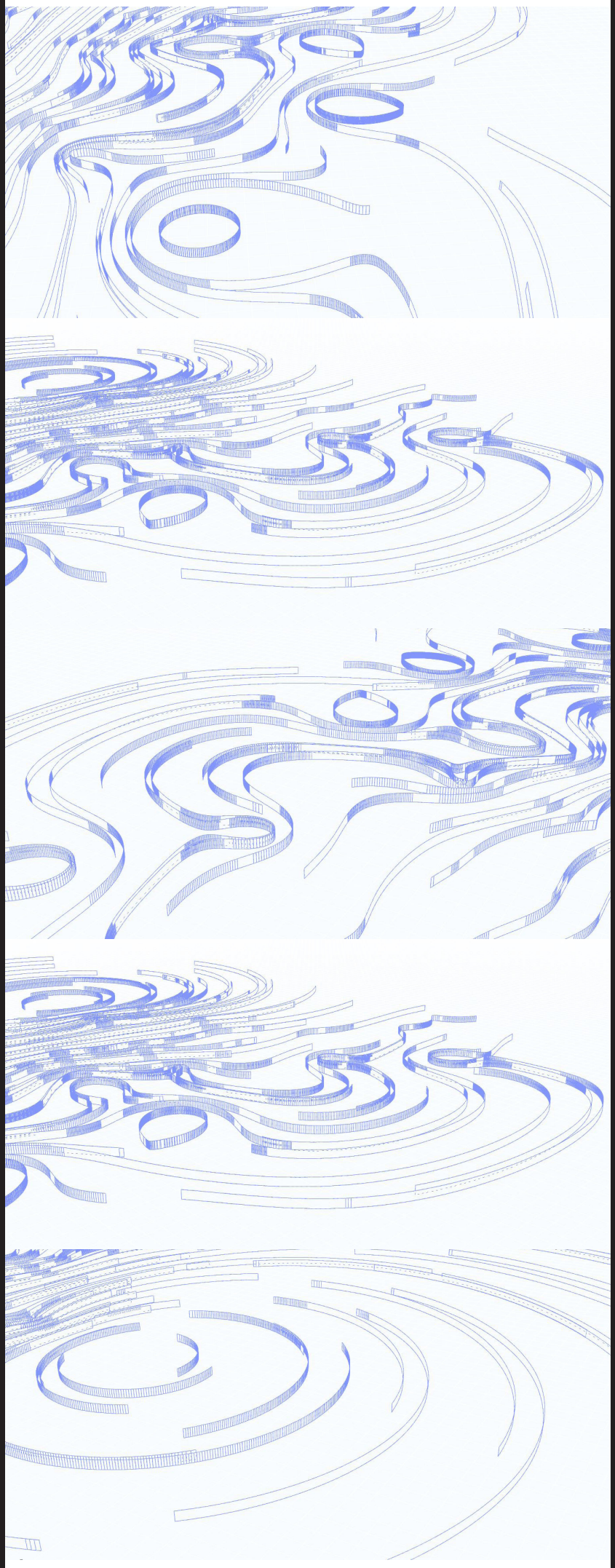


Figure 12_Ribbon geometry derived from spin forces depicting oceanic currents of the Pacific Ocean.



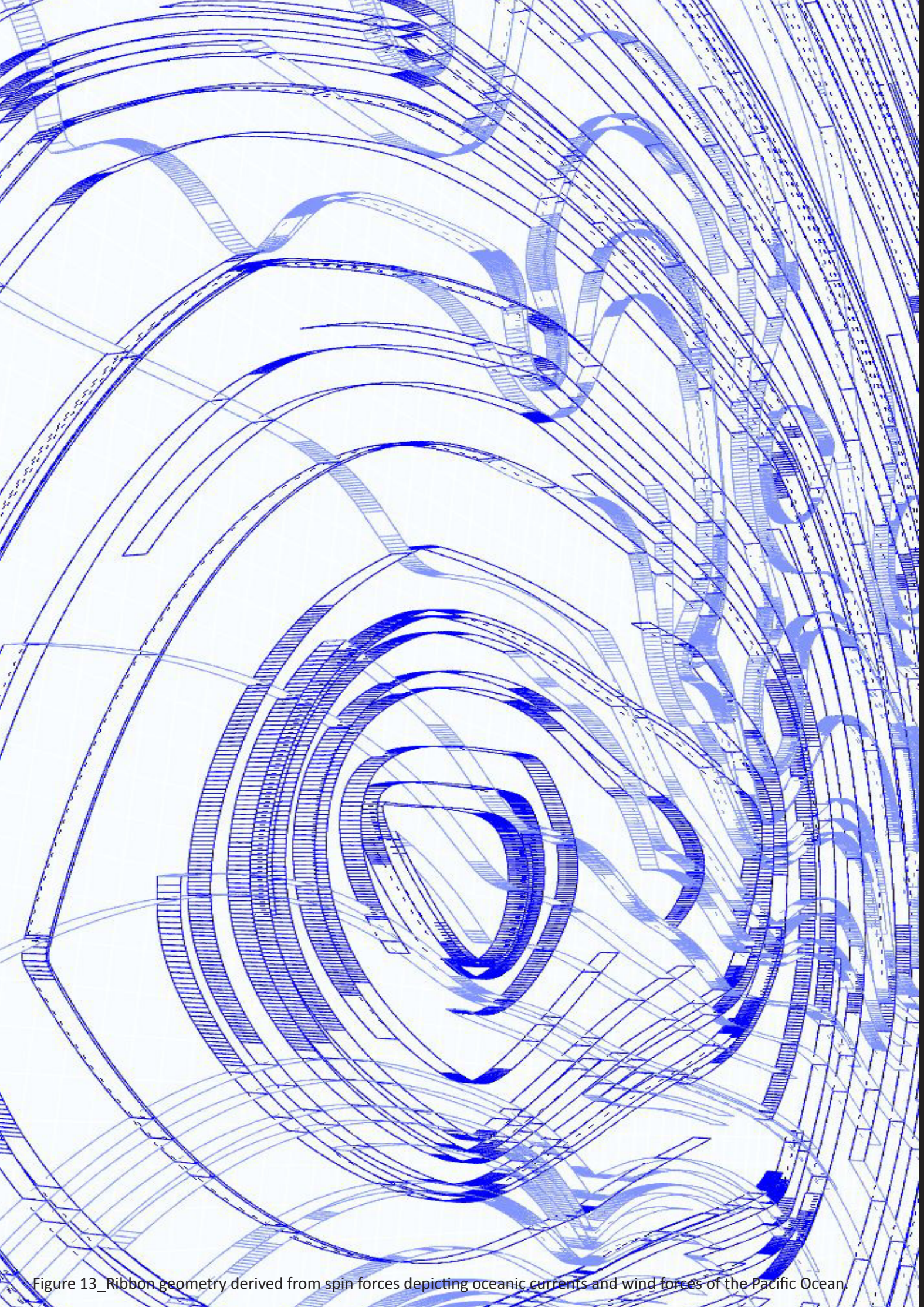
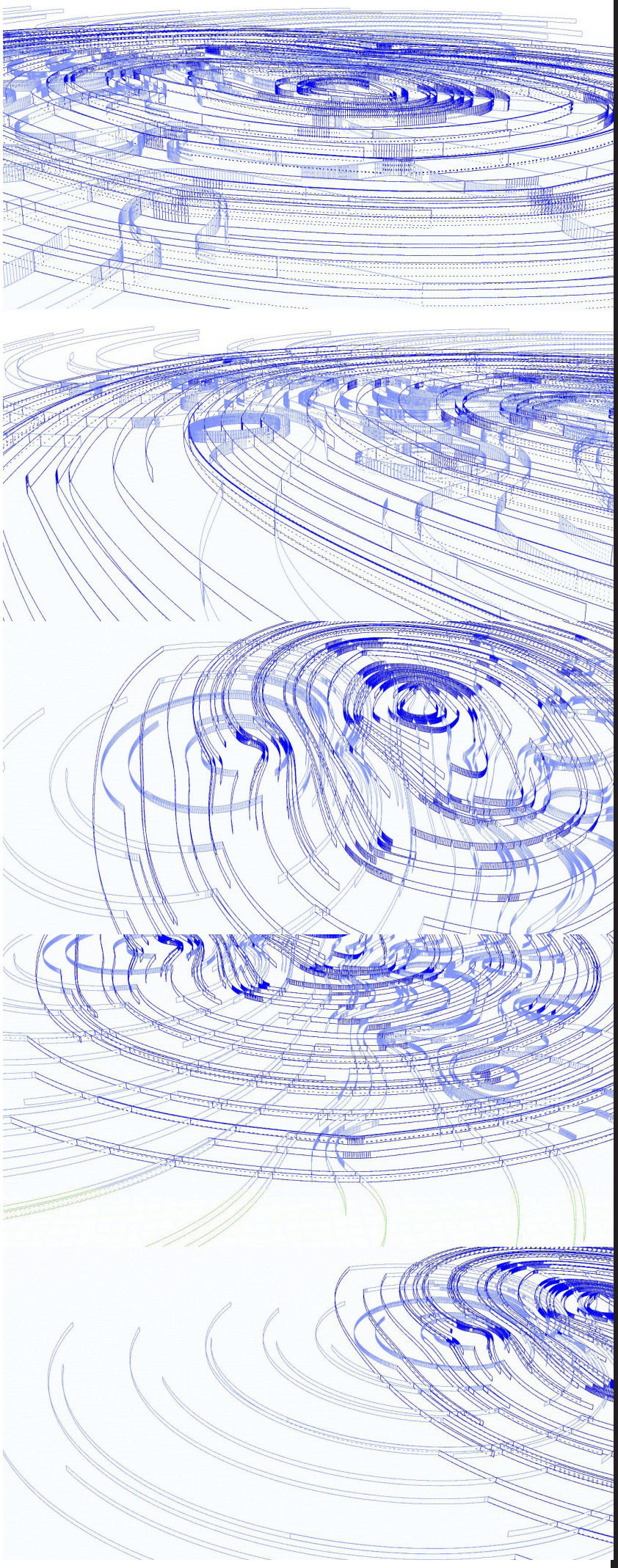


Figure 13_Ribbon geometry derived from spin forces depicting oceanic currents and wind forces of the Pacific Ocean.



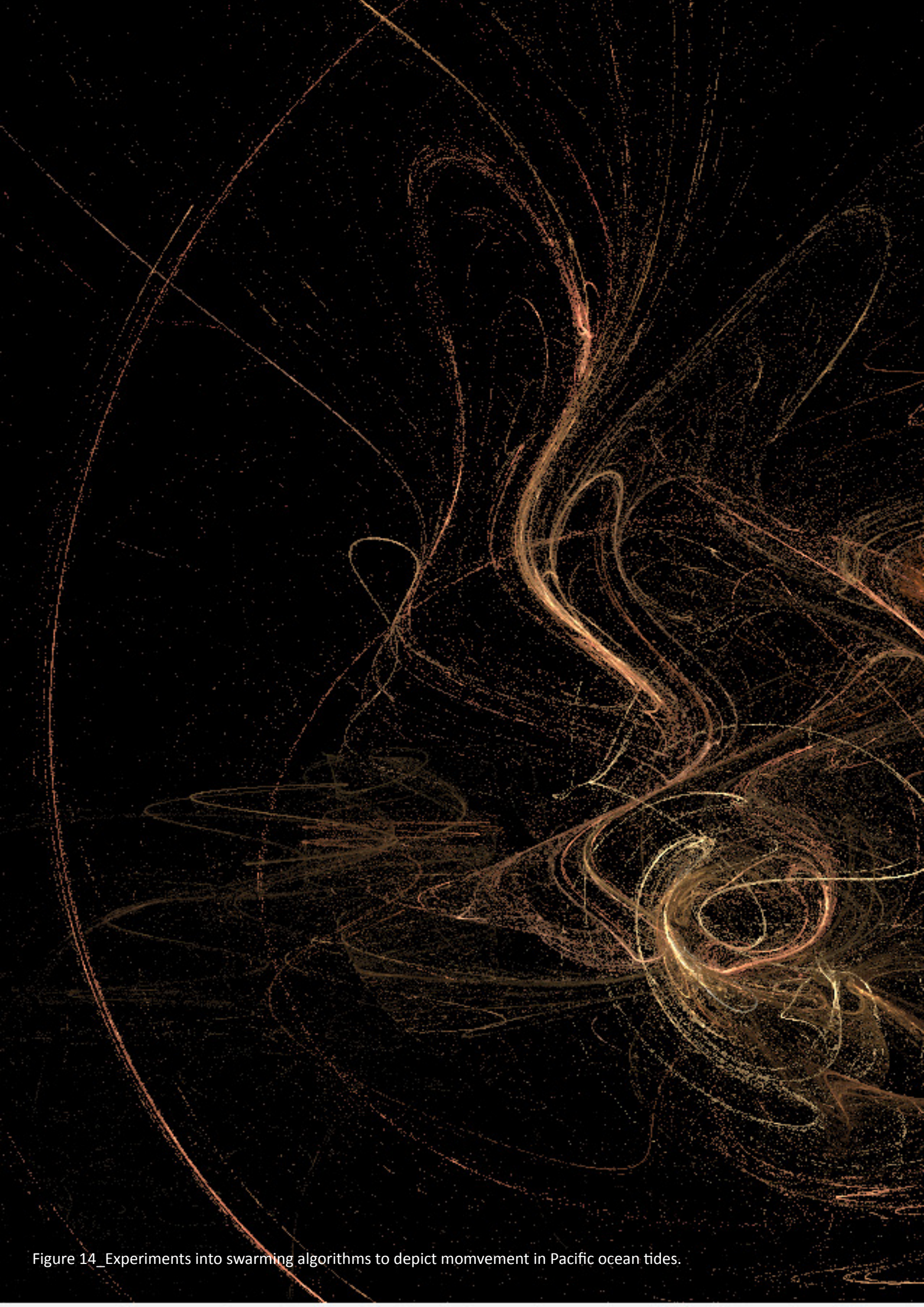
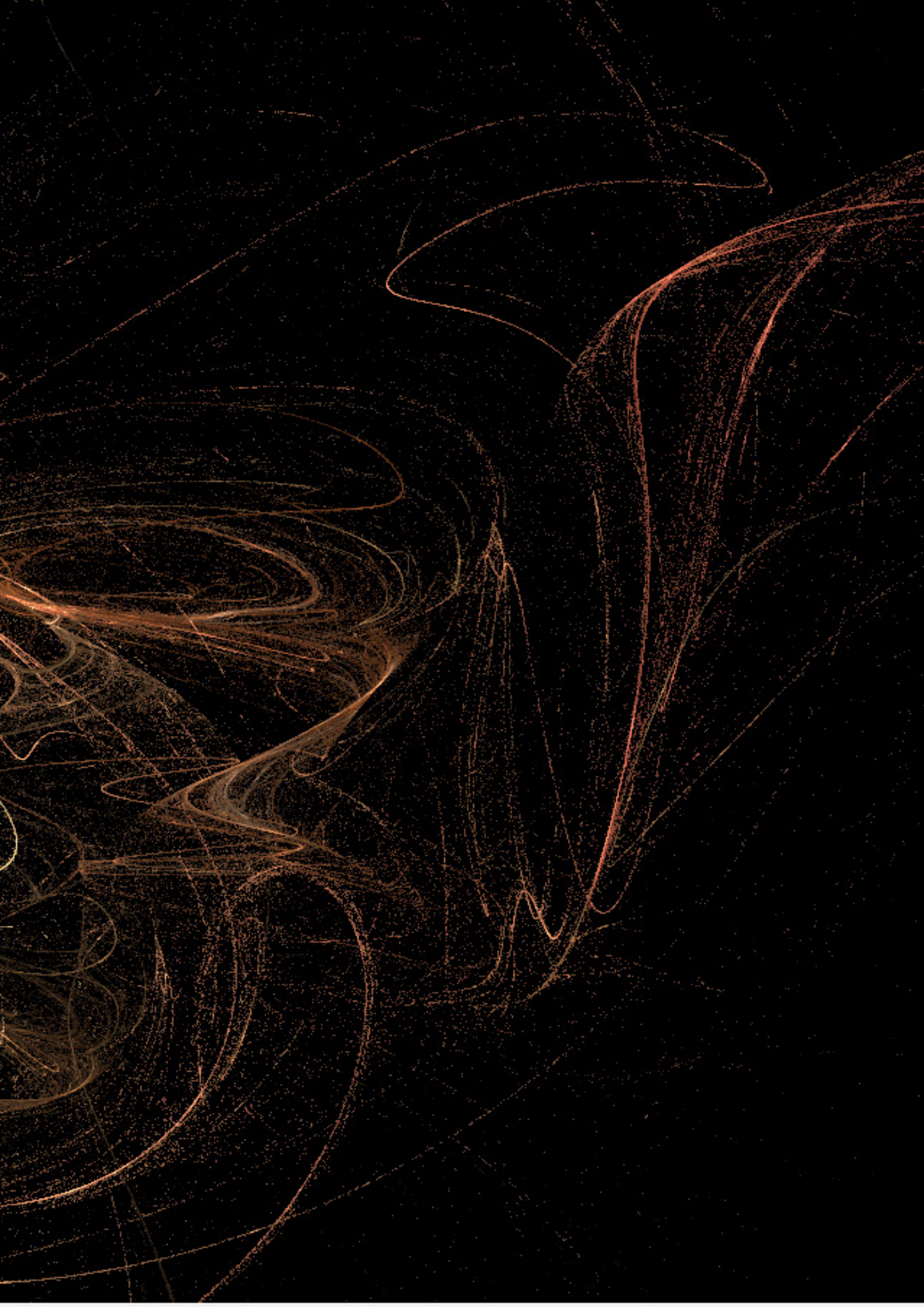


Figure 14_Experiments into swarming algorithms to depict momvement in Pacific ocean tides.



Sculptural Cartography

Each point on the line indicated the physical distance between the island (or set of islands) that were settled throughout the Great Pacific migration prior to the arrival to Aotearoa (New Zealand). Jeff Evans (1988) has indicated the areas of settlement throughout this time and the direct route has been identified in this experiment: from South-East Asia to Aotearoa.

The inclusion of polygons at the individual island points allowed for a particular set of data to be implied relating directly to that location. For example, population of area, land mass, environmental factors, etc. As long as the information can be understood numerically, the data can easily be parameterised into the component. For this particular exercise, the radius of the polygons indicated strength of prevailing winds at the individual island.

In the design of the scultural mapping, there was a series of iterations that lead to the final product. This example includes the offsetting of polygons that were utilised to show prevailing wind direction at the indicated island. Lofting the polygons together generated a sculptural form that highlights influences of wind along the voyage from Aotearoa, the base of the sculpture, to South East Asia, top of sculpture.

To highlight the location of each island on the lofted sculpture, a series of piped curves were utilised to connect the alternating corners of each successive polygon.

Critical Reflection

In contrast to the Preliminary Design 1 where established Grasshopper components were used largely to generate design outputs, this experiment required generating a Grasshopper logic that implied full control of each element. This form of parametric design, allows the designer to predict the outcome far more easily than the initial experiment, but creating such a logic is far more time consuming.

In doing such, a sense of design ownership is regained as all elements are and influences are controlled in relation to each other. This is true for the initial experiment as well, but in the case of Spin Forces, control of the final outcome is dependent on the number of influencing nodes and the strength of each but again, meaning and design intent can be easily lost in more complicated arrangements. Occasionally, the meaning given to parameters will not generate a form you desire.

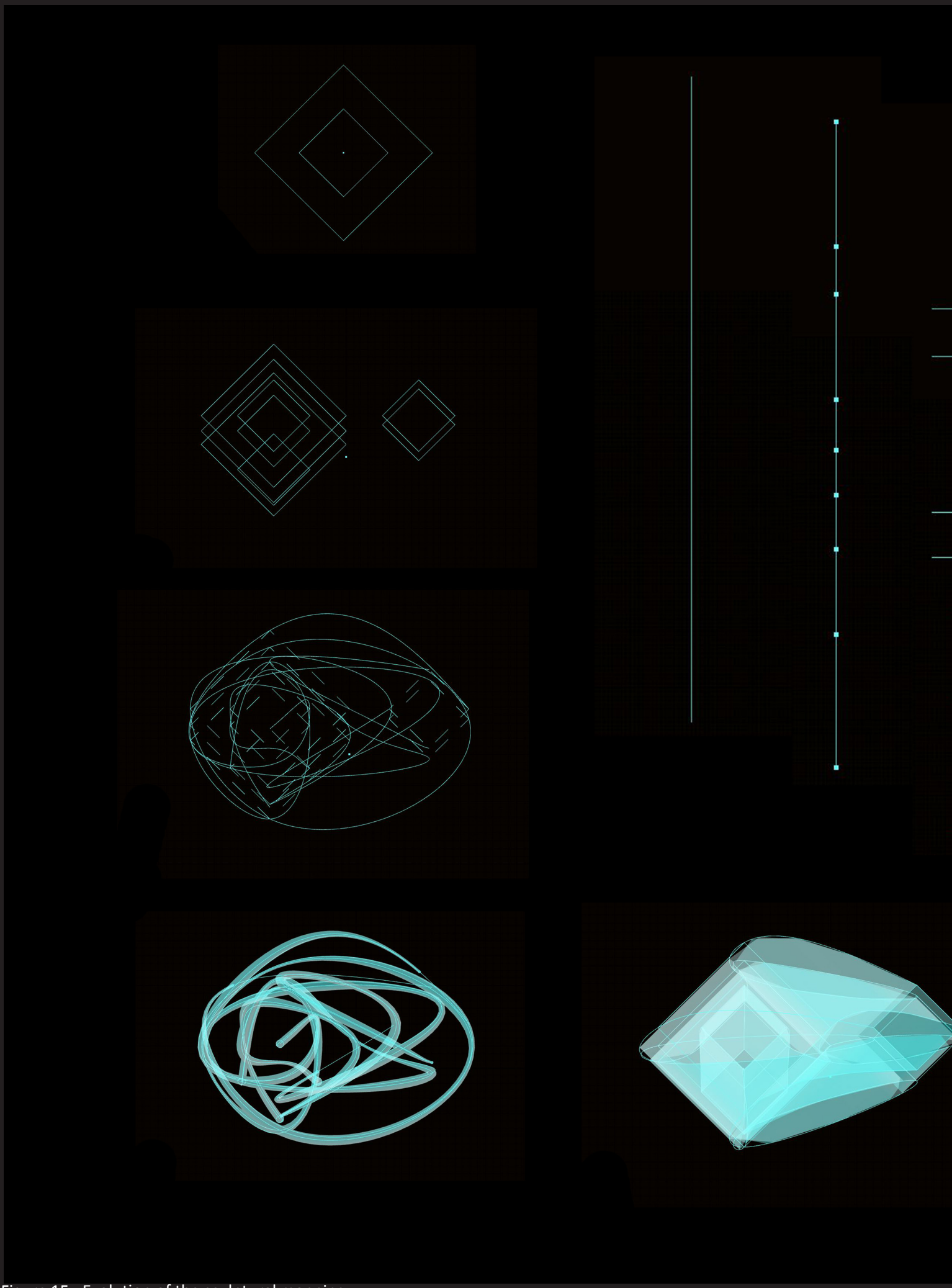


Figure 15_ Evolution of the sculptural mapping.

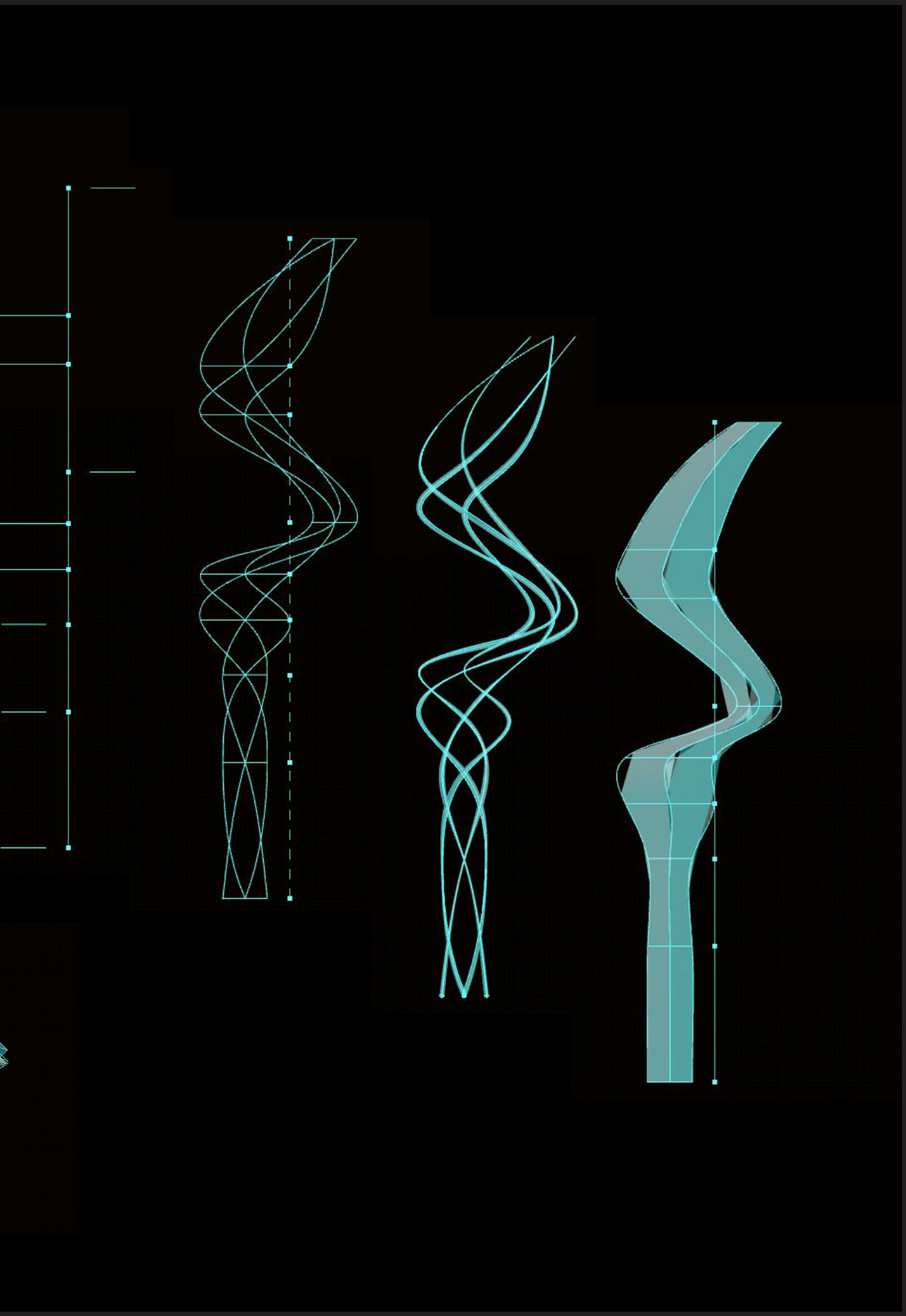


Figure 16_ Rotated views of the sculptural map.

Figure 17_ Mould casting of sculptural map.

Figure 18_ Wax cast of sculptural map.

Figure 19_ Wax cast of sculptural map.

Figure 20_ Wax cast of sculptural map.

Figure 21_ Wax cast of sculptural map.

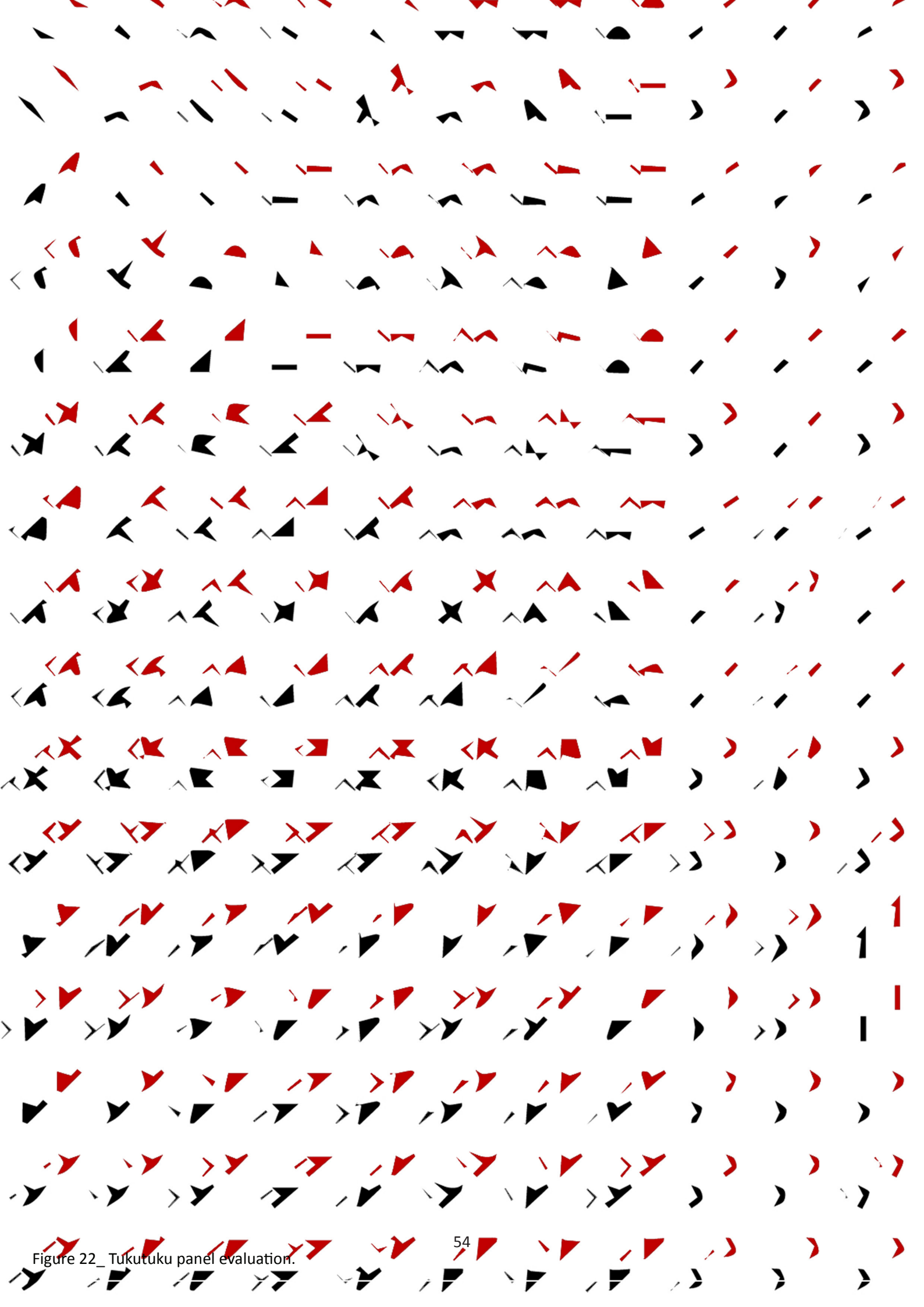


Figure 22_ Tukutuku panel evaluation.

Chapter Two

Stage Three_ Scripting Traditional Patterns in Whakairo

Art and architecture are combined in many Whare Tipuna around Aotearoa. Independently, these pieces of art tell the narratives; when combined they form the whakapapa of the people. Māori art is formed under the tikanga associated to the craft, which is a coded process and a knowledge set that is embedded into the piece. These factors have been analysed and reinterpreted through parametric modelling tools to produce new ways of viewing these narratives. In order to build on what is known in Māori carving, I need to start from what exists. This will give me more of an insight into what the patterns mean and how they are translated to the general public.

To move to a more "parametric" stylised form of pattern generation, I will use the traditional pattern translation and imbed it into the more generative pattern making. This will have more resonance in the Māori community as it will have a grounding in what is known already. Taking one of the most predominenant patterns used in whakairo; the rauru (spiral).

"Spirals depict movement and accentuate the round form, so they are placed on parts of the [carved] body such as cheeks, shoulders, wrists and knees. Spiral designs include maui - a continuous spiral that emanates from the rauru pattern, and makaurangi or korurangi - a design that looks like a thumbprint. This design begins with a bulb, then a line extends outwards in a koru (fern-like shape)"
(Mulholland and Bargh, 2015).

In order to generate a parametrically controlled rauru, I took the ques from the readings and images taken of the whakairo (carvings) of Kahuranaki marae. These curves can be used as a base to sweep a series of various shapes along its forms. These sweeps can emulate the path of a carving utensil as it would be done with whakairo.

However, this is a purely mechanical way of doing things, obviously when a master carver (tohunga) works with a piece of timber, there are natural characteristics of the material that is worked into the design. There is a dialogue between carver and medium that needs to be mediated in order to achieve the desired outcome. But for the purpose of this thesis, I am looking at how contemporary subtractive prototyping technologies (CNC-milling) can be used for Māori craft; in particular whakairo.

“Like other kinds of sculpture, whakairo rakau (wood carving) is a reductive process; the artist gradually takes away the extraneous material to reveal the essence of the form. The literal meaning of whakairo is to eat away (an iro is a maggot)”

(Mulholland and Bargh, 2015, p.6).

CNC (computer numerical control) milling has been selected as the tool to translate the forms generated on Rhino/Grasshopper into a physical object. As a contemporary prototyping tool, it operates in a subtractive manner; drilling material away to attain its final form. CNC milling itself has the capability of producing a large variety of finishes to the final object. And it is this process of mediating between the tool and the designer that will ultimately generate the product, embedding the final object with a personal/humanistic touch that some have argued is lost when using machines. It must be said that this process is not intended to emulate any traditional whakairo (carving) techniques or take away from the highly skillled artform, but merely act as a testing ground for the capabilities of CNC in terms of a prototyping technology and recognising any potential issues of its cultural appropriation when used to create a physical object from digital models, especially the wakahuia.

Figure 23_Kahuranaki Marae, Te Hauke, New Zealand.

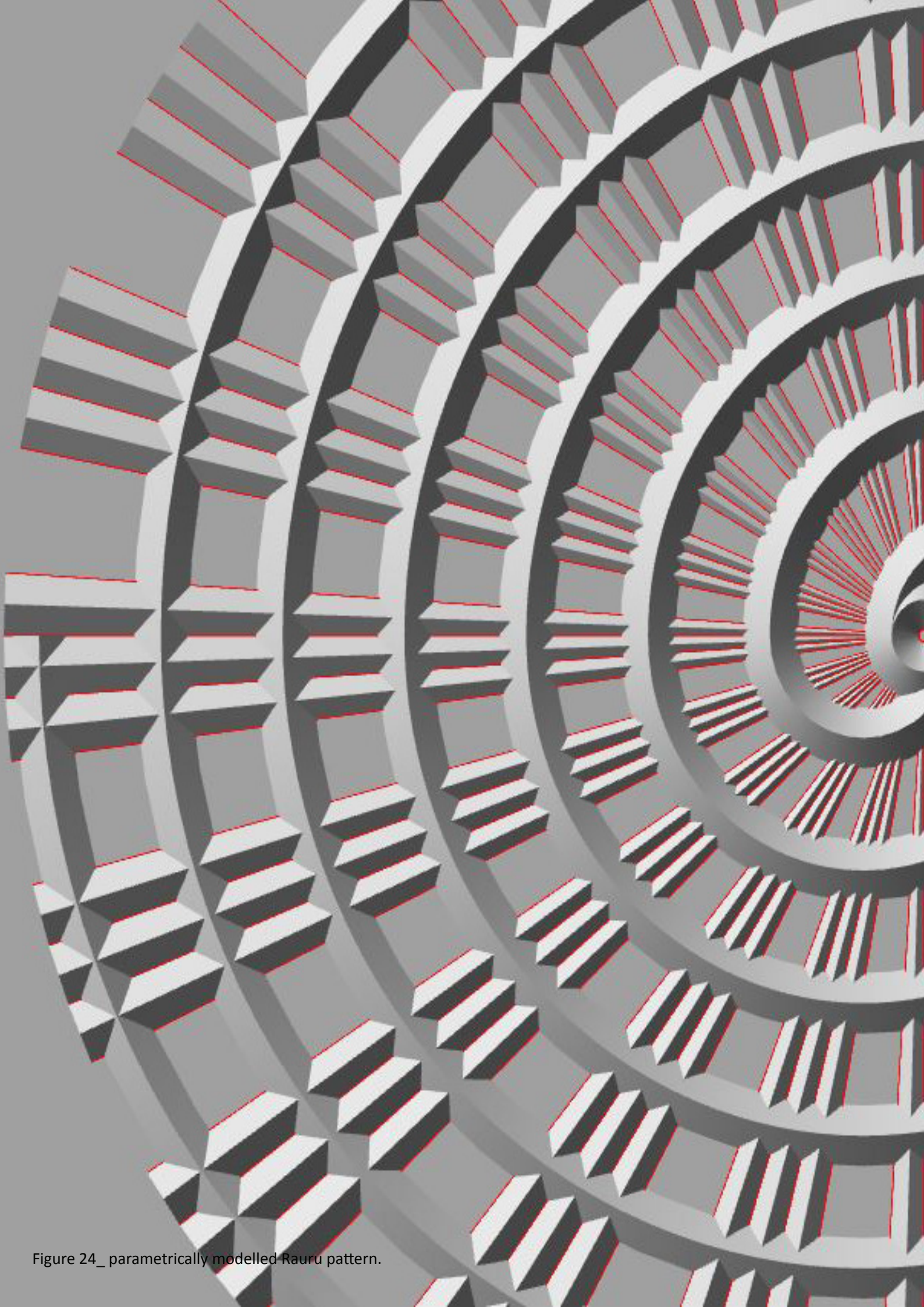
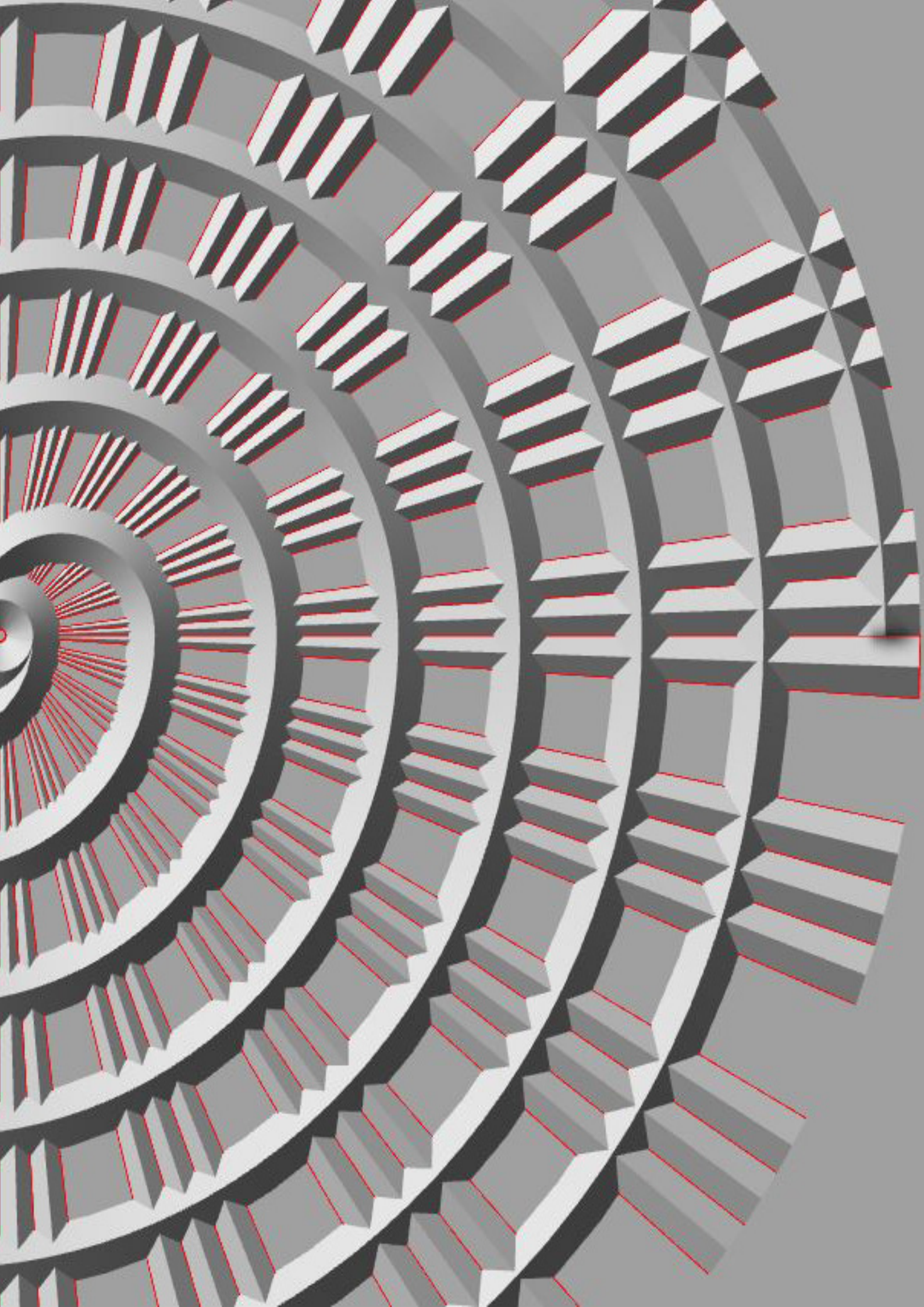


Figure 24_ parametrically modelled Rauru pattern.



Stage Four_ Preliminary Design 3

Designing with Narratives

This exercise developed on the ideas gained from previous experiements which assigned set of data to given parameters, nodes or splines. Establishing the design parameters within the vacinity of Te Hauke (located in the Hawkes Bay region of New Zealand), allows for a more refined approach to developing the design output.

Pēpeha can refers to a collection of culturally significant geographic landmarks that links Māori people to a specific area, establishes ties between whanau (families) and traces back to their tipuna (ancestors). As these landmarks are physical entities, it is possible to establish them as points or nodes on a map that will allow for a series of algorithmic relationships to be established between each of these elements (Mead & Grove, 2001).

Nga Pēpeha O Ngāti Rangikoianake

These are the traditional sayings of Ngāti Rangikoianake (my hapu or sub tribe) and of our marae (sacred meeting place) called Kahuranaki.

Ko Takitimu te waka
Ko Tamatea Arikinui te tangata
Ko Ngāi Te Rangikoianake te hapū
Ko Kahuranaki te maunga
Ko Ngaruroro rāua ko Tukituki ngā awa
Ko Poukawa te waiu
Ko te Hāpuku te tangata
Ko Tumapukiarangi te tekoteko
Ko Te Whatui-Apiti te Rangatira
Ko Kahuranaki te marae

In order to translate the design of the elements of the pēpeha, I have utilised the use of Vector Fields to depict the relationship between the different elements. Radial lines are generated from the central point which indicates the place of importance. The folds in the curves generated show the relationship between the elements, interacting by repulsion.

“If an artist wishes to make a wakahuia, then the name itself, the word, demands that he proceed in the full knowledge of what that word means. His choices are limited by what has happened in the past, and by what is occurring in the present. Thus the form and size selected by the artist are already clothed in a thousand words”
(S. M. Mead, 1984).

Critical Reflection

This exercise proved very successful in the design intent and the processes used to achieve it. Taking from the first two exercise was a need to control the logic used but relinquish the need to design the final output. In doing so, an artefact was produced that allowed for more interpretations through the people of my iwi, and offering them the opportunity to clothe the object in their own words.

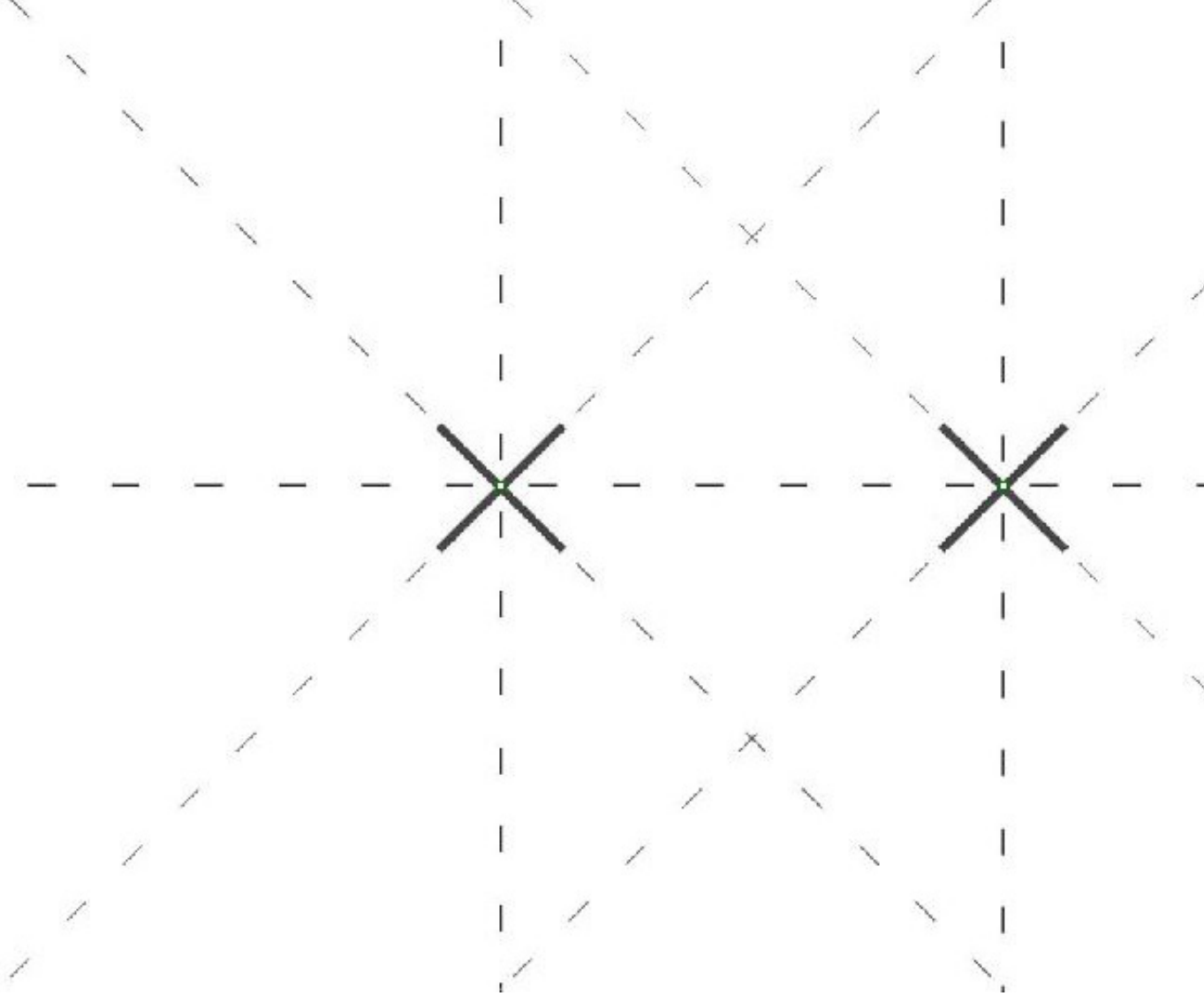
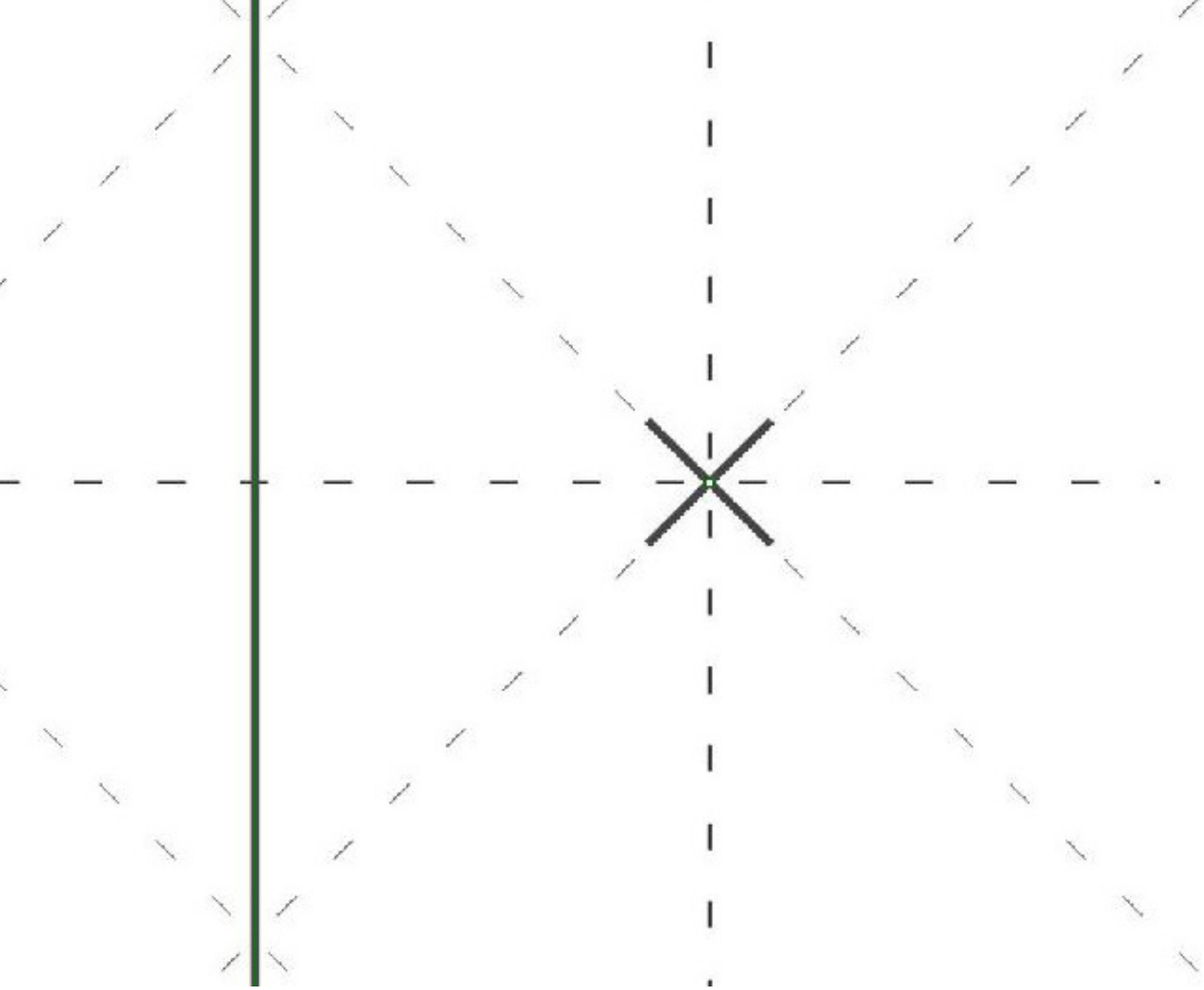


Figure 25_ Simplified disgram of Te Hauke’s significant sites (marae, lake, river and mountain).



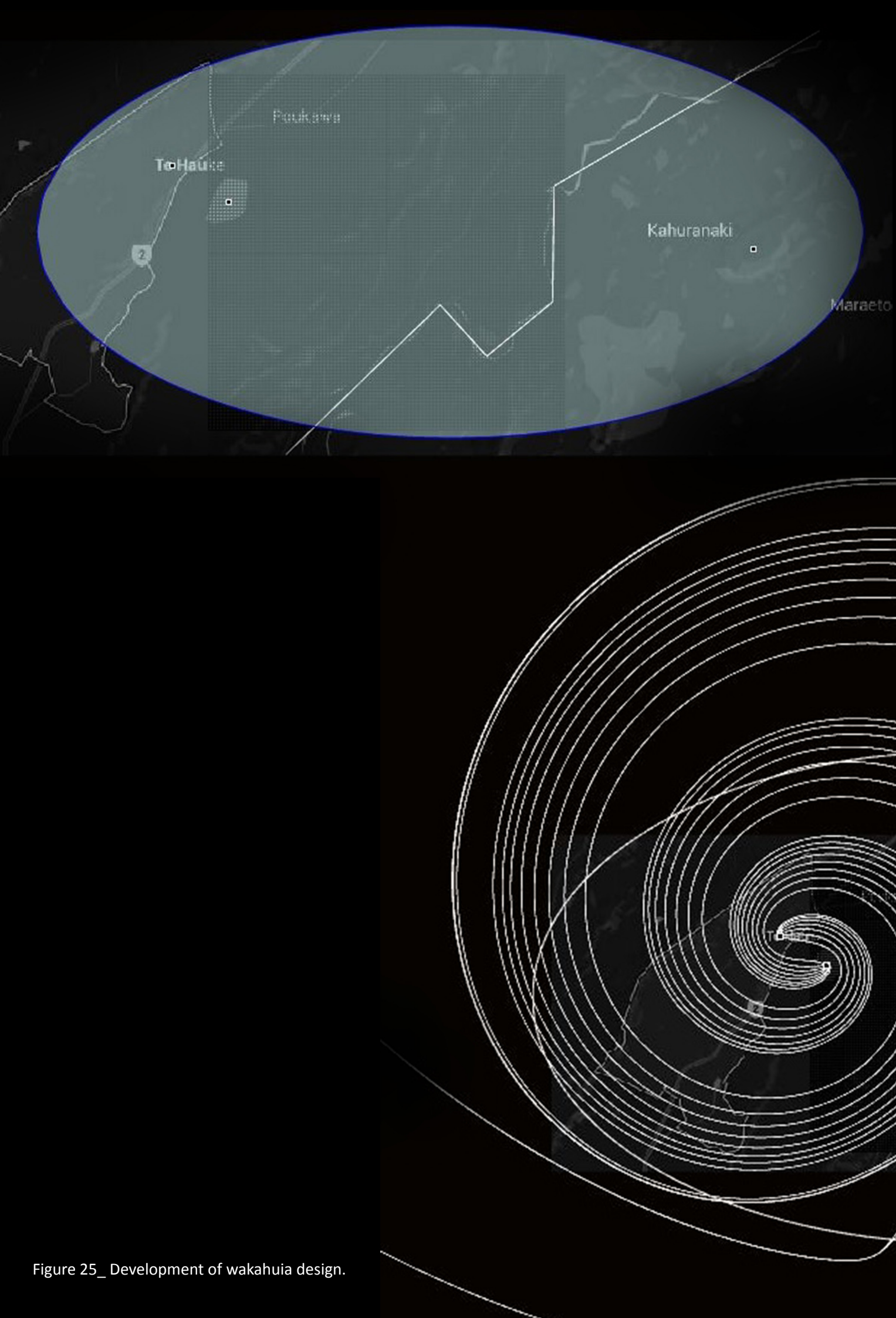
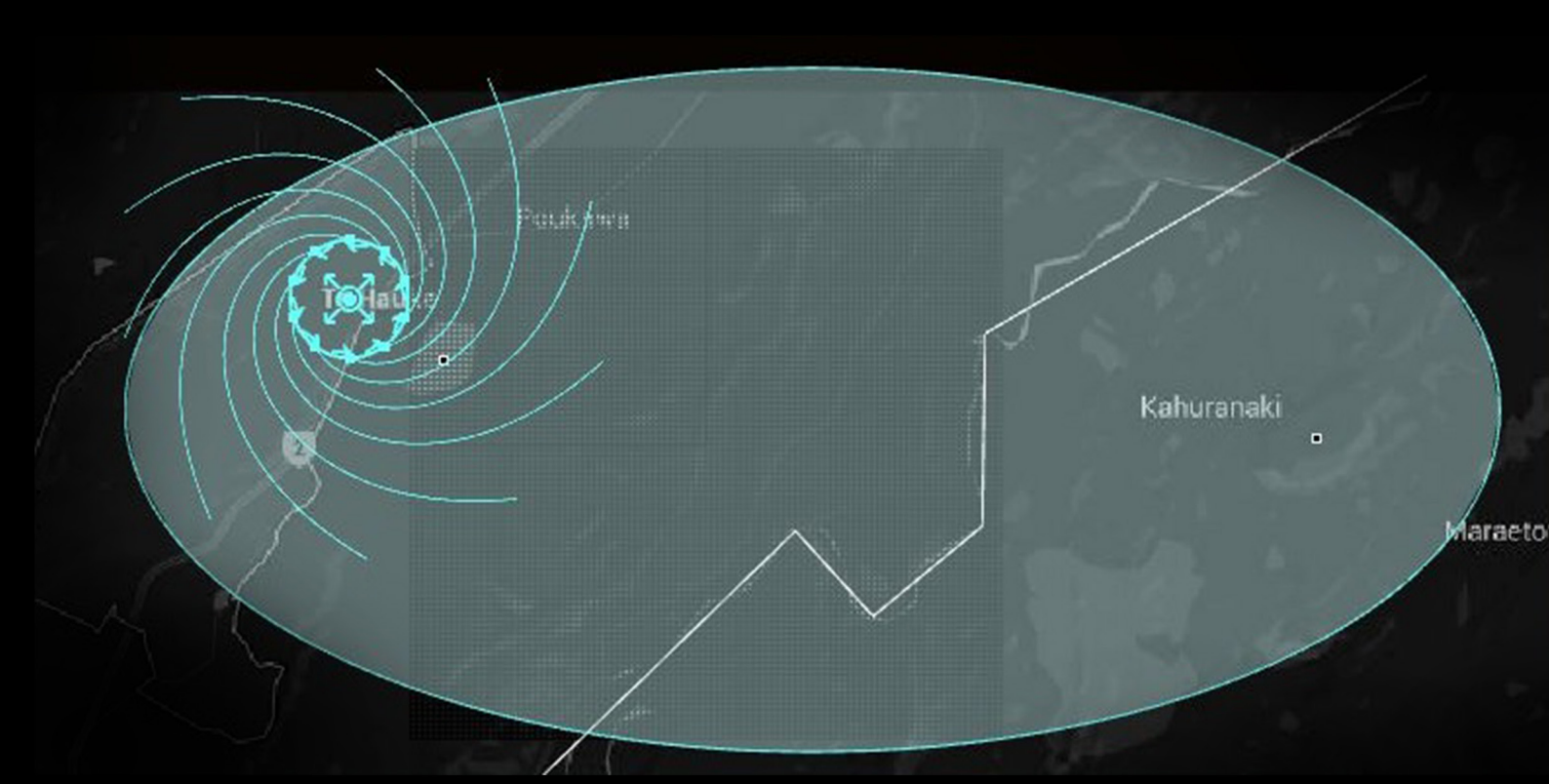
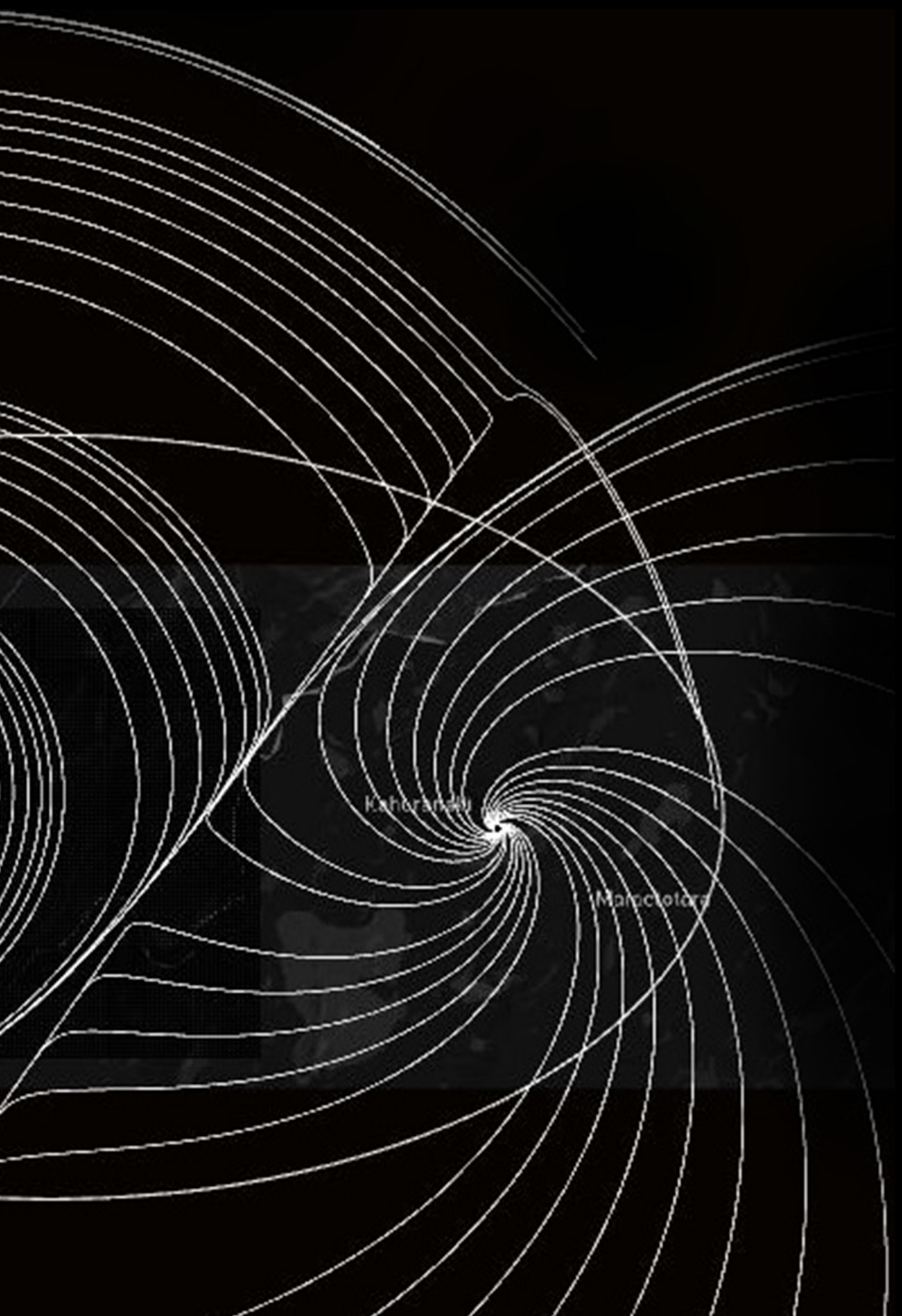


Figure 25_ Development of wakahuia design.


Kahuranaki
Maraeto



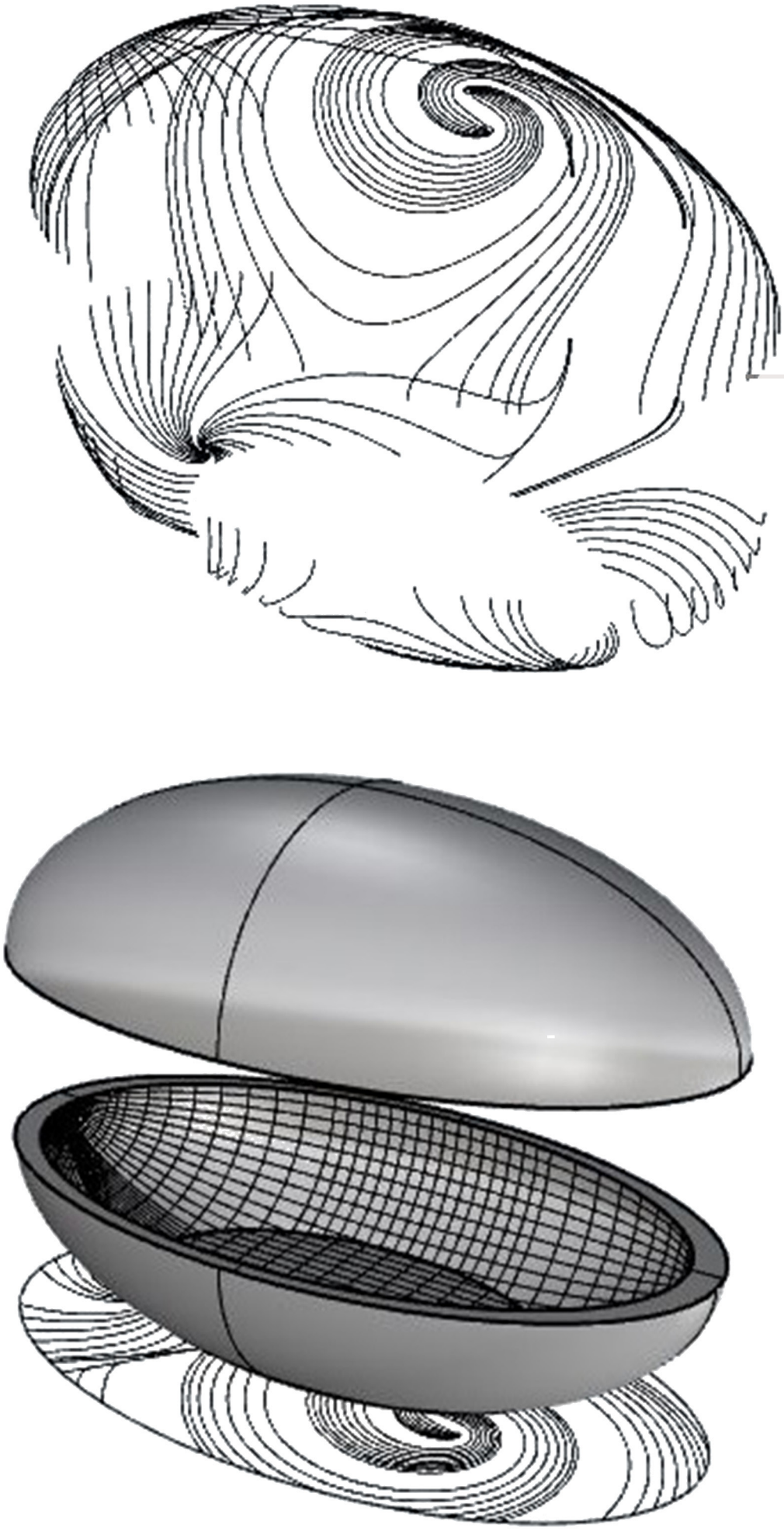


Figure 26_ Development of wakahuia design.

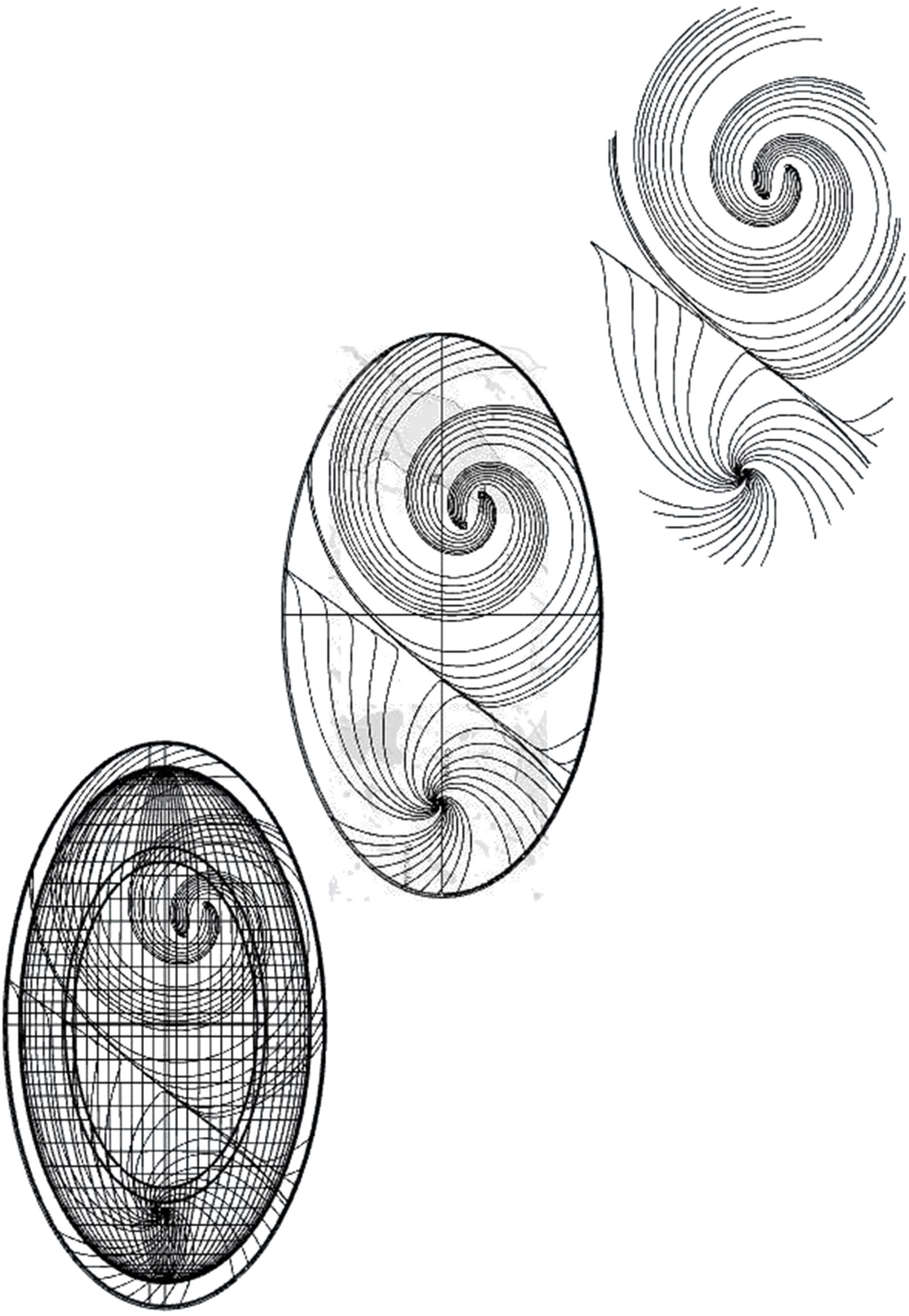


Figure 27_ Development of wakahuia design.

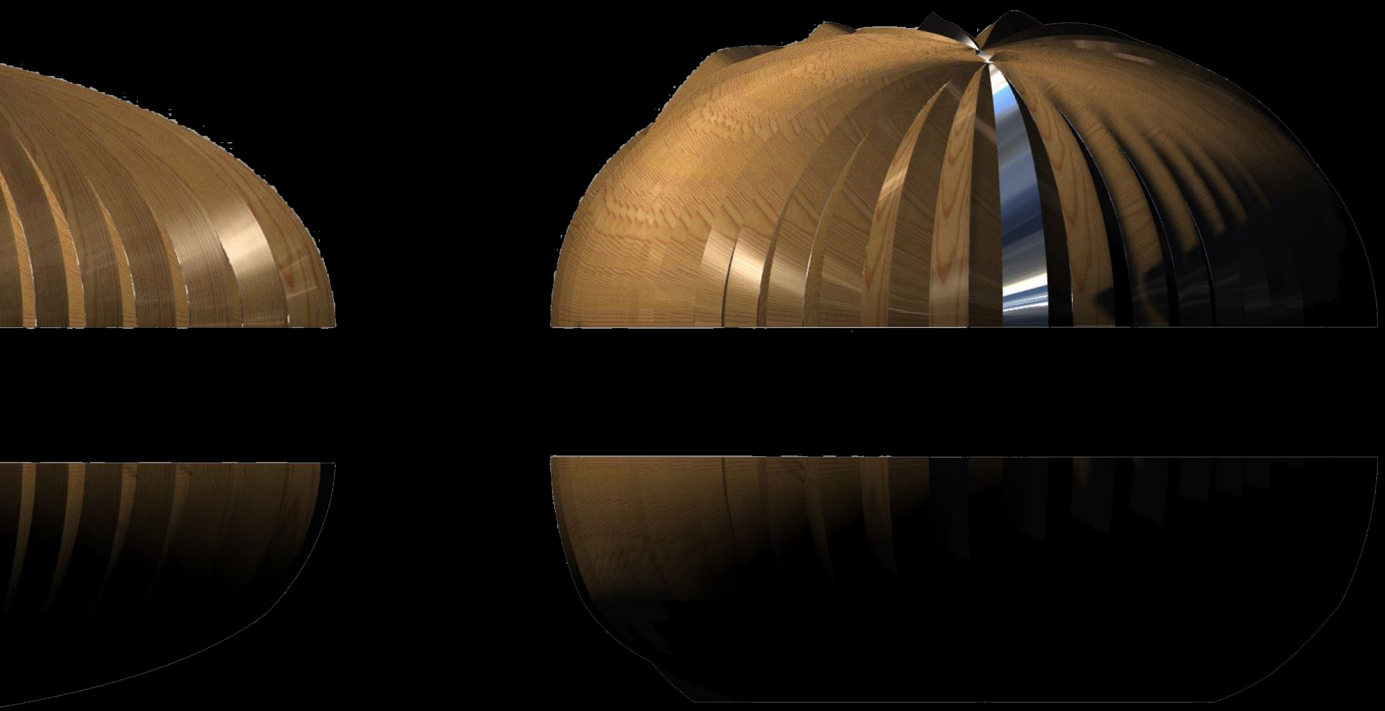


Figure 28_ Development of wakahuia design.

Figure 29_ Development of wakahuia design.

Figure 30_ Development of wakahuia design.

Stage Five_ Coded Toolpaths (G-Code)

Through exploration into generating traditional forms within Rhino/ Grasshopper, it quickly became apparent that to embrace the capabilities of the tool and dictating the shapes and finishes created. By this I mean (in terms of using the CNC machine) allowing the drill bit itself create the shape of the haehae (these are the parallel lines that are carved in whakairo). As opposed to modelling these shapes to look like what a traditional haehae would look like.

This is intended to be more in keeping with the idea of utilising the CNC machine as a tool, akin to a hammer and chisel, and allowing the designer the freedom to express intention through a digital interface. Using different drill bits (bullnose, square head, etc) will give a different appearance and allow for different finishes to occur on the finished surface.

RhinoCAM Tool Path Milling for Modella

Using G-code is a step into getting towards a way of using tools that reflects back on the mark of the maker (designer in conjuction with machine). The CNC machine is viewed purely as a tool in this context. Ultimately, the designer is still in control of the process and the design. The machine is the tool that makes the digital model into reality. Therefore, this exercise in G-Code is an attempt to maintain a sense of control of the process as a designer/manufacturer.

Process of Māori carving (traditionally). First the timber is imprinted with a design of the form, the timber is roughly chiselled out to get the basic shape, then the details of the patterning is placed on the rough cut form, and the fine detailing is carefully carved out (Mulholland and Bargh, 2015). These steps are reflected in the process of CNC milling machines as well. Initial rough cut of the general shape is milled, followed by a more time consuming fine detailing that requires a more refined tool.

Tool path options:

X-axis

Y-axis

Radial

Island Path

X and Y axis paths operate in the same way, just in different directions so finish (should) be similar, only having variations based on design of object being milled and material used (for example, using timber, the grain of the wood would affect the finish of the product based on the direction of the tool path either X or Y).

Radial path would produce a very different finish, as the name suggests the tool follows a path from the centre of the object to the outer perimeter of the object. This will generate a fine detailed finish in the centre of the object and as the tool moves further out, the less detailed the cut marks will be (resembling a rough cut than a finished one).

Island path is when the tool path follows the contours of the object being cut at designated increments as it moves from the top down.

Critical Analysis of Work

All Māori artforms have a series of tikanga that is associated with it; this is in place to keep the artist and the artwork ‘safe’. The initial venture into CNC routing without the full comprehension of the tikanga involved, made this very apparent. But it also highlighted that as one develops their artform, the tikanga also evolves with it.

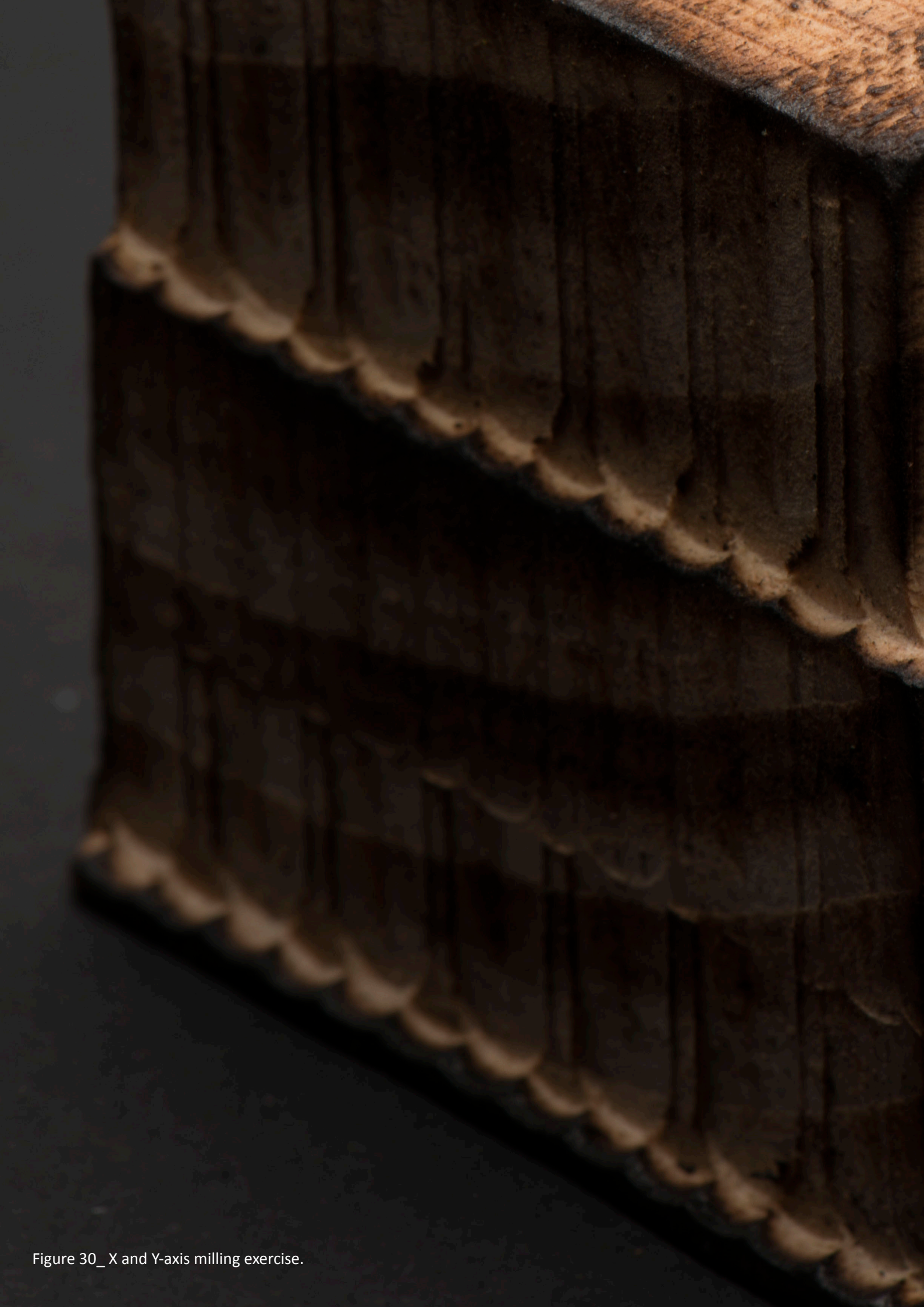


Figure 30_ X and Y-axis milling exercise.

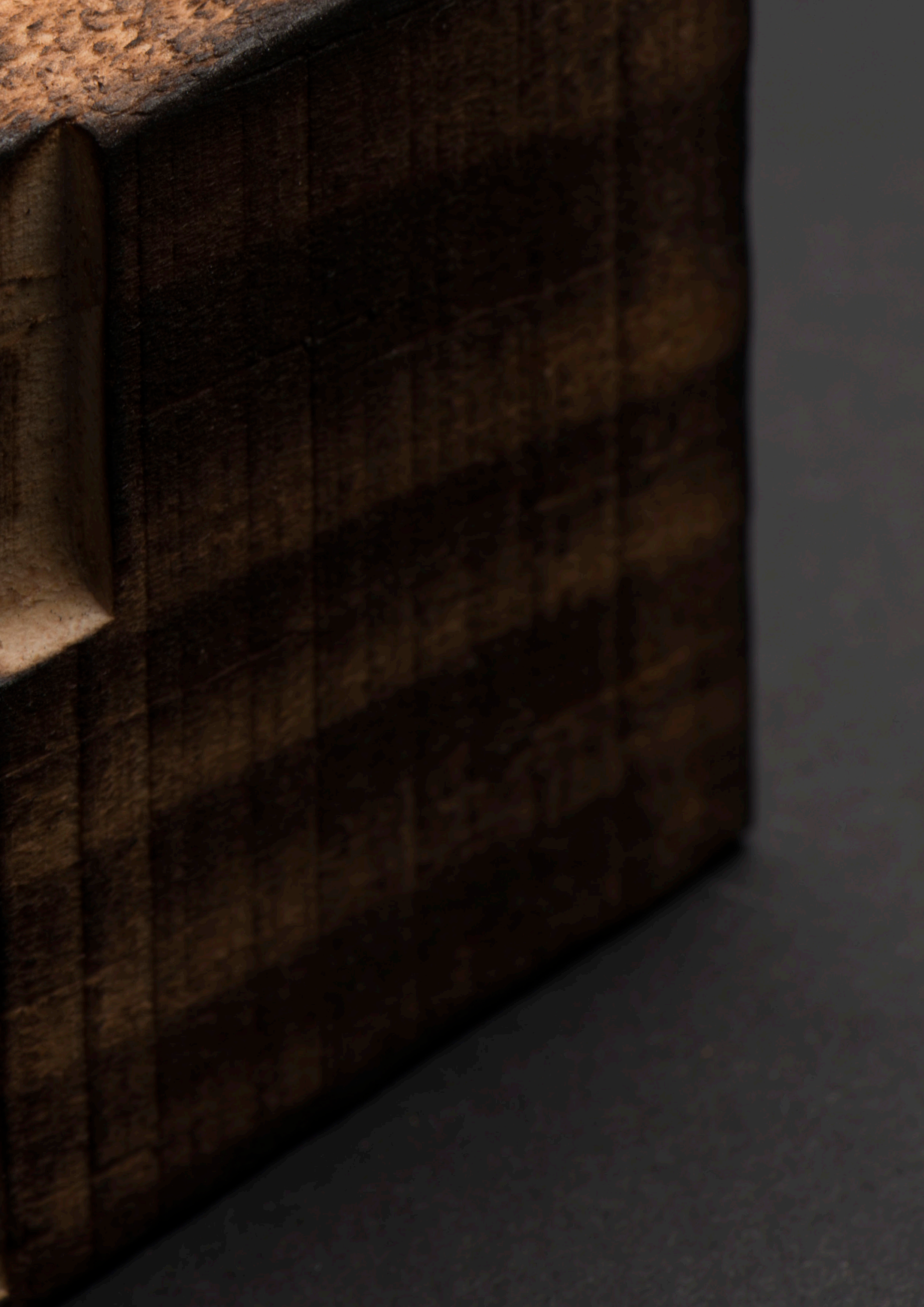


Figure 30_ X and Y-axis milling exercise.

Figure 31_ Radial milling exercise.

Figure 32_ Radial milling exercise.

Figure 33_ Spiral milling exercise.

Figure 34_ Spiral milling exercise.

Figure 35_ Island milling exercise.

Figure 36_ Island milling exercise.

Figure 37_ Island milling exercise.

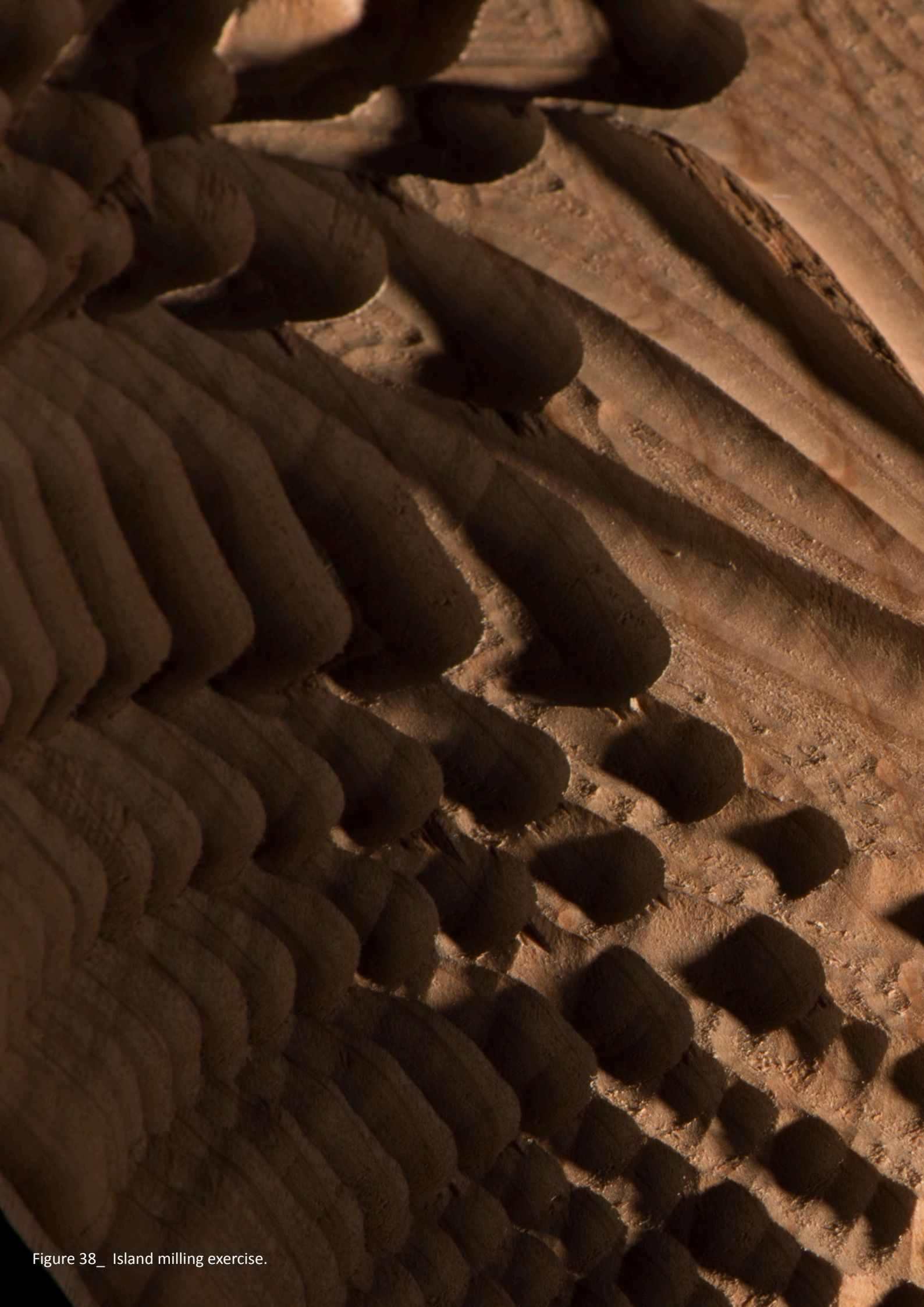


Figure 38_ Island milling exercise.

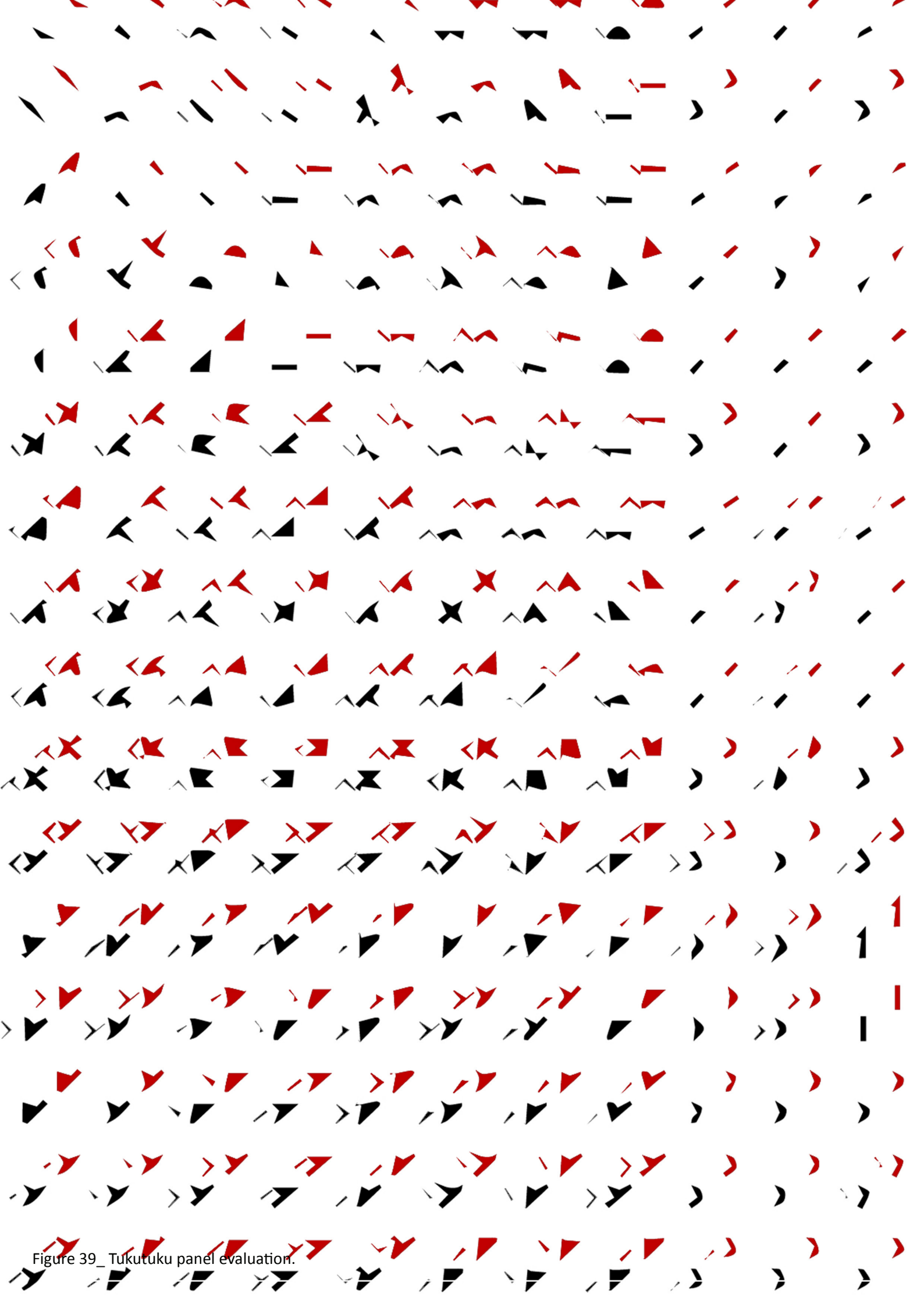


Figure 39_ Tukutuku panel evaluation.

Chapter Three

Site Analysis

The history of Te Hauke and their tipuna (ancestor) Te Hāpuku, who established the settlement of his people within the area in 1876, revealed some key factors that made Te Hauke a most desirable location. One of the most prevalent factors was Lake Poukawa. This body of water provided the tangata whenua access to an abundance of readily available food sources while also being surrounded with workable materials that were used for everyday use, which included the versatile plant harakeke (flax) along the banks of the lake.

When Te Hāpuku settled in Te Hauke, this lake encompassed a much larger area than what can be seen today. It must have been foreseen by Te Hāpuku that the land which the lake covered would be drained to access the fertile peatland below. Before passing away on the porch of the whare tipuna, Kahuranaki, fearing that the recent sales of land to the British crown would lead to Lake Poukawa being destroyed, Te Hāpuku uttered his final decree to the world.

“Now this is my word; that the Poukawa lake shall not be touched or meddled with by any Māori or European, nor shall anyone dig or make drain by which the water shall escape. I have a name. I have authority. This portion shall be left as it was in the days gone by. This, my Māori law, shall take effect…”

(Ballara, 2009)

Today, Lake Poukawa is considerably smaller and shallower due to the active draining of the lake in the 1920’s. Such development has been to the detriment of wildlife, fisheries, and ecological values in that the once extensive wetland vegetation has declined under the drainage-induced reduction of water levels and continued grazing pressure. However, the lake remains a sufficient supply of food resources which include tuna (eel) (Jellyman and Sykes, 2009), the Shoveler duck (Currie, 2015), and recent implementations have been added to allow Inanga [white bait] access through to the lake to the local people.

Lake Poukawa remains to this day a culturally significant landmark to its local iwi. Any interventions imposed to the body of water and its surrounding land will need to reflect the current use of the lake; which is in part used for recreational duck hunting. Every May, Lake Poukawa is a hive of activity with ducking hunting season. The development of maimai (ducking shooting huts) has been selected to move the design from artefact to architectural structure.

Maimai Structure and Surface Treatment

The tukutuku pattern; Roimata Toroa (Albatross Tears), is used extensively throughout Aotearoa, but traces its origins to Ngati Porou. The story tells of their ancestor Pouranagua who had brought kumara back to his tribe, accompanied by two albatrosses, which the tukutuku pattern derives its name. The story resonates with ideals relating to tikanga and the importance of acknowledging the relevant Atua (Māori god) (Orbell, 1998). This pattern was selected for its strong ties to the sky, making it a fitting choice for the structure while carrying with it the narratives of the tukutuku design.

The algorithm developed for this surface treatment follows the rules of a basic two-way woven structure. In one direction, a structural rod has been modelled running parallel to each other at a set interval. In the perpendicular direction to these rods, flat strips have been utilised and controlled with the use of an image sampler component.

Critical Reflection

A clear series of errors had occurred during the design process of the maimai structure. Further research into the fundamentals of Māori architecture and its associated tikanga involved is required to develop meaningful design outputs.

Taking from this, there is a need to imbed the whakapapa of the intended use of the structure into the design of the logic itself. This will progress in to a form which does not need to rely on established cultural patterning to make apparent the intended use of the structure.

Figure 40_ Lake Poukawa, Te Hauke

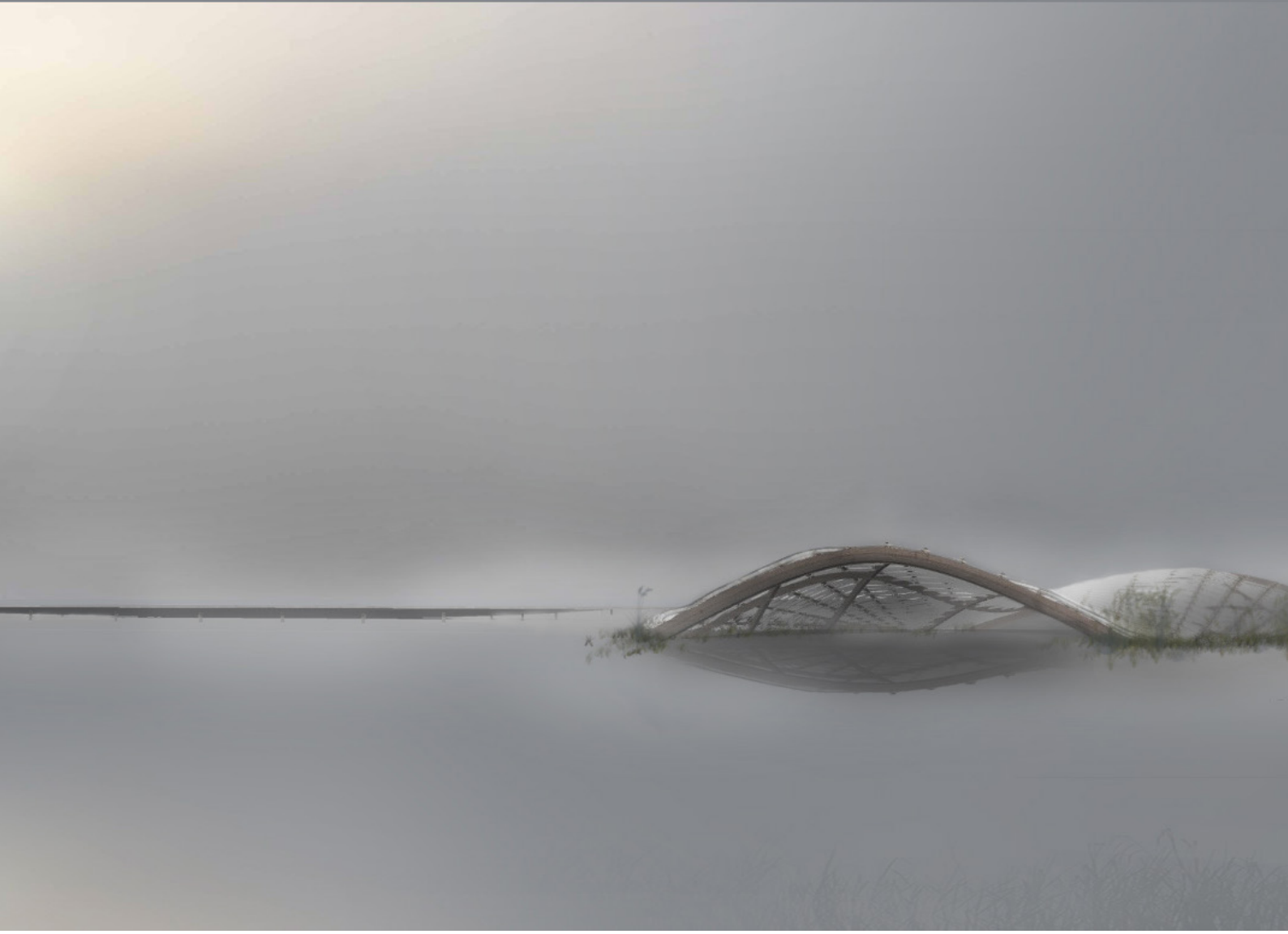
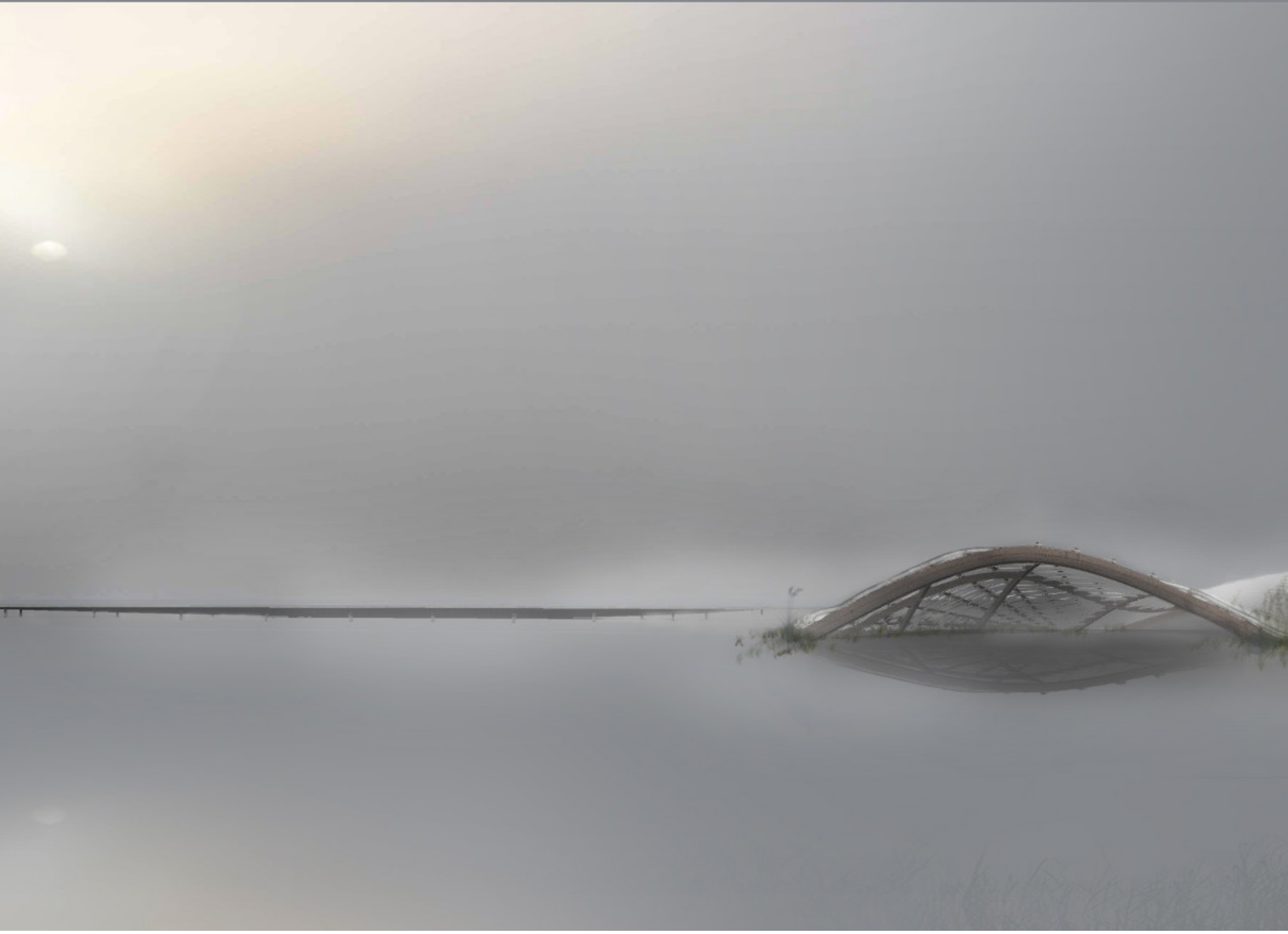


Figure 41_ Lake Poukawa maimai

Figure 42_ Lake Poukawa maimai



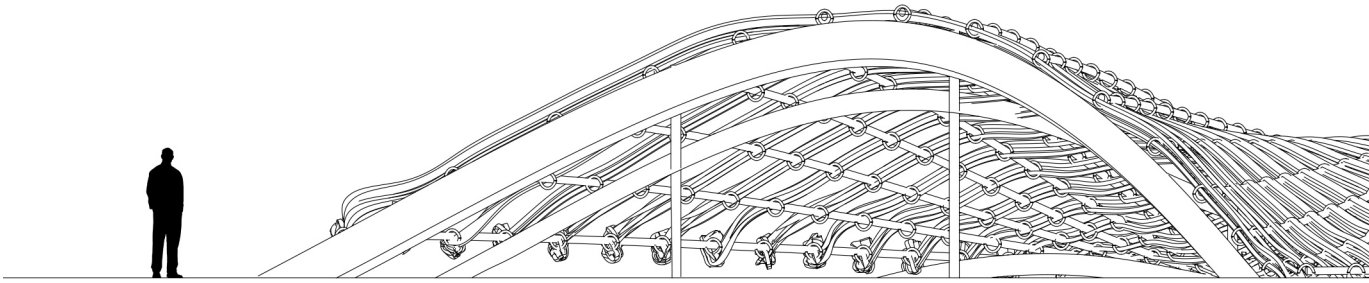


Figure 43_ Lake Poukawa maimai

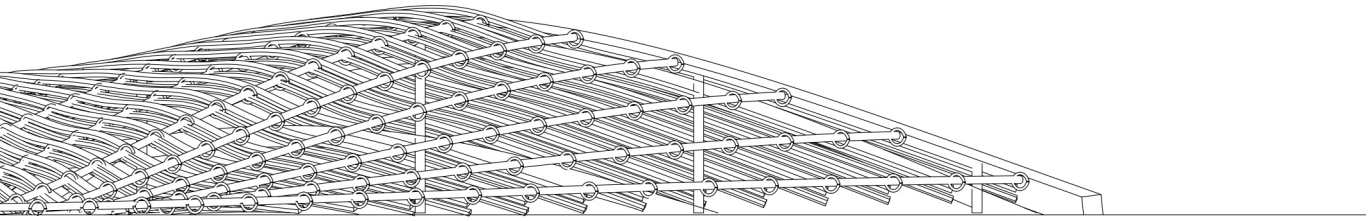


Figure 44_ Lake Poukawa maimai elevation

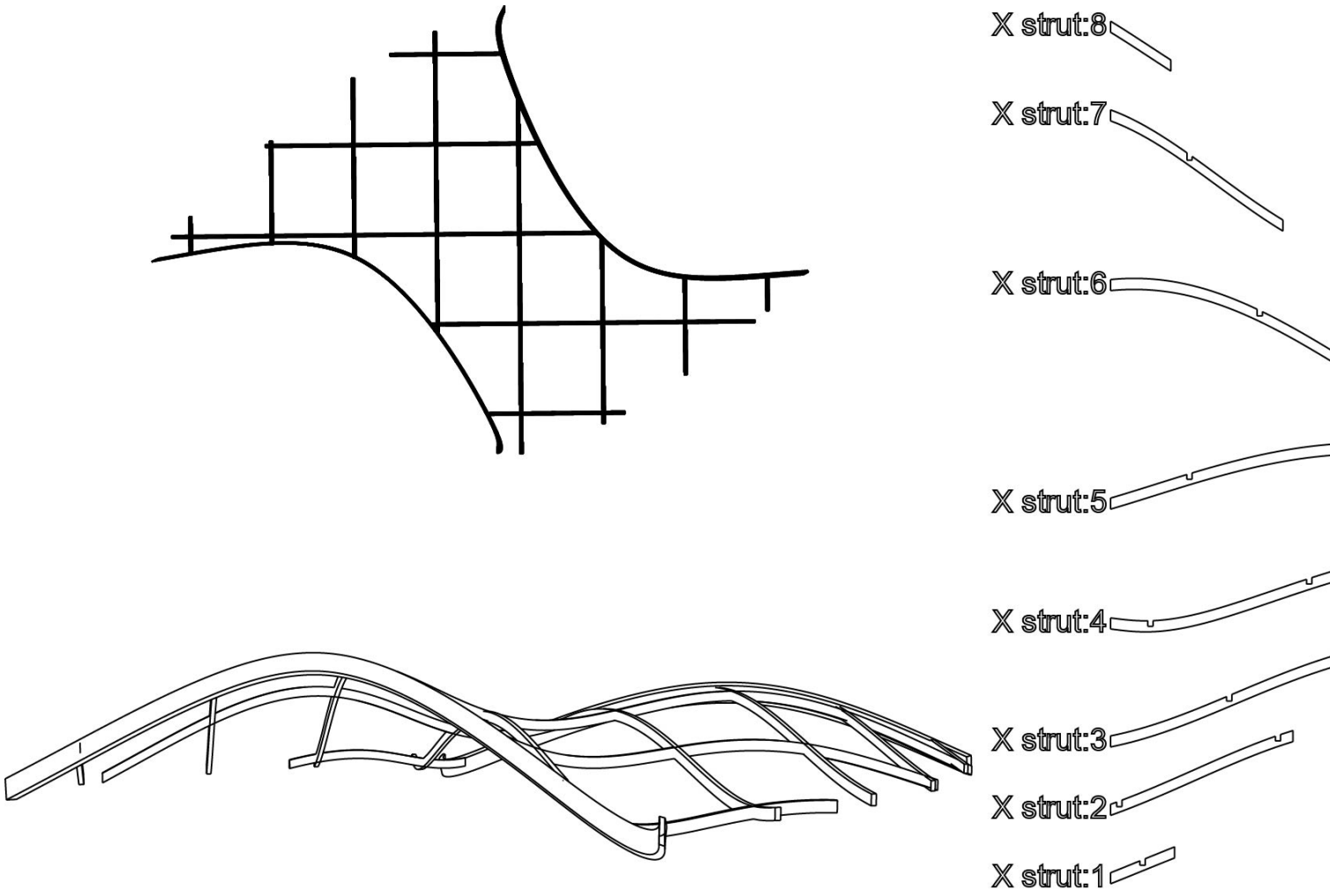
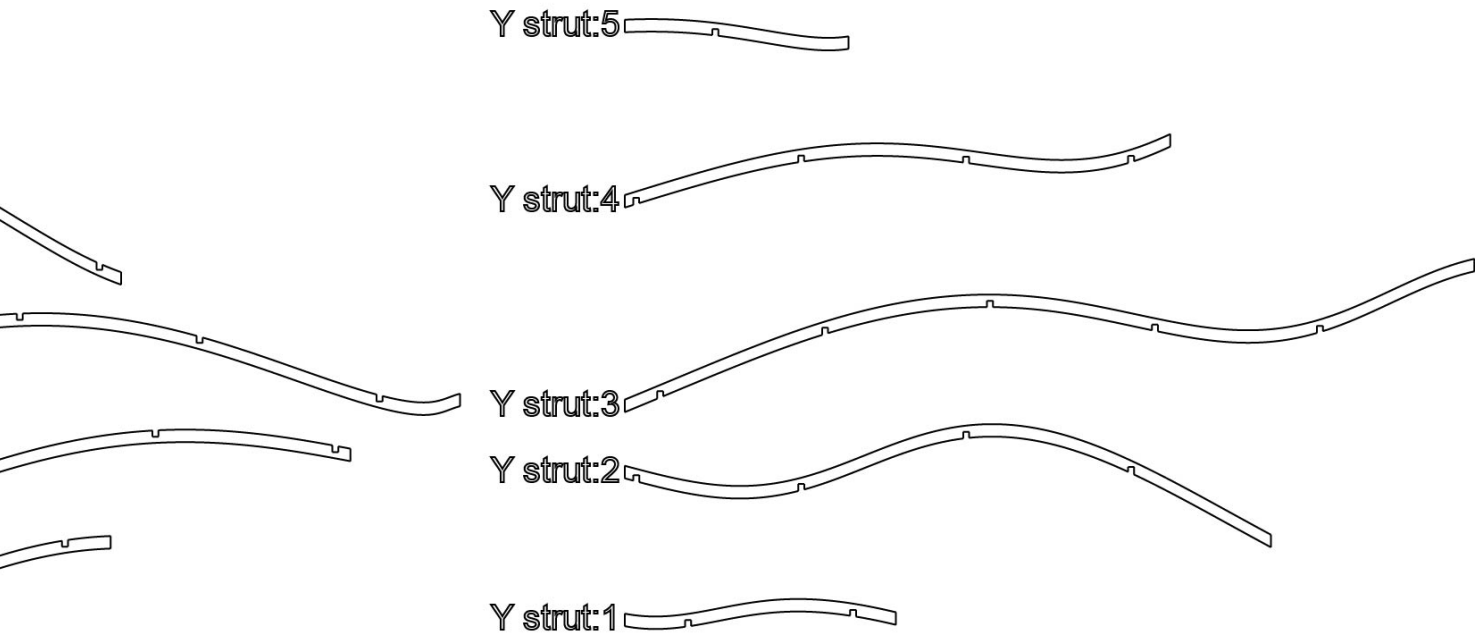


Figure 45_ Lake Poukawa maimai structure assembly.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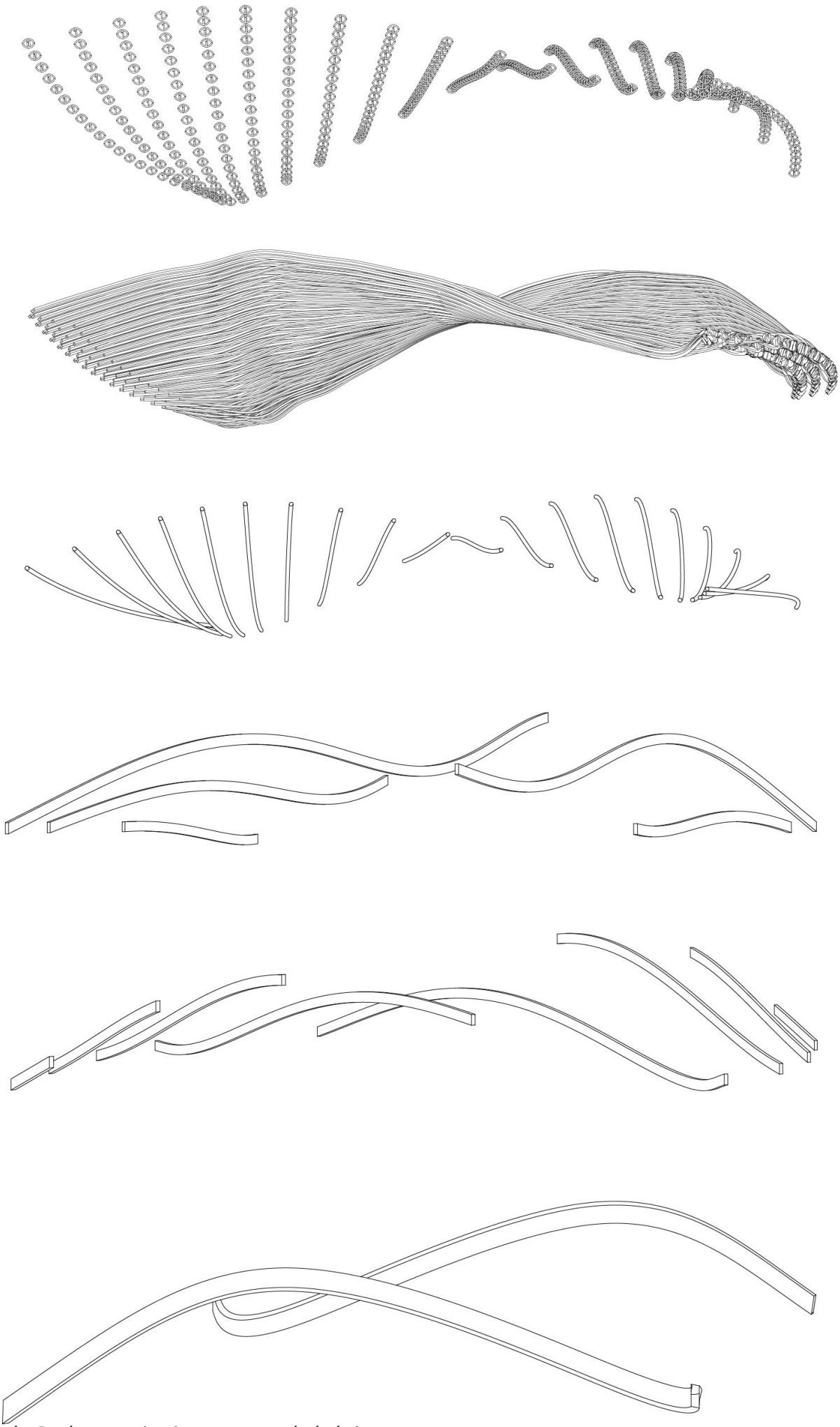


Figure 46_ Lake Poukawa maimai structure exploded view.

Connecting ties binding the raupo thatching to the secondary structure

Raupo thatching

Woven beams, binding the thatching to the initial structure (X-axis & Y-axis)

Y-axis structure

X-axis structure

Edge beams

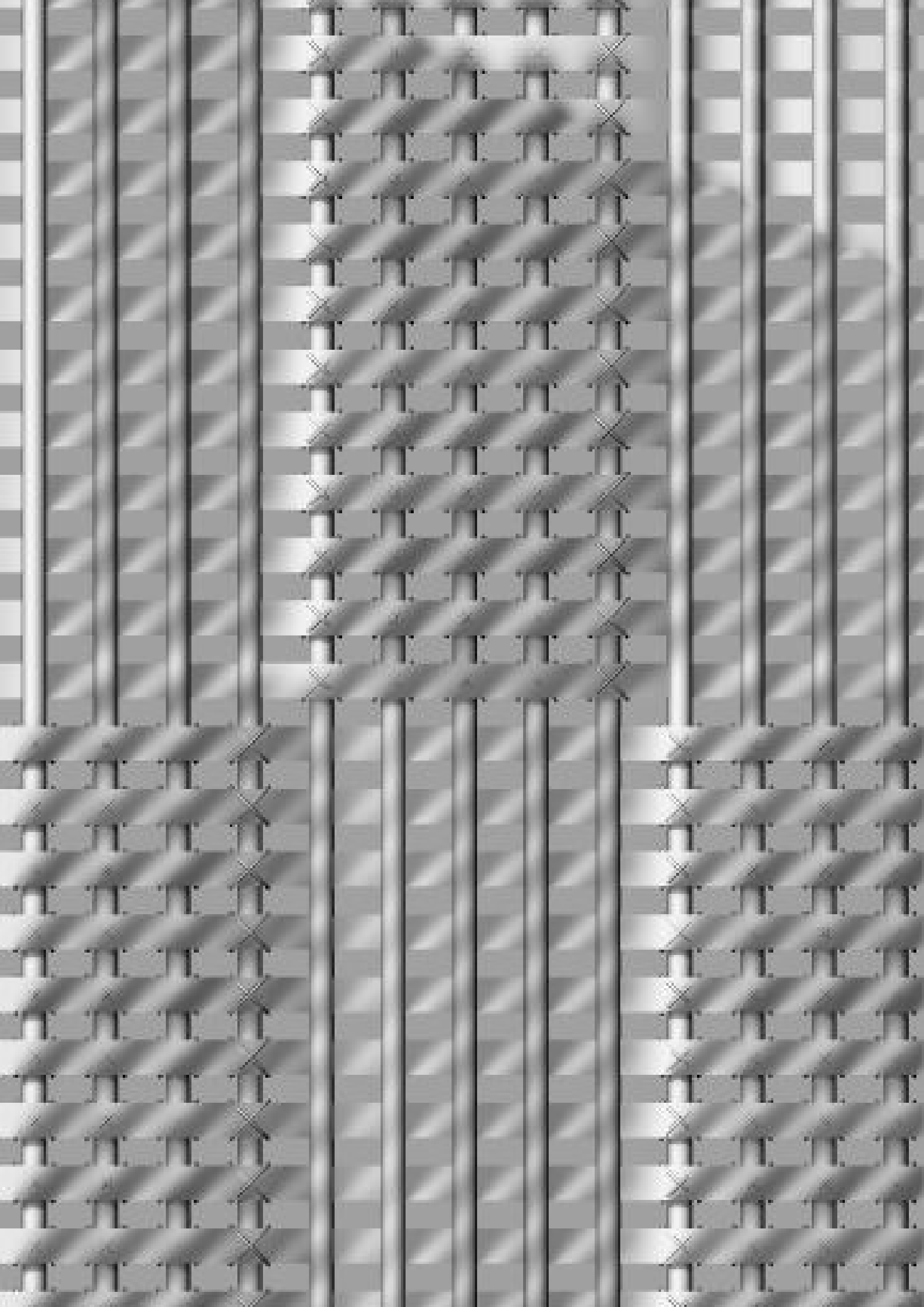


Figure 47_ Maimai surface treatment

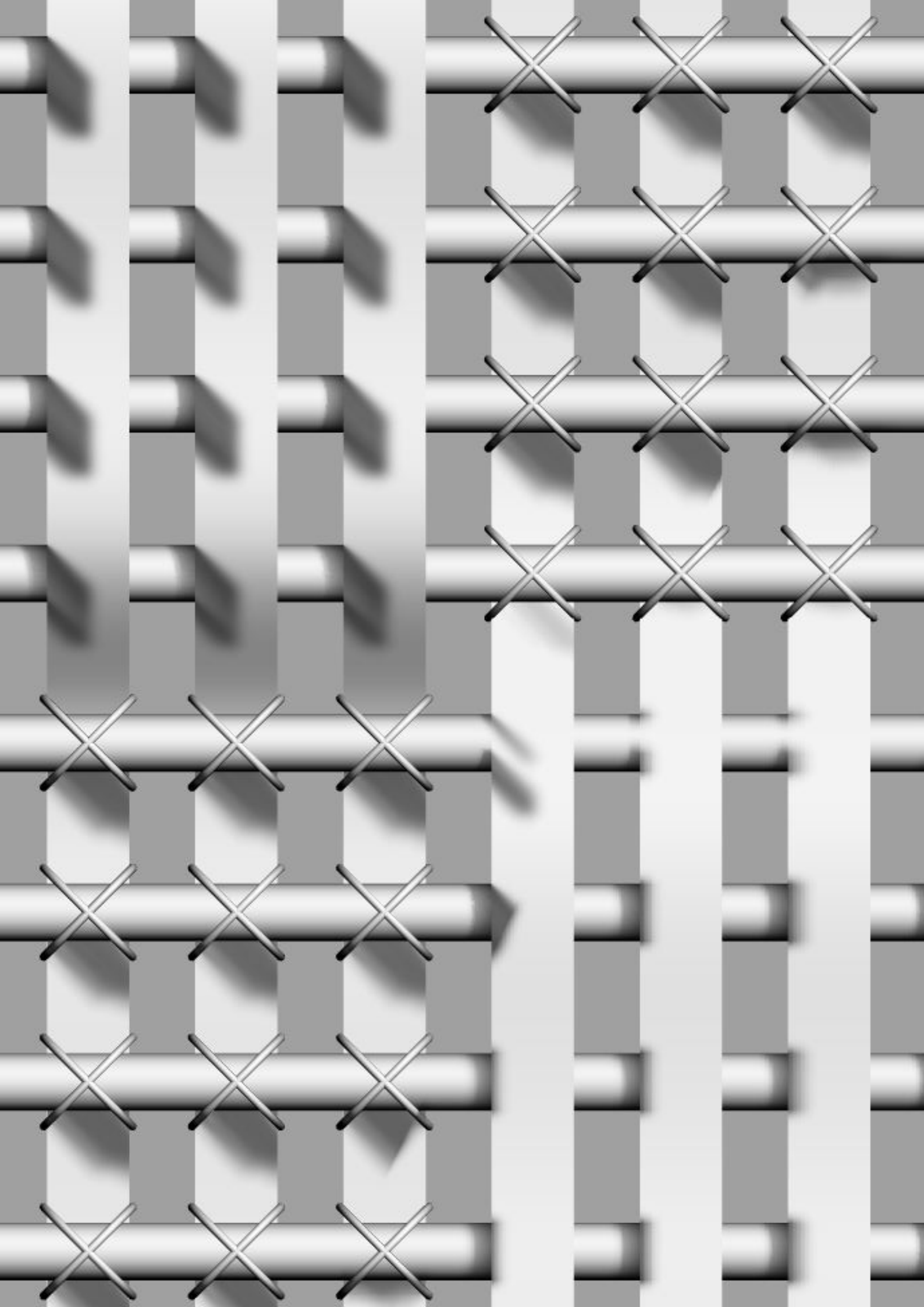


Figure 48_ Maimai surface treatment detail:.

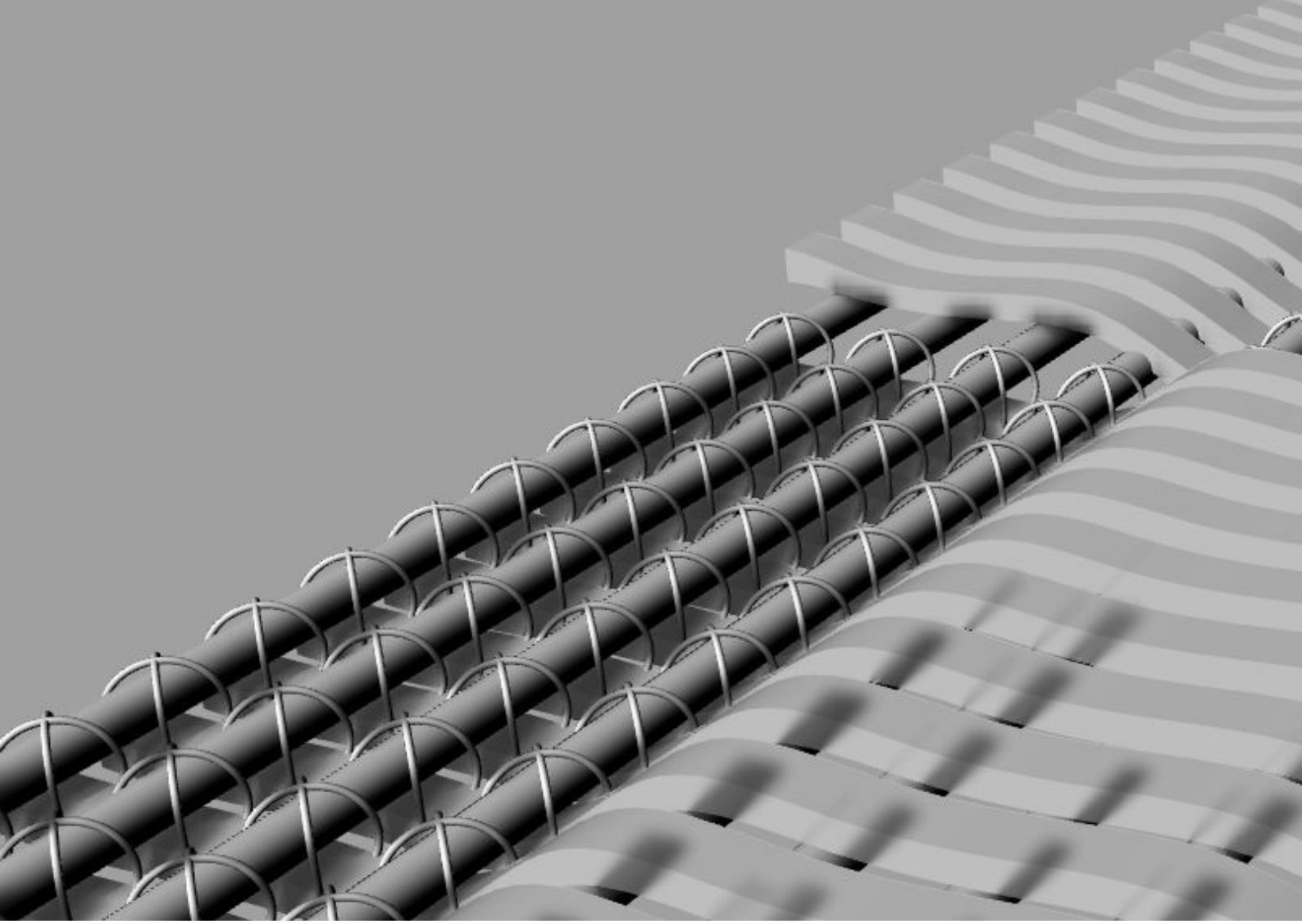


Figure 49_ Maimai surface treatment

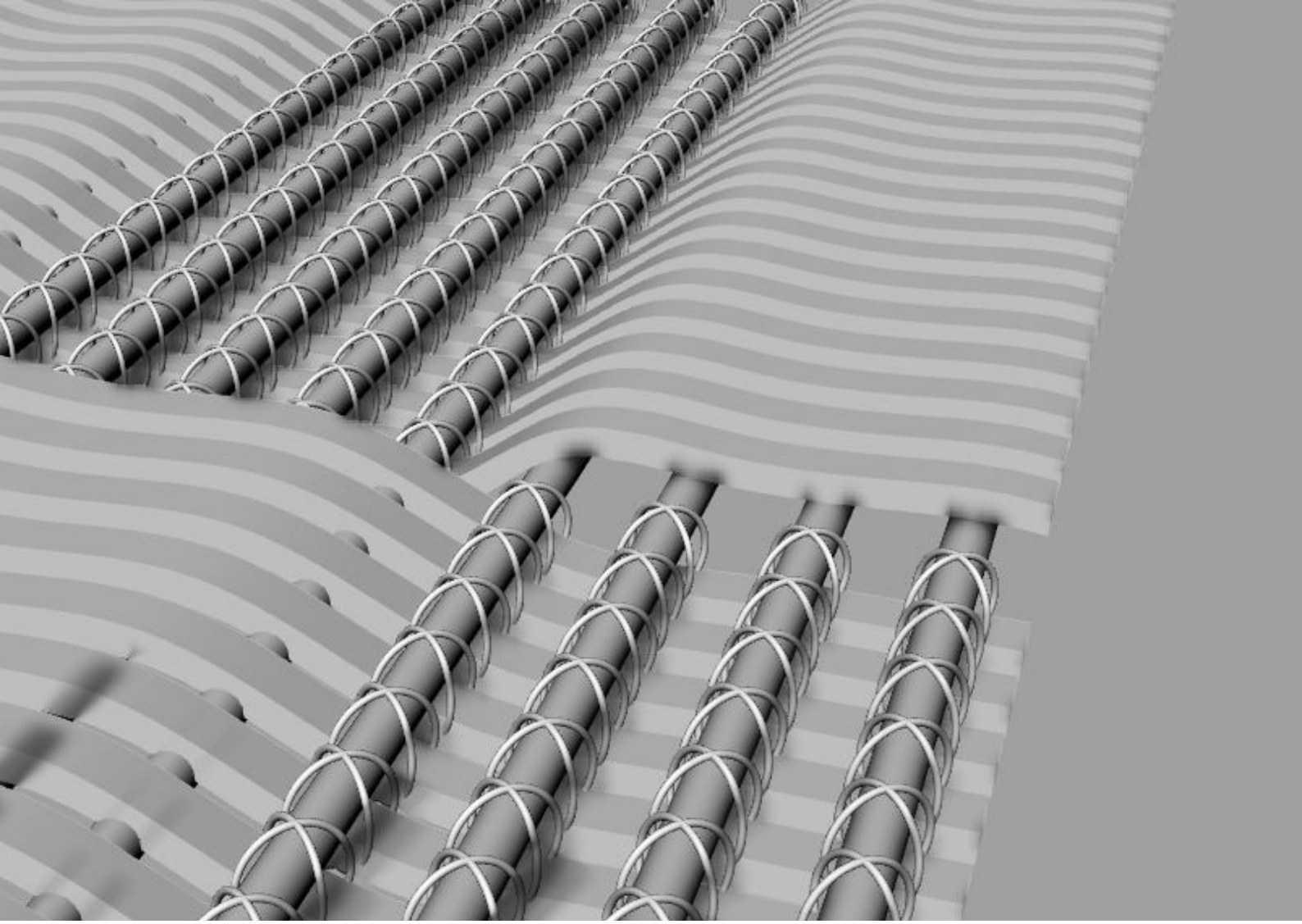
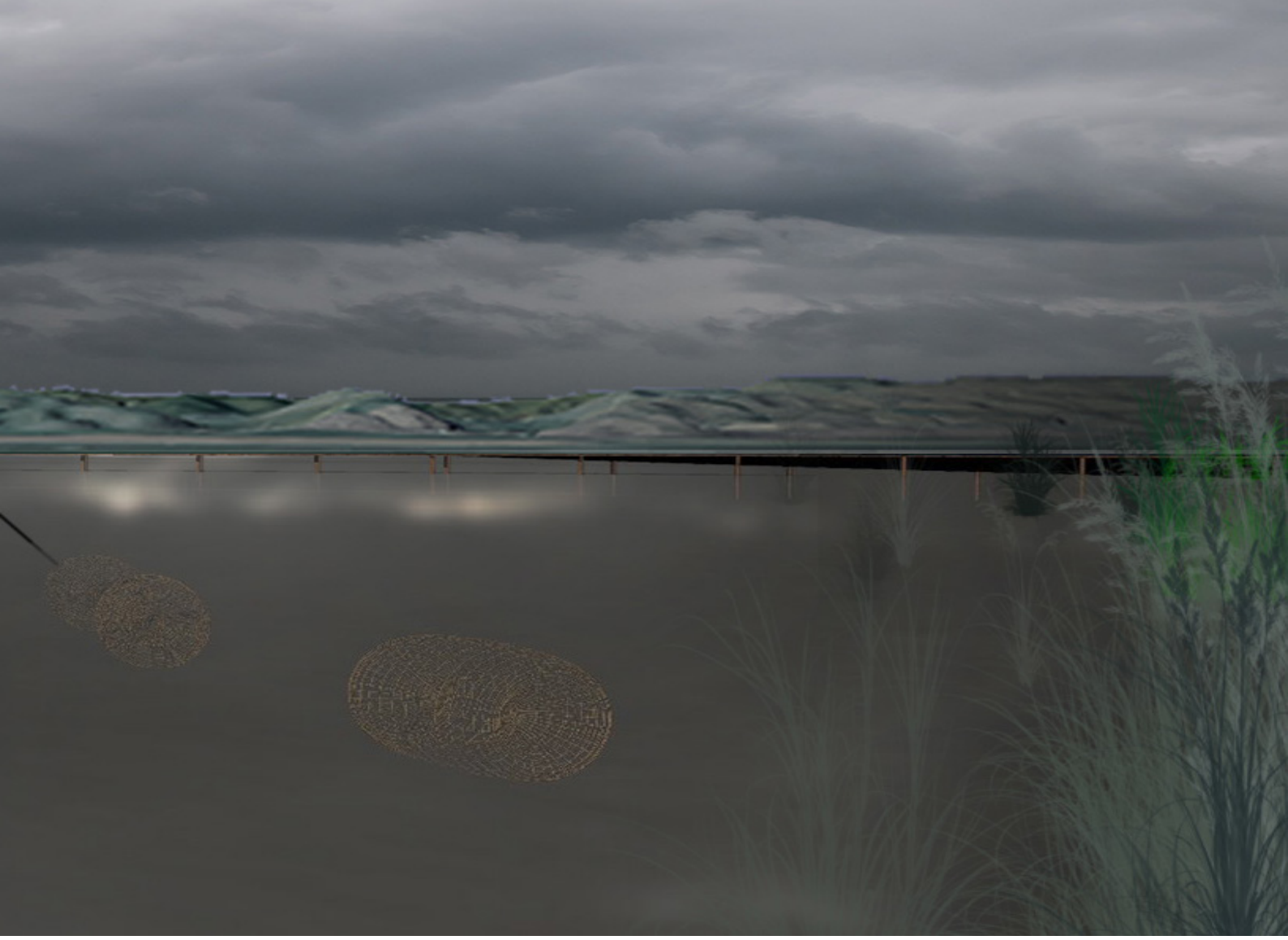


Figure 50_ Hinaki collection platforms.



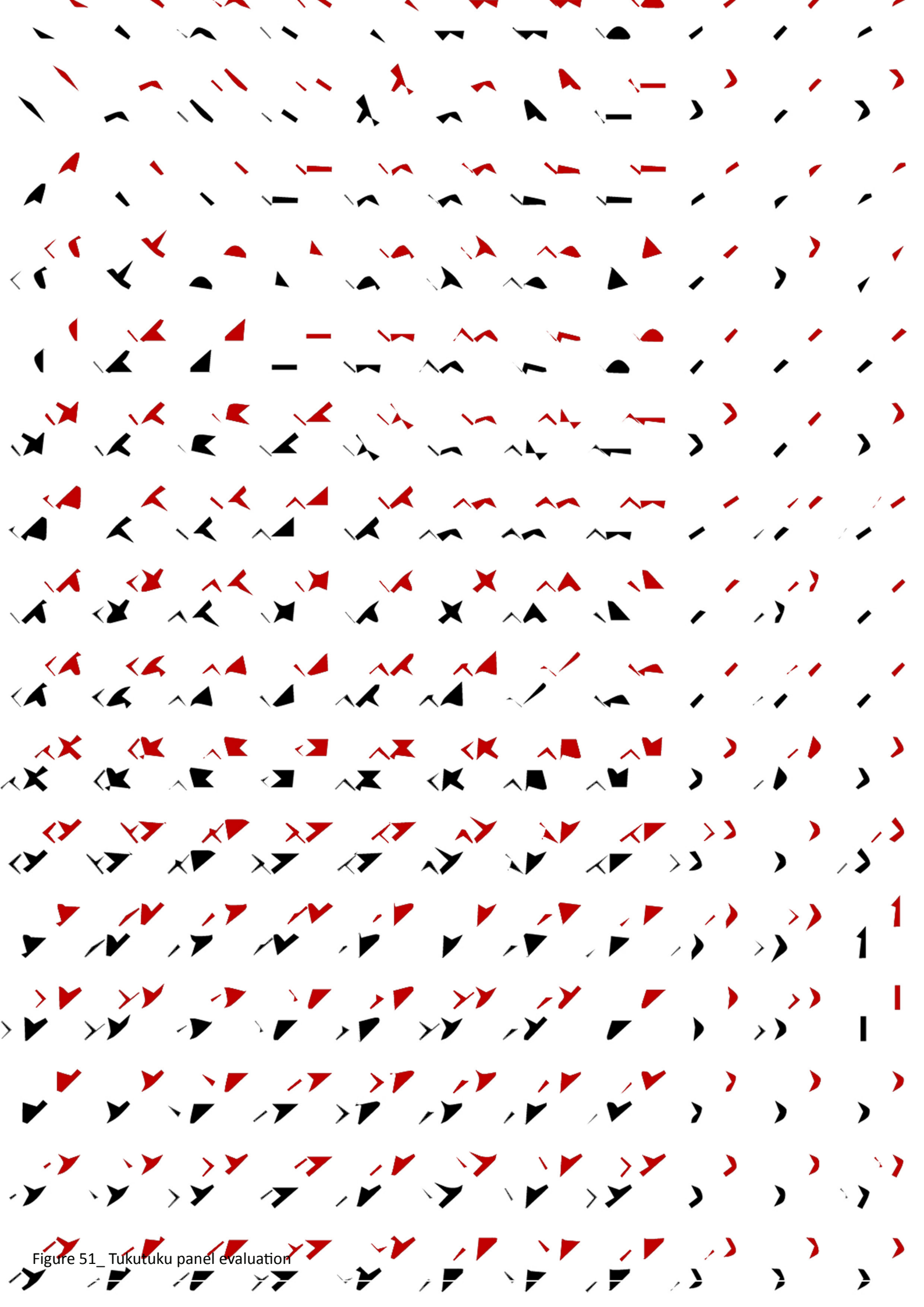


Figure 51_ Tukutuku panel evaluation

Chapter Four

Stage Seven_ Final Design

Floating Platform and Canopy

The structure for the final developed design revolves around the life of Tuna (eel) that live in Lake Poukawa; a floating platform is designed accompanied by a covered canopy.

Tuna (Eel) are an important source of food the live in Lake Poukawa, which are exclusively comsumed by the tangata whenua for special occasions. Hinaki are used in the lake to capture the Tuna which are accessible only by boat. With he floating platform, the collection of Tuna becomes much easier for the tangata whenua. The floating platform acts to support both the people of Te Hauke while also providing shelter for the eels, whom prefer dark shaded spaces to which the platform provides.

The platform also reacts to the varying water levels of the lake also. When the lake is at its highest point, the platform floats and extends out creating a flat platform to be easily used. However, when the water levels fall the platform buckles and becomes unusable due to the uneven platform that takes shape. This is also a sign to leave the tuna to rest as when water levels fall, stress levels in the tuna heighten. Therefore, the platform itself facilitates a functional barrier for allowing only the capture of healthy tuna, stress free tuna.

Critical Reflection

The development of design outputs in this body of research followed a clear direction from 2-dimensional pattern generation through to final architectural structure. This was mainly due to the limit of scope and utilising whakapapa where ever possible in the design of Grasshopper logic.

However, moving from a product design mind frame in Chapters 1 and 2 (where the artform of parametric design was expressed) to an architectural way of thinking in Chapters 3 and 4, a series of mistakes were made in conjunction with lack of research into the tikanga of the architectural structures designed. Therefore, unwittingly performing these mistakes has created an awareness of how important it is to focus on all aspects of tikanga Māori when designing for Māori communities.

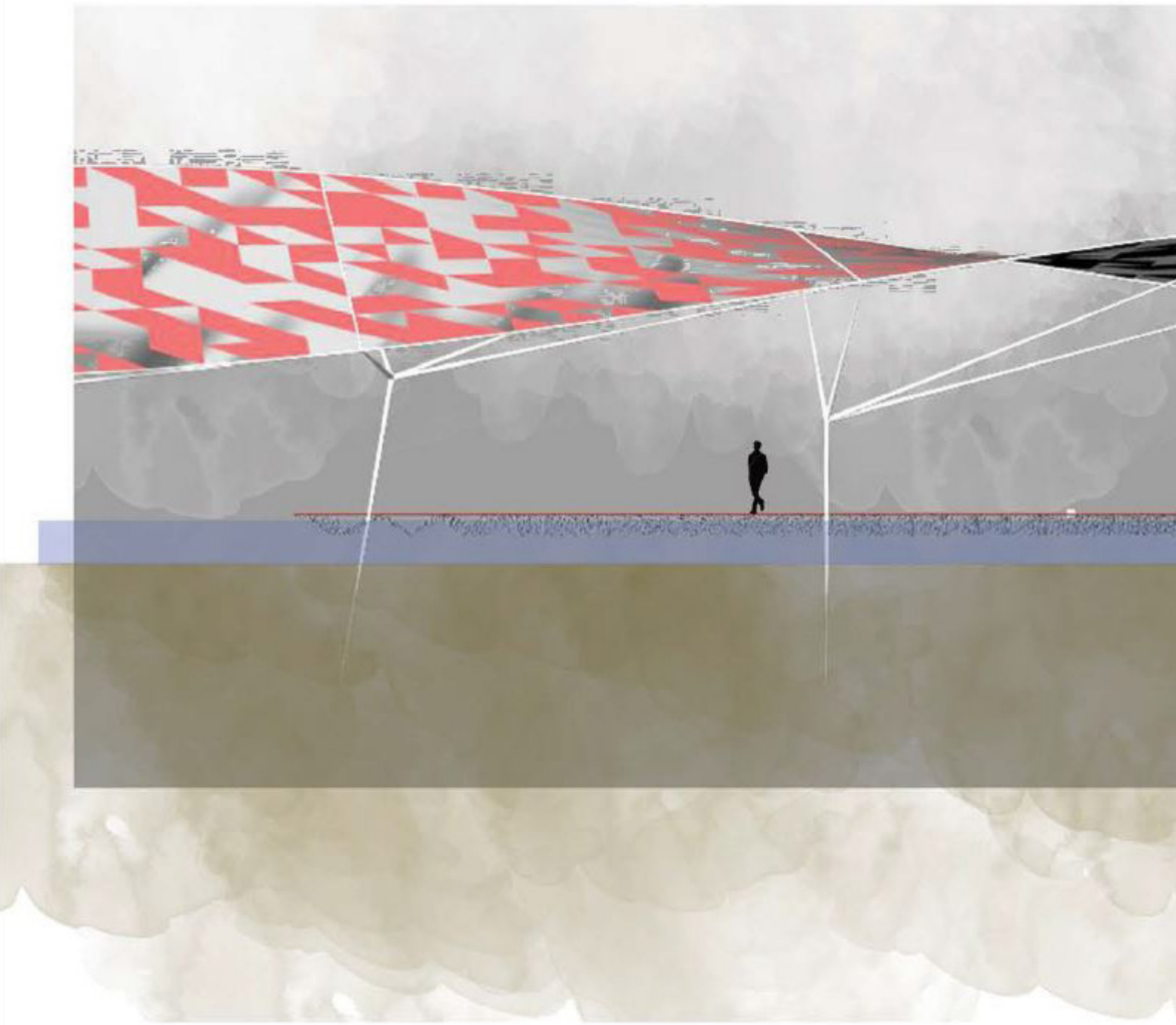
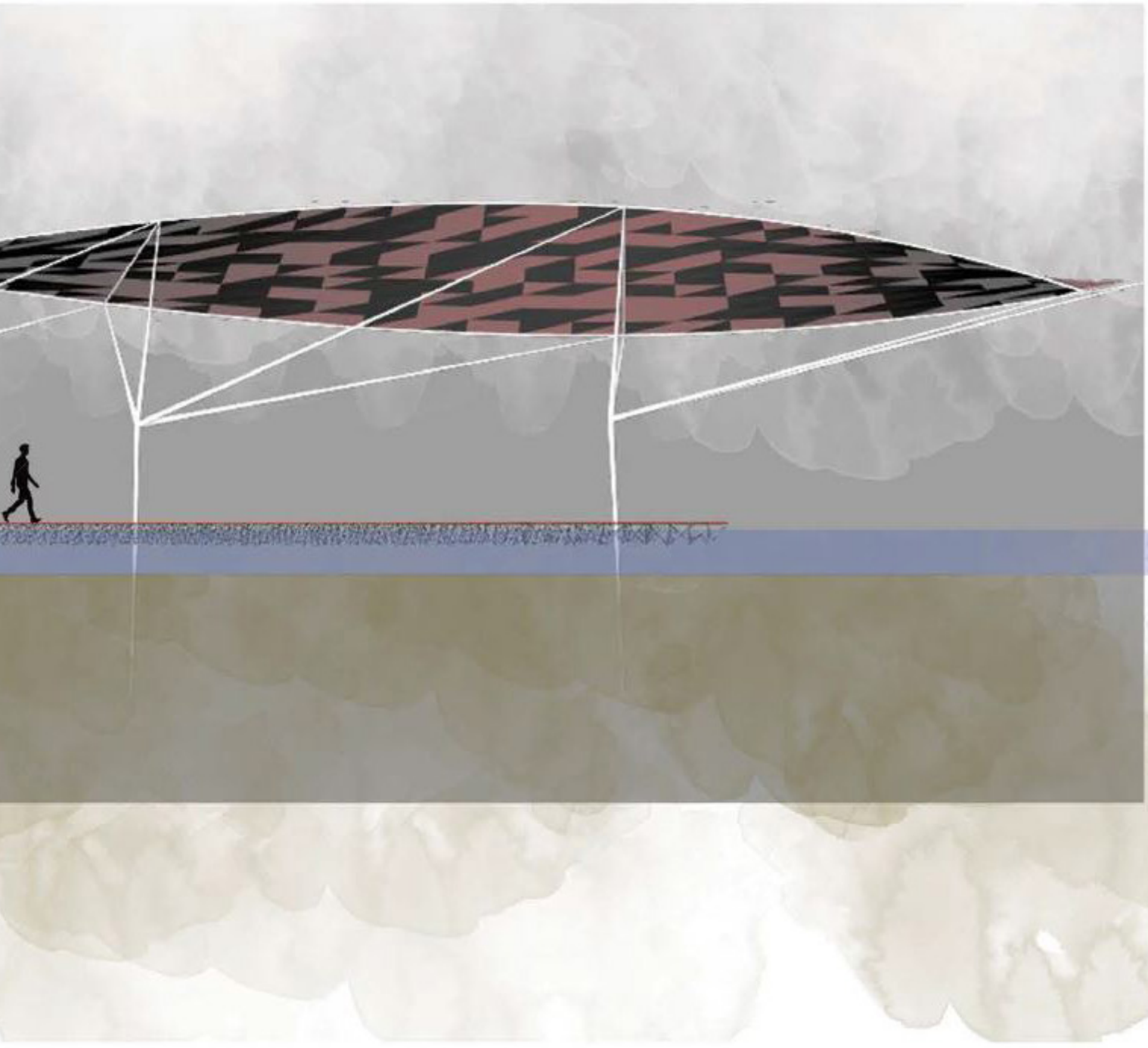


Figure 52_Elevation of platform and canopy



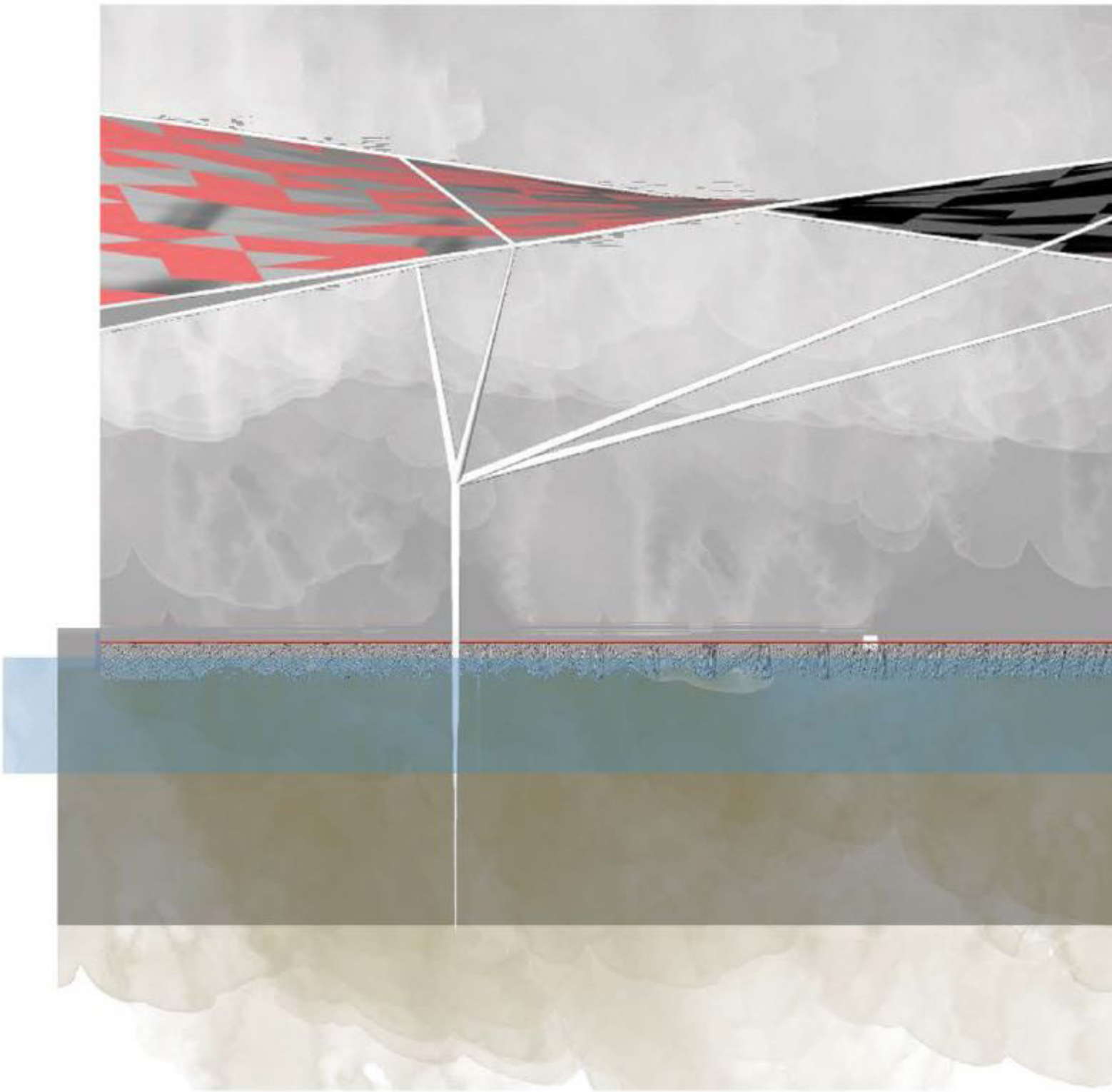
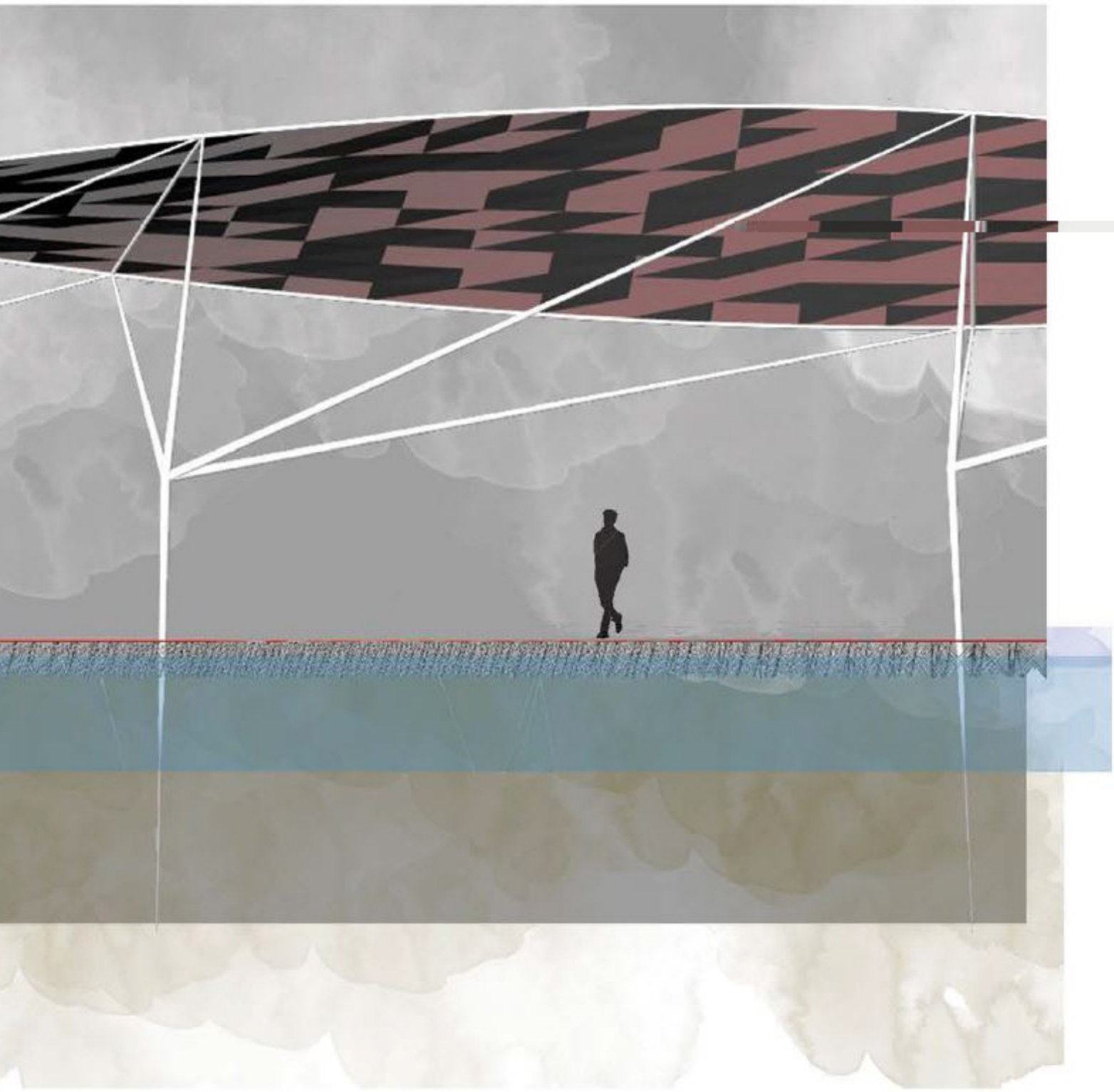


Figure 53_Elevation of platform and canopy



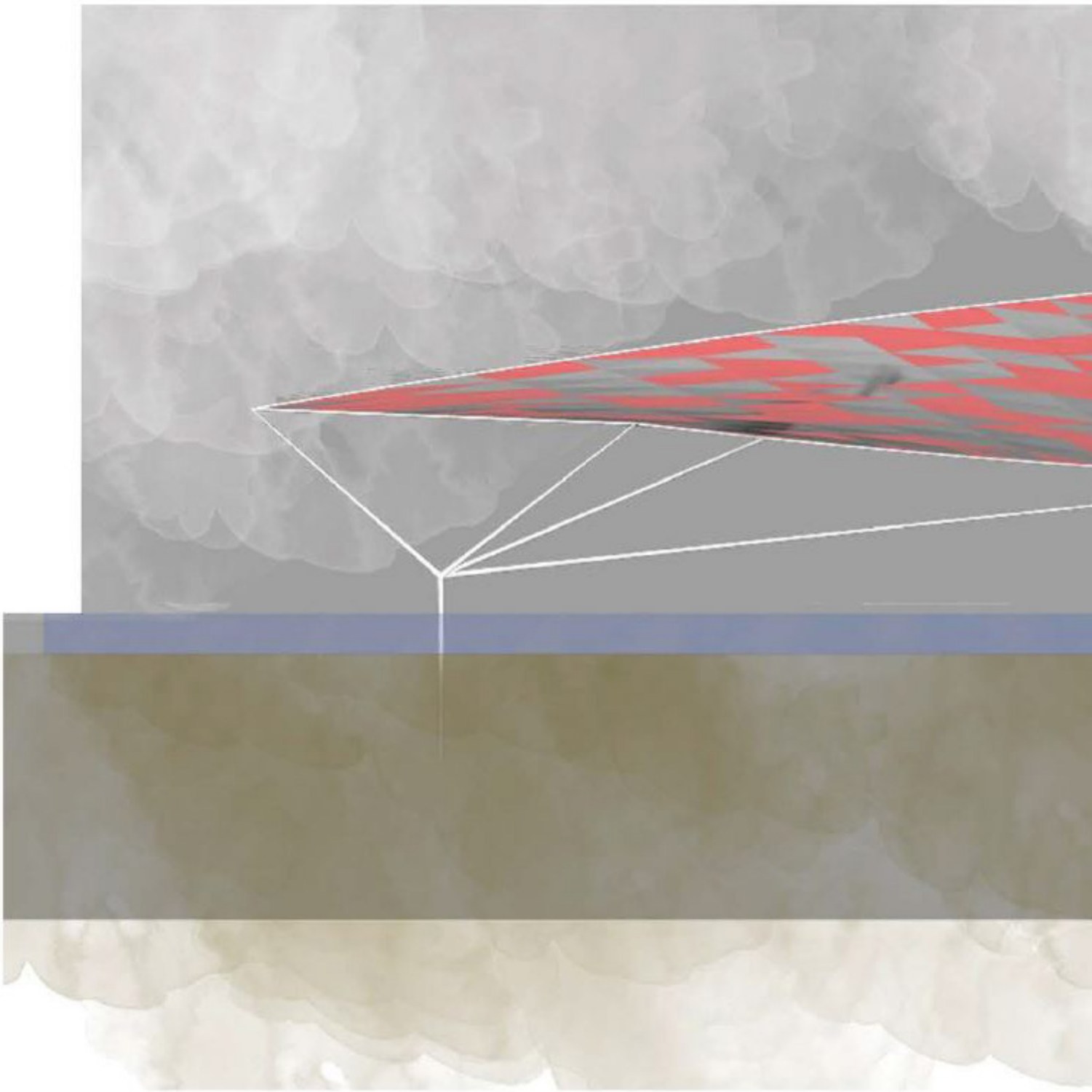
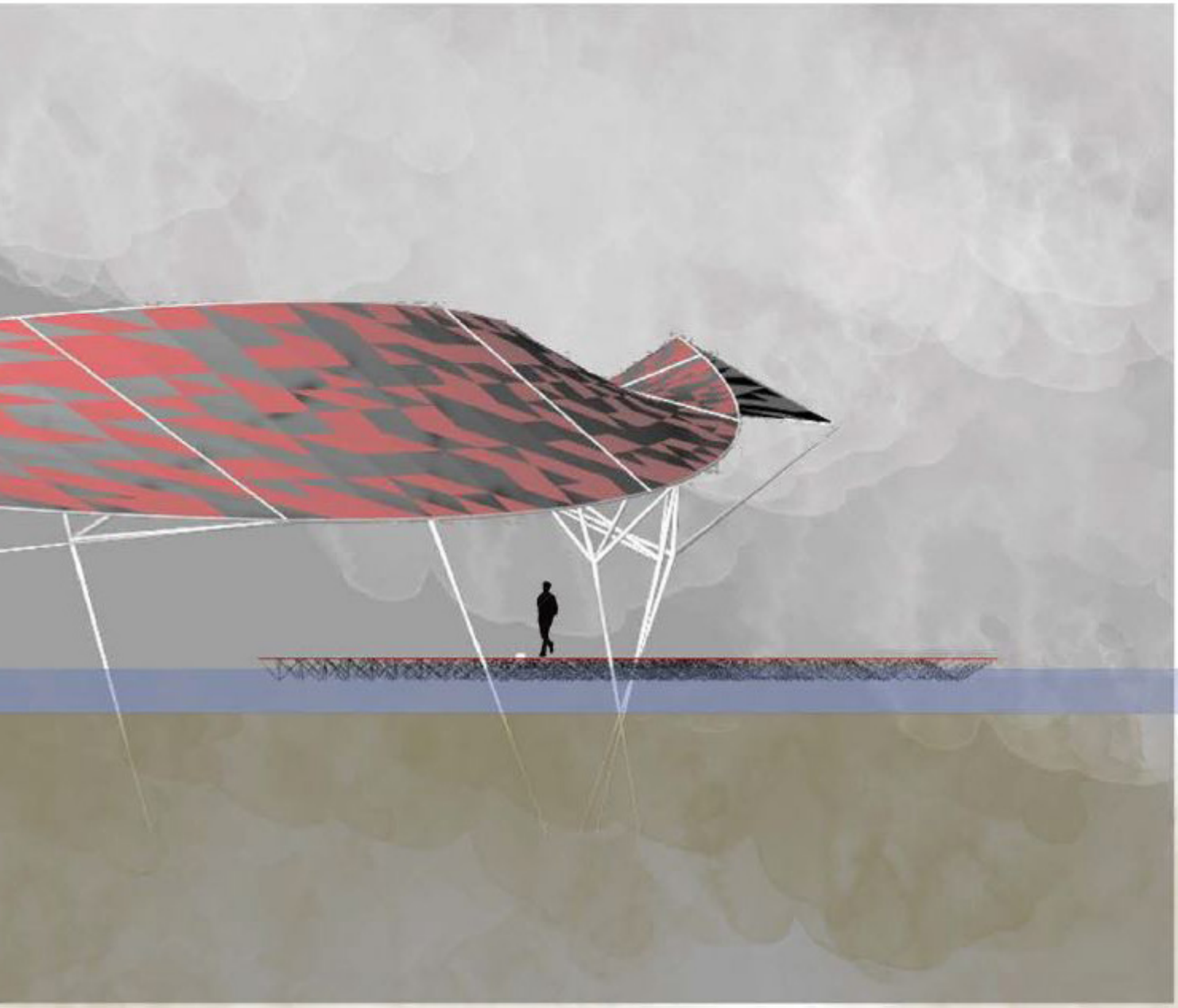


Figure 53_Elevation of Platform and Canopy



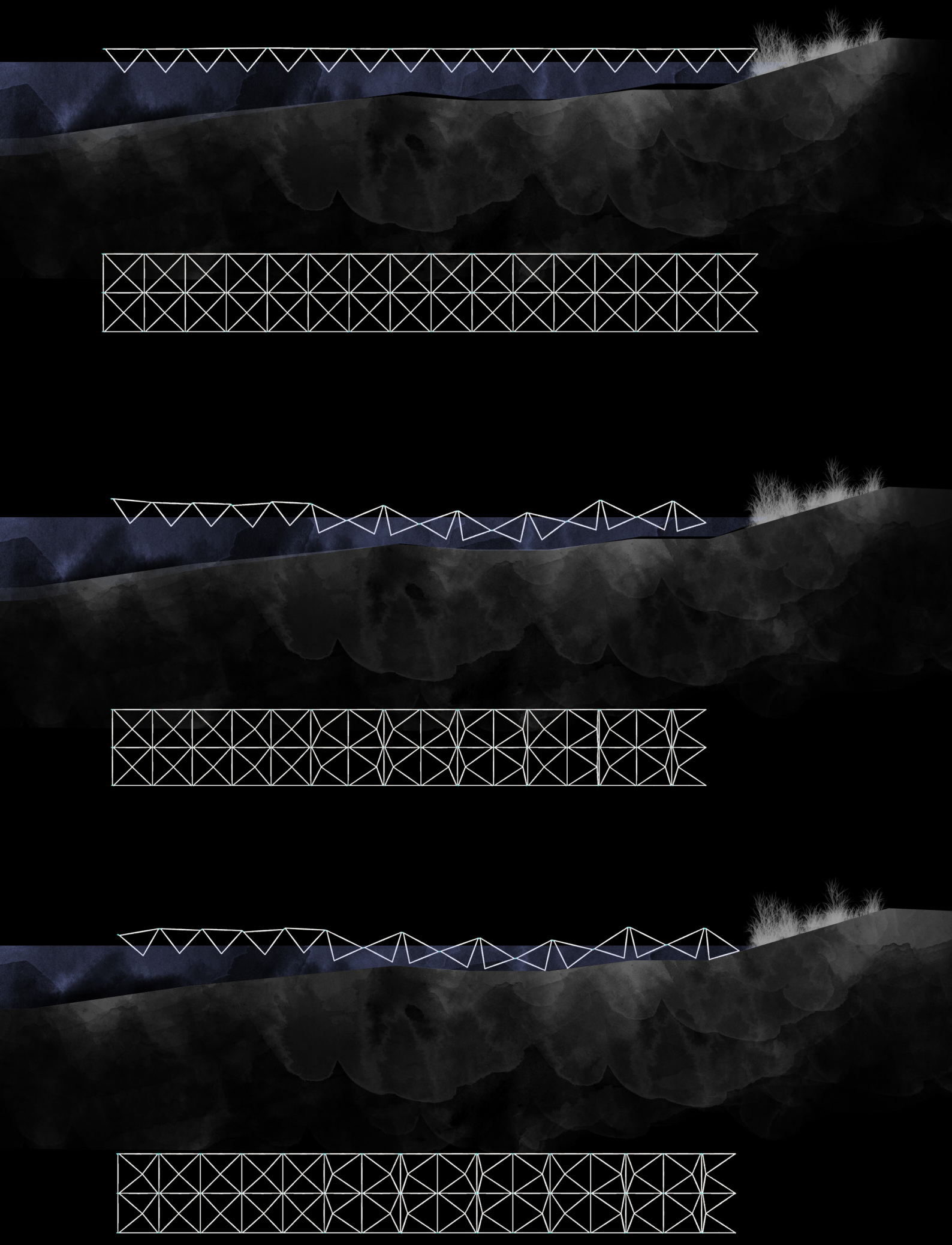
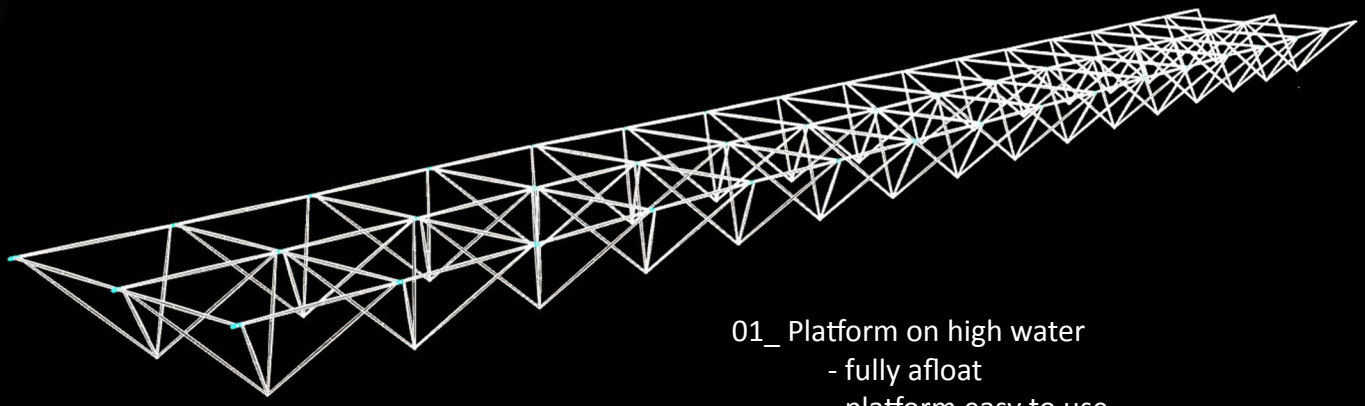
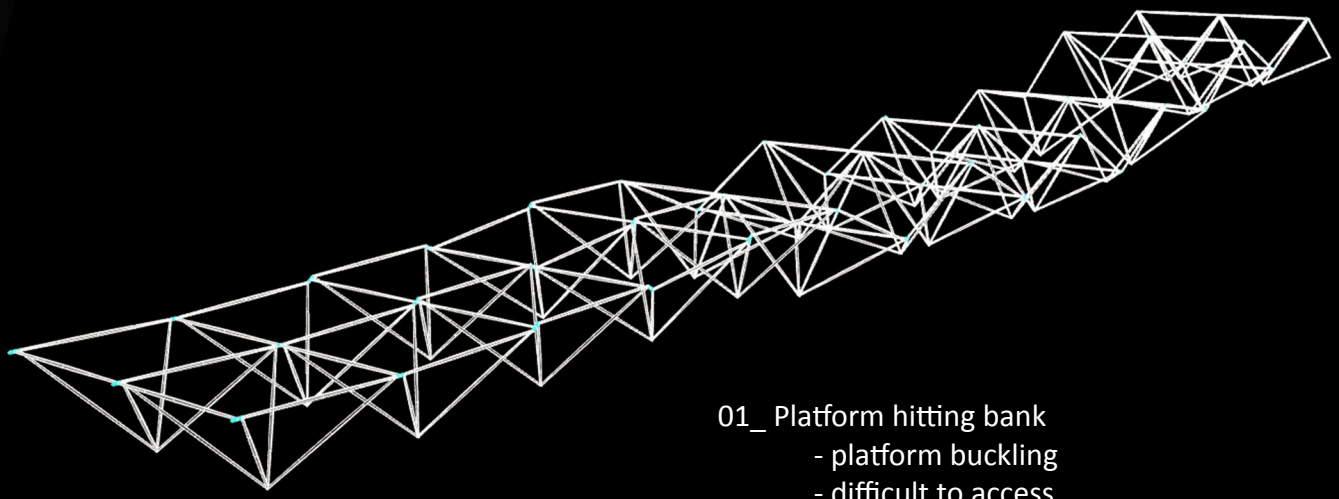


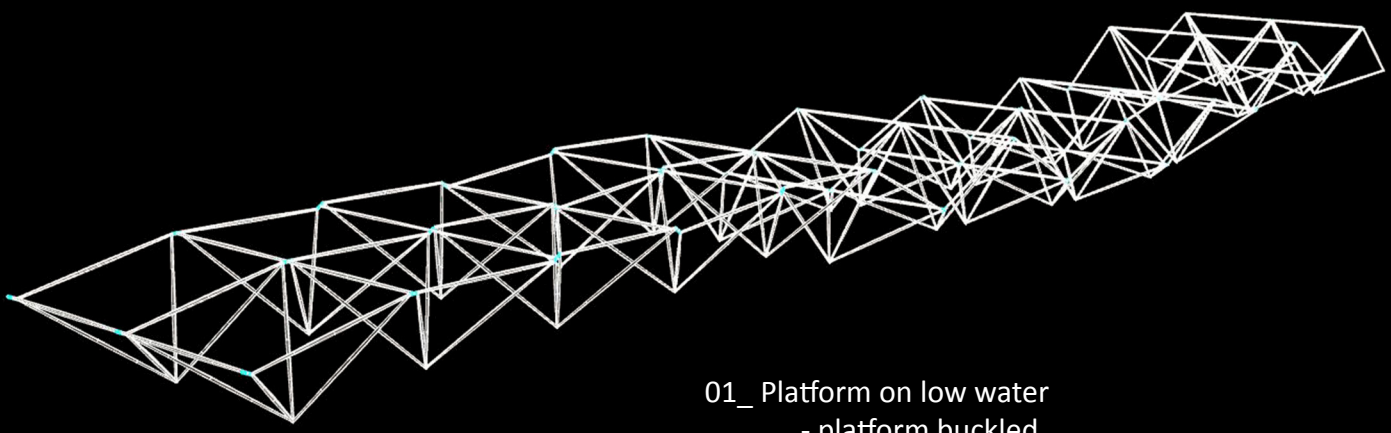
Figure 54_Platform changing due to water level.



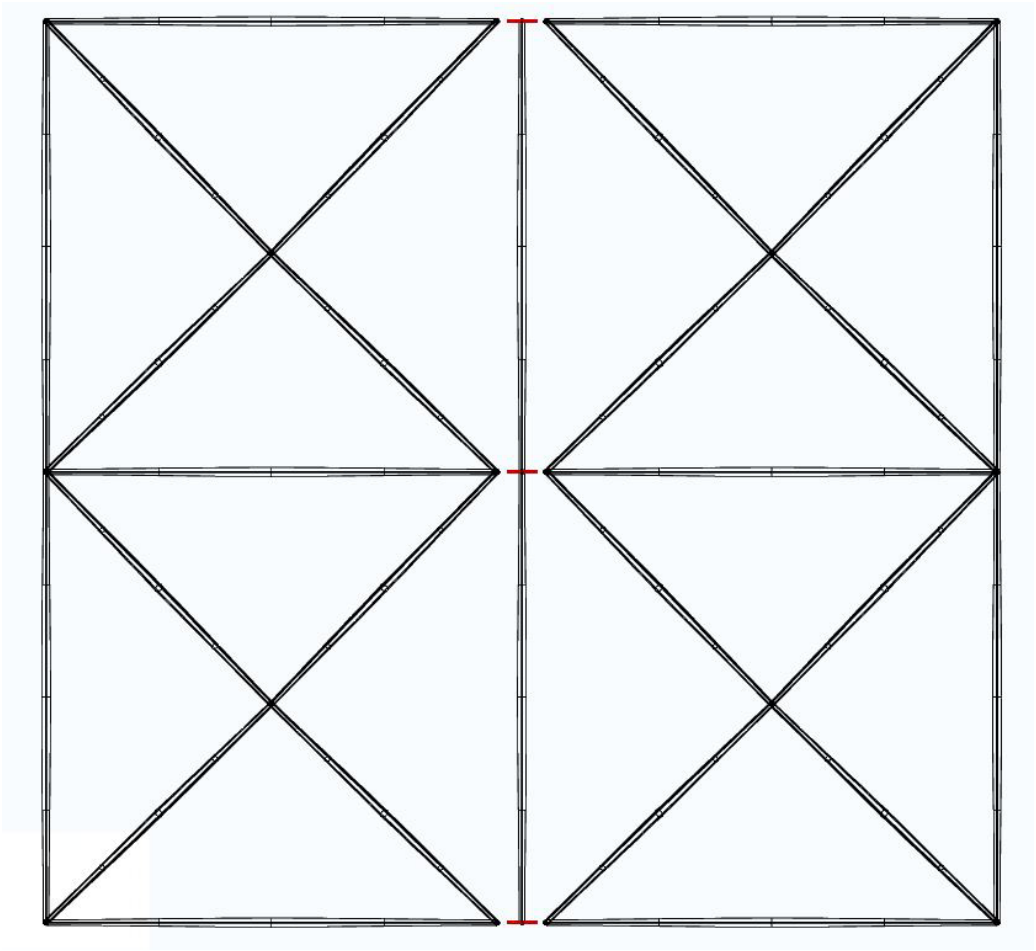
01_ Platform on high water
- fully afloat
- platform easy to use

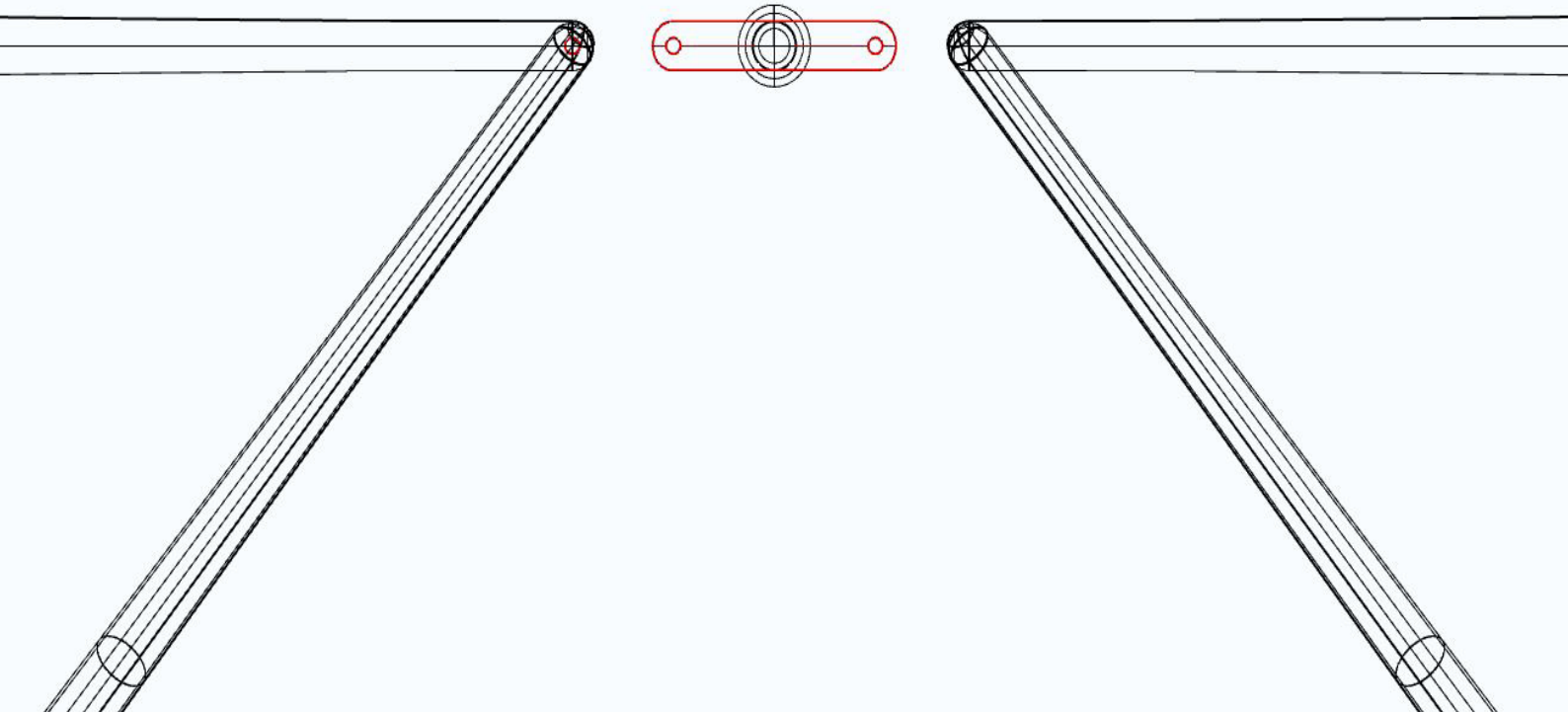


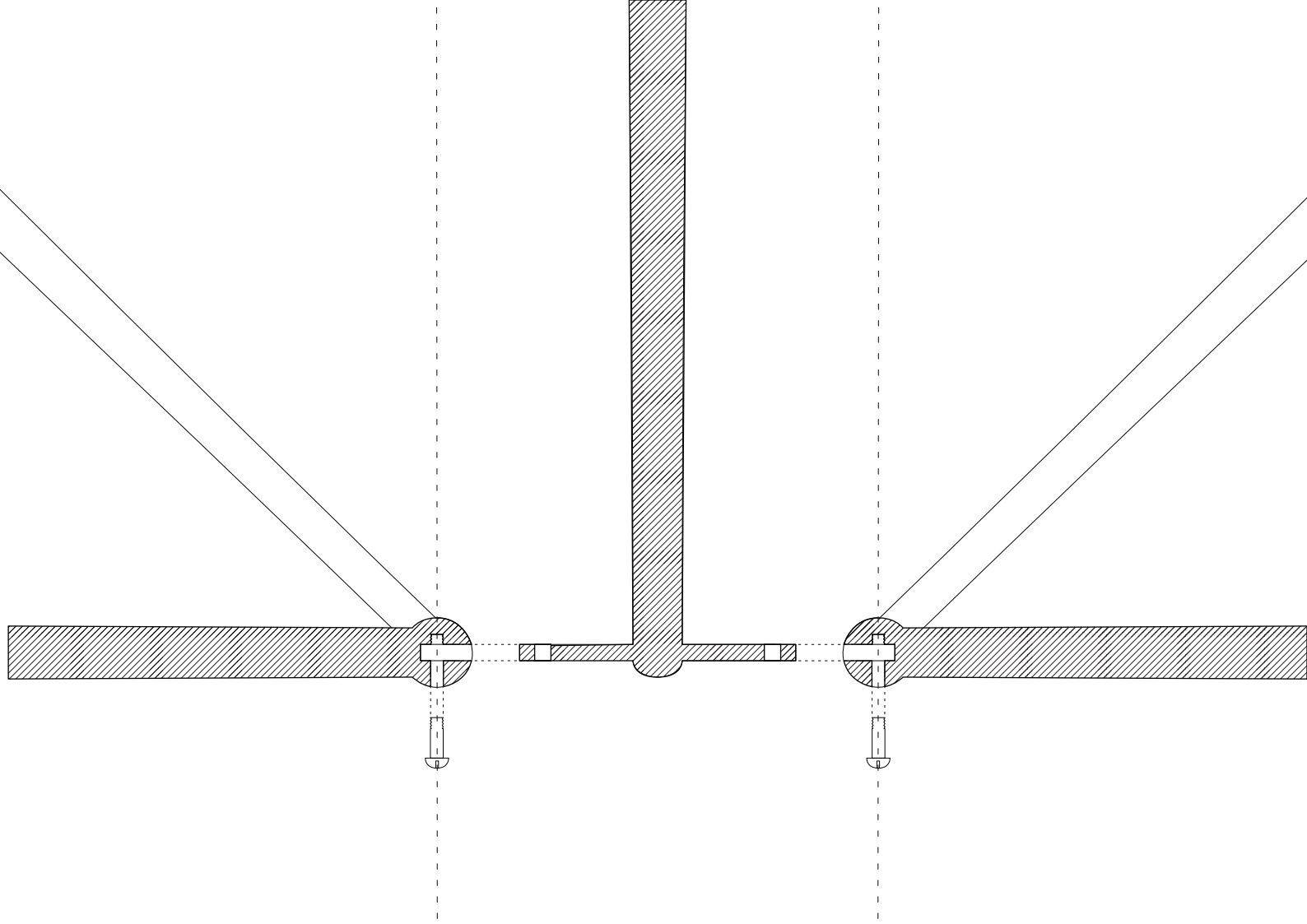
01_ Platform hitting bank
- platform buckling
- difficult to access



01_ Platform on low water
- platform buckled
- platform unusable







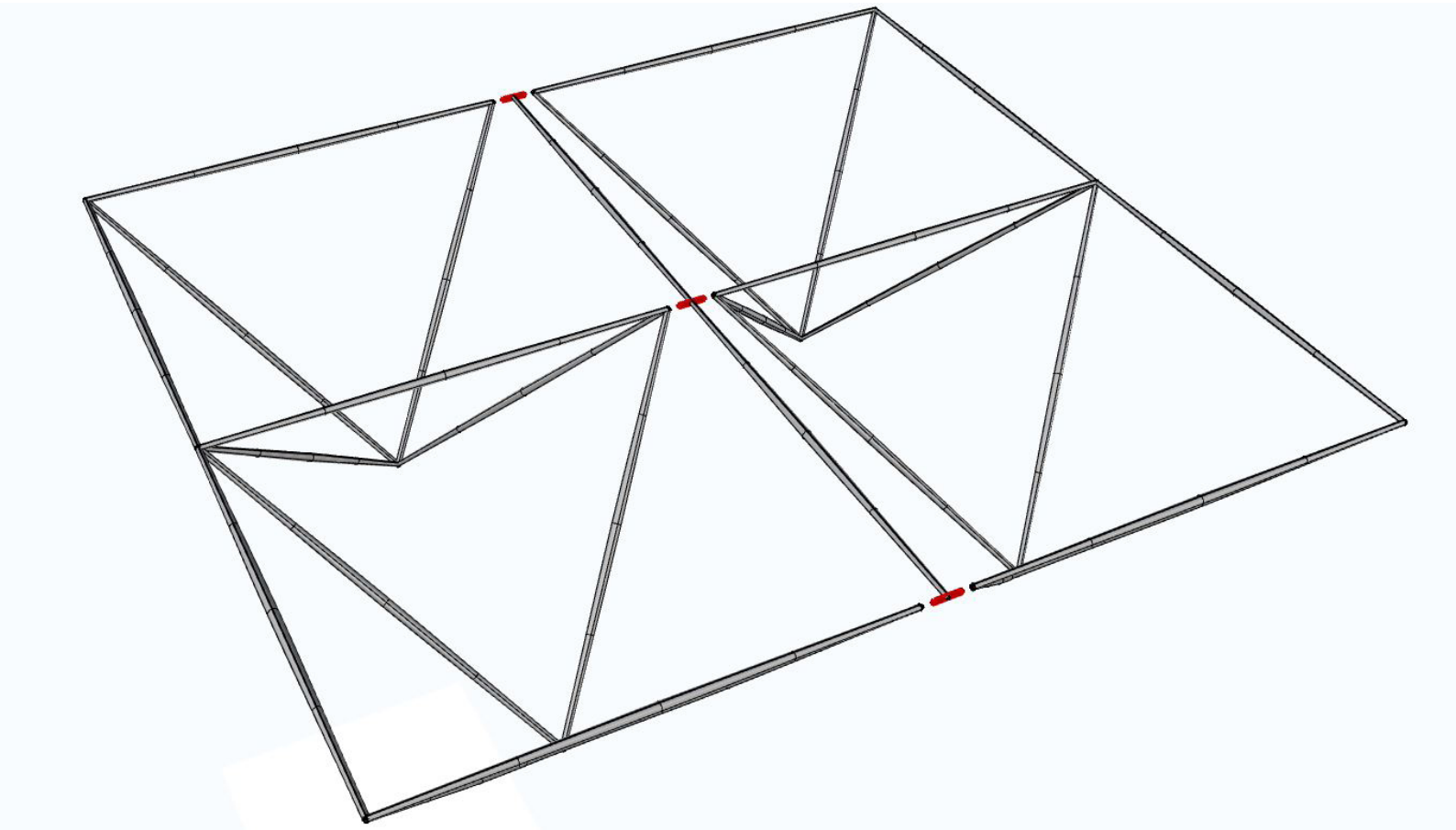


Figure 55_Platform component detail views

Conclusion

This research should be viewed as a continuation into the debates surrounding the use of contemporary design tools to facilitate Māori narratives in architectural design. But has it answered the question:

“How can parametric design to help reconnect Māori narratives, values and procedures into architectural form?”

From the start, this research subject was restricted in terms of scope in order to remain focussed on the subject at hand, generating parametric logic from Māori narratives. In doing so, a lot of potential influences were disregarded as the main focus for generating meaningful inputs stemmed from landmark entities. However, it made decision making clear and aims achievable because with these landmarks came established data that was used in the logic.

Therefore, parametric design can help reconnect Māori narratives, values and procedures into design outputs as long as the tikanga relating to the design output is observed and there is a clear feed back loop between the designer and the people to which the design is intended for. Without the input of the community, it is easy to lose track of the integrity of your work and break tapu (restrictions).

Taking from this experience, is a renewed appreciation for Māori culture and who I am as tangata whenua. Through learning the whakapapa of Ngāti Kahungunu and the stories of my tipuna, I am regaining my sense of self again through the discovery of cultural identity.

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