Preserving Waihi's Golden Past

A Research into the culture of the Game and its Engine to support and enrich an explorative engagement with Waihi's gold mining industry

Christopher Green

Explanatory Document

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Chemistry Engine: An underlying system created for 'Breath of the Wild' that drives the events the player creates when interacting with different objects in the game world (i.e. fire ignites wood and grass, certain objects gain buoyancy in water, etc - fundamental rules similar to the real world)

(Calamity) Ganon: The main antagonist in the Legend of Zelda 'Breath of the Wild'.

Game Engine: A developmental software that facilitates the visual rendering and physics of game environments. It also functions to support other fields that fall under game design such as audio design and coding.

Generative Architecture: Like 'Procedural Architecture', however uses unique elements created by a designer for a specific game design project, or collected from other sources for a specific intent. A product of working in game design software.

Precursor (architecture/ tower): A style of architecture belonging to the 'Precursors' - an ancient civilisation in the 'Jak and Daxter' series.

Level: A game space that players are able to roam to complete a series of designated objectives. Most games are composed of multiple levels that make up a complete linear, or open world experience.

For example, 'Super mario' is built up off small levels with distinct cuts between them where as 'Jak and Daxter' and 'Breath of the Wild' are built up of many levels that designed to seamlessly transition between eachother to give the illusion of a larger game world. The final project only uses one level.

Procedural Architecture: A type of architecture that is the product of working in a standard architectural software that uses generic architectural elements to build an architectural scheme.

Precursor Orbs/ Power Cells: A relic that belongs to the ancient civilisation known as the 'Precursors', and in the context of the game, is an object that players must collect in order to progress within the game.
My interest in the topic of examining ‘game architecture’ as a precursor to an architectural methodology stems from its capacity to formulate unorthodox space. Game architecture uses references to 'real architecture' to generate a layer of information that convinces the observer that the virtuality is related to their real experiences. This enables game designers to ground concepts of thought into interactive experiences. The means of managing an environment through the lens of a Game Engine requires designers to develop and organise libraries of objects. These objects are described under the prolific term ‘asset’ which is used to categorise all objects that are essential to building a game world environment. An ‘asset’ broadly defines every conceivable object in every form of matter, whether it be a solidity of a wall, the liquid state of water flowing down a stream or the gaseous smoke that bellows from an industrial building. Assets are produced in a variety of software, optimised for creating sounds, 3d objects and particle animations, and are managed by their file types. The Game Engine mostly supports mainstream file types to enable these externally created libraries of assets to be used within the parameters and tools provided by the Game Engine. The principle of importing an external asset assists designers to compose libraries of personally developed or acquired assets to satisfy their design objectives.

In contrast, 'Procedural Architecture' that uses industry standard software, like Revit, does not require the import of external assets.

Revit's workflow is supported by a library of parametric tools and generic objects that provides designers with enough to work within its framework. Revit does not require its software structure to distinguish file types in the same way as the Game Engine and as such an architectural designer could work within Revit to produce a desirable result. Producing content in Revit’s interface, has a strong preference for the visual perspective of an architect's normal perceptions of plan level, section and axonometric. Revit’s preference for the use of drawings in the design process encourages an inherently 2D view of architecture. Revit’s framework for utilising a distinctive internal library allows designers to produce architecture that might be described as 'Procedural Architecture'. 'Procedural Architecture' is a product of working within Revit's framework. That is in Revit's case, objects created using an internally coded tool such as generating a wall that uses direction and magnitude, a vector, to produce a 'wall' object.

In contrast to Revit's existing library, the Game Engine is designed to support file types from various generative software, meaning the Game Engine is not designed for creating environmental content, rather supporting the placement of content in the creation of game world environments. The Game Engine has a preference for constructing world environments in 3D as testing play and lighting conditions occurs in 3D conditions if the game is
designed to be viewed in 3d space. The state of the product is how one may differentiate the two frameworks. Revit is designed to generate a set of drawings that can be used to plan the state of a building's physical architecture. By contrast, the Game Engine creates active game world environments as a virtual product which one may call digital architecture. The aim of the comparison is to establish that the Game Engine is designed to draw from a larger pool of resources to deal with a better presentation of 3d reality than the 'Procedural Architecture' can utilise. The research project embodies an interest in the Game Engine as a way of deriving 'Generative Architecture' as a contrast to the standard process. In this case, this research project is going to use this capacity to generate a keen sense of a historic narrative. As a case study, the history of Gold Mining in the Hauraki region of New Zealand provides a lively historic context which has influenced the tourist strategy of the townships within the region. One should be clear that the document does not intend on creating a facsimile of the parts that make up the history of gold mining. Instead, the project intends on interpreting the history as a piece of architecture that is entirely fiction rather than a faithful rendition of history. The objective of the project is to define a quality of architecture that is present in the design of media-based architecture in areas such as games, film and literature, but not in real architecture. This quality is described as the 'fantastical'. The aim of the project is to analyse game architecture to summarise the characteristics of this 'fantastical' quality and how this can be translated to real architecture. The state of project's final architecture as a typology is not relevant and as such the Game Engine becomes a mediator of an exploratory experience in order to investigate what qualifies architecture to take on a 'fantastical' quality.
To explore the implications of the increased capacity of the 'Generative Architecture' environment, the research document will be supported by an iteration of a narrative written to justify an encounter into the stages of proposing a working prototype of a video game. This involves working through the studio hierarchy that can be disassembled into two groups: the 'artists' that are responsible for building the world, its characters and how its policies of sciences, philosophy and politics works and the 'asset creators' that translates their vision into parts that can be constructed within a Game Engine. The process of game design, which is inherently broader in scope will prioritise elements that are necessary in an architectural brief to provide helpful boundaries for what is designed within the capacity of the Game Engine to sufficiently present the view of the research project. The primary limitation addresses the focus of the context that an architectural design will create a visual language that is inspired by the theme of the history of Gold Mining in the Hauraki region of New Zealand. The secondary limitation focuses on the adaption of the Martha mine to promote its role as a host for presenting regional historic architecture that supports creative movement in game space in contrast to designing a gravity-bound display space like a museum.

The intention of introducing architectural components as limitations on the broad scope of game design is to explore the potential of 'real-time interfacing' provided by implementing a controlled character in game space within a scheduled and small-scale project with the unique potential of designing an architectural project around gameplay.

1.1 Project Outline
'Generative Architecture' is the consequence of the Game Engine and its extensive and detailed capacity for designing 'living' worlds. The implication of designing architecture as a part of a world system of game assets contrasts with 'Procedural Architecture' that is created within a limited and self-contained digital environment by design. The research project aims to raise awareness of a state of designing architecture that considers its potential within a gameplay environment to design intuitive space. The aim is to analyse the concept of 'game architecture', as a type of architecture that is designed to support the actions of players that act through a character controller they operate in real-time. Game architecture contrasts real architecture in its limitation to express “the characteristics of an object [that] afford certain means of action upon it, based upon the rules of our physical reality” known as 'affordance' that is widely available in real architecture, however constrained and reduced in game architecture and the space around it.

The document will compile an analysis of design philosophies from international game studios gathering research from design interviews, game design texts and analytical drawings of levels from a selection of their acclaimed game titles. The analysis will focus on the essence of play, a quality inherent in all parts of a game that is inspired by a principle that all designers in a project agree upon. In the interview transcript "The Indefinable Essence of Zelda", programmer Satoru Iwata brought together six junior designers that worked on the game title Legend of Zelda: Twilight Princess to describe their perception of what the 'essence' of the title is. Iwata describes essence as "if I were to pinpoint what it is that binds all of [sic] [the game designer's] seemingly disparate elements together, I would say that it is each individual's concept of what makes Zelda unique." The essence of the game is the point where most designers agree upon the values that all experiences of play must adhere to in order for the game to be enjoyable. This leads into an analysis of the architecture of the game world and how it employs the principle of 'affordance' in the psychology of visual and auditory elements to suggest a preferred progress through the game space.

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1.2 Aims and Objectives
How can the concept of the *Game Engine*, its technologies and the philosophies of Game Design support an interdisciplinary approach to creating architecture?
The research project requires a broad understanding of most areas relevant to constructing a game prototype. Instead of designing architecture within real world constraints, the focus is to design aspects of the game world related to the player and their rules of movement that re-define the perception of Martha mine as a game space. The objective of the project within its scope is to inform the discussion of game concepts as a part of interdisciplinary thinking into the field of architecture.

The intention of the research document is to provide grounds for an analysis of a selection of game design philosophies. This will focus on a studio's treatment of two important concepts: the essence of play and its influence on navigating game space and its architecture. This to introduce readers to the elements that differentiate game architecture's adaption of real world 'affordance' from real modern architecture's rejection of pre-existing functional language. The conclusion will further summarise these qualities of game architecture so as to enable intuitive design by its capacity to be tested in real-time environments as a means of encouraging a generative approach to architecture.

1.4 Scope and Limitations
The research document accessed a variety of texts, video essays and interview transcripts that focus on discussing game design analytically and broadening the field into academia by improving the accessibility regarding its industry processes. Tynan Sylvester's 'Designing Games: A Guide to Engineering Experiences' is one such text that is an introduction to the Game Engine as a system that can be understood by the emotions that it elicits being categorised as either fictional or mechanical. The fictional layer consisting of visual and audio world building material that relates to our own reality gives the game world the ability to make the player feel humour, sadness, shock or fascination3. On the other hand, the mechanical layer consisting of the rules that govern the competitive nature of the game can generate feelings of tension, loss, relief and triumph4. Sylvester's 'Designing Games' introduces the Game Engine to the project in a way that reinforces the Game engine as both a medium to communicate multi-dimensional concepts and as a method of testing architecture's viability in the real world.

Furthermore, the text allows the document to compare ideas that may focus on more specific parts of game design such as the collection of essays brought together by Bernard Perron and Mark J.P. Wolf's 'The Video Game Theory Reader 2'. Former games journalist Mark Brown provides an archive of video essays under the series title 'Game Maker's Toolkit' that analyses the design intention of various game titles, offering an insight into different ways that the fictional and mechanical layers of the Game Engine have been created.

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4 Tynan Sylvester, Designing Games, 31.
A game design philosophy is a set of definitive statements or questions that a studio reflects upon to help judge the integrity of their artistic identity and their relevance in the market. The research document aims to develop this section as a means of producing a comprehensive analysis of a selection of studios and their game titles, reflecting on the essence of play, a quality that is definitive in establishing the real-time interaction of the Game Engine, and the design of the studio’s game architecture that guides players through the designer’s intention. Ultimately, design philosophy queries where in the structure of game development the studio begins, what kind of experiences the studio is known for and the kind of experiences the studio will be designing in the next decade.

This section will analyse two design studios: Naughty Dog of America and Nintendo of Japan. Naughty Dog was founded in 1984 by programmer Andy Gavin and game designer Jason Rubin initially developing game titles for computers and various game consoles. Gavin’s contribution to the development of efficient strategies of data management while studying at the MIT artificial intelligence lab in Cambridge, Massachusetts supported the production of graphically superior titles during his time at Naughty Dog. The influence of smart technologies set the standard in programming efficiency and artistic quality across all of Naughty Dog’s developed titles. Rubin talks about the pair’s vision for the company “when I sat down to play Uncharted 2: Among Thieves five years later [after Rubin and Gavin’s departure], I realized that Naughty Dog had finally fulfilled our foundational dream: story and game interwoven seamlessly in a character action game.”

Fusajiro Yamauchi began Nintendo all the way back in 1889 in Kyoto as a business producing hand-made playing cards known as Hanafuda Cards. Up until its transition to game development in 1975, Nintendo provided cab and hospitality services, sold food and toy products that maintenance engineer Gunpei Yokoi helped design and whose innovation would have a hand in developing Nintendo’s game hardware systems. Nintendo’s design philosophy is built upon developing both its own game hardware and titles, bringing on talent such as Yokoi and Shigeru Miyamoto – a game designer trained in industrial design. Miyamoto has provided creative direction for Nintendo’s flagship titles Super Mario and The Legend of Zelda and it should come as no surprise that Miyamoto says “it’s very important to design these things so its function would be easily understood.” A member of Nintendo’s Entertainment Analysis and Development, Tominaga echoes one of Miyamoto’s principles in “another thing that’s important is having fun getting side-tracked from the main story” that “having a game full of experiences like that might be what makes a Zelda game.”

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2.1.1. Inciting Adventure: Exploring the Form and Hierarchy of Jak and Daxter's Ancient Architecture

At the time, Jak and Daxter was a project that epitomised smart design decisions – technically and narratively – that supported Naughty Dog’s ambition for an open world experience. The game world is navigated as a platformer, a game type that challenges the player to navigate obstacles to progress through the game environment, and as a brawler which allows players to perform multi-layered attacks by chaining multiple controller inputs resulting in the character performing simple or complex attacks. After the player has completed the tutorial level designed to teach new players the basic controls, they are tasked with scouring locations for two types of collectibles – 'Precursor Orbs' and 'Power Cells'. 'Power cells' can be either found in hidden locations, acquired by completing certain tasks in an area or traded by non-playable characters for 'Precursor orbs'. Acquiring a certain number of 'Power Cells' grants the player access to further regions.

One of the first major exploration invites the player to breach the walls of an ancient precursor tower. The initial set-up is when the player exits the hut elevated above the village below and they catch a glimpse of the tower in the background, behind the cliffs in the midground. This is the first visual technique the director uses to communicate to the player the initial direction they should head in.

![Image](image1.png)

**Fig 1.** Diagram shows the tower in the background which is separated from the village by the mountain range to distinguish it as a way-point - an icon of adventure.

![Image](image2.png)

**Fig 2.** Drawing of the Green Sage's hut behind the player from fig 1.
As the player moves closer, the tower transforms from a piece of waypoint architecture into a weenie — a term coined by Disney Imagineering to describe a visually dominant element in an arrangement of buildings that allows visitors to track their location relative to their view of the element's facades. Disneyland in Anaheim, California utilises this concept in the centre of its site plan “like the four cardinal points of a compass” like the castle in the centre and elements in each of the four themed quadrants of the park. The design of the tower’s composition is circular in plan and is composed as a collection of stepping cylindrical towers making each perspective unique.

From a narrative perspective, it is the player’s first encounter with the architecture of the Precursor race within the context of the game’s narrative. The tower’s relative scale to the forest is one of the few gestures that indicates the superiority of the ancient race. The internal and external layout comprises of platforms that introduce a crucial game and narrative mechanic that is ‘Blue Eco’—one of five energies that in the context of play are ‘power-ups’ either enhance the player’s existing or provide new abilities. ‘Blue Eco’ increasing the player’s speed, collects object from distances and powers various Precursor technologies. The latter quality of ‘Blue Eco’ is fundamental of how the player is taught to conduct the world’s energy to make objects move. This is taught where the tower introduces two types of platforms that either move on a path, or flip intermittently when powered. The player's experience in the catacombs of the tower is short and intended to expand upon three ideas. Firstly, the tower explains through action how 'Blue Eco' works. Furthermore, the catacomb develops the core experience of exploring Precursor architecture that will be developed as the player progresses the world. Finally, it continues to teach players about interfacing with the game by putting them on their toes by pitting their reflexes and proficiency with the movement controls against a ‘boss monster’. It is also the first lesson that exploring catacombs has a run-on effect on the rest of the world. Unlocking caches of 'Blue Eco' vents granting access to puzzles that unlock previously inaccessible locations and disabling threats in the forest that while a minor nuisance, is indicative of the player’s actions in one area having influence in others.

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13 LiamK, "The Original Disneyland Prospectus from 1953" accessed 18 April 2018, liamk.org/disneyland/
Fig 4. Site plan showing the path leading to the Precursor Tower

Fig 5. Looking to Precursor Tower at the entrance to the Forbidden Forest

Fig 6. Entrance Facade of Precursor Tower that shows the form of the ancient architecture that contrasts with the rest of the scene shown in fig. 5
Fig 7. Axonometric plan of inside the Precursor Tower that shows how the player progresses through.
2.1.2. Framing Adventure: The System of Symbolic Colours and Views

Another notable encounter is the Precursor Architecture called the “Lost Precursor City”. Compared to the Precursor Tower, it is indicative of a piece of waypoint architecture – it can be viewed from the Blue Sage’s Hut (a crucial point in forwarding the main narrative) and from the town hall. From the town hall, its placement is lined up symmetrically with contextual elements inside the hall to frame the part of the city on the water surface. The symmetry of the context surrounding the focal point, the dome that reveals the lost city, reinforces “a natural tendency to be aware of certain patterns” known as the ‘law of similarity and proximity’ reiterated as a principle of The Gestalt Art Experience that theorises how the human brain arranges visual information. Despite the symmetry of the room, the player approaches the lost city from a path of floating platforms from a dock to the right of the town hall’s entrance – an asymmetrical path relative to the set-up. We see this meticulous framing in Square Enix’s Tomb Raider that adapts the torii – a gateway used in the layout of paths in Shintoism as a strategy of framing an auxiliary experience from the main narrative of the game, of which is heavily influenced by the mythology of Shintoism. Unlike the town hall, the arrangement of a broken torii in the pattern iterates on another principle of Gestalt - the ‘law of closure’ as “a natural tendency to complete whole and

effect the closure of “open” or unfinished parts of wholes.\textsuperscript{15}"

Once inside the precursor dome, the player encounters an event like the one that played out on-top of the Precursor tower. The player must interface with a button to make the platform surge downwards – a gesture that the player recognises from a previous encounter as being iconic to entering precursor architecture. However instead of the player pushing the button, the game breaks the player’s control of the character and operates the platform elevator itself. Given the game had already introduced this concept in a previous encounter, the designer breaks controls for no clear reason. After riding the elevator down, the player enters a lobby like the one they arrived at in the Precursor Tower; one door for entering the city, and one for exiting the building’s circulation loop. The entry door proceeds the player into the hallway of the city and introduces the two environmental dangers within the city’s layout – the heated pipes and the electrified water. The player will likely never hit these instances of the obstacles on purpose, or within the challenge of the game. In this instance, the objects serve to indicate direction and hazard by lining up with the hallway’s existing path and using bright and triadically complementary colours on the colour wheel to signify their danger in contrast with the surrounding environment, respectively.

The heated pipes are used to provide increased difficulty to the

\footnote{\textsuperscript{15} Nancy Amendt-Lyon, "Art and Creativity in Gestalt Therapy", Gestalt Review 5, 231.}

foundation challenge and the intermittent electrification of the water intends to provide an avoidable consequence to failing a platforming challenge. One of the most notable additions to the environmental puzzles are the rotating platforms. It is first introduced in the second room from the entrance that always come in sets of two. While the player stands of one of the two

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image}
\caption{Drawing of the Blue Sage's Hut showing the make-shift style of the architecture in the world of 'Jak and Daxter'}
\end{figure}
platforms, the second platform rotates around the one the player is standing on. The rotating platform will rotate a full 360 degrees but if it collides with the environment, it will rotate in the opposite direction thus limiting its maximum degrees of rotation. Once the player jumps off the platform, the rotating platform will cease until the player jumps on it causing the other platform to rotate.

This element influences the design of the last main room as the designer has created an open first floor that players can experiment with the rotating platforms and a water-based ground floor. The value of an open space and the rotating platforms inspires the proposed challenges to be more open-ended such that the objective provides direction, but do not remove or add to the established rules that the previous rooms have laid foundation to. The only added rule is the time limit intended to provide challenge. The ‘time trial’ puzzles utilise the rotating platforms and the nature of the game as a platformer to make something competitive. The puzzles are not meant to be contemplated in the player’s own time – the aim is to make the mechanics easy to understand so that the urgency the game puts on the player does not overwhelm the experience. In fact, the player can repeat the puzzle after failing it to improve the player’s performance with the enhanced knowledge of how it works. The puzzle contrasts the contemplative quality of intellectual puzzles by designing such that rewards players with insight upon failure to make the eventual success more satisfying. Because most 3d games are open physics systems, this type of puzzle works with the intended interactivity of the game world and physical traits of their mechanical systems, like the rotating platforms.

![Image](image1.png)

**Fig 11.** Inside the Last Precursor City showing the floor levels: the challenge (red) and the water beneath (white)

![Image](image2.png)

**Fig 12.** Path into the Last Precursor City indicating environmental dangers (top) with a colour palette analysis (right)
2.1.3. Conclusion: The Importance of Form and Colour in Guiding the Adventurer

Analysing two similar explorative encounters in the Jak and Daxter universe, there is a fair amount to learn from the designer’s first attempt at an open-world experience – particularly in the strategies the designer implemented to create a subconscious sense of direction. Using a prominent language in the design of pre-era architecture in both scale, colour contrast and shape helps evoke interest in a place. These are lessons that the studio still builds upon today in their game titles as they have moved into comparatively linear experiences with an emphasis on building games that borrow and balance the principles of game design and film. Game Journalist Mark Brown discusses the strategies of subconscious direction in Naughty Dog’s Uncharted series that, compared to Jak and Daxter, builds a high-budget film aesthetic that draws upon the advantages of cinematic framing, exotic and realistic locales and knowledge of camera techniques. Brown says beyond assisting navigation, all these elements can “set the right tone, motion [of objects on-screen] can be used to make sure the player is looking in the right direction, and frames in the level design ensures the player gets the best viewpoint for the most important scene.” Brown also reiterates a quote from one of Naughty Dog’s game designer Emilia Schatz that “[level design is] very much a game in psychology. You need to figure out what your environment is

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16 Mark Brown, "Why Nathan Drake Doesn’t Need a Compass | Game Maker’s Toolkit" published 26 October 2015, video, 8:15, www.youtube.com/watch?v=k7o_jeVOcG0&t=328s

telling the player." This concept of the language of architecture parallels the works of Giovanni Battista Piranesi's etchings of the 'Imaginary Prisons' "as a parallel to [Piranesi's] own experiences whilst under the influence of the drug." These drawings depict "vast Gothic halls, on the floor of which stood all sorts of engines and machinery, wheels, cables, pulleys, levers, catapults." These etchings establish architecture as a spectacle; full of the parts that are reminiscent of things that are mechanical and therefore suggest rational space, but is anything but. "You perceived a staircase... follow the stairs a little further, and you perceive it come to a sudden abrupt termination... But raise your eyes, and behold a second flight of stairs still higher, on which again Piranesi is perceived, by this time standing on the very brink of the abyss." To compare these spaces to the etchings of Hadrian's Villa that are ruins of a real place, but are reminiscent of a virtual place that frames its grounds in volumetric lighting to bring forward the ruin's scale.

Fig 14. Piranesi's etching of 'Hadrian's Villa' - an example of a 'fictional' scene that is representative of a real space

18 Mark Brown, "Why Nathan Drake Doesn't Need a Compass"
20 Arthur M. Hind, Giovanni Battista Piranesi by Arthur M. Hind, 10.
2.2.1. Designing for Function: An Insight into Nintendo's Famous Tutorial Level

Under the Nintendo company, Shigeru Miyamoto’s first game project as a creative director was Super Mario Bros in 1985 – a successor to Mario Bros in 1983, and is a clear example of the ‘form follows function’ philosophy that underpins all this game studio’s titles. We will look at one of the later levels designed for the 1985 title and the first level that the player experiences. The game builds upon the character 'Mario' who utilises jumping as his fundamental mechanic for moving and navigating the game world and its challenges. Appropriately titled 'World 1-1', the aim of the level design is to teach the players how to interface with the world through the character of Mario. This is done by creating encounters that utilise elements of the game that can be broken down into three categories: 'power-ups', 'enemies' and 'obstacles'. The player is taught how each category interacts with the fundamental controls of 'Mario' and his jump, by creating events that are strung together to form the environment. As shown in the diagram, each event is clearly distinguishable by how the obstacles break up each encounter that teach the player different concepts pertaining to the three categories. For example, the first encounter can be seen on the

![Image of Super Mario Bros level design](image-url)

Fig 15. and 16. Breakdown of Super Mario Bros' Level 1-1 (1985) (top) and breakdown of the basic mechanics of the character (bottom) that show how encounters are broken up and the affordance of 'action' the player has in the game world

2.2 Nintendo: A Functional Philosophy
far left where the player is face-to-face with a Goomba which can either be jumped over, or defeated by landing on its head. The secondary element of the encounter, as described by Miyamoto, is “if we have a question block, [the player] might want to try and tap that as well [and] when they see a coin, it’ll make them happy and they’ll want to try again. 23 ”’This curiosity leads the player to discover the mushroom, a 'power-up' which spawns from the question box when hit, collides with the game world and creeps towards the player. When the player absorbs the mushroom, it makes the player taller and able to break the brick platforms by jumping upwards. All these encounters focus on teaching the visual language of the game – that expressions of play should be intuitive and hedonistic. This principle influences the game’s architecture by instilling a clear relationship between elements that generate a response to the player’s actions and elements that do not. Unlike their real-world counterparts where all objects have a response, the intention of this principle is to set boundaries to establish early in the player’s experience that ‘reactive’ elements relate to the essence of play. While all game design recognises this to an extent, Nintendo’s approach to the design process, is such that how the world works must be established before designing how the world looks like it works.

23 Eurogamer, “Miyamoto on World 1-1: How Nintendo made Mario’s most iconic level” published 7 September 2015, video, 8:18, www.youtube.com/watch?v=zRGRjRULswY&t=1s
2.2.2. Playing With Physics: 'Breath of the Wild' and its Chemistry System

In 2017, Nintendo released ‘The Legend of Zelda: Breath of the Wild’ as an addition to the narrative of the fictional world of Hyrule. The story follows the character of Link as he wakes up from a 100-year slumber, only to awake in a world that has changed significantly since his last adventure. Upon waking, the kingdom of Hyrule has been overthrown, in an event dubbed the “Great Calamity”, and a mysterious creature, Calamity Ganon, looms in the Hyrule castle. Unlike a traditional narrative that forces the player to make intentional moves to explore all parts of the world of Hyrule, the game provides only one condition that the player must satisfy, and that is to defeat Calamity Ganon. Instead, the game’s narrative is about preparing you for this fight, that “you can take Ganon on at any point, but because you will likely be killed before you can approach Hyrule castle, you’re not delaying your showdown… you’re training for it.” This open-ended approach to story-telling gives the player more control over how they operate within the game space and how they learn the systems that govern it. Learning how the parts of the wider game system work is perhaps the most important prospect of the player’s adventure and offers insight into how Nintendo has invented the internal mechanics of the game world. In ‘Breath of the Wild’, Nintendo has approached the design of the game world’s mechanics by

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Fig 17. Breakdown of a mechanic from 'Legend of Zelda: Breath of the Wild' (2017) that shows the limitless potential of problem solving in its world that does not restrain action
importing a reaction system inspired by our understanding of chemistry, or how different types of matter reacts with each other. This system, dubbed the ‘Chemistry Engine’, tags objects in the world as either materials, like clothing, weapons and foliage or elements, like wind, fire and electricity. The engine stores rules that dictate what happens when three different scenarios play out. Either an element reacts with another element, or a material reacts with an element or a material reacts with a material. This system provides an appropriate reaction that plays out visually as a response to the player’s actions, such as fire setting a tree alight. This simplified model of a pseudo-chemistry is substantiated by game designer Tynan Sylvester when he states that “games are composed of mechanics, which define how the game works [and] during play, mechanics and players interact to generate events.” These events trigger a response from a spectrum that Sylvester calls the ‘Basic Emotional triggers’. The ‘Chemistry Engine’ creates events that can be summarised by three emotional states: ‘Emotion Through Learning’, when the player creates a connection about the reaction between two objects; ‘Emotion Through Challenge’, when the player considers how the reaction can overcome a puzzle and finally, ‘Emotion Through Spectacle’ when the player develops a vast knowledge of these reactions and tries to chain a complex string of reactions that overcomes a puzzle in a satisfying way.

27 Tynan Sylvester, Designing Games, 7.
28 Tynan Sylvester, Designing Games, 7.
2.2.3. The Colour, Sound and Familiar in the world of Hyrule

When the player is first introduced to the world of Hyrule, they wake up in a gloomy room reminiscent of the crypt of a cathedral. The crypt space has established a clear architecture language that corresponds with it – the somewhat indeterminate ceiling, columns with reliefs from the wall and the symmetry of the building’s path are clear references to religious architecture. The space adopts a complementary colour palette with a green-brown colour used to identify the boundaries of the catacomb and the artefacts inside it and a saturated indigo for the ambient lighting. The Indigo lighting establishes the atmospheric qualities of the space and is described by artist James Gurney as on the spectrum of ‘healing colours’\(^{29}\) that corresponds with the concept of the seven Chakra as “centers [sic] in our bodies in which energy flows through \(^{30}\)” of which indigo is linked with awareness. The catacomb also has a distinct shape language designed for this typology that lines the player’s walking path, the skirting of the building’s walls and the columns reminiscent of Celtic detailing like on the Pontypidd Water fountain in Wales. All these design elements work in conjunction with one another to suggest a place embedded in the sanctity and mythology of its place that references the works of religious places of Europe and the mythology of the Celts. This reinforces the game’s intention of creating a visual storytelling experience that Brown’s analysis of the game substantiates when he says that “most


*Fig 18. Analysis of the 'Shrine of Resurrection' that shows how objects form paths and the familiarity of the 'fictional' language that references real architecture

\(^{31}\) Pinterest, "Pinterest" accessed 25 April 2018,

\(^{32}\) Pinterest.com/736x/11/8c/39/118c396bead9b337136868326a72ca07--fountain-wales.jpg

Paul Dobraszczyk, *Cryptic Space*, accessed 25 April 2018

[ragpickinghistory.co.uk/2012/08/17/cryptic-space/](http://ragpickinghistory.co.uk/2012/08/17/cryptic-space/)
of the game’s storytelling is done through the ancient ruins, giant bones, forgotten battlefields and other bits of the environment."

Exiting the catacombs puts the player outside on a stretch of cliff that reveals a vast open landscape. Unlike the cliff scene, the catacomb lacks a layer of music that instils an eerie silence that compliments the almost complete darkness of the catacomb. The only audio is the ambient sounds consisting of the wind gusting past the catacomb’s opening and the footsteps of the character. Though as the player approaches the end of the cliff, the character’s movement and its direction are intentionally replicated as the game takes control to create a cinematic opening. Two keys of the piano are struck in repetition and the trumpet and drums building up as a subtle overlay to create tension that follows the camera that exposes the panoramic view of the landscape. The tension is released with a crash from the drum’s top-hat and the character stands in awe at the end of the cliff. The camera pans out and a short melody is played on the piano. An eerie and high-pitched noise sounds off in the distance during the start and end of the melody that references the 'echo effect' to give the scene visual depth. The crash of the high-hat indicates the end of the melody and, a melody from the trumpet plays accompanied by the flute and overlaid by the piano as the camera rotates around the character and back down to the player’s view height to observe the ruins of a cathedral in the background and an old man standing in the midground, as if anticipating the player, a canopy formed by the terrain providing shelter to a roaring fire.

Fig 19. Open vista after exiting the Shrine of Resurrection in 'Legend of Zelda: Breath of the Wild' that shows the power of cinematography in world building

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33 Mark Brown, "The Legend of Zelda: Breath of the Wild – An Open World Adventure | Game Maker’s Toolkit"
The next action the player engages in is finding a tree branch while descending the cliff that can be picked up and wielded as a weapon by the character. It can be flailed about and introduces play as a variable that can be controlled as a unique trait of interfacing with a game environment. As the player progresses, they acquire a large axe that, compared to the branch, is top-heavy meaning each strike takes longer to land. Though this teaches the player the physics of how different weapons work, the axe also introduces the ‘Chemistry Engine’ as we see a material (axe) react with an element (wood.) The concept of creating a system of reactions that can implicate differently on the events created by mechanics and the player is one of the core principle that frames the essence of play in this game world. Game theorist David Myers indicates a contrast between the natural behaviour of play and the act of ‘reading that‘ is a learned behaviour and, therein, an unnatural behaviour.  

Myers’ argues that because reading and thereby, literature is a concept that has to be learned, it is a behaviour that is not universally understood. On the other hand, play “can be motivated and directed by game rules but also appear without evocation.” To figure out a way of isolating the qualities of play that make it inherently universal and can be learned in designing game and real architecture, one needs to understand that there are three different types of play. These are firstly locomotor play, that is the actions of a body during real play; secondly object play, that is like real play but within the scope of game space and its objects that are

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36 “The Video Game Aesthetic: Play as Form”, 46.
conceptually like their real counterparts, and thirdly social play, that occurs with other players or artificial intelligence that is intended to replicate a social player. ‘Breath of the Wild’ manages to retain basic states of locomotor play, like walking, fighting and cutting down trees, and enhance them by contrasting their realistic qualities with the fantastical capabilities of object play. In the game space, the player can create magnetic fields that can be dynamically move metallic objects, or statically lock them and build momentum in those objects and release that momentum as movement of the object. The function of these actions are simple to operate, and easy to understand and consequentially, the player can find ways to implement them in any situation. This precedent offers an interesting insight and opens discussion about how real architecture can implement a level of object play within the boundaries posed by a rigid circulation system of that architecture. In the instance, 'Breath of the Wild' has embraced the fantastical characteristics of the game system to empower the player with opportunities to manipulate an abstract physics system and predict the game’s response. This works well with the game world’s narrative that builds the player's knowledge to engage in a showdown with Calamity Ganon that embraces the hedonism of adventure.

Fig 21. Finding the Tree Branch that, when wielded, showcases the potential of the world’s physics

Fig 22. The player encounters an ace that, when swung, cuts the grass that shows the level of detail gone into the physics system
As established previously, a lot of the information that the player gains about the world is received through their exploration of the game world’s architecture. This correspond with the narrative established at the beginning that the character had not been active in the game world for the last 100 years. The player’s first experience of storytelling through architecture is an encounter with the ruins of a cathedral that, for those familiar with the world will recognise it as ‘The Temple of Time’. From exploring the main building and its auxiliary buildings, the player can establish key information about the place. The dilapidated and overgrown state of the surrounding buildings suggest that time has passed since the civilisation instigated its existence, and the monsters that lurk in the ruins supports this idea. One of the buildings leading up to the main building has a fossilised spider tank, known as a ‘Guardian’, that contrasts conceptually with the Gothic elements of the building. This instance also offers a clear example of how the designer borrows the symbolism of a tank as a formidable machine in the design of the Guardian’s shape. In fact, a lot of the architectural imagery established is inspired by real context and builds on the assumptions players will make when exploring the world. This idea builds on Nintendo’s philosophy that echoes architect Louis Sullivan’s ideas that “the pervading law of all things organic and inorganic… physical and metaphysical… human and all things superhuman… that the life is recognizable in its expression, that form ever follows function.” Replicating gothic

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architectural elements and using them to create a context for the designed path that the character follows reflects the memory of real objects in the game space that the player can navigate. This process of creating a visual language from our natural tendency to symbolise objects, indicates how game architecture distinguishes itself from real architecture. Symbolism derives from the process of perception that is inherent in all visual beings and forms a significant part of how we learn information. Gestalt Psychology theorises perception that can be broken up into two active groups: form reduction and figure/ground, that explain how we simplify and process shapes, and closure and pattern recognition, that explains how we identify and recall shapes. Because perception is an internalised and active part of our strategy of gaining information, the player can break down visual environments by associating previously learned connections to make new connections. Because the player has an existing connection between the shapes that define gothic architecture, the player can reaffirm and build new contextual relationships based upon what they already know about that subject and how the game world uses this. Breath of the Wild’s game architecture is particularly interesting because it contrasts the 'functional', that is, the qualities that makes it reminiscent of its real counterpart, allied to the nature of its fantastical characteristics. The design of the architecture, either real-like or fantastical, focuses on developing the style of its precursory language over inventing any form. In the instance where it radicalises form such as the Divine Beasts, the designers

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38 “Art and Creativity in Gestalt Therapy”, 231.

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Fig 25. Break-down of one of the auxiliary buildings in the Temple of Time
reference the primal language first established in the crypt and builds upon it as the player explores the game world. The areas that are designed with the game's visual language generally ignores the practicality of real architecture now embracing the fantastical.

Breath of the Wild and its vision for the Hyrule Kingdom has embraced an opportunity to tell a story through a familiar architecture, while injecting a unique visual language that introduces the player to its Hyrule's technological past. The actions available to the player embrace the essence of play that are actions that use the underlying systems of the game world and their conceptual similarity to real space to create a game space that is both simultaneously familiar and of fantasy. Conceptualising real architecture as a part of the game world allows the designer to reference all the symbolism that the player already assumes about its function to build intuitive and enticing spaces. Nintendo knows that subverting and betraying the rule of 'form follows function' has an opposite effect on intuitive design. The game world's use of gothic architecture subverts its culture of richly dark interiors for an open and lit space in a romantic gesture to the fantasy genre. This change in the perception of how real architecture is perceived in game space, irrespective of its context, rewrites its place in history as being something of another world rather than of our own. Regardless of this historic shift, our understanding of the gothic architectural language based in religion fits its functions in the game world as a place of faith in the game's mythologies. This idea extends beyond our understanding of the rudimentary relationship between form and space and directly implies that past encounters with such archetypes influences the manner in which one accommodates game experiences.
Fig 26. The Divine Beasts (clockwise): Divine Beast Van Mudoh, Divine Beast Vah Rudania, Divine Beast Vah Ruta and Divine Beast Vah Naboris that indicates something that is considered against the virtue of contemporary architecture: the deification of 'familiar' living objects, such as animals, in architectural forms.
Fig 27. Prototype Sketches that investigates the potential of 'concept art' as a way of discovering the 'fantastical' quality of architecture

3.0 Design Process
3.1 Concept Art: The Art of Designing Mood

Concept art is a medium that aims to provide a visual script, or a language that allows an artist to make intentional decisions about how they translate the world from a two-dimensional medium to a three-dimensional scene. The process of building the layers of information that make an image recognisable are characterised by neuroscientist Dr. Margaret Stratford Livingstone as the “where” stream that distinguishes the concepts of space, motion and depth as tone and the “what” stream that distinguishes detail as colour, or hue. These two streams receive information separately however “under the normal light conditions, the rods and cones [of our eye] cooperate to create an interpretation of reality.” These principles compose what is essential to our perception of reality such as what we see and the images produced by digital photography and validate the qualities the artist strives for in concept art. Compared to our own visual reality, concept art aims to extrapolate a vision for a reality that exists as a product of many layers of information; from travels, film, video games and other media that have been organised into a new image. Concept designers are responsible for “[developing] a solid design language” for the production of 3d media and concept artists “sum up the game in one image.”

As a part of engaging the design of game-centric architecture, a variety of concept sketches were produced to experiment with the principles that develop the ideology of shape design that comes with creating figure-ground sketches. The effectiveness of the method of sketching substantiates ‘The Gestalt Art Experience’ that theorises “we create figures and background spontaneously and naturally.” The aim of creating iterations of this sketch type is to produce a range of different shapes that query their relevance to the core experience of the game architecture in its space. Through the precedent analysis, the project has established a clear interest in two areas: how architecture can be designed to be intuitive in its circulation and forming a design language for this architecture that is a response to the fantastical quality of the game environment that can make interesting use of real shapes.

The first round of figure-ground sketches explores the potential for how objects can populate a real space to form a game arena that can be freely navigated by a player with extraordinary movement capacity. The production of these sketches utilises a digital model of the Martha Mine in Waihi to capture a range of different camera angle perspectives that the sketches use to reference topography and a variety of random concept sketches from other artists as shape references. These sketches focus on the shape of the buildings in frame and the ratio of objects in frame compared to the ‘negative space’ around them.

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39 James Gurney, Color and Light, 136.
40 James Gurney, Color and Light, 136.
41 Elliot Lilly, The Big Bad World of Concept Art for Video Games, (China: Design Studio Press, 2015), 14.
42 Elliot Lilly, The Big Bad World of Concept Art for Video Games, 14.

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43 Nancy Amendt-Lyon, ”Art and Creativity in Gestalt Therapy“, Gestalt Review 5, 231.
The sketches aim to design the shape of architecture that responds to the enhanced movement of the character in the game world as a main experience while framing a secondary experience of exploring Martha Mine as a real space. Another core principle of exploring the Martha Mine as a game space is to ensure that the design of the game architecture distinguishes its addition from the ‘real’ space of Martha mine. In these sketches, game architecture develops through phases that focus on certain qualities of its design. Figure ground sketches focus on the design of the shapes and how they are composed within their environment. Value or colour drawings focus on the three dimensionalities of the shapes and the added detail that establishes how it is read as a part of the visual narrative. Most importantly, building shapes that are familiar to the characteristics of the typology as well as establishing a definitively contrasting language is a notable challenge.

A method of iterating on the design of the 19th and 20th century gold mining town through the conceptual process derives from the theory of ‘conceptual contrast’ that artist Sinix uses to describe the juxtaposition of two ideas to explore the viability as a joint concept to create a newly defined visual language44. The township of Waihi became a prominent location for gold mining towards the start of the 20th century that marked its industrial growth.

Before this point, Thames was the focal point of the gold mining industry in the Hauraki region with towns close to Waihi like Waitekauri and Karangahake, “the town that did a vanishing trick”, building the industry eastward. Waitekauri built up its operation in 1870 as an array of huts and shanties surrounding the battery building that worked the quartz reef until 1912. The township of Karangahake was located next to the Mt Karangahake & Talisman Gold Mine built up by well-established prospectors and companies during 1880-90 while opportunists tried their luck west, on the Ohinemuri River45. Most of the region’s major development is framed in four decades of the Victorian era and its architecture style, significant development in industrial architecture and engineering and the prevalence of the steam engine in travel and the subterranean exploration necessitated by the growing gold mining industry. This provides a base for the visual narrative of Waihi and the wider Hauraki region as a progressive time in industry during Britain’s colonial establishment of New Zealand.

The initial investigation of the research question that frames the project is whether the Game Engine can benefit the design of intuitive architecture. Analysing game titles and their design of game architecture in response to the ‘essence of play’ provided insight into how the language of real space and its functionality inspires intuitive game spaces. The layer that is exclusive to designed media such as game space is the ‘fantastical’ that one may find in a space designed that merged the architectural style of the

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rapid industrialisation of Waihi during the gold mining era with the pre-western culture of Tokugawa Japan. The resulting contrast in culture, societal structure and technological progression provides opportunities for unique shape design and re-writes the narrative respective of the new context. The tension in defining an architectural language that is neither native to Japan or New Zealand is definitive of conceptual contrast and the quality of game that one may call ‘fantastical’.
Circulation

Movement Axis

Starting Point

Entry

Rail Buildings

Affordance

Time Rift
NOTES

1. Multi-layered
2. Close spaces
3. Vertical language
3.2. 3D Models

The process of building a game environment requires a relationship between the tone of the visual narrative, that is designed for the game space, and the use of familiar architecture that are the building blocks for a logical space. Nintendo’s approach to the architecture in the ‘Breath of the Wild’ was a take on the Gothic architecture of Europe as traditional and Celtic art as a design foundation for its mythical and precursory architecture. In comparison, the Martha Mine is a reminiscence of a man-made landscape with a history of industry spread across the Hauraki district. Most of the buildings that made up the original Waihi township and its industrial architecture have been lost in time.

One of the critical approaches of recording Waihi’s old visual language within the project involves re-creating building elements as 3d models from photographic archives. The modules are built to represent the style of construction popular in Waihi during the 19th and 20th century as a conceptual object that can be used in the game space. These modules are built to a standardised dimension so that they can be swapped out easily to make unique design configurations. These modules are categorised within the Game Engine as different parts that compose the reference buildings. Understanding how these elements fit within their photographic context and whether certain industrial elements are part of a larger system becomes invaluable when considering how they can fit in a game space within the context of Martha Mine.

Building up primary information such as buildings, bridges and industrial sites provides the most immediate feedback to the player in establishing where they are. The project considers the vast and superior buildings represented in game design that embody a vision for an alternate or futuristic reality that support or reveal the aspect of the game, that is narrative and its tone. Designing these buildings is important as the primary focus of the architectural scheme where the game architecture indicates what has happened to the area and the buildings that represent 19th and 20th century Waihi identify where the player is.
**Narrative:** the Player enters the game space from a 'dream' state - the 'cockpit' holds a console that controls the construct of the architectural space outside the 'cockpit'.

The panels (red objects) holds information about a parallel reality that can be broadcast outside the cockpit, translating it into the three dimensional construct.

The mechanical arms pick up the 'panels' so that new ones can be allocated to the cockpit. The mechanical arms' motion (green lines) indicates how they change out the panels and move away from the cockpit. This motion will also indicate to the player where they should go next.

**Fig 29. Opening Sequence inside the Cockpit (this was an initial concept, and later rejected)**
Fig 30. (From left to right) 'Long Mine Shack' and 'Small Mine shack', building assets representative of the architecture of the era.
3.3. The Game Engine

The Unreal Engine provides a foundation with the potential for the user to code powerful tools within its framework as either a visual programmer, in the node-coding interface, or as a written programmer through the comparatively larger scope of the C++ programming language. There are advantages to both method of approaching the engine’s code where Unreal’s visual interface provides a user-friendly way of approaching the same problems as written code. Instances where the code derived from ‘visual programming’ suffers from an unnecessarily complex or impossible logical structure can be simplified with the help of C++’s scope. This makes visual programming a method for developing code that falls within a comparatively smaller scope that Unreal’s technicians have built to help artists.

The initial structure of the Unreal Engine consists of basic creation tools that focus on ‘blocking’ out a prototype game space and advanced tools that allows designers to bring their own work into the engine – art assets like characters, architectural elements, environmental objects; rocks, foliage and terrain information; visual effects and character animations. This offers a foundation for the development of detailed environment and architectural spaces. Beyond composing the game space, designing the real-time experience requires the designer to create the rules that govern the objectives of the experience. Building systems like the character's actions that the player can activate, the mechanics that create events when triggered by the player and ultimately, how the player achieves the final objective and reaches the end of the experience.

In order to design the game prototype, the project required a set of parameters to be established based on the research gained from the precedents stemming from the intention of the research question. The first parameter, regarding the controllable character in game space, establishes the intention of designing an architectural scheme that considers the character’s three different states of movement. There is ‘basic locomotion’, movement in real architecture replicated in game space, like walking, running and jumping; ‘enhanced locomotion’, that is introduced in the prototype of the game space as the concept of ‘wall running’ that is an enhanced modification of basic locomotion exclusive to game space and finally, ‘instantaneous locomotion’, that is represented as the use of a grapple to reach a point in game space almost instantly to contrast the limited ‘real’ motion with the infinite ‘game’ motion.
From this, the architectural scheme establishes its typology in game space as a ‘moving machine’, a system of architectural modules that are designed to showcase the different combinations of movement that are capable in game space that reference the initial three states of motion. The second design parameter in designing these modules considers the ‘range’ of these motions like the fundamental quality of wall running that the player can only optimise this type of movement on horizontal planes. Furthermore, considering the design of architectural encounters such that the player can combine two states of movement to create unique events that exceeds the potential of utilising only one type of movement.

The third parameter in the design of these modules is the visual layer, the design of a unique visual language exclusive to the game, and the functional layer. The visual language is designed to be characteristically like the design of real architecture, but is indicative of what it inherits from our real world and how it identifies as a language of its own universe. The functional language considers the ‘theory of affordance’ that describes the design of architecture that uses symbolism, like in form and colour, to clearly identify how and if the player can interact with a game object. For example, the cross is symbolically used to indicate strong discouragement towards the passage of a dangerous or incomplete place. Designing an architecture scheme within game space that considers all these parameters reflects upon the document regarding the design of intuitive space that modern ‘real’ architecture appears to rebel against in favour of being gestural in its design. In contrast, the design of game architecture indicates an appreciation for the pleasure of hedonistic design that are inspired by the rules that are inherent in all architecture as a functional system that is a part of a built civilisation. It is this perception of the familiar that game architecture transcends to incite the exciting encounters of game space.
The initiator for the topic of the thesis came from a place of passion for the stories told in the fictional war-grounds, kingdoms and ethereal planes of game worlds I enjoyed being in as a child, and still wonder and admire today. The field of game design manages to create worlds that are grand in scope and full of architectural language that appears to subvert the normalities of real space to create locations of sci-fi, fantasy and mythology that are much like our own, but as a result, are so very different. The thesis was about studying what the designers managed to get the player to feel and experience when being exposed to the designers' world. The initiating hope, that out of all of this, was that there would be some sort of inspiration that encourages architects, who enjoy these places, to create architectural design allied to an ambition to create 'fantastical' architectural quality.

Perhaps it is because these places exist in game space that an architectural thesis can contribute an idea of what defines the fantastical quality of game space unfamiliar in the field of architecture, but capable of interpretation or use in real architecture. Game architecture uses familiar symbolism in shape and function to influence a clear representation of what feeds into the overarching player experience as though to reference our visual understanding of real architecture. This strategy of using game space to inform architecture creates a level of conceptual contrast where two or more symbolic systems interact in one of three different ways: alien, where a unified game language is created from two different real symbolic languages, extra-terrestrial, when two game symbolic systems use contrast to indicate their difference from each other and reality, and hereditary, where two game languages inherit qualities from one distinctive real symbolic language. These two principles underlie the functional and familiar layers of game architecture that define the 'fantastical' quality that distinguishes 'game' from 'real'.

The research on this subject concludes that game space is undeniably a place that values the foundation of a functional language, using real space's rules of culture, infrastructure and mechanical systems. Game space in real architecture is a valuable field of research because it is capable of simulating and testing the rules of the real world and delivering immediate feedback for the performance of architectural space. This project focuses on presenting an architectural scheme, designed to a game design theory, that influences the design of the characteristics of the architectural scheme. Though game space is bound to the potential of a designed and tweaked physics system that validates movement strategies that are beyond the feasibility of real space, implementing this as a part of an architectural system, can benefit the interactivity in game space and provide a precursory stage for a real architectural system.

4.0 Conclusion
The reality of game space is that not every layer of its systems can be feasibly translated into real space without compromising the functionality of real architecture. Game spaces are designed to empower the player with physicality beyond the limitations of reality and to be fun. The ambition for the research project is to build architecture with the virtues of the fantastical, in order to enhance the pleasure of architectural space.


5.0 Bibliography
Eurogamer. *Miyamoto on World 1-1: How Nintendo made Mario’s most iconic level.* Published 7 September 2015. Video. 8:18. www.youtube.com/watch?v=zRGRJRUWafY&t=1s


Mark Brown. *Why Nathan Drake Doesn’t Need a Compass | Game Maker’s Toolkit.* Published 26 October 2015. Video. 8:15. www.youtube.com/watch?v=k70_jvVOcG0&t=328s


6.0 Software Structure

Unreal Engine
Game Engine

Krita
Concept

Scribus
Document

GIMP
Textures

Blender
3D Modelling

VisualSFM
Generating Point Cloud Data via Photogrammetry

Meshlab
Point Cloud (Photogrammetry) to Mesh
Fig 31, 32 and 33. Drawing of final level 'God and Maia's Citadel' in Jak and Daxter (2001) (top), elevation drawing of an area between Sandover Village and Forbidden Forest (far left) and drawing cutting through the Precursor Tower (left).

7.0 Appendix 1: Analytical Drawings
Fig 34. Drawing of the opening in Square Enix’s Tomb Raider (2013)
Fig 35. Sketch study of an aircraft
Fig 36. Sketch study of an AC-130 (top) and unknown aircraft. Accompanied by Fig 35, these sketches explore the form and colours of the aircraft for the final design scheme.
Fig 1. Character overlooking Sandover Village (left) towards Precursor Tower in the Forbidden Forest (background)

Fig 2. Drawing of the Green Sage's hut from fig 1

Fig 3. Disneyland, Anaheim, California

Fig 4. Level structure/ Site plan showing the path leading to the Precursor Tower

Fig 5. Looking to Precursor Tower at the entrance to the Forbidden Forest

Fig 6. Entrance Facade of Precursor Tower

Fig 7. Axonometric plan of inside the Precursor Tower

Fig 8. Looking towards the Lost Precursor City

Fig 9. Path leading to a hidden Shinto Shrine

Fig 10. Drawing of the Blue Sage's Hut

Fig 11. Inside the Lost Precursor City

Fig 12. Path into the Lost Precursor City indicating environmental dangers (top) with a colour palette analysis (right)

Fig 13. Piranesi's 'Imaginary Prison'

Fig 14. Piranesi's etching of 'Hadrian's Villa'

Fig 15. and 16. Breakdown of Super Mario Bros' Level 1-1 (1985) (top) and break-down of the basic mechanics of the character (bottom)

Fig 17. Breakdown of a mechanic from 'Legend of Zelda: Breath of the Wild' (2017)

Fig 18. Analysis of the Shrine of Resurrection

Fig 19. Open vista after exiting the Shrine of Resurrection in 'Legend of Zelda: Breath of the Wild'

Fig 20. Serial Vision showing the placement of the camera in 'Legend of Zelda: Breath of the Wild'

Fig 21. Finding the Tree Branch

Fig 22. Cutting the Grass

7.1 Appendix 2: List of Figures
**Fig 23.** Break-down of the path leading up to the Temple of Time

**Fig 24.** Break-down of the environment in the Temple of Time

**Fig 25.** Break-down of the one of the auxiliary buildings in the Temple of Time

**Fig 26.** The Divine Beasts (clockwise): Divine Beast Van Medoh, Divine Beast Vah Rudania, Divine Beast Vah Ruta and Divine Beast Vah Naboris

*image references for fig 26. (in order of figure)*


segmentnext.com/2017/03/06/zelda-breath-of-the-wild-walkthrough-3/


*beast symbols: zelda.gamepedia.com/Divine_Beast*

**Fig 27.** Prototype Sketches

**Fig 28.** A drawing over a rough 3D model depicting the Transdimensional Ship from page 46: using Christopher Alexander's concept of 'levels of scale' to create an object that defines the boundaries of the architectural scheme that will eventually be broken to allow the scheme to 'bleed' into the context of the mine.

**Fig 29.** Opening Sequence inside the Cockpit

**Fig 30.** (From left to right) 'Long Mine Shack' and 'Small Mine shack', building assets representative of the architecture of the era

**Fig 31, 32 and 33.** Drawing of final level 'Gol and Maia's Citadel' in Jak and Daxter (2001) (top), elevation drawing of an area between Sandover Village and Forbidden Forest (far left) and drawing cutting through the Precursor Tower (left)

**Fig 34.** Drawing of the opening to Square Enix's Tomb Raider (2013)
**Fig 35.** Sketch study of an aircraft

**Fig 36.** Sketch study of an AC-130 (top) and unknown aircraft. Accompanied by Fig 35, these sketches explore the form and colours of the aircraft for the final design scheme.

7.2 Appendix 3: Final Project
How can the concept of the *Game Engine*, its technologies and the *philosophies of Game design* support an interdisciplinary approach to creating *intuitive architecture*?

7.2.1. Powerpoint Presentation
Real Space: Seddon Street to Martha Mine
Game Space: Martha Mine
Technical School Building, 1913-62:
Waihi Art Centre and Museum, January 1962-

Waihi Arts Centre & Museum, *Has it all begun….*, accessed 3 June 2018, www.waihimuseum.co.nz/art-
gallery/has-it-all-began/
Gold Discovery Centre, I-site in Waihi, May 2015

Gold Discovery Centre, Discover Gold in Waihi, accessed 3 June 2018, golddiscoverycentre.co.nz/
7.2.2. Concept Sketches
7.2.3. Game World
7.2.4. Plaster Model
Full name of author: Christopher Green

ORCID number (Optional): .................................................................

Full title of thesis/dissertation/research project ('the work'):
Preserving Waihi's Golden Past: A Research into the culture of the Game and its Engine to support and enrich an explorative engagement with Waihi's gold mining history

Practice Pathway: ...........................................................................

Degree: M.Arch (Prof) .....................................................................

Year of presentation: 2018..............................................................

Principal Supervisor: David Chaplin ..............................................

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Principal Supervisor: David Chapati

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Student number: 1419-64...