Vitrine-Gothic

A SECULAR REVIVAL OF THE GOTHIC

By

Reilly John Bell

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Abstract

Gothic for a time was the architectural style that represented all of Western civilization, in subsequent centuries it has been reasserted as the Western style in periods of cultural, national, and religious revivals. The thesis identifies the current societal conditions as conducive to potentially another such revival, this is the niche the thesis explored architecturally. To consider Gothic architecture in the context of modern secular society, using fractal based computational design to realize this 'new secular Gothic', a 'Vitrine-Gothic'.

The concept of a Vitrine-Gothic was explored through the development of tool sets and design processes, experimenting with the best methods for integrating fractals as a secular substitute for traditional Gothic symbolism. The tools aimed for maximal adaptability, and design control, which were tested by how well they responded to a range of secular user requirements derived from spiritual concepts. Demonstrated architecturally in the creation of experimental pavilion's, illustrating the validity of the developed tools, and the cultural relevancy of the architectural results in aesthetic, and functional terms.

The research suggests that there is an opportunity for merging digital tools with traditional architecture, to re-examine the fundamentals of traditional architecture in terms of aesthetics, function, symbolism, etc, in relation to the cultural and technological realities of modern society. Thus producing architectural results with greater cultural relevancy.

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Introduction

Gothic, It should come as no surprise, was developed as a Christian style of architecture, and because of this is deeply connected to religion and religious institution, in it you will find religious symbolism, mythos, and historical event integrated into its architecture ornamentation and design methodology (Nelly, 2015). The importance imbued in the Gothic style itself can be hard to fully appreciate today, let alone understand the greater societal implications it had in its prime. Gothic architecture at its most influential was not solely the architecture of religious institutions, instead, this style quickly expanded beyond the church proliferating throughout Europe into palace, government, and other public and private buildings (Branner, 1965, p. 10). It became the defining architectural style of not just religious institutions, or nation states, but became a civilizational style, a style representing all of western civilization for a period of several centuries peaking in the 1400's (Branner, 1965, p. 10). As expressed by Aleksandr Solzhenitsyn, the medieval period had come to its natural end, it exhausted itself with excessive focus on the spiritual life, and as a result came to oppress of people's physical desires. Naturally, the period that followed shunned the spiritual and instead embraced the material world (Solzhenitsyn, 1978). This led to the Renaissance, and from that to the Enlightenment, over which time Gothic's popularity was slowly eclipsed by Renaissance, and Neoclassical architecture (Watkin, 2015, p.211, p.369), which came to view Gothic as a barbarous style, and likened derogatorily to the visage of Goths sacking Rome, hence its modern name, Gothic. Centuries after Gothic's decline, the style had a resurgence in popularity known as the Neo-Gothic (or Gothic revival). Initially spawning from England in the mid 1700's, the Neo-Gothic revival caught on with the rest of the Western world, proliferating during the 1800 & 1900's (Lacey, 2021, p.366). Neo-Gothic came to symbolize the nostalgic re-assertion of Gothic architecture as a historically important style, representing the traditional aspects of culture & history of said nations, it came as a reaction against the rapid industrialization and subsequent cultural changes (Lacey, 2021, p.366). When Neo-Gothic waned in popularity, this time it was largely due to an increased importance placed on functionalism in architecture, and new materials (ie, glass, steel), making Neo-Gothic less tenable (Lacey, 2021, p.366).

As noted, the shift away from religion and the spiritual has resulted in the secularization of the West, which is increasingly material focused, described by philosophers as in a *'crisis of faith'* (Solzhenitsyn, 1978). This is not to state however, that modern Western society does not want for a spirituality, this desire can be seen in several examples throughout history and in the present day. For example, if we look towards the far east in modern day China, roughly 30% of the population reports to be religious or spiritual in some manner (Johnson, 2017, p. 36), that is, in a country with strong government incentives against any form of religion, or spiritual activity. And yet, there has been a kind of spiritual reawakening, a return to traditional religion and faith for an increasing number of people, seeking answers, morals, and values, not entertained by the radically secular world of modern China (Johnson, 2017, p. 24). As described by one Chinese citizen, *"we thought we were unhappy because we were poor. But now a lot of us aren't poor anymore, and yet we are still unhappy. We realized something was missing and that's a spiritual life"* (Johnson, 2017, p. 24). Even on more familiar shores, America for example has had several "Great Awakenings" of Christian faith up into the 1900's. In each, the old rigid formalities of religion were forgone in favour of a more flamboyant and emotive preaching that focused on the religious experience, captivating people on a deeper and more personal level (Ahlstrom, 1975, p. 353). It is proposed that these periods of religious revival arose as a response by the people to fundamental changes in the cultural fabric, addressing changing *"moral, religious, intellectual, and social conditions"* (Ahlstrom, 1975, p. 362). The result of these periods was a revived interest of faith, creating a renewal of spiritual conviction and

moral resolution on both personal, and national scales (Ahlstrom, 1975, p. 354). These fundamental changes to the way religious experience was delivered were also translated architecturally, as was the case for the '*First Baptist Church of Minneapolis'* constructed in 1853 during the second awakening (Kilde, 2005, p. 6). Its most striking feature is its spatial arrangement, contrasting the more traditional rectangular and crucifix floor plans in favour of a semi-circular arrangement, seating the congregation around a raised stage area, framed by the choir and organ in a 'theatre' like manner, from which it took its inspiration (Kilde, 2005, p. 6).

Both the Chinese and American contexts, we see this desire for spiritual revival in periods when religion / spirituality is waning, and in periods of societal change or unease. Such periods in the Western context have also resulted in the rejuvenation of the Gothic style, as was the case with Neo-Gothic architecture, and the subsequent cathedrals constructed during the American Great Awakenings. We can see similar situations in todays society, as is pointed out by philosophers such as Aleksandr Solzhenitsyn, this gives credence to the idea that Gothic once again could be used as a source of inspiration to aid in the development of a desired secular Western spirituality. It would be fair to state that a secular Western spirituality would look introspectively at its own traditions and history as a primary source of inspiration, taking from its traditional Christian foundations, distilling its ritual and theology into their key spiritual components, thus forming foundations of a secular Western spirituality. While this thesis does not prescribe exactly how a secular spirituality would arise, or exactly what it should incorporate or focus on, it instead explores how a secular spirituality can be expressed architecturally. By considering some of the key aspects of traditional Western religion, we can determine some key fundamental characteristics a secular faith would likely contain, translating these into secular requirements of a Western spirituality.

And from this line of reasoning spawned the driving question of this thesis, *How can a new Gothic architecture be adapted in a secular manner to suit a secular society?*

A Concept For Spirituality

Thesis Intent

It shall be stated here that this thesis is not an exploration of theology, or the nature of spirituality. Instead, it utilized traditional Gothic and spirituality as sources of inspiration from which a secular architecture could be derived, the thesis explored the implication of these traditional concepts in a secular architectural setting. Secular spirituality can be thought of as Harald Walach expressed in his book, ‘ a secular spirituality’, *“[as the] experiential core of any religion as opposed to its doctrinal clothing”* (Walach, 2015, p. 2), it was established from this that traditional religious rituals contain fundamental aspects of ‘spirituality’ (the ‘experiential core’), by distilling these ‘spiritual’ aspects into terms of ‘what’ they achieved and ‘how’, a set of secular user requirements can be established. Towards the end of the thesis these are expressed architecturally as the design outcomes of this thesis. From this line or reasoning developed one of the aims of the thesis, *‘What are the architectural implications of a space informed by a Western secular spirituality?’.* The thesis thereafter explores this aim through the development of a pavilion as an experimental canvas, with the intent that it will be integrated into a public space somewhere in Wellington city, to validate the design in terms of its cultural relevance to the greater society it finds itself in.

Secular Spirituality: User Requirements

To encourage spiritual activities through an architectural intervention, common attributes associated with traditional Christianity could be derived into their secular parts, thus forming a set of secular user requirements which inform the pavilion designs latter in the thesis. In assessing the many rituals and traditions of Christianity, three aspects were chosen as important expression of Christian spirituality. These being, the *act of meditative prayer*, of *pilgrimage*, and the *architectural expressions of faith*.

Meditative Prayer

In Christianity the act of prayer is fundamentally important, it is essentially a form of meditative self reflection on oneself, and relationship with the world and Christ, reflecting on the Christian teachings. Prayer can be understood in two categories;

-*Vocal Prayer:* To use rehearsed gestures and phrases, and generally not intended as communication with Christ. ie, ‘saying grace’, or ‘the sign of the cross’.

(HolyFaith, 2021)

-*Mental Prayer* A form of unrehearsed prayer, which can be distinguished as two separate types;

Meditative prayer, the practice of reflecting on the teachings of God to understand the biblical verses and their implications.

Contemplative prayer, is less defined yet no less important, it is the “being aware” of Christ though a zen-like, trance-like, or reflective focus (the experience differs by person) to open ones mind forming a personal relationship with Christ.

(HolyFaith, 2021)

Vocal prayer can be considered a literal expression of religious symbolism, thus it is unfit to be used as secular inspiration. Mental prayer however, can be considered as a form of mental isolation, the act of pensive self reflection. Architecturally this can be represented by physical isolation, isolating individuals from each other, to create areas conducive to a pensive self reflection.

Pilgrimage

In Christianity the labyrinth was used as a tool for spiritual attainment. In practice, people would follow the starting line of the labyrinth inscribed on the ground, following it as it spiraled towards its center. As they meandered towards its center, people reflect on the spiritual teachings of God and themselves. At its center people would linger until they concluded their thoughts, before exiting. Symbolically, this is both a physical and spiritual journey, towards some end state, some form of insight (UnspokenElements, 2021). This concept of journey, transition, and destination, can be translated architecturally as hallways or paths that transition people between markedly different spaces, isolating people as they move through, a pilgrimage towards some symbolic end point.

Spectacle as Architecture

The final important aspect is the means in which Christianity has expressed itself architecturally. One of the foundational aspects of Gothic is the idea of God’s light, as Dionysius wrote “this stone or that piece of wood is a light to me because all visible things are material lights reflecting the infinite light of God himself” (Watkin, 2015, p. 151). This was used as justification to use light as a pivotal element of the Gothic style, it enabled the justification of using ‘richly ornamented’ and ‘brightly shining’ architectural elements. Focusing on “shrines, metalwork, stained glass and mosaic, as a means of raising [man’s] thoughts from the material to the spiritual world by focusing in a trance like concentration on their glitter” (Watkin, 2015, p. 151). That is, to create an experiential atmosphere through spectacle, capture ones attention and elevate ones thoughts. Similar trends can be seen in the Neo-Gothic cathedrals built centuries latter during the Great Awakenings of the Americas. The architecture of these cathedrals became ever more flamboyant and theatrical in their designs and ornamental finishings (Kilde, 2005, p. 6). Reflecting the flamboyant changes in preaching style, with the intent to strike awe and capture people’s attention. From these examples we can understand one of Gothic’s driving inspirations is its spectacle, to create something architecturally distinct, eye catching, and beautiful, as a means of engaging people.

Secular Gothic: Gothic, Fractals, & Secularism

The focus of modern architecture is largely concerned with what is happening today and its relation to the developments of new digital tools, ignoring the genealogies of the past (Antoine, 2013, p. 13). An important aspect of Gothic design is the fractal-esque patterns it create as a consequence of its design methods and source of inspiration Naturally producing designs with fractal like qualities, as seen in floor plans, down to the ornamentation (Nelly, 2015, p. 170). The opportunity exists then, to use computational tools, specifically those that create and control the design of fractals, as the basis from which to produce a new, and secular Gothic. Where traditional Gothic arrived at a fractal-esque design as a consequence of its methods, this thesis will use fractals as a starting point from which to build a secular Gothic, thus substituting the religious symbolism infused with traditional Gothic with a secular fractal pattern. This then, becomes the technical aim of this thesis, asking *'How can fractals be integrated as a foundational pattern, used as a secular substitute for the religious symbolism abundant in traditional Gothic?'.*

But not only can fractals be used to create a secular Gothic, they can also be used to enhance the functions noted in the user requirements. Fractals are known to be aesthetically pleasing patterns, with the attribute to depress 'psychological', and 'physiological' stress in people (Joye, 2007,p. 318). Some scientists have theorized that the human mind is optimized to understand fractals (Joye, 2007,p. 317), since fractals are the governing principle underlying many natural phenomenon (plants etc) in the world we evolved from. That is to say, it is not plants that reduce stress in people, instead it is fractal pattern governing the plants appearance (Joye, 2007,p. 318). Given a fractal's ability to reduce stress, it will make a good aesthetic bases for a secular Gothic, as it should aid at enhancing the qualities of pensive, tranquil areas.

Gothic Histories

Gothic Design Methodology

Gothic architecture contains oddly geometrical yet naturalistic ornamentation that adorns it. The way in which elements multiply, repeat, and at multiple scales, can be found in most aspects of Gothic design, from the floor plans, vaulting, windows, and general ornamentation. The way in which Gothic ornament presents itself is often described as fractal-esque in appearance, which is the result of the design methods used in Gothic architecture. These methods are the focus of this chapter.

This geometric way of thinking led Medieval architects & masons to envisage all parts as interconnected, thinking in terms of ratios, geometrical relationships, and progressions. Geometry was not simply a tool used as means to an end, it goes deeper than that, geometry was a way of thinking, of structuring ideas with an internal logic linking all aesthetic, structural, and philosophical considerations together at all scales. This internal logic mattered more to the Gothic architect than achieving any structural or aesthetic impulses independently through some predefined orthodoxy or strict hierarchy of design (Nelly, 2015, p. 135).

This singular obsession with geometry stems from the poor mathematical understanding Medieval architects & masons had beyond basic addition and multiplication (Mark, 1982, p. 3). Many types of complex numbers are somehow present in Gothic architecture (the Fibonacci sequence, golden ratio, pi, square root of 2, etc), an impressive feat given many of these irrational numbers and complex ratios are difficult (if not impossible) to produce accurately with arithmetic. These can however be easily produced using simple Euclidean geometry, this can be seen with irrational numbers such as pi, the relationship between a circles circumference and its diameter was considered *"truly divine"*, the only method of accurately inscribing this was through drawing circles (Nelly, 2015, p. 142). Other mathematical relationships, for example the numbers $\sqrt{2}$, $\sqrt{3}$, and $\sqrt{5}$ are complex, but easily inscribed by drawing an arc around the diagonal length of a square, it was thus believed that the true numerical value of such irrational numbers and complex ratios could only be understood by God himself hence their divinity (Nelly, 2015, p. 141).

(Nelly, 2015, p. 142)

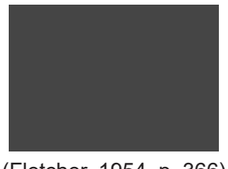
Resulting from this geometry was an organically produced fractal language, the inspiration derived from two primary sources.

Firstly, inspiration came from the natural world which has a peculiar tendency to develop its own fractal-esque language. The Medieval belief was that *"God [himself] spoke through these [natural] forms and it was through these forms that people should appeal to him"* (Nelly, 2015, p. 170). The Medieval architects & masons wittingly or otherwise developed a fractal language through the act of copying the natural world and its formal language,

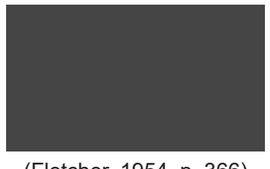
which can be seen reflected in the architecture of the era. This is a formal language of ratios and progressions, where all parts at all scales relate to each other. The Second influence was the keen medieval intuition for geometry. This geometrical understanding is predisposed to the concepts of ratios and progressions and was a natural extension of those examples provided by nature. Naturally these concepts resulted in methods of design including the idea of modulation which the Medieval architect almost exclusively design in (Nelly, 2015, p. 170). Modulation allows a cathedral to be considered in parts easing the design process, but it also allows each module to be designed self-similar to the last, naturally leading to a progressive scaling of elements as each portion of the cathedral is subdivided into ever smaller modules. These progressive patterns took on religious connotations, believed that they *"extend outward to the limits of the Heavens and inward to the smallest particle, but never vanish*" (Nelly, 2015, p. 170), therefore, unlike numerical progressions, it would never reach zero or negative states. This property was believed to provoke *"Divine protection"* from natural and divine disasters, hence the desire to integrate God's geometrical language into cathedrals (Nelly, 2015, p. 142).

KOCH SNOWFLAKE & FLOOR PLANS OF CATHEDRAL APSES

(Nelly, 2015, p. 162)



(Fletcher, 1954, p. 366)



(Fletcher, 1954, p. 366)

(Fletcher, 1954, p. 395)

KOCH SNOWFLAKE & ORNAMENTAL CUSPING

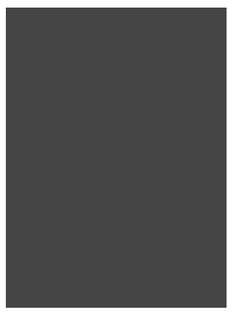
(Nelly, 2015, p. 162)

(Nelly, 2015, p. 162)

(Nelly, 2015, p. 162)

(Nelly, 2015, p. 162)

FRACTAL TREE & CEILING VAULTING

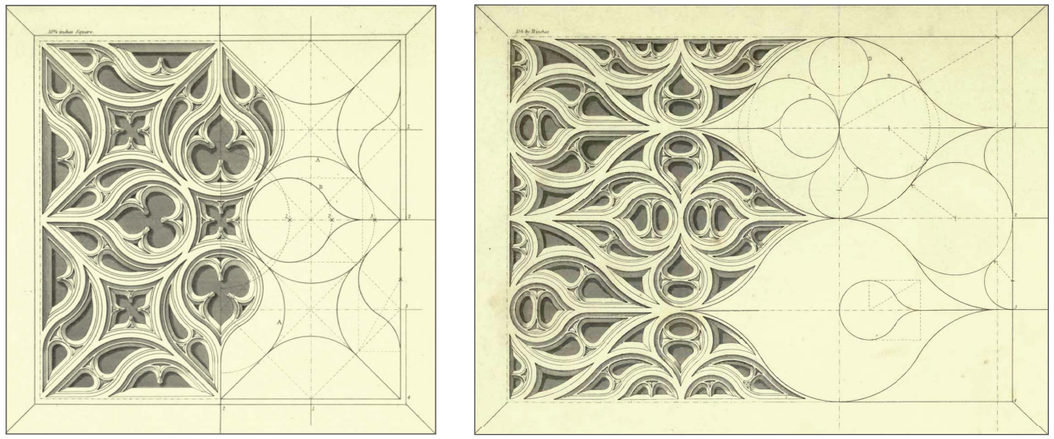


(Nelly, 2015, p. 164)

(Nelly, 2015, p. 164)

(Nelly, 2015, p. 164)

Through this process of modulation, a complex network of lines and relationships develop allowing this progression of elements to seamlessly occur while the constructional influences are hidden behind the veil. In effect there exists two cathedrals each serving a different purpose; these can be considered the *"visible"* and the *"invisible"*. The visible is designed for the *"earthly eye of man"*, to encapsulate his attention and wonderment of the heavens, derived from the invisible network of sacred geometries, complex ratios, and modulations making up the constructional drawings, the invisible cathedral. The invisible is believed to only be intended for the *"heavenly eye of God"*, a sacrificial form of geometry used for divine protection through integration of Gods language of geometry, this invisible geometry is the constructional drawings. Complex ratio's, numbers, and networks exist in Gothic architecture, but it requires prior knowledge of these concepts to decipher the hidden relationships of Gothic, not intended for earthly observation (Nelly, 2015, p. 136).



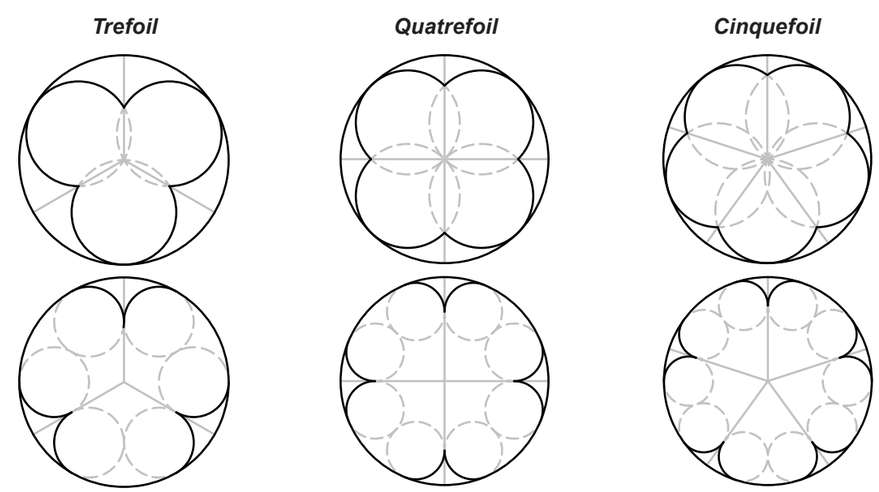
(Billings, Illustrations of Geometric Tracery from the Carlisle Cathedral, 1842, p.23, 17)

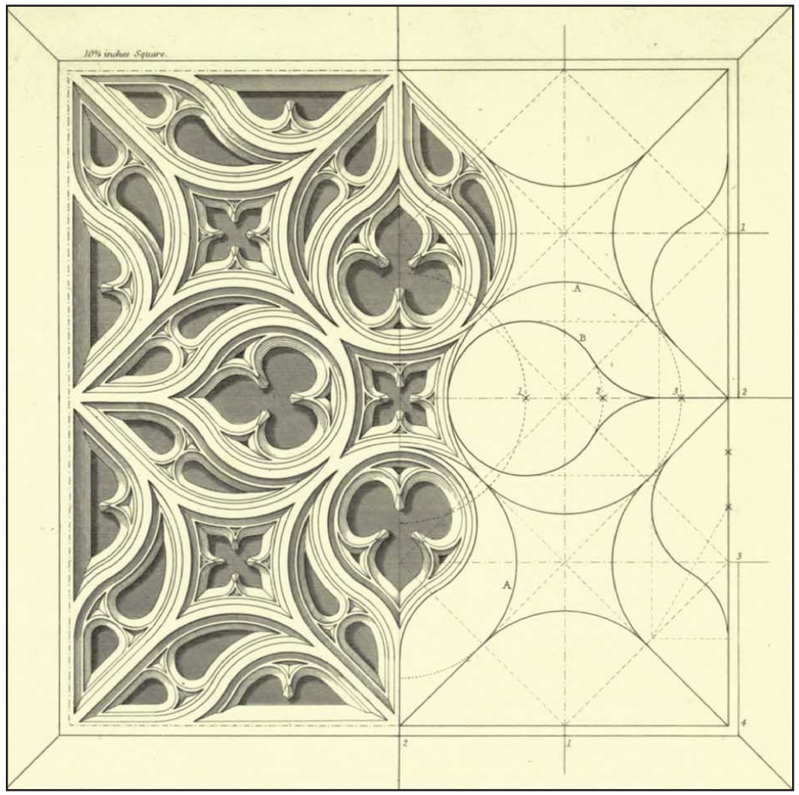
Constructing Gothic Tracery

We can observe these design principles in practice by examining the construction drawings of Gothic tracery. Tracery at first glance appears a complex system of patterning, of which it is, but once the constructional drawings are understood the final results, and the process used to reach it become more comprehensible.

On the following page, we can see the steps involved in this process of modulation and subdivision, how they are used recursively to build up a complex network of simple euclidean geometries, where each new shape bears some geometric relation to another. The skillful layering, and trimming of these shapes produces a complicated pattern. From this, profiles are be added to the pattern making them into mullions, and while there is no hard rule, in general four - six light windows use a thicker profile for the center mullion, while a five light window will thicken both central mullions (Cecil, 1961, p. 57). Likewise, the main divisions elsewhere in the window can also have their profiles thickened, while subsequent divisions generally do not (Cecil, 1961, p. 57). One of the final additions is an architectural element known as a foil (French for "leaf"), which is placed in many of the remaining gaps in the pattern. The foils are created by overlapping several circles and trimming them, they are commonly grouped in three's (trefoil), four's (quatrefoil), and five's (cinquefoil), but rarely more (Walker, 1926, p. 116).

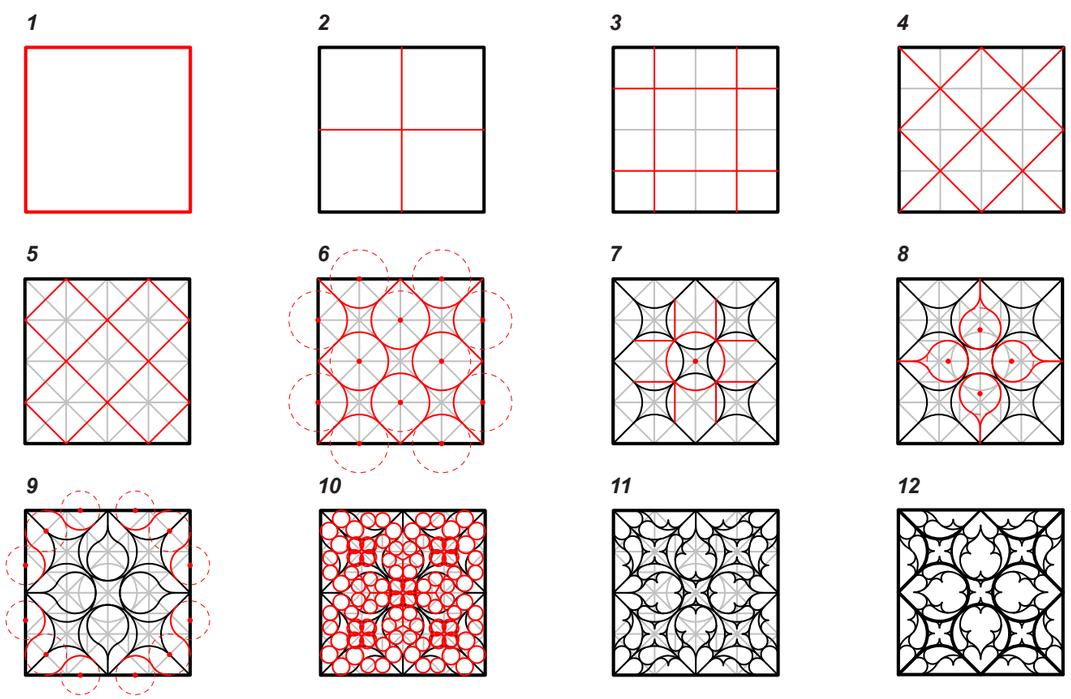
And the result of all this, is completed tracery as we see it in Gothic buildings around the world,with its intensive constructional process hidden away.





(Billings, Illustrations of Geometric Tracery from the Carlisle Cathedral, 1842, p.23)

CONSTRUCTION PROCESS OF GOTHIC TRACERY



Tracery: History & Development

The architectural implementation of stained glass windows (refereed to as tracery) was an innovation associated almost exclusively with the Church and by extent Medieval Europe (Cecil, 1961, p. 71), this architectural innovation initially spawned from the Churches of the Byzantine Empire which quickly spread across the rest of Europe, becoming one of the defining elements of the Gothic style (Darke, 2018, p. 41). In Gothic architecture these mosaics of stained glass show visual depictions of the Christian mythos, figures, and important historical events (Cecil, 1961, p. 54). The importance of the window in Gothic architecture cannot be understated, many of the architectural developments of Gothic architecture were inspired by this element, and in latter centuries even entire cathedrals would be defined by the tracery they contained, like that of Sainte Chapelle (Watkin, 2015, p. 157).

Gothic developed as a distinct style of architecture originating in France during the 1100's (Watkin, 2015, p. 149), developing out of the many architectural innovations of the Romanesque cathedrals that preceded it. Gothic quickly proliferated throughout the rest of Europe as these budding nation states were developing a new found prosperity and confidence in themselves (Watkin, 2015, p. 149). One of the most important buildings in the development of Gothic was the 1135 renovations of St-Denise in France. Its patron, Sire Abbot Sugar, was pivotal in its flamboyant architectural developments, and its driving design philosophies, becoming a precedent for future cathedrals to take inspiration (Watkin, 2015, p. 150). Sugar's understanding of God was as the *"superessential light"* of the world, inspired by works derived from Christian author Dionysius of the 3rd century. Dionysius stated that *"this stone or that piece of wood is a light to me because all visible things are material lights reflecting the infinite light of God himself"* (Watkin, 2015, p. 151). Sugar came to see God's light as beauty: this justified his fascination with objects 'richly ornamented' and 'brightly shining'. Sugar strove to implement these qualities in his 1135 renovations of St. Denise, through the use of "shrines, metalwork, stained glass and mosaics, as a means of raising [man's] thoughts from the material to the spiritual world by focusing in a trance like concentration on their glitter" (Watkin, 2015, p. 151).To achieve these qualities structural systems like the flying buttresses, vaulting etc, were taken from Romanesque architecture, however, what makes St-Denise distinct is how these elements were used to produce a new interior aesthetic defined by patterning of light & shadow, and a vertical tension (Watkin, 2015, p. 151). The resulting building was visually distinct as something new, becoming an important precedent for its emphasis on these qualities. Because of the importance Gothic tracery has as a defining element to the Gothic style, and the importance it played in its development, the thesis from this point onward will consider Gothic architecture in terms of its tracery, using this element as a primary source of inspiration.

Gothic tracery can be considered in two broad categories, *"plate tracery"* and *"bar tracery"*. Plate tracery, the earliest style of tracery was used until the 1200's (Cecil, 1961, p. 54). The distinct aesthetic of this style is defined by the technological limitations of the period, window designs are kept simple, composed of simple geometric figures piercing the thick stone walls making the window appear as though it was made from large plates of stone, window openings are commonly 1.8 – 2.7m wide (Cecil, 1961, p. 71). Glass production techniques were limited to small panes joined together using a lattice of lead, lead was soft enough to easily work into the required shapes, but this also made the window susceptible to the high wind loads once installed. Consequently, a grid of iron bars is used to reinforce the window, this is clearly noticeable as this grid often

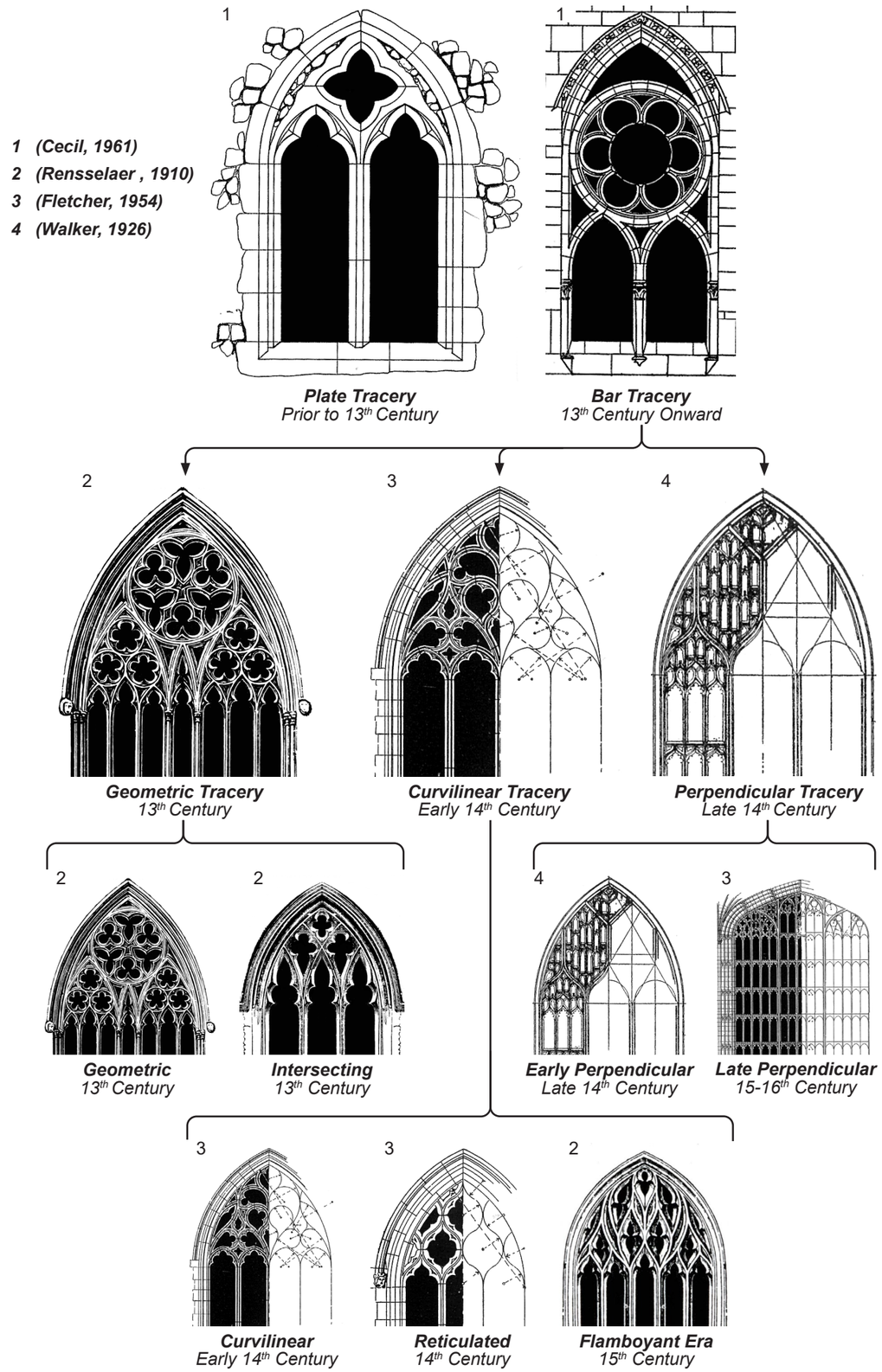
regulates the artistic composition of the glazed murals (Cecil, 1961, p. 71). By the mid 1200's plate tracery was phased out in favor of the new bar tracery style. This developed from a change in fabrication methods, stone mullions were now carved to the required shape, instead of the traditional method of cutting geometric openings into stone blocks (Cecil, 1961, p. 54). The mullions are spaced at intervals of 0.9 – 1.2m replacing the vertical reinforcing bars of plate tracery, the slender stone mullions were favored because their flowing form could be better integrated with the composition of the glazed murals (Cecil, 1961, p. 71). Over centuries of development more complex designs arose, naturally several sub-styles of bar tracery developed, these being the; *Geometric*, *Curvilinear*, and *Perpendicular styles*.

Geometric Tracery spawned in the 1200's as the earliest and subsequently the simplest style bar-tracery style (Curl , 2006, p.699). Distinguished by large geometric shapes, it often uses circles and triangles filled with foils and smaller iterations of these shapes, the most prominent feature is the large circular opening at the window head, which is almost always present (Curl , 2006, p.785). A sub style of geometric tracery is intersecting tracery, which is visually defined by the overlapping of several smaller arches, with each arch being drawn from the same center point as the window's head arches (Curl , 2006, p.785).

Curvilinear Tracery spawned in the early 1300's, characterized by a more fluid pattern allowing greater variance in design and integration with the stained-glass compositions it housed (Cecil, 1961, p. 55). Ogees are a favored shape in this style, defining its 'curvilinear' appearance. From this style developed Reticulated net like tracery and Flamboyant tracery. Flamboyant tracery emerged in the 1400's as a development from the formal vocabulary of curvilinear tracery (or Rayonnant in the French context) (Watkin, 2015, p. 164). With the desire for ever more ornament, Flamboyant it is characterized by the flame like double curves that dance and writhe upwards in a dense visually complex manner (Watkin, 2015, p. 164).

Perpendicular Tracery was the last major style and spawned in the late 1300's, developed out of economic concerns for an easier to make and cheaper style of tracery, caused by labor shortages due to the Black Death (Cecil, 1961, p. 56). The distinguishing feature of this style is its grid like design, tall straight mullions extend from the window base to the head where they split off into several smaller arches, and only interrupted by the occasional horizontal transoms, (Kuiper, 2019). Visually, the rectangular divisions create a paneled aesthetic unique to this style. Further development was made in the 1400 & 1500's as the windows became increasingly massive sometimes filling the entire wall between supporting buttresses, this era of perpendicular windows is usually subdivided into several smaller arches allowing for a flatter window head that makes it distinct (Curl , 2006, p.785).

The development of tracery across the centuries shows the dynamic relationship between economic, structural, and aesthetic concerns, and the disparate types of tracery that resulted from them. It is obvious that Gothic tracery is an adaptable window system, able to respond to a range of different concerns, the results of which are, at least in aesthetic terms, radically different from each other and yet, they still retain that Gothic character. We can use this to justify historical basis to justify the research of this thesis, by taking the constructional methods of traditional Gothic tracery and exposing it to computational, fractal, and parametric tool set, we can expect Gothic tracery will take on a new aesthetic form in relation to these new stimuli. From here on the new secular, fractal based Gothic this thesis explored is referred to as Vitrine-Gothic, to distinguish it from the traditional Gothic style. Vitrine, being French for 'glass case' (Cambridge, 2021), a symbolic nod to the fact Gothic originated in France, and that the designs developed throughout this thesis take inspiration from traditional Gothic tracery.



Design Exploration

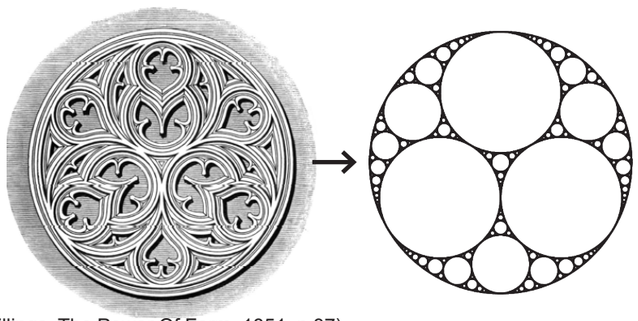
Design Exploration #0 - Vitrine-Gothic Fractal Patterns

This first bout of design exploration is an attempt to find a design tool set and process that satiates the thesis aims, to create a *'secular Gothic'* with a digital tool set allowing us to build from a *'fractal foundation'*. This first exploration is carried out in only 2D, allowing the focus to on tools and methodology without the complexities of 3D space. The lessons, tools, and methods learned from this are be taken into the later explorations to be translated into 3D, to eventually be used in creating a fully realized 3D pavilion. By introducing fractal patterns at this early stage of design the goal is to quickly generate a complex base pattern, effectively bypassing the manually laborious task of subdivision and modulation used in designing traditional Gothic tracery. How this fractal pattern is generated, and manipulated is the focus of this exploration.

Tool Development

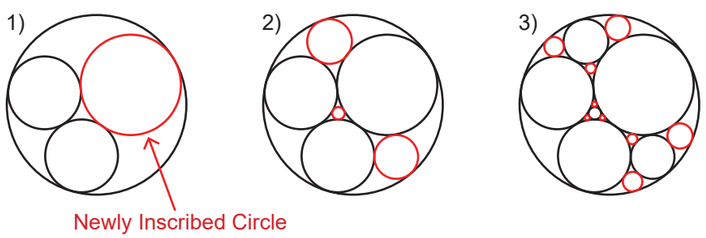
Apollonian Gasket - The chosen fractal pattern will form the base constructional drawings on which the rest of the work will be built. This fractal will have influence over the aesthetic of the final design outcomes, so it is important to begin this work with a strong foundation, in this case, by selecting a fractal with at least some visual similarities to traditional Gothic tracery. A particular fractal known as the *'Apollonian Gasket'* was identified as an appropriate candidate because of its visual similarities to some Gothic rose windows (refer to below images). The fractal is generated by first manually inscribing three circles, dubbed 'spawning circles', they define the starting conditions. In the next stage a new circle is spawned in the triangular gap between the three spawning circles, this new circle tangentially touches its spawning circles (Kocik, 2020).

ROSE WINDOW & APOLLONIAN GASKET SIMILARITIES



(Billings, The Power Of Form, 1851, p.37)

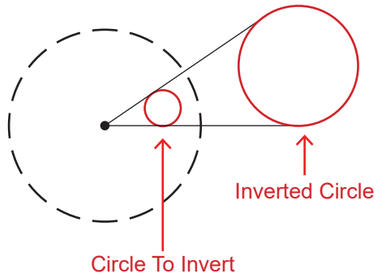
GENERATION OF APOLLONIAN GASKET



Careful placement of the spawning circles can create distinct patterns quickly and easily, however, there are some limitations inherent to the design of the Apollonian fractal. Firstly, new circles are successively inscribed between the three spawning curves, in effect making them the boundary condition of which the generating pattern cannot expand beyond. Secondly, there is a practical limit on pattern resolution: past a particular point newly generating circles are so small they effectively become invisible.

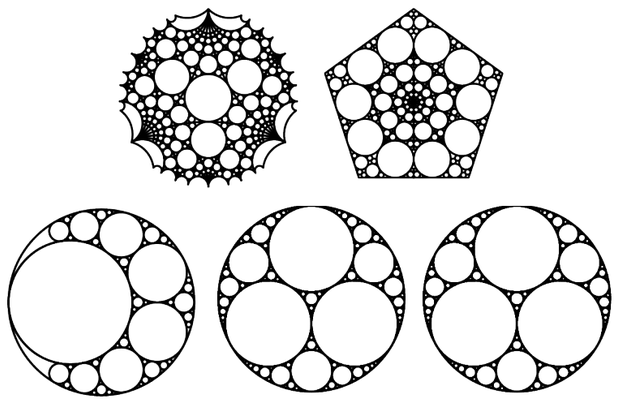
Inversion - To overcome these limitations several methods of modifying the pattern after it was generated were considered. Manually modifying the pattern was one method, but the idea was to also use a form of transformation to distort the pattern as well, as a type of quick modification. The most commonly used transformations were considered, ie; Rotation, Translation, Scaling, and Reflection, none of which solved these limitations. But there is another, less commonly used transformation known as Inversion, effectively the process of turning shapes inside out (Weisstein, 2020). One of the noticeable attributes of this transformation is the resulting shapes become distorted from inversion, however, this is not the case for arcs or circles which remain circular even after inversion. Thus making it a good method for distorting the circular formations of the apollonian gasket

THE PROCESS OF INVERSION

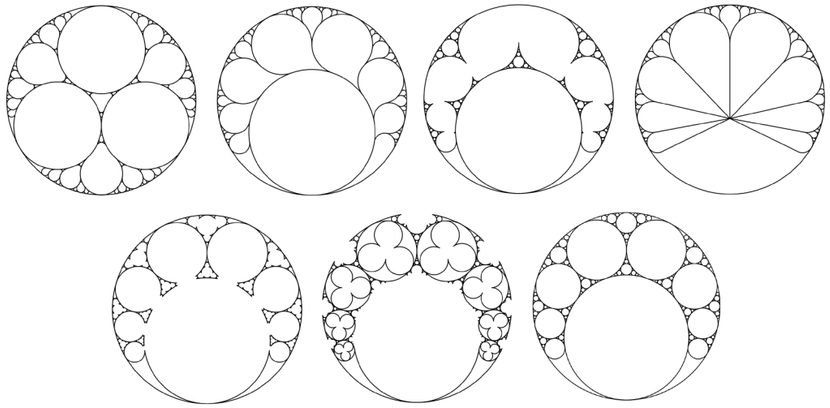


Design Exploration

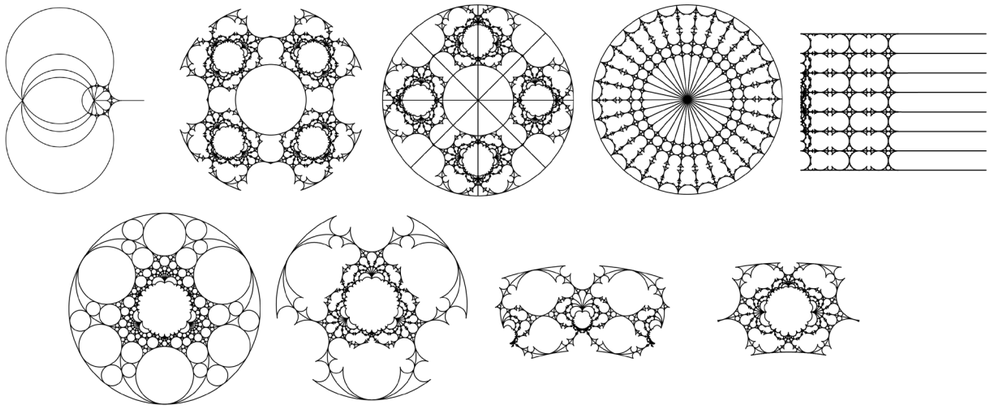
The base Apollonian fractals are quick to generate using the developed tools, and while the arrangements of Apollonian fractals could be considered practically limitless, the number of noticeably distinct arrangements was much more limited.



This can be expanded however through manual modifications. By selectively trimming and extending curves a broader range of distinct patterns can be generated, though the amount of manual labor required to modify these intricate fractals is arduous. On top of this the patterns were still limited to within the bounds of their spawning circles, this is where the inversion tool was introduced.



Once these manually altered patterns were inverted they produced a diverse range of new and distinct patterns that were generated in quick succession. It also allowed the patterns to morph into new non circular arrangments further expanding the range of producable patterns.



Conclusion

Once the correct set of tools was identified the design exploration and development was a straightforward process. Overall, this 2D exploration has proven that the thesis aim of creating a ‘secular Gothic’ can be achieved using a digital tool set with a ‘fractal foundation’. By using a combination of manual modifications, and the new inversion tool, made altering the Apollonian gaskets a much more manageable task. Because the fractals could be manually altered at the behest of the designer and then inverted, the resulting Vitrine-Gothic patterns were diverse in aesthetic, each generated in quick succession. These Vitrine-Gothic patterns also lacked the religious symbolism synonymous with traditional Gothic architecture, thanks to the visual similarities between the Apollonian fractal and traditional tracery. Going forward the challenge will be translating this 2D success in 3D, which will become the focus of the following explorations as it is the key to creating a fully realized pavilion.

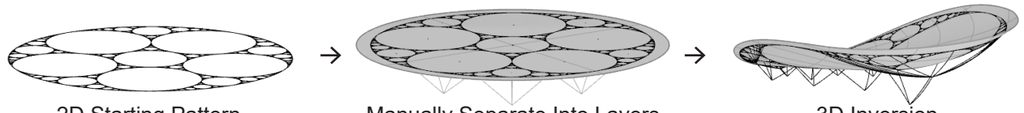
Design Exploration #1 - Inversion Method

This second design exploration attempted to build upon the successes of the last, attempting to take the lessons learned in 2D space and translate them directly into 3D, testing the viability of these tools to create structures in 3D space. The primary tool used was the inversion tool, which was modified to operate in 3D space. The Vitrine-Gothic patterns developed in 2D were then manipulated into 3D space using the updated Inversion tool.

Design Exploration

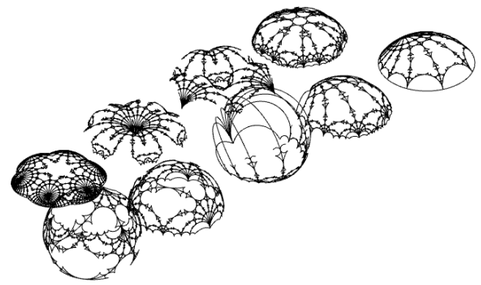
This exploration was straight forward in its approach. The 2D patterns could be controlled manually, this entailed vertically separating the pattern into different layers, which could then be used to form the different structural members of the pavilion. These layers were then inverted, the result of which was a more dynamic form. However, the resulting pavilions would always mimic the form of their inverting shape (Which in 3D space was a sphere, thus all the resulting pavilions were deformed spherically), thus this process can only be considered partially successful. Making matters worse, there is no direct control over any particular aspect of the pavilion, at best the designer can hope the column and beam placement will end up in usable positions, the layout of the pavilion is also unadaptable making it unable to meet any specific user or site requirements demanded of it.

DESIGN METHOD



2D Starting Pattern → Manually Separate Into Layers → 3D Inversion

OTHER INVERSION RESULTS



Conclusion

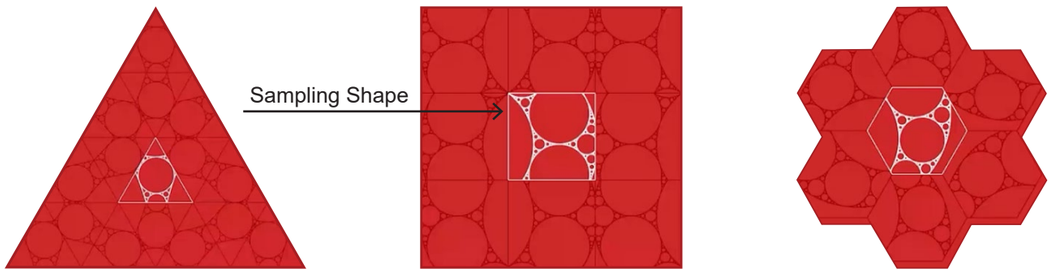
In short, this was a brief design exploration and was terminated at an early stage as the problems inherent in this method proved to be its features, not its bugs. The primary issue was the inflexibility of the design process, it was bound to follow the starting 2D patterns because it did not have the ability to modify them in any meaningful manner. This led to poor habitability of the pavilion as columns, beams, and ceilings are at odd positions, heights, and angles, making much of the pavilion unusable or uncomfortable to inhabit. This inflexibility also extends to its inability to respond to any specific user requirements. In terms of the tool set, unlike its 2D counterpart, 3D inversion cannot be considered a worthwhile tool as it lacks the ability to meaningfully influence the pavilion beyond distorting it into spherical forms.

Design Exploration #2 - Modular Method

This exploration, dubbed the “Modular Method”, explored how 2D patterns could be abstracted into 3D building modules, which could then be assembled to construct a pavilion. The expected outcome of this method was a building system with a wider array of design options and greater design flexibility than its predecessor, which failed primarily because it was an inflexible method that could not adequately adjust its designs to user requirements.

There are many paths this exploration could have taken, but the best method for abstracting the 2D patterns into 3D was the kaleidoscope. The simple act of mirroring a pattern produced results imbued with perfect symmetry, this symmetry made the newly generated patterns tillable, it allowed them to connect to themselves with seamless joins, able to be tiled forever creating infinite patterns. There is also a poetic union between the kaleidoscope and this work. To give some backstory, its inventor, David Brewster, believed the kaleidoscope would become an indispensable tool of design for architects and artisans, *“architectural ornaments, **circular Gothic windows**, ceiling moldings, carpets, and jewelery”* (Jeanne, 1982) would be produced with his device allowing designers to see the world from a new perspective. Brewster was partially correct, the kaleidoscope found success but not as a tool of rational design, but instead with the general public, quickly spreading across England and other nations as a toy of novelty (Jeanne, 1982). Given the underutilization of this tool and the powerful results it promises, it was the perfect tool for this bout of design exploration.

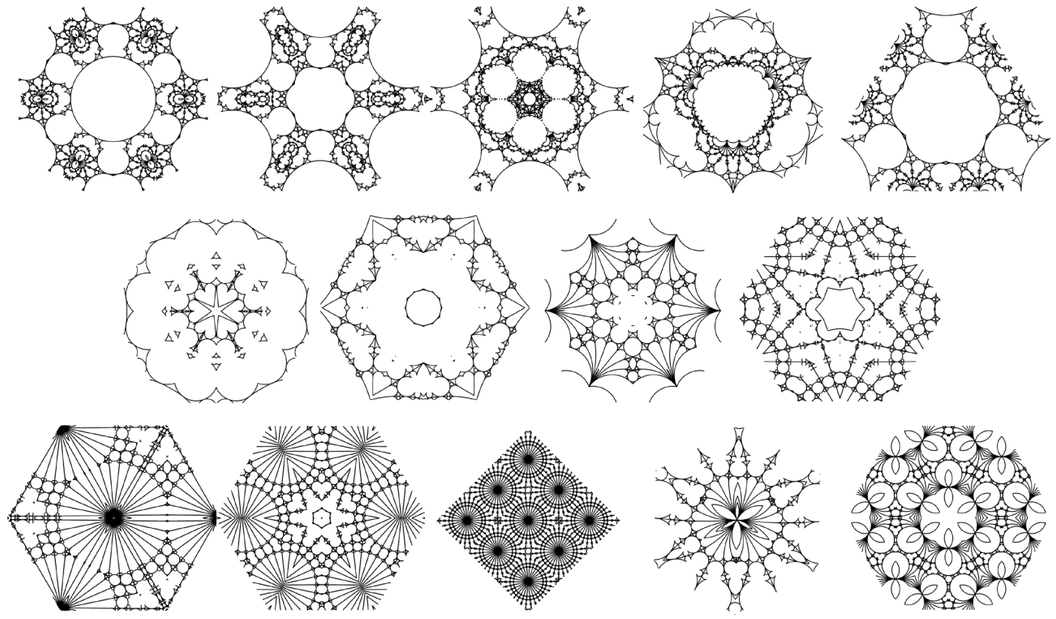
THE KALEIDOSCOPIC PROCESS



The previously created 2D patterns are passed through a ‘sampling shape’, this cut out a sample of the pattern. The sample was then mirrored along the edges of the sampling shape to create a new, repeatable, kaleidoscopic pattern. Sampling shapes using triangles, squares, and hexagons, are ideal in 2D, as these shapes create perfectly tilable patterns. (To translate this process into 3D, a 3D sampling shape was used instead of a 2D one, thus the pattern was converted into a 3D module using square, pyramid, and rhombic dodecahedron’s as 3D stackable shapes)

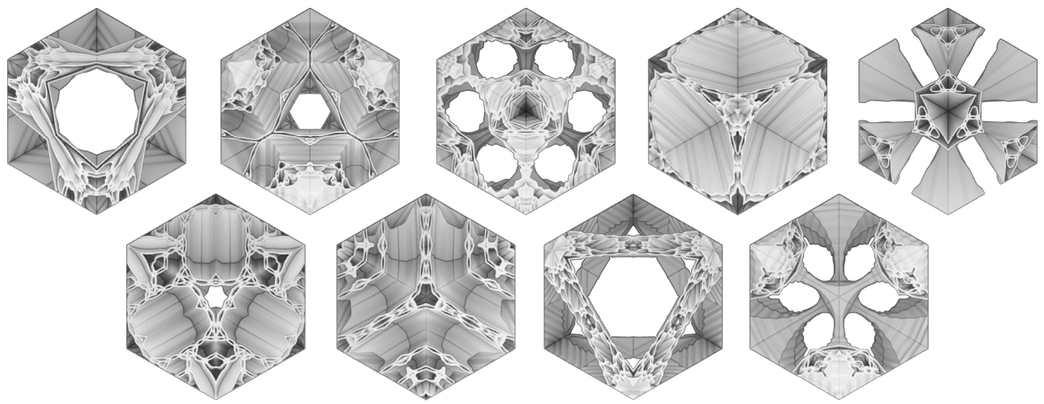
Initially, to test the validity of the Kaleidoscope it was first explored in 2D, if the results were unfruitful then it would not be explored further in 3D, saving time on tool development. Shown below are early examples of the kaleidoscope being tested in 2D, which proved the validity of the tool. New patterns could be generated with perfect symmetry making them more aesthetically appealing, yet most importantly they were seamlessly tilable allowing the patterns to expanded Infinitum beyond their initial confines.

EXAMPLES OF GENERATED 2D TESSELATABLE PATTERNS



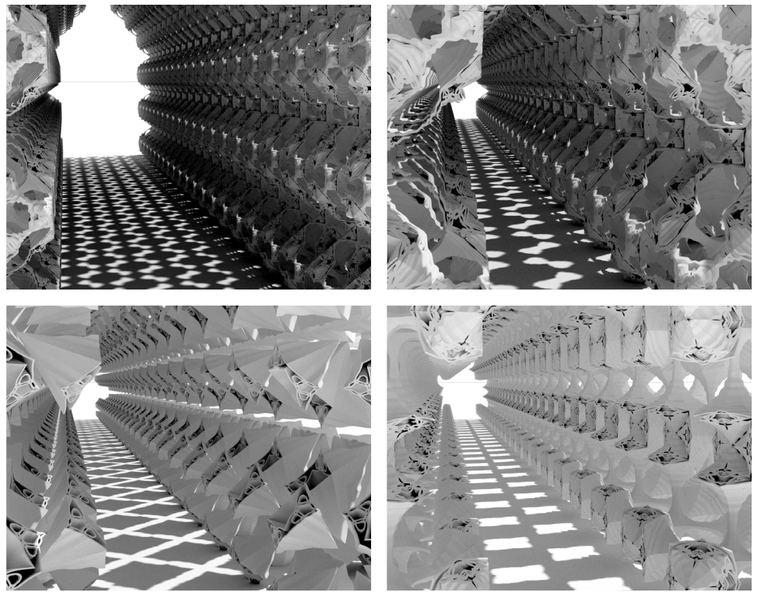
Considering these successes in 2D, the process was then ported into 3D. Here, the concept of tilable patterns (or in 3D, stackable modules) became singularly important, the symmetry they displayed allowed modules to be stacked seamlessly together creating a physical connection where the modules meet creating the opportunity for a joint system to hold everything together. Satiating, in theory, the structural necessities of this approach.

EXAMPLES OF 3D GENERATED MODULES

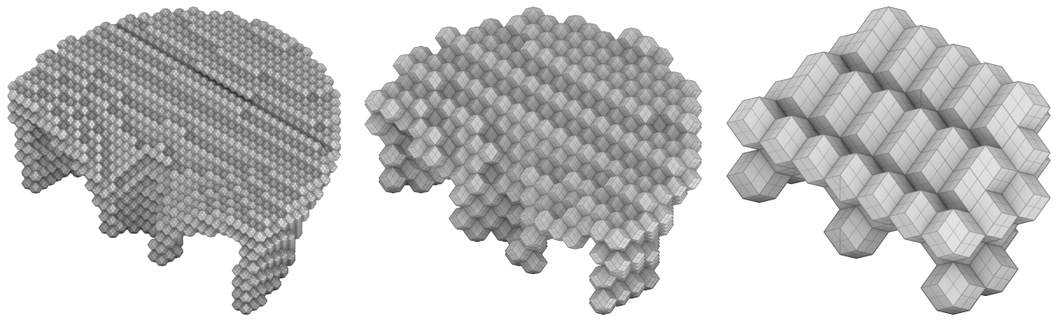


Considering the failure of the previous *'inversion method'* of Exploration #1, the lack of direct control from the designer over the design lead to this failure, thus the design was unable to adequately adapt to any design requirements making the design process inflexible. It was important in this exploration to give as much control to the designer as possible, affording them as much design flexibility as desired. One of the advantages of the 3D kaleidoscope was the speed at which it could generate modules, by categorizing the results into groups of say, porosity, structural potential, or simply their aesthetic qualities etc, a diverse library of modules could be amassed. Thus giving the designer direct control over which modules to use and where, for example, selectively building from modules of differing porosity would produce a pavilion with contrasting internal areas of light and shadow. The overall form of the pavilion was also directly controlled by the designer, skillful placement of these modules could produce a practically limitless range of forms. Shown below are results that experimented with these two concepts of, multiple modules types, and in varying arrangements.

MODULES OF DIFFERENT POROSITY INFLUENCE INTERNAL LIGHTING CONDITIONS



ARRANGEMENTS OF BLANK MODULES IN VARIOUS SIZES



100mm^3 modules 200mm^3 modules 400mm^3 modules

These tests indicated the effects of the module arrangement and module type had on the pavillion's aesthetic qualities. Varying the type of module selected, in this case by the permeability of the module, created several different interior dappling effects, indicating the level of control the designer has over the internal lighting conditions. In terms of the module arrangement, the ideal module size is 100-200mm^3. If the modules were made smaller the walls would need to be built several modules deep to support itself resulting in the pavilion being less permeable to light. However, make the modules too large and they loose the accuracy to construct smaller pavilions producing jagged results. It is demonstrated that this design method is highly adaptable by nature, both aesthetically, and in layout, in this regard this exploration could be considered successful than its.

Conclusion

The major success of this exploration was the ability to create a flexible building module responsive to site and user requirements. In 2D the new kaleidoscopic tool proved invaluable, expanding the range of producible patterns, and more importantly infinitely tillable patterns, allowing the boundary restriction in previous explorations to be overcome. Going forward this 2D kaleidoscopic tool was added to the tool set for pattern generation in latter explorations. Translating this tool to 3D produced similar results in the form of building modules. Despite the wide range it could produce this portion of the exploration could be considered a failure for several reasons.

Firstly, the intricate ornamental patterns of each module were aesthetically pleasing, yet this ornament was positioned at the corners of the modules, when multiple were joined together the ornament became hidden inside the junction.

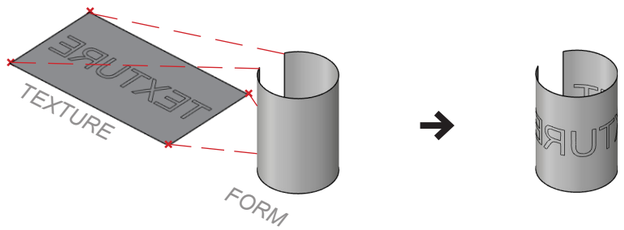
Secondly, there are serious questions about the practicality of this method in terms of fabrication and construction. The complexity and uniqueness of each module singles out 3D printing as the only practical fabrication method, a slow process poorly suited for mass production of modules, so overall not *that* practical. Also, how do modules connect at their junctions? Adhesive, or embedded plates could be used, but each module varies significantly in design and porosity, some modules feature large junction areas which are ideal. However, other modules have small junctions, or even none at all, even worse was some of the generated modules featured floating geometry inside of itself making these particular modules impossible to fabricate. Thus any implemented jointing system could not be standardized, it would have to responsively adapt to the unique conditions of each module, in some cases this would be difficult, if not impossible.

Thirdly, and most importantly, was the loss of the Gothic connection. The distinguishing elements of Gothic, its clear hierarchy of parts, and union of structural / aesthetic considerations, are absent in this exploration. The 2D Vitrine-Gothic starting patterns became so abstracted in 3D that their Gothic inspiration became arbitrary, even with the wide array of modules that could be generated they lacked a clear hierarchy between them, the resulting pavilions looking overall homogeneous and jagged, or to use the more technical term, a bit jankey.

In summary of the *'modular method'*, it had the capacity to produce a wide array of modules that individually make for fine trinkets, but stack them together and any redeeming individual qualities were lost in the collective. The problem in translating the 2D patterns to 3D was they became too abstracted, aesthetically losing their Gothic inspiration.

Design Exploration #3 - Mapping Method

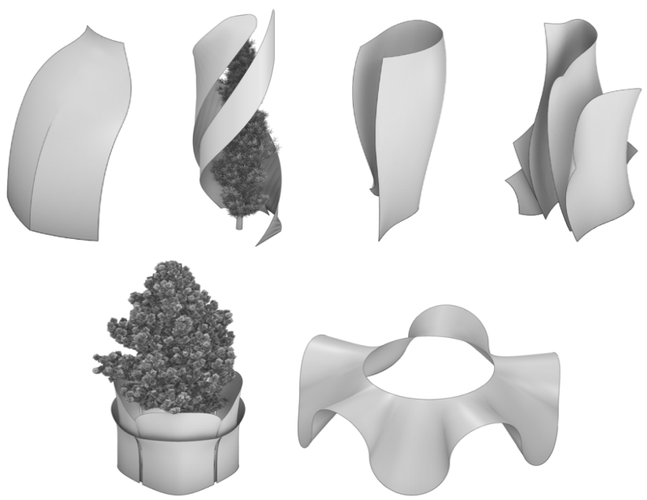
To summarize the process so far, there have been a range of tools developed (the Apollonian Gasket, 2D Inversion, and 2D Kaleidoscopic tools) which are successfully utilized in the development of 2D Vitrine-Gothic patterns. However, problems arose when these 2D success were translated into 3D space, using a range of methods and tools to achieve this translation. On closer inspection the reason for these failures became apparent, the 2D Vitrine-Gothic patterns are native generated in 2D space, when these patterns are forced into 3D space using distortion and abstraction the results always lost desirable aesthetic qualities or design adaptability, due to the nature of these forced translation processes. Instead, a more successful approach would utilize this 2D nature of the patterns, not fight against it. As a result, the concept known as *'UV mapping'* was utilized, which essentially took these 2D pattern and maps it onto a 3D shape, similar to the way you can wrap a 2D sheet of paper into a 3D shape.



EXAMPLE OF UV MAPPING

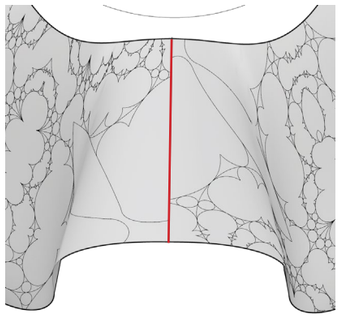
Exploration

From the get go this method proved a valid one, the results produced did not sully the aesthetic qualities of the 2D Vitrine-Gothic patterns when mapped onto 3D forms. Even better the design of these 3D forms was highly controllable by the designer, allowing for all manner of sculptural forms of various shapes and layouts to be created.

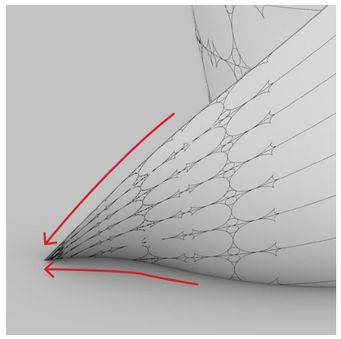


There were, however, several minor design challenges when using this method which need to be consciously considered.

1) Where multiple surfaces join, the two patterns will not line up, in these scenarios a symmetrical pattern works best as their sides will join seamlessly
2) 3D forms with exaggerated geometry will likewise stretch the applied pattern, producing unsightly distortions. In the example below the pattern gets pinched the closer it gets closer to the corner.



1) MISALIGNMENT OF PATTERNS AT JOIN OF TWO SURFACES



2) PATTERN DISTORTION CAUSED BY DISTORTED SURFACE

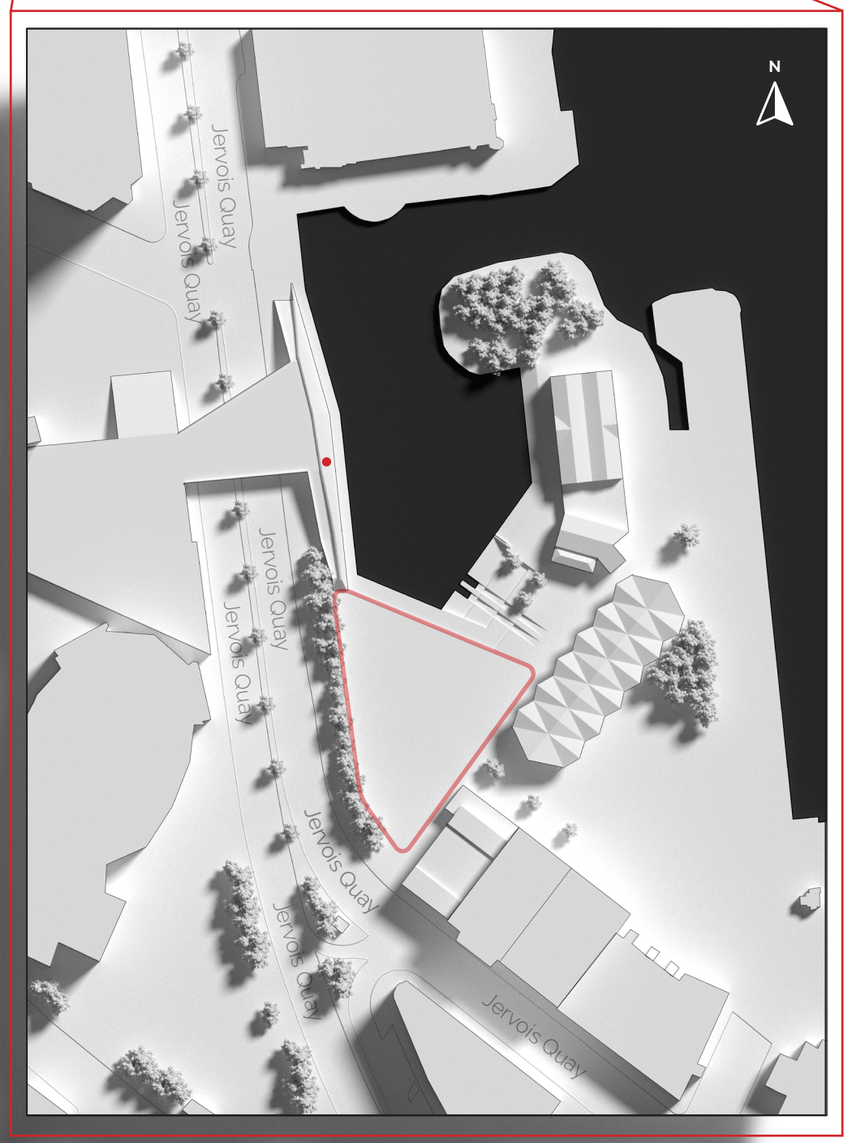
Conclusion

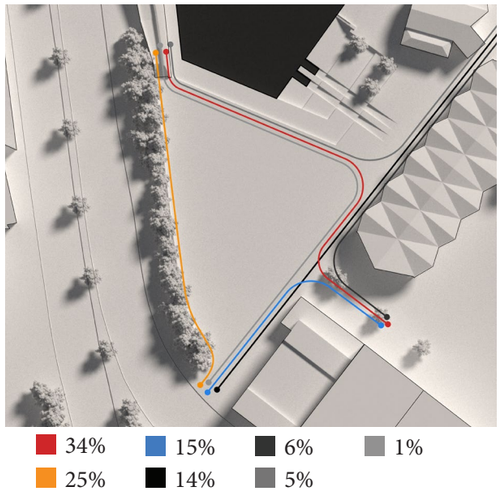
This method was considered successful as it took the 2D patterns into 3D in a manner that allows for design flexibility and doesn't abstract the pattern to the point it became arbitrary, as was the case in previous explorations. While there was several minor design issues with this method as discussed above, they could be consciously avoided. Taking all this into consideration, this method was proven to be the best as it was the only one to produce aesthetically desirable, and adaptable, results which satiated the technical aim of this thesis, *'How could fractals be integrated as a foundational pattern, used as a secular substitute for the religious symbolism abundant in traditional Gothic?'*. In the next chapter of the thesis, this design method and tool set would be explored further, but in regard to the second aim of the thesis, *'to produce a pavilion exploring the architectural implications of a space informed by a Western secular spirituality'*, the outcome of which would become the final pavilion that satiated both thesis aims.

Site Analysis

Site Analysis

The site that was finally selected was the Whairepo Lagoon on Wellington's waterfront. A cultural center of the city, it sits in close proximity to several cultural icons such as; the Te Papa Museum, the Civic Square, and the Wellington City Art Museum. This area of the waterfront was also one of the first to undergo development for public use in the 1980's (WellingtonCityCouncil, 2015, p. 6), making it a somewhat symbolic location for revitalization of the old for A new public culture, symbolically this theme makes it a fitting site for the pavilion.

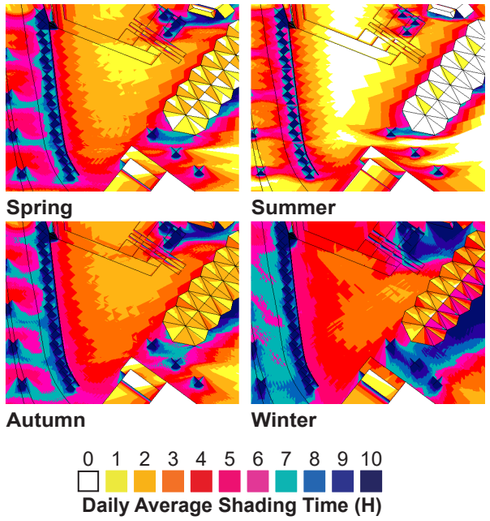




Pedestrian Movement

The site is situated at a busy pedestrian junction, connecting several pathways along the water front and from the city, of which roughly 60% of all user movement is along two routes (highlighted red and yellow). All paths go around the sites perimeter, and will likely not be interfered with by the pavilion, if they do meet however, their integration with the pavilion should not lengthen or inhibit movement along the two primary pathways.

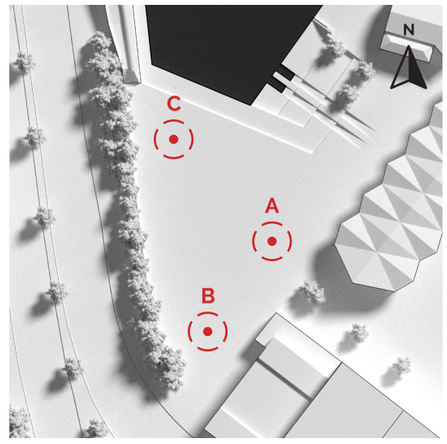
Observations Collected by Author
10/12/2020
1:30 - 2:30pm



Sun Shading

The final pavilion design will feature large quantities of stained glazing, this requires the pavilion to be situated in an area with little to no shading for optimal effect. The sun shading analysis indicates that year round there is favorable lighting conditions on site, particularly at the sites center. Obviously, more shading is present closer to the adjacent structures, the pavilion should be placed away from these to avoid their impact.

Simulated by Author
Software: Shadow Analyses for Sketchup



The site panoramic giving a general impression at particular spots. It would be optimal to place the pavilion towards the back of the park near points A and B, this keeps the front half of the park as a green area and thus provides an unobstructed view of the lagoon. Careful consideration should be given to any structure built at point A as this could visually obstruct view shaft C, also it could potentially interrupt pedestrian movement at this location.

Design Refinement

Design Refinement

The thesis thus far has concluded its broad exploration phase, the technical problem of producing a secular Gothic had been partially answered. It has created a tool set and design pipeline that is capable of producing secular Gothic patterns, and showed promise that it could produce a wide range of adaptable and versatile structures. What hadn't been tested at this stage was *how* practical, how adaptable, the developed tools and pipeline really were. This chapter focused its research on this aspect, the versatility and adaptability. To develop an understanding of the design implications of the developed tools and pipeline, establishing rules of thumb, so to speak.

Design Pipeline

The previous thesis chapter had established a successful design pipeline, during the *'Mapping Method'* phase, in which 2D patterns could be transfered into 3D space. The stages below summarize the design pipeline developed:

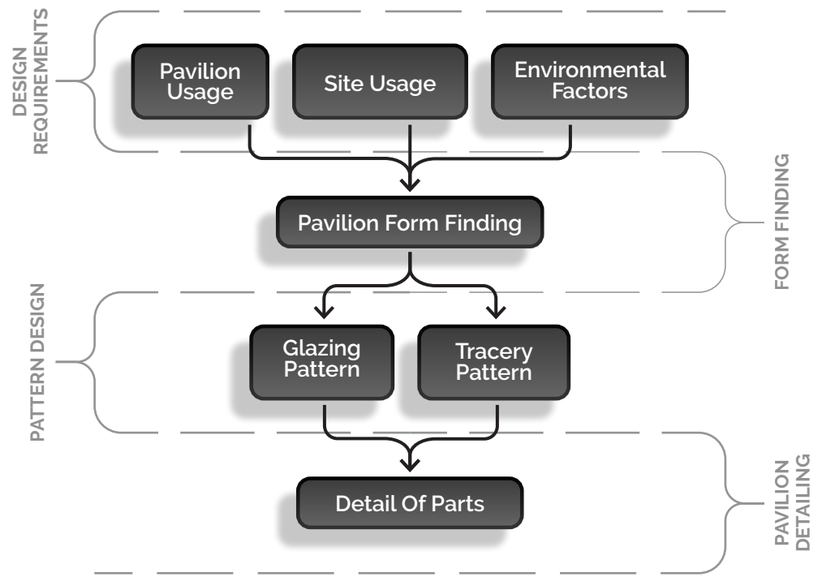
1) **DESIGN REQUIREMENTS STAGE -** The unique site and user requirements are taken into consideration to form design requirements.

2) **FORM FINDING STAGE -** A quick design phase that explores a range of forms that best suit the design requirements.

3) **PATTERN DESIGN STAGE -** A range of Vitrine-Gothic patterns are generated and applied to these forms, finding the best combination of the two.

4) **PAVILION DETAIL STAGE -** Fully models the joints, mullions, glazing etc, to produce a fully realized pavilion.

DIAGRAM OF DESIGN PIPELINE
DEVELOPED DURING THE DESIGN EXPLORATION CHAPTER



Form Finding Stage

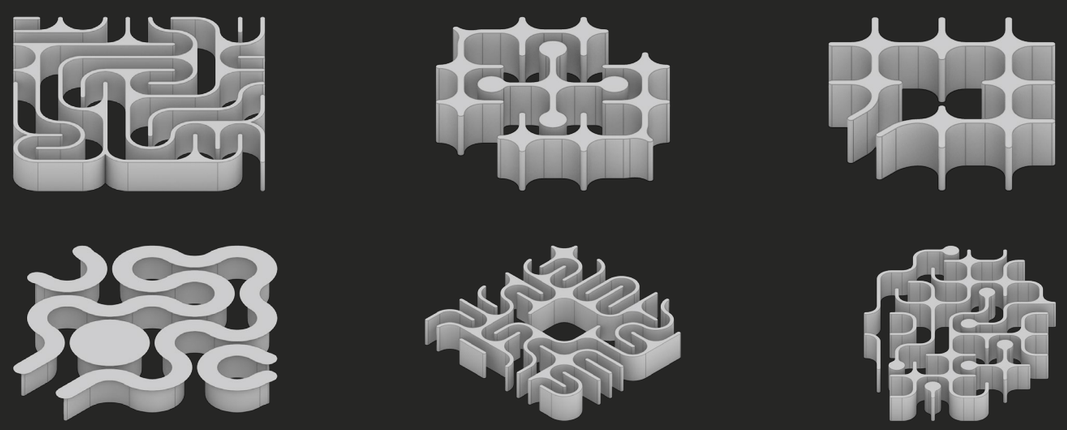
This chapter developed a range of forms based on the secular user requirements, from which, the most suited forms were taken and adapted to meet the site requirements. Producing the final pavilion design. As noted, the user requirements are those concepts derived from traditional Christianity, which had a spiritual influence but could also be implemented secularly. To summarize these concepts:

Meditative - Derived from the practice of internalized mental prayer, this concept isolates people from the outside world creating a refuge of solitude and self-reflection. Achieved architecturally through walling off and creating aesthetically distinct areas will bolster the feeling of beinf removed from the outside world.

Pilgrimage - Derived from the Christian labyrinth as a spiritual tool, in which the physical journey is symbolic of a spiritual journey. Architecturally achieved through hallways and paths separating distinct areas, making the transition between them obvious.

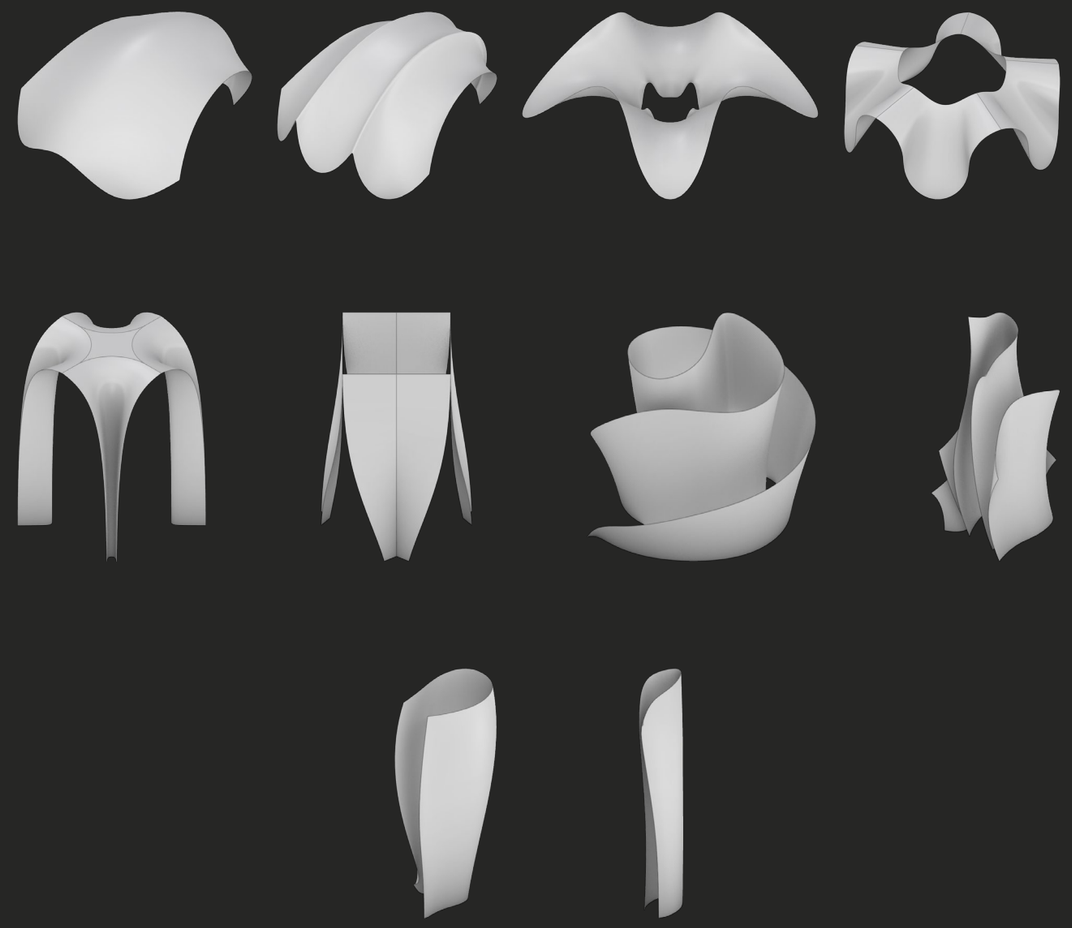
Spectacle - Gothic Architecture was in many ways an interpretation of the Heavens; to inspire awe, placing people in a trance like concentration on its beauty (Watkin, 2015, p. 151). This concept is to give people a point of interest and beauty on which to focus, to get lost in thought.

'PILGRIMAGE' PAVILIONS



For this approach, a profile is extruded along a guiding curve, the resulting pavilions are quick and easy to produce at both large and small scales. Each of these prototypes featured the 'pilgrimage' concept, the most successful prototypes also included elements from the "meditative" concept, creating small pockets of solitude connected in a larger network of pathways.

'MEDITATIVE PAVILIONS

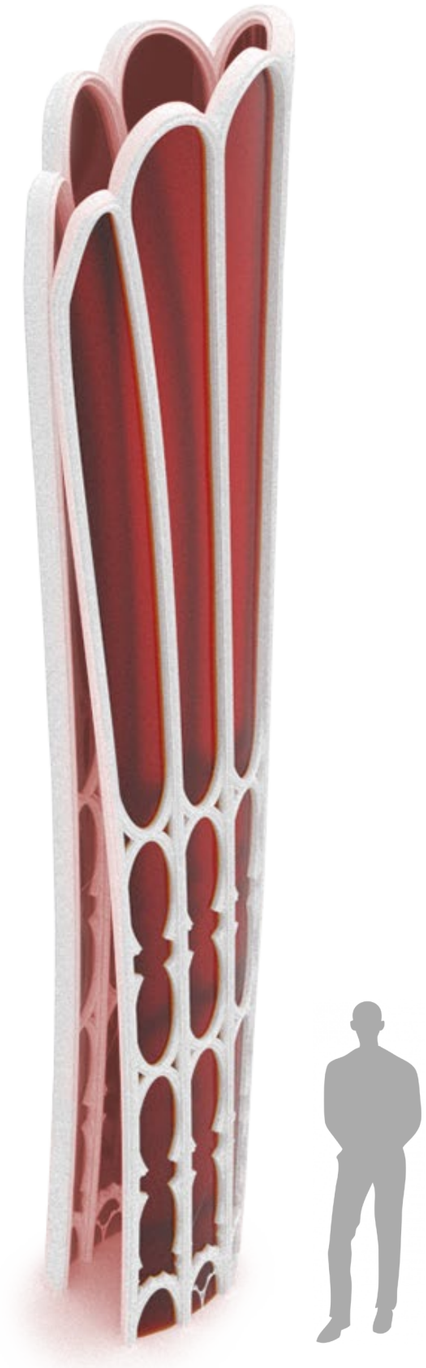


For this approach each prototype is hand tailored to produce a range of unique and expressive forms. The downside being the time involved for each one making it a suitable choice for small areas. Of these prototypes the most successful are also the most enclosed, emphasis the quality of isolation when inside.

Pattern Design Stage

Several of the prototype pavilions developed during this *'form finding'* stage are taken into the next stage, *'pattern design'*. In this pattern design stage, when the Vitrine-Gothic patterns are mapped onto the forms the designer can choose to either highlight desirable visual traits of the form, or obscure them. (Examples on next page)

In this example, the form is similar to a traditional Gothic vault, geometrically the most notable trait of this form is its symmetry. The ideal pattern then, is one that is also symmetrical, thus emphasizing this pavilion's trait.



Here, the narrow verticality of the form is its primary trait. The ideal pattern is one with long, uninterrupted linear elements that run parallel to the form's verticality, emphasizing this attractive trait.

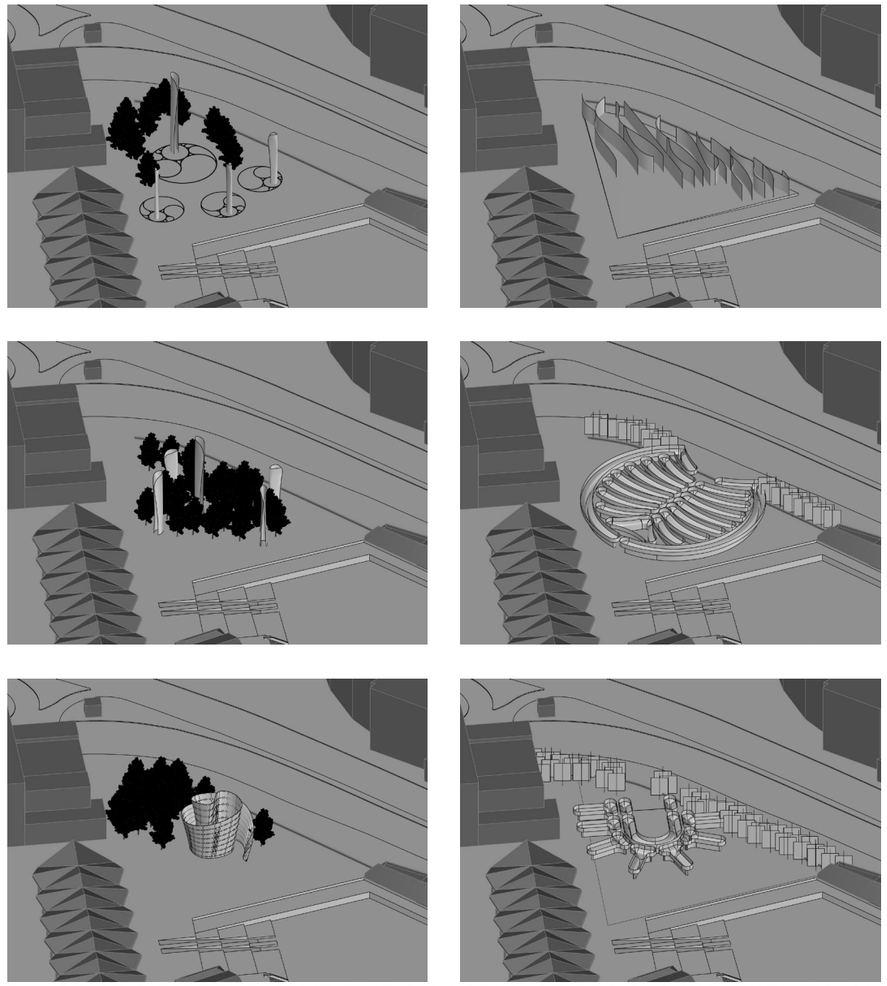
Conclusion

The tools & pipeline developed can be considered a success, they displayed adaptability to met various secular user requirements, and consistently produce aesthetically desirable results. This was due to the autonomy the designer has over the tools at each stage, encouraging creative freedom. The previous two models shown in the ‘Pattern Design Stage’, illustrated this degree of design freedom in how different they were from each other in function, and aesthetic.

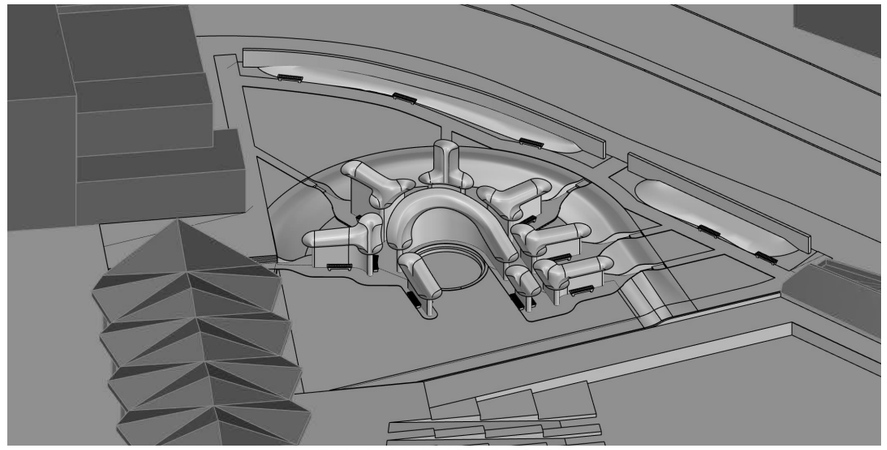
Illustrated to the right, was the final design exploration of the thesis. The tool set had been validated in terms of the secular user requirements, but in a vacuum. Situating the design research in a real location grounded the research in real terms, not solely considering secular user requirements, but also site requirements .

The site proved too large for singular pavilions based on the Meditative concept, they produced a disparate network of individual pavilions scattered across the site which were loosely connected through paths and landscape interventions. They never resulted in a cohesive scheme, these pavilion types would be better suited for smaller sites.

For site’s of this size the sprawling maze like designs based on the Pilgrimage concept produced a more cohesive scheme. They gave the sense of a single cohesive pavilion, creating distinct areas connected through paths and hallways to eacother, the established pedestrian walkways, and important areas around site (ie, the waterfront). The final pavilion illustrated these concepts cohesively, a balance between site & user requirements while also taking into account their broader cultural implications. The final pavilion is discussed in more depth in the following chapter.



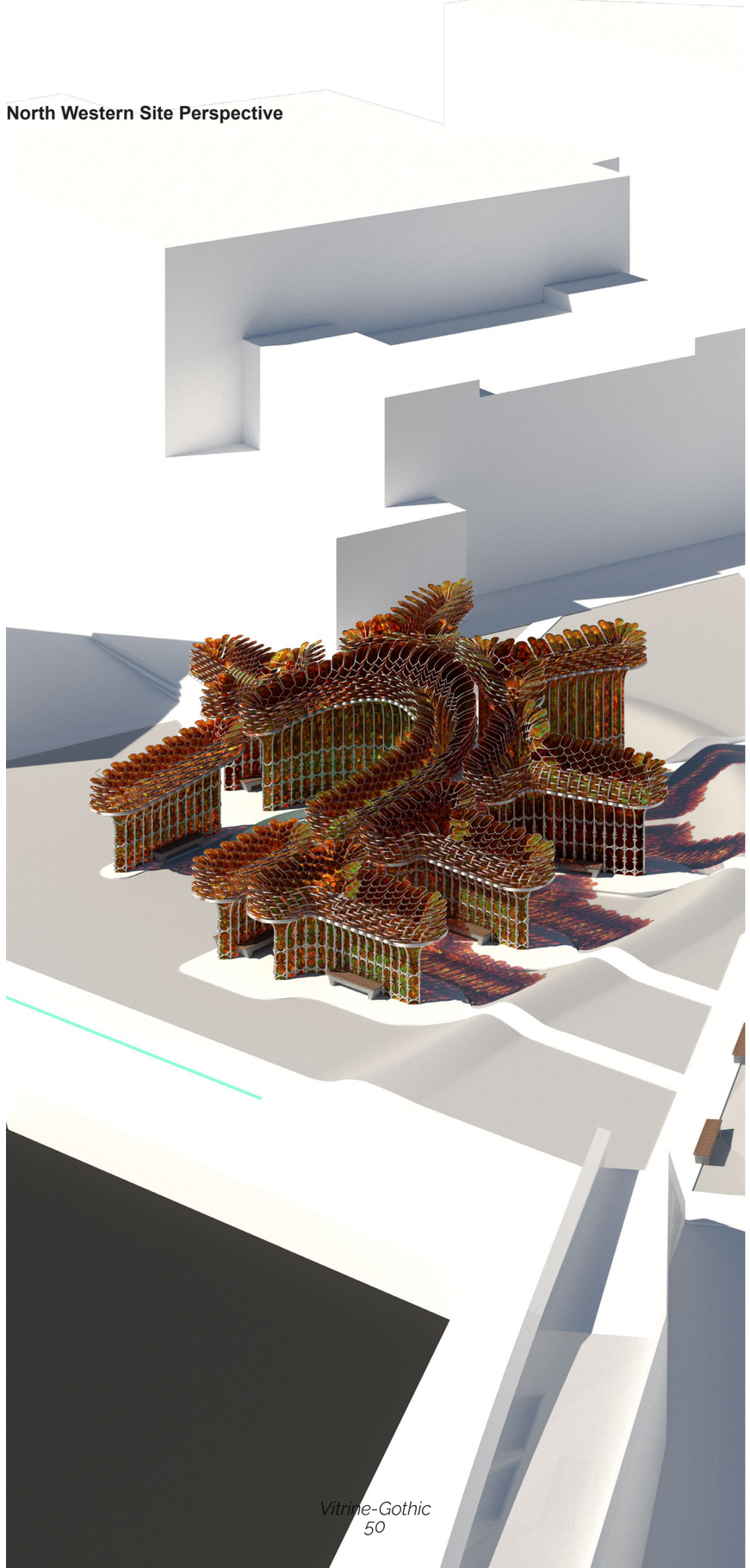
RANGE OF DIFFERENT MEDITATIVE & PILGRIMAGE DESIGNS IMPLEMENTED ON SITE



FINAL PAVILION DESIGN

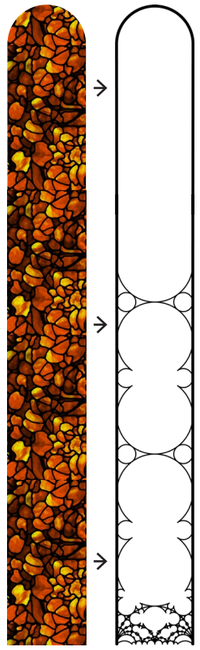
Final Design

North Western Site Perspective

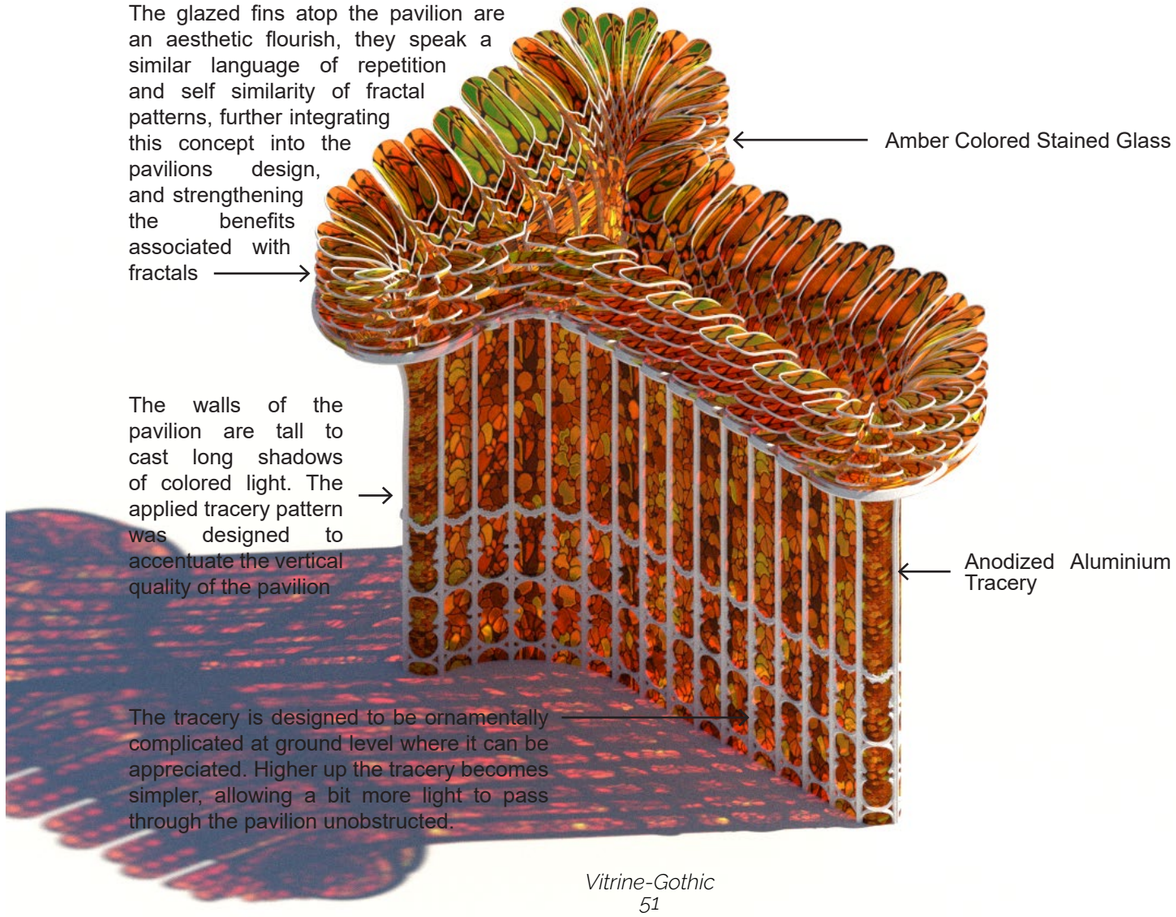


Glazing Design

In keeping with the secular nature of Vitrine-Gothic, the glazing design could not depict any traditional religious iconography, while creating a design that becomes a background element, leacing the function, and furniture of the space the main focal points, not the glazed walls. This was achieved by taking inspiration from how traditional Gothic glazing is comprised, by taking the irregular splotchy divisions it commonly features, we were able to integrate this geometry into this secular mural as a symbolic aesthetic tribute. The resulting pattern is one that resembles the foliage of a tree canopy, in this regard it features a patterned uniformity with no distinct markings that could become focal points, thus making it the ideal pattern for blending into the background of a setting.



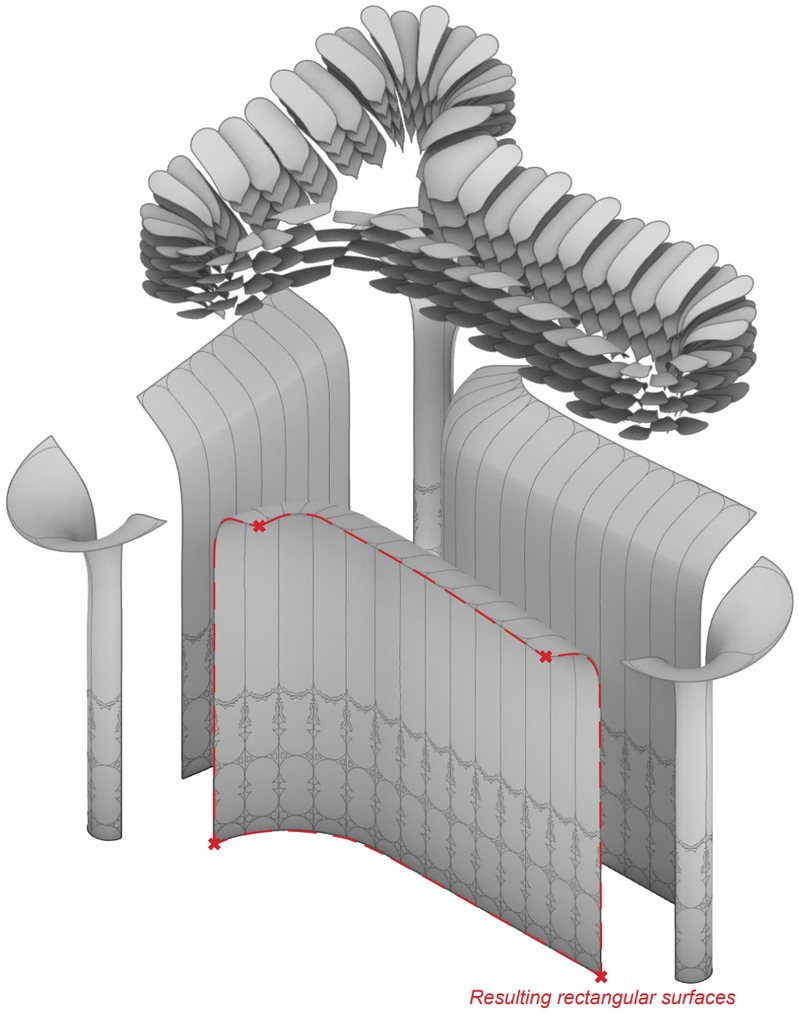
Varying the opacity of the stained glass pieces allows the pavilion to control the level of light in particular areas. A high opacity creates a spectacular display of light where the window shines, in contrast when the opacity is low then the result is dark and shadowy. The play of these two lighting extremities is used to highlight areas in the pavilion of special importance, from other lesser areas. This is evidentially shown in the renders.

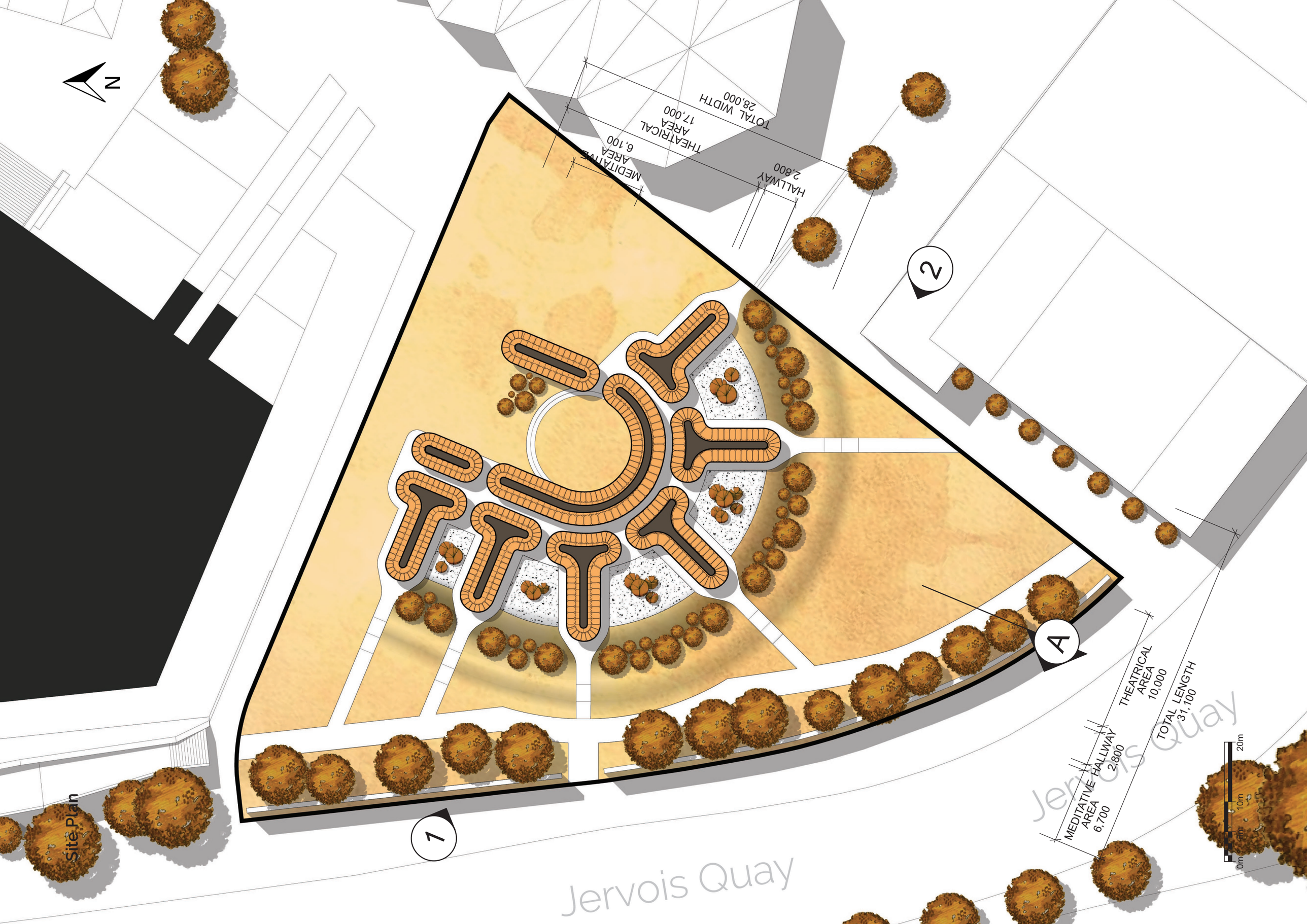


Limitations & Solutions

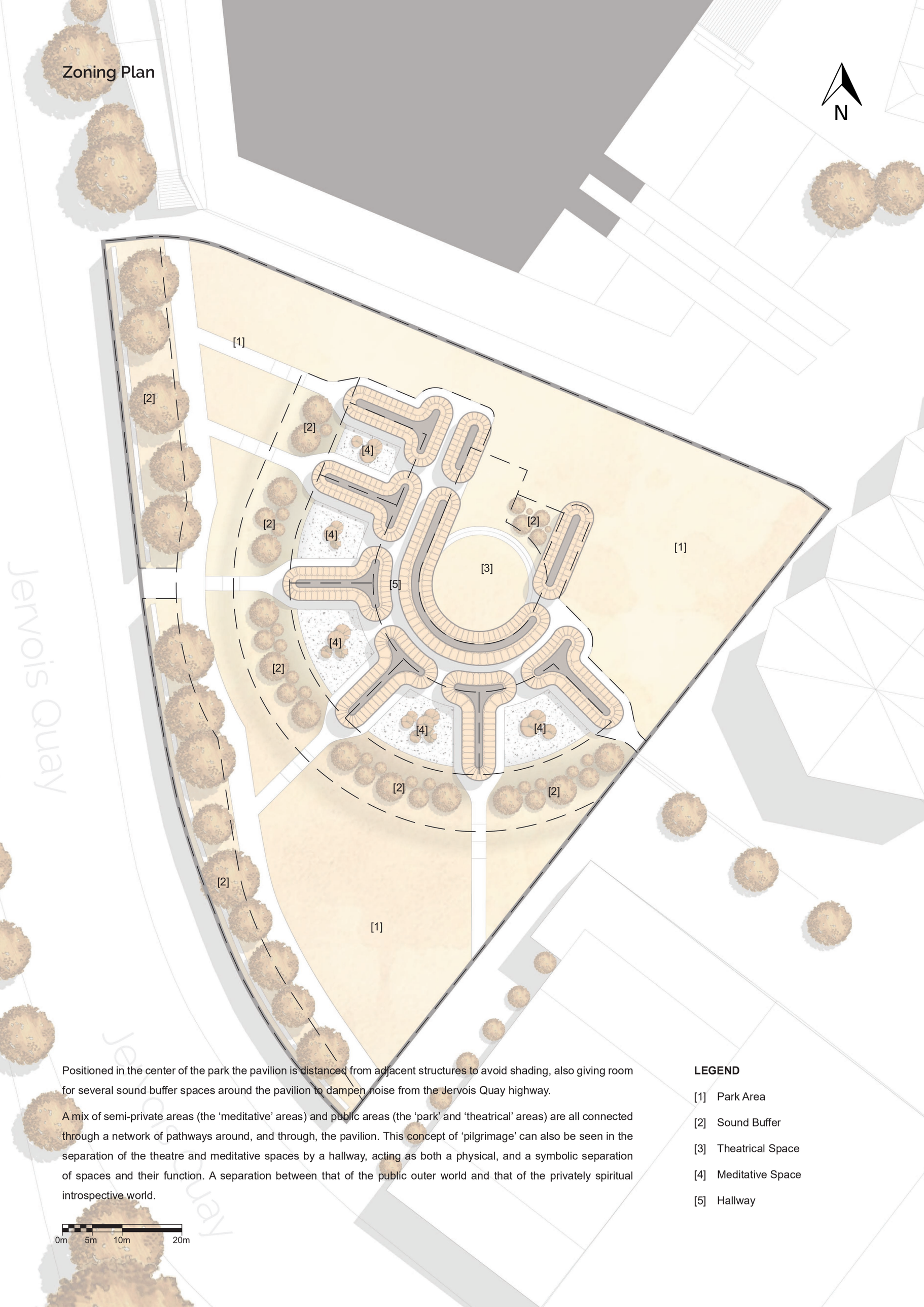
However, due to limitations of the mapping method the pavilion was segmented into several smaller pieces, these segmented pieces became 4 pointed rectangular surfaces onto which the rectangular 2D pattern could be applied with predictable results. Another benefit of doing it in this manner was the exact control the designer had over the position of the pattern, as the applied pattern would extend only to the boarder of its surface. Thus by controlling exactly where a surface segment started and ended allowed the pattern to be placed in exact locations in reference to the overall form of the pavilion.

EXPLODED ISOMETRIC OF PAVILION'S SURFACE SEGMENTS




Site Plan
N
MEDITATIVE AREA 6,100
HALLWAY 2,800
THEATRICAL AREA 17,000
TOTAL WIDTH 28,000
MEDITATIVE AREA 6,700
HALLWAY 2,800
THEATRICAL AREA 10,000
TOTAL LENGTH 31,100
1
2
A
Jervois Quay
Jervois Quay
0m
5m
10m
20m

Zoning Plan



Positioned in the center of the park the pavilion is distanced from adjacent structures to avoid shading, also giving room for several sound buffer spaces around the pavilion to dampen noise from the Jervois Quay highway.

A mix of semi-private areas (the 'meditative' areas) and public areas (the 'park' and 'theatrical' areas) are all connected through a network of pathways around, and through, the pavilion. This concept of 'pilgrimage' can also be seen in the separation of the theatre and meditative spaces by a hallway, acting as both a physical, and a symbolic separation of spaces and their function. A separation between that of the public outer world and that of the privately spiritual introspective world.

LEGEND

[1] Park Area

[2] Sound Buffer

[3] Theatrical Space

[4] Meditative Space

[5] Hallway

Theatrical Area

The Theatrical area is intended for communal use, at its center is an amphitheater for theatre, music, and other impromptu gatherings.

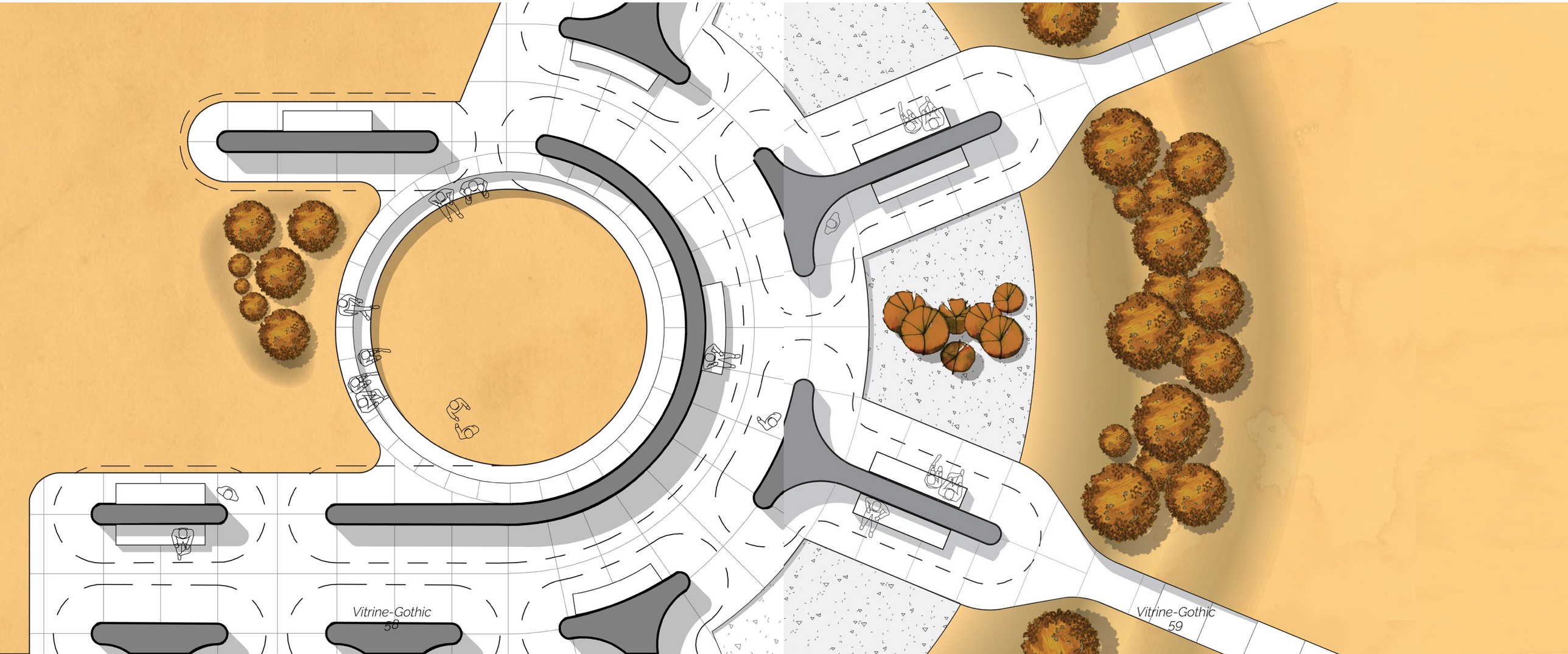
This area is surrounded on 3 sides by glazed walls, intended to make a spectacle. But the Northern most side is open to the public park area, indicating the public nature of this space, and opening it up to visages of the Whairepo Lagoon.

Meditative Area

The intent of the meditative spaces was to embody the noted concepts of *'meditation'* and *'spectacle'*, with the intent purpose of creating a tranquil area conducive to pensive thought. Its most prominent architectural feature is the tall walls surrounding this area on 3 of its sides, bathing the interior space in its shadow of light, color, and spectacle.

The 4th wall is a sound buffer composed of shrubs and small trees, creating a visual and auditory separation of the park and meditative areas. At the same time not completely severing the two spaces,

The center piece of this area is the internal garden, it adds a tranquil point of focus, while also obscuring the seating on the parallel wall. Symbolically the implementation of an internal garden takes after the romanticized visage of overgrown Gothic ruins, traditionally looked upon for aesthetic pleasure, and philosophical, moral reflection (Townshend , 2019, p. 162). Though in this case, the vegetation sits amongst a new Gothic, implementing these traditional implications and celebrating their rejuvenation, not reflectively on their decay.



LEGEND

[1] Park Area

[2] Sound Buffer

[3] Amphitheater

[4] Hallway

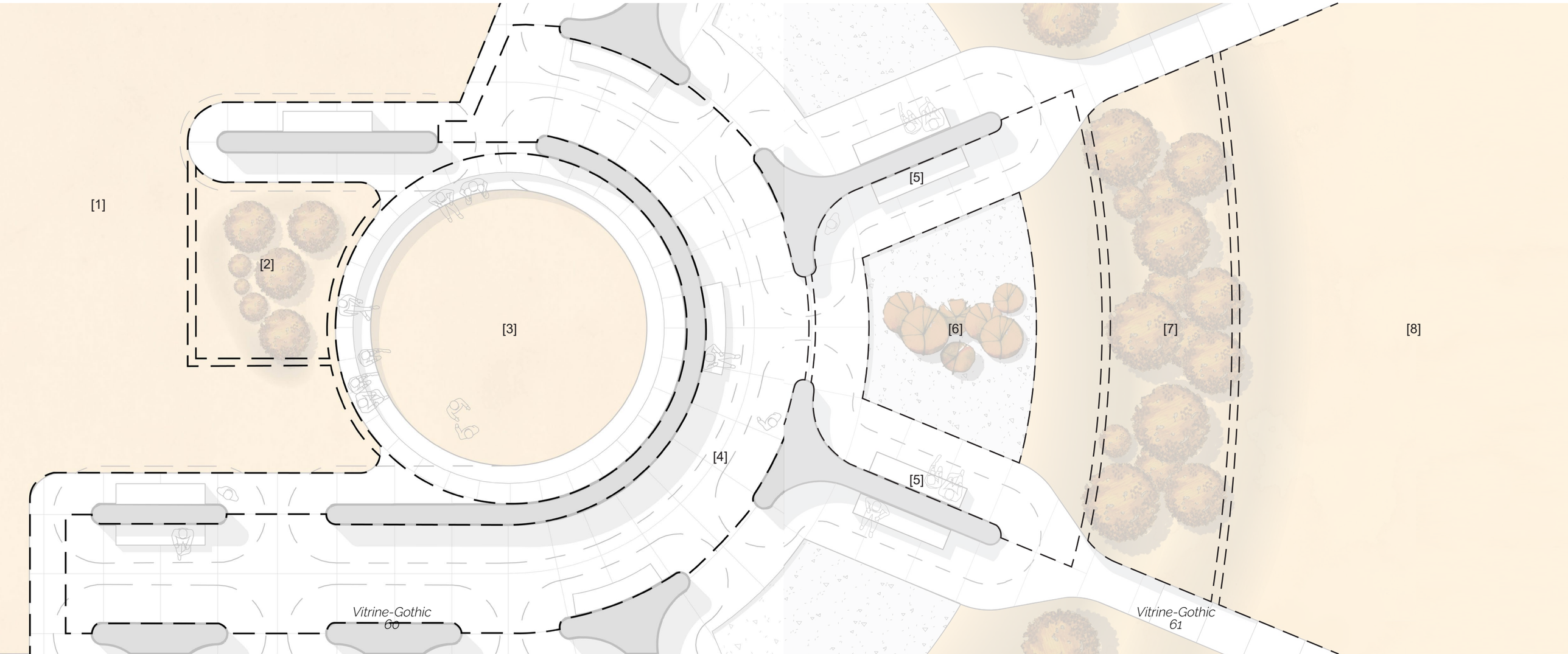
LEGEND

[5] Meditative Space (Walkway & Seating)

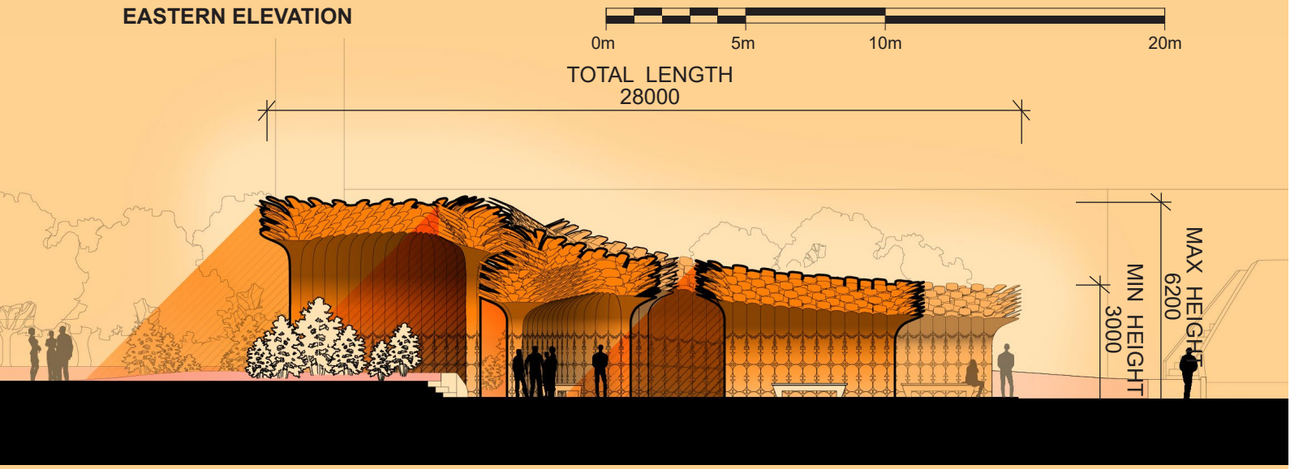
[6] Interior Garden

[7] Sound Buffer

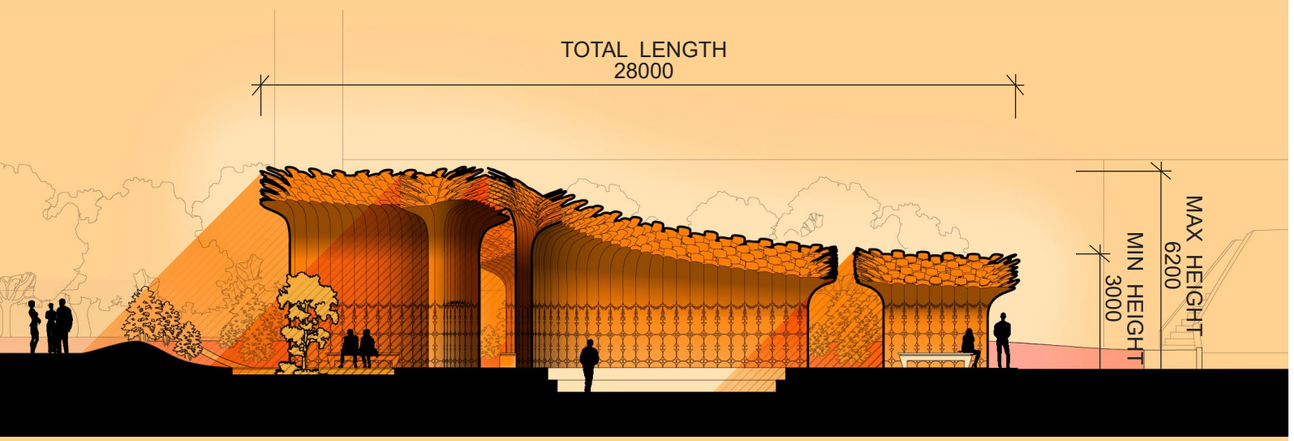
[8] Park Area



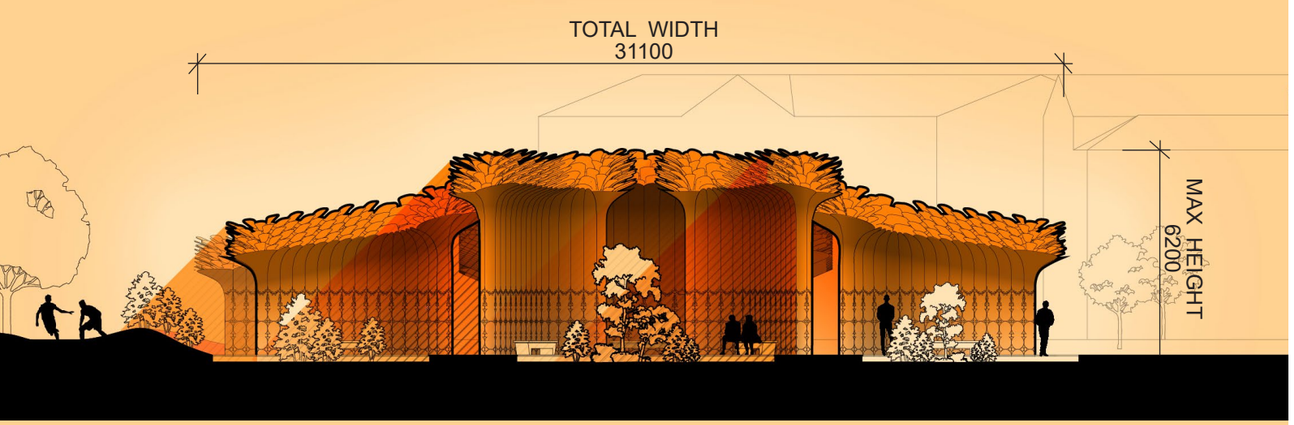
EASTERN ELEVATION

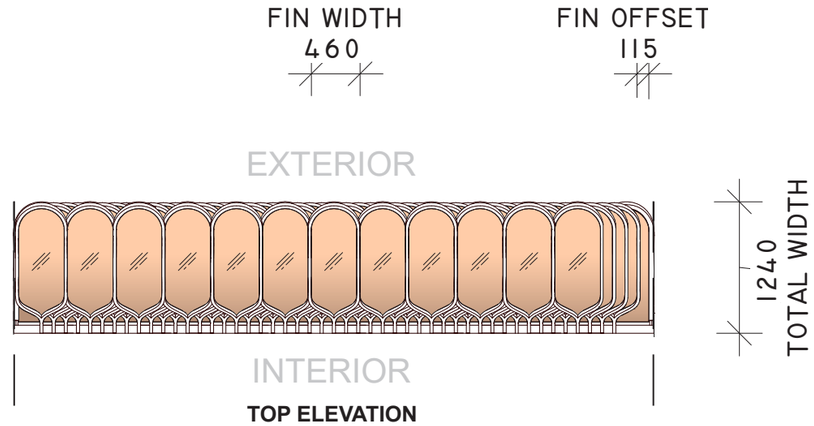


EASTERN SECTION



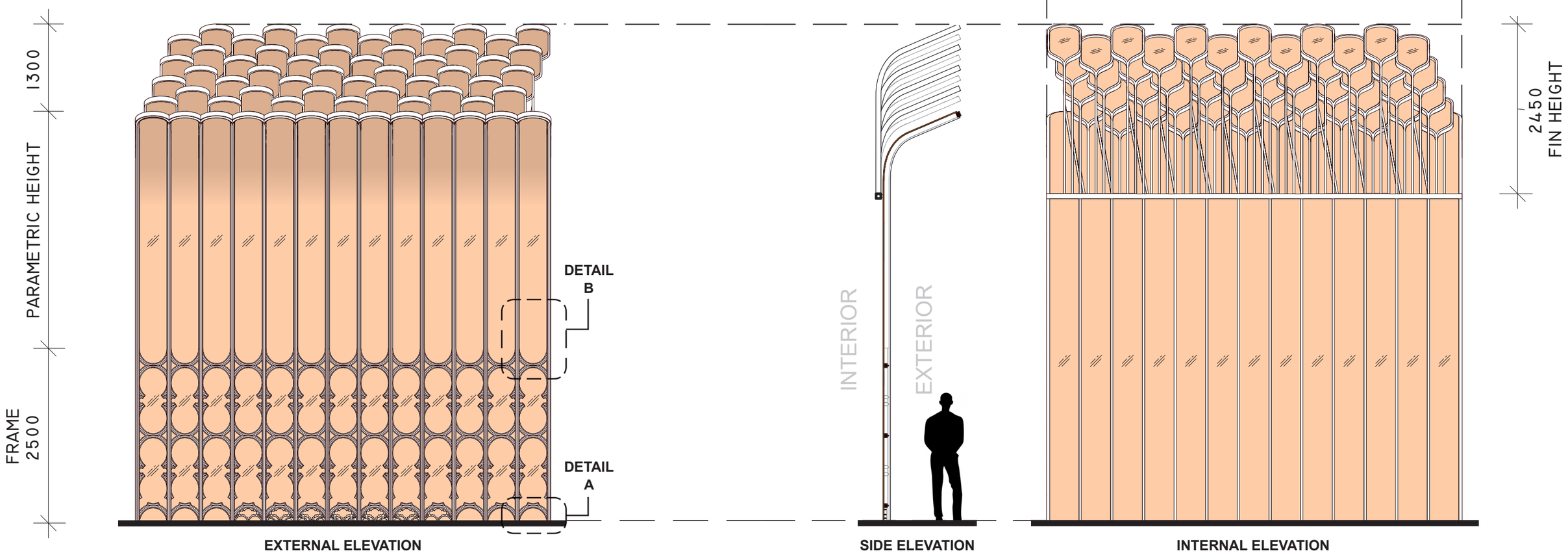
SOUTHERN ELEVATION





TOP ELEVATION

DEVELOPED SURFACE DETAIL



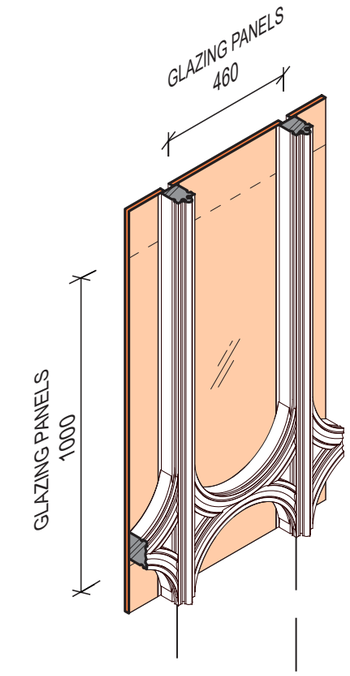
EXTERNAL ELEVATION

SIDE ELEVATION

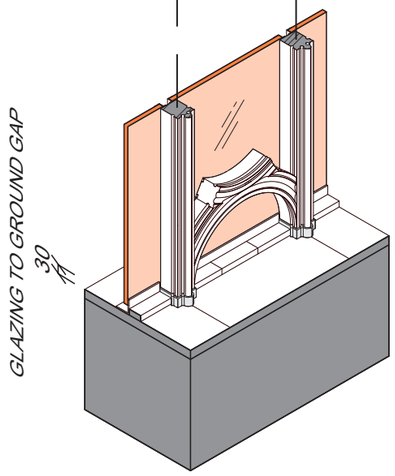
INTERNAL ELEVATION

460
FRAME

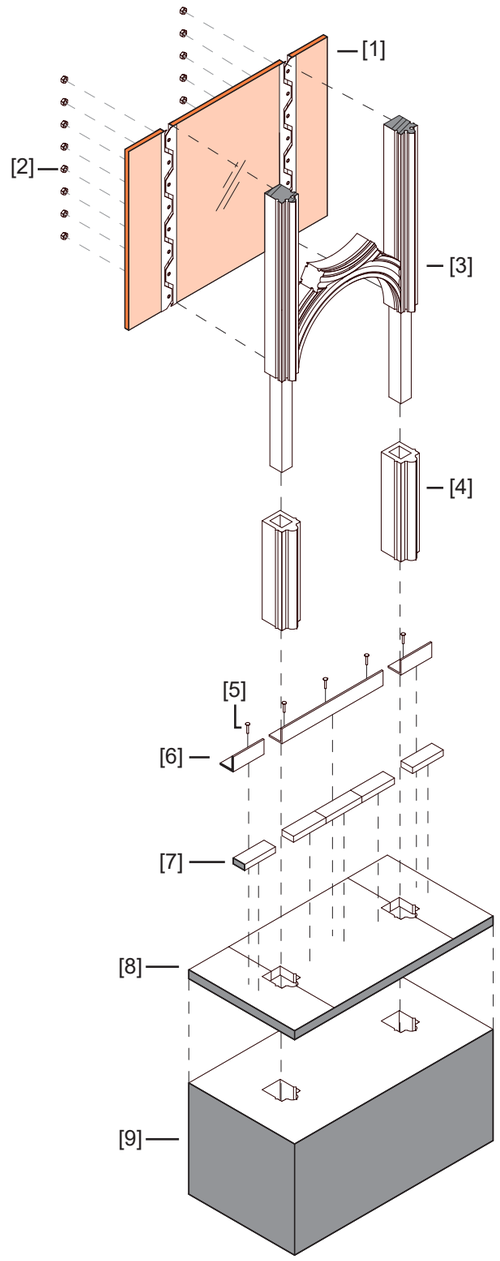
DETAIL (B



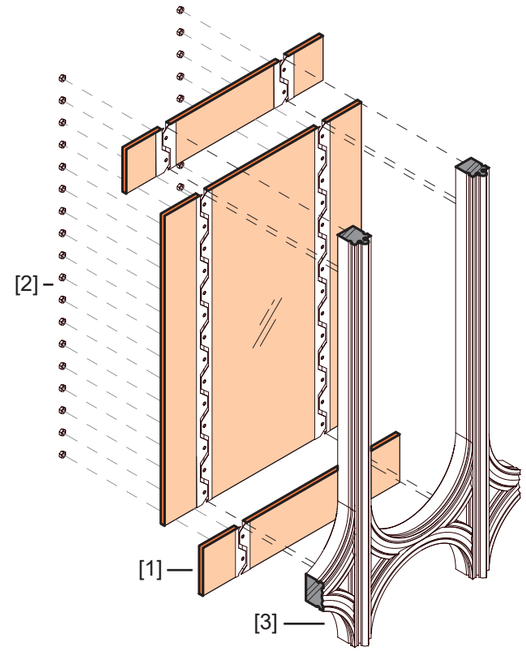
DETAIL (A



DETAIL (A



DETAIL (B



LEGEND

[1] Leaded Glazing Panels, Using 15mm Thick Acrylic

[2] M10 Nuts, For Fastening Glazing Panels To Framing, At 75mm Centers

[3] Aluminum Uni Frame, 3D Printed, Polished Finish

[4] Plastic Sheath 5mm Thick, As Aluminum / Concrete Barrier

[5] Screws For Fixing Aluminum Angle To Ground

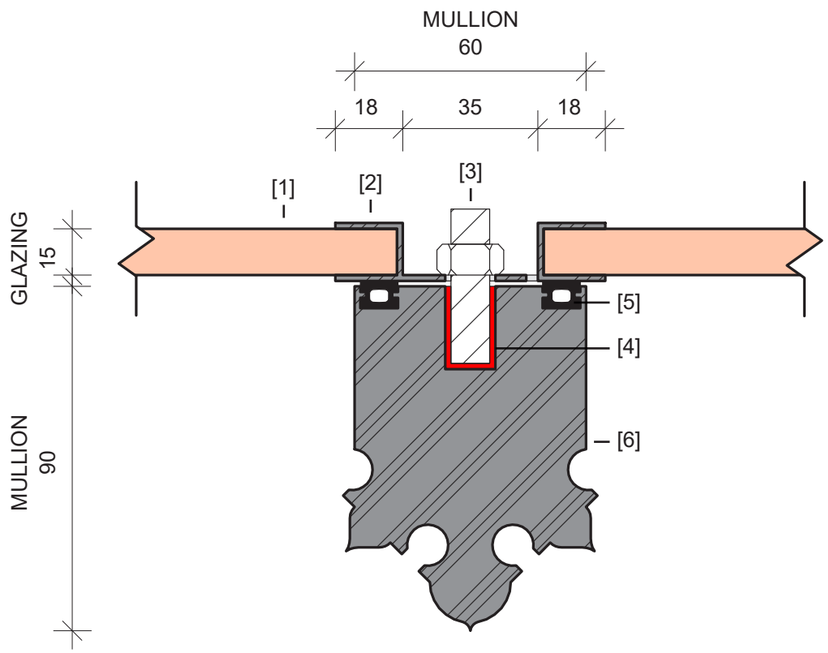
[6] 50mm Aluminum Angle (As Cover For The 30mm Glazing To Ground Gap)

[7] Tiling, Coem Silver Stone White Tiles (100x40x20mm)

[8] Tiling, Coem Silver Stone White Tiles (600x1200x50mm)

[9] Concrete Slab As Foundation, w/ Aluminum Uni Frame Cast Into Slab On site

MULLION DETAIL



LEGEND

[1] Leaded Glazing Panels, Using 15mm Thick Acrylic

[2] Aluminum Angle Flange, (Prefabed w/ Glazing)

[3] M10 Nuts, Fastening Glazing Panels To Framing

[4] 10mm Thick Threaded Rod Epoxied Into Mullion

[5] Rubber Strip As Seal

[6] Aluminum Uni Frame, 3D Printed, Polished Finish


Meditative Area


Skylight


Hallway Area


Theatrical Area

Thesis Conclusion

Conclusion

The question that drove this thesis forward was, ‘How can a new Gothic architecture be adapted in a secular manner to suit a secular society?’. This question was explored throughout the thesis in two aspects, the first aim being a technical exploration, ‘How can fractals be integrated as a foundational pattern, used as a secular substitute for the religious symbolism abundant in traditional Gothic?’. And the second aim was the cultural implications, ‘What are the architectural implications of a space informed by a Western secular spirituality?’.

In these terms the thesis was successfully explored through extensive periods of design research, the conclusion of which was the development of a digital tool set and pipeline used to produce a final pavilion, which answered the thesis question & aims. These tools were developed to during the *‘Exploration’* phase to satiate the technical aim of the thesis, from which a range of aesthetic and spatial qualities were developed in accordance with secular and spiritual requirements in the *‘Refinement’* phase satiating the secular architectural aim of the thesis, in which the creation of the final pavilion validated these tools as both technically masterful, and culturally relevant. The bodies of work this thesis find itself in relation to, are projects such as Michael Hansmeyer’s Digital Grotesque, in which a reimagining of architectural design techniques, and modes of thinking, in relation to modern digital technologies. Though, the research in this thesis differs slightly in its end goal. While Hansmeyer attempted to use fractal based computational design to create something architecturally familiar, yet wholly new, the research of this thesis instead took a different approach. Using fractal based design to revisit the architectural heritage of Gothic, allowing the thesis to explore not just the technical aspects of this, but also the broader cultural implications, reconsidering what this architectural style represented to Western society historically, and its reimagined relation to modern society.. The development of this thesis occurred over the course of three major phases, the *‘Research’* phase, the *‘Exploration’* phase, and the *’Refinement’* phase.

The Research phase is defined by the analysis of both traditional Gothic architecture (tracery in particular), and select rituals from traditional Christianity, thus establishing a historical context in regard to modern society, and from this a criterion for success. The revelation of fractal-esque geometries as an emergent property in traditional Gothic, consequential of its nature sourced inspirations and method of design, made their inclusion no less important. The opportunity existed then to explore a new Gothic, using fractals as the foundation for doing so. This gave singular importance to the use of fractal patterns, the success of their utilization could be gauged in relation to how well they secularized the Gothic aesthetic, informed by secular standards derived from traditional Christendom. The thesis thus illustrated these concepts by developing a new Gothic architecture, ‘*Vitrine-Gothic’*, demonstrating the technical practicality of the tools it developed, in relation to the cultural relevancy of their secular architectural qualities.

The *‘Exploration’* phase was subsequently the pure technical development of a digital toolset, and design approach. Early in this phase, a secular Gothic based on fractal generation and manipulation was demonstrated to be a success, though expressed in only two dimensions, the concept and toolset used to create it were proven valid. Thereafter the bane of this exploration was translating these patterns into the third dimension. The most successful approach was the *‘Mapping Method’*, which worked within the constraints of the 2D patterns, instead of abstracting them. Though it did present several of its own limitations, limited to rectangular 4-pointed surfaces, and limitations around joining multiple surfaces. In light of this, the method was successful

at preserving the aesthetic integrity of the 2D patterns, while also allowing greater degree of design freedom than the comparable methods.

The *‘Refinement’* phase implemented these tools and pipeline in the development of the final pavilion, intended to demonstrate their adaptability, and versatility to meet site and user requirements, answering the second thesis aim of a secular & spiritually informed space. The success in this phase, of merging the technical knowledge with the secular user requirements, was largely due to the degree of freedom the designer had over the tools. This was also due to the ease of use and speed of the developed tools, which helped facilitate the creation of a wide range of designs in pursuit of the secular user requirements. This created an architectural language that could respond to cultural implications, in both its aesthetic, and functionality design. The final pavilion proved their validity by situating itself in a real world context, illustrating the adaptability of this research to integrate itself into the cultural and architectural context of a given site.

In summation, this thesis successfully explored the concept of a *‘new secular Gothic’ (‘Vitrine-Gothic’)*, in both technical and aesthetic terms, the culmination of this work was expressed in the form of a final pavilion. The qualities of the developed tools made it possible to express Gothic in secular terms, and be informed architecturally by secular user requirements. The result was a pavilion culturally relevant to the greater society it finds itself in, both aesthetically, and functionally. The thesis suggests the merging of digital tools and traditional architecture can be used to re-examine the fundamentals of traditional architecture in terms of aesthetics, function, symbolism, etc , adjusting these to suite the requirements of modern society.

Further Research

The concept of a secular fractal based Gothic was thoroughly explored throughout the thesis with a specific focus on tracery, from this several opportunities arose in which the thesis could have explored, though due to time constraints it could not. These are;

-This thesis explored Gothic tracery in a secular fractal manner, but extend these tools to the development of glazing it housed. An opportunity for further research is a fractal based approach to the design of stained glass murals, in terms of their aesthetic development, and symbolism / subjects they could potentially depict.

-One of the issues that arose from this research was the transformation of 2D fractals into 3D space, for a time this became a major roadblock. However, the opportunity exists to explore a secular Gothic using fractals native generated in 3D space, bypassing the translation issue, while opening up a wider range of design possibilities more that would likely be more expressive in 3D space.

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