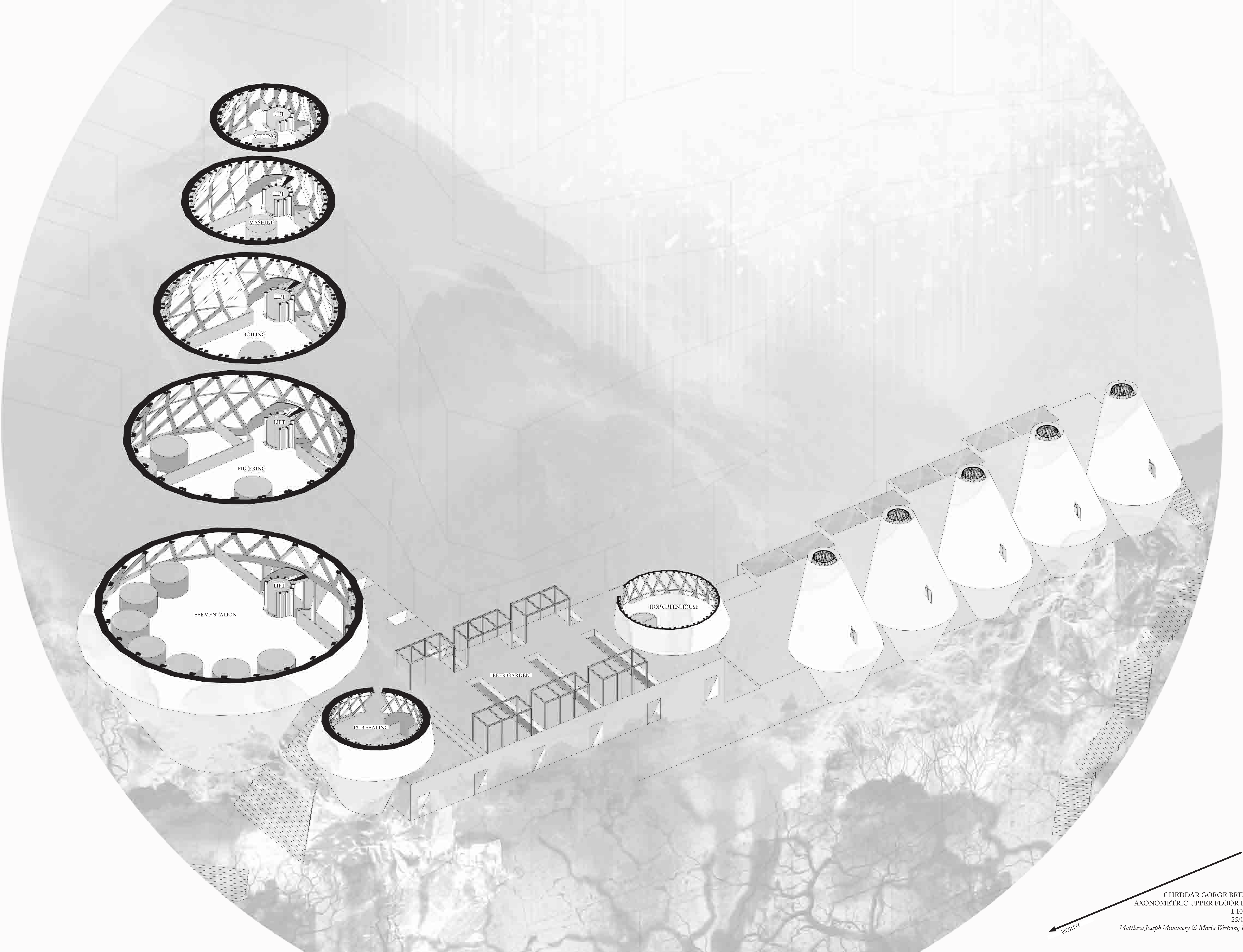
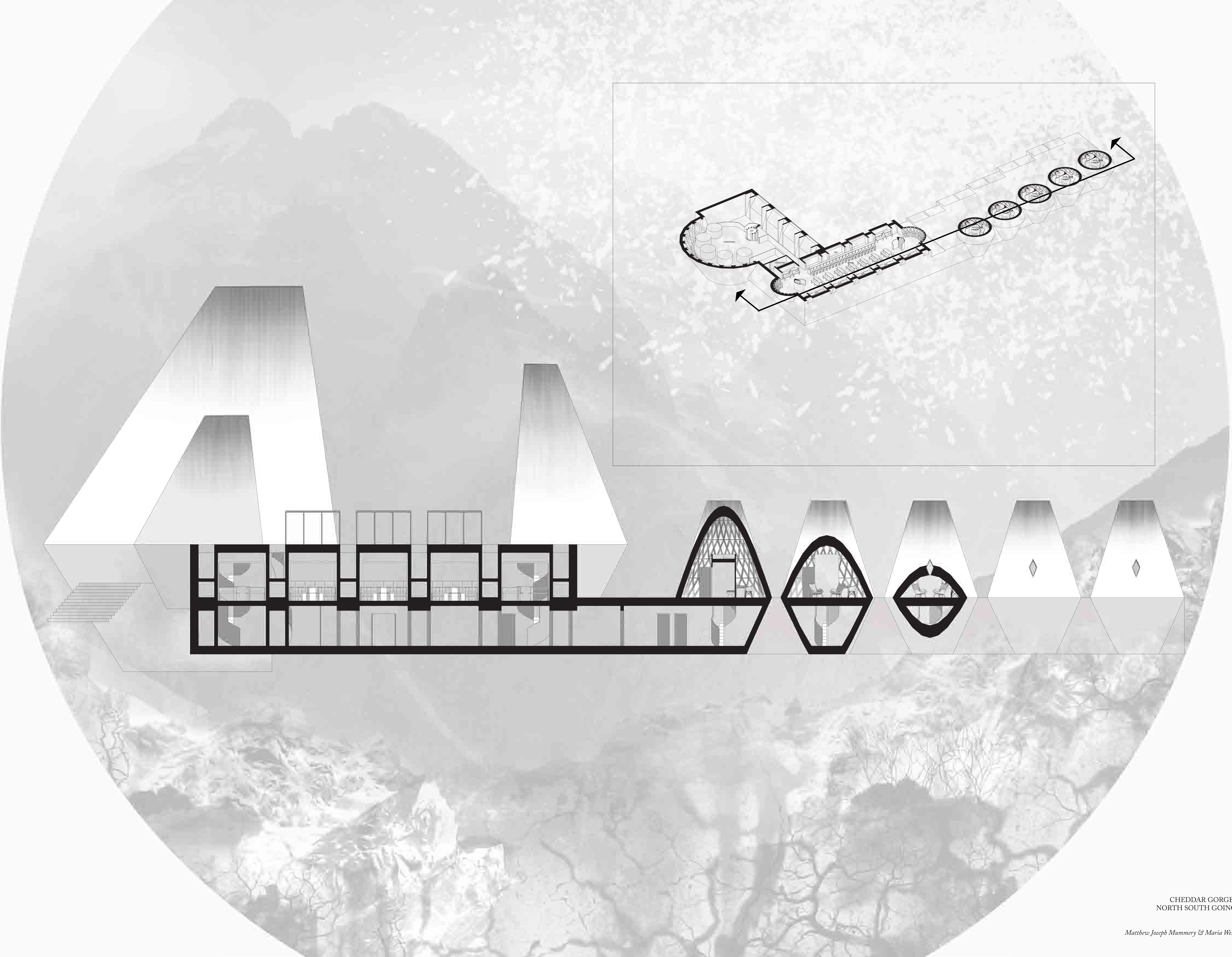
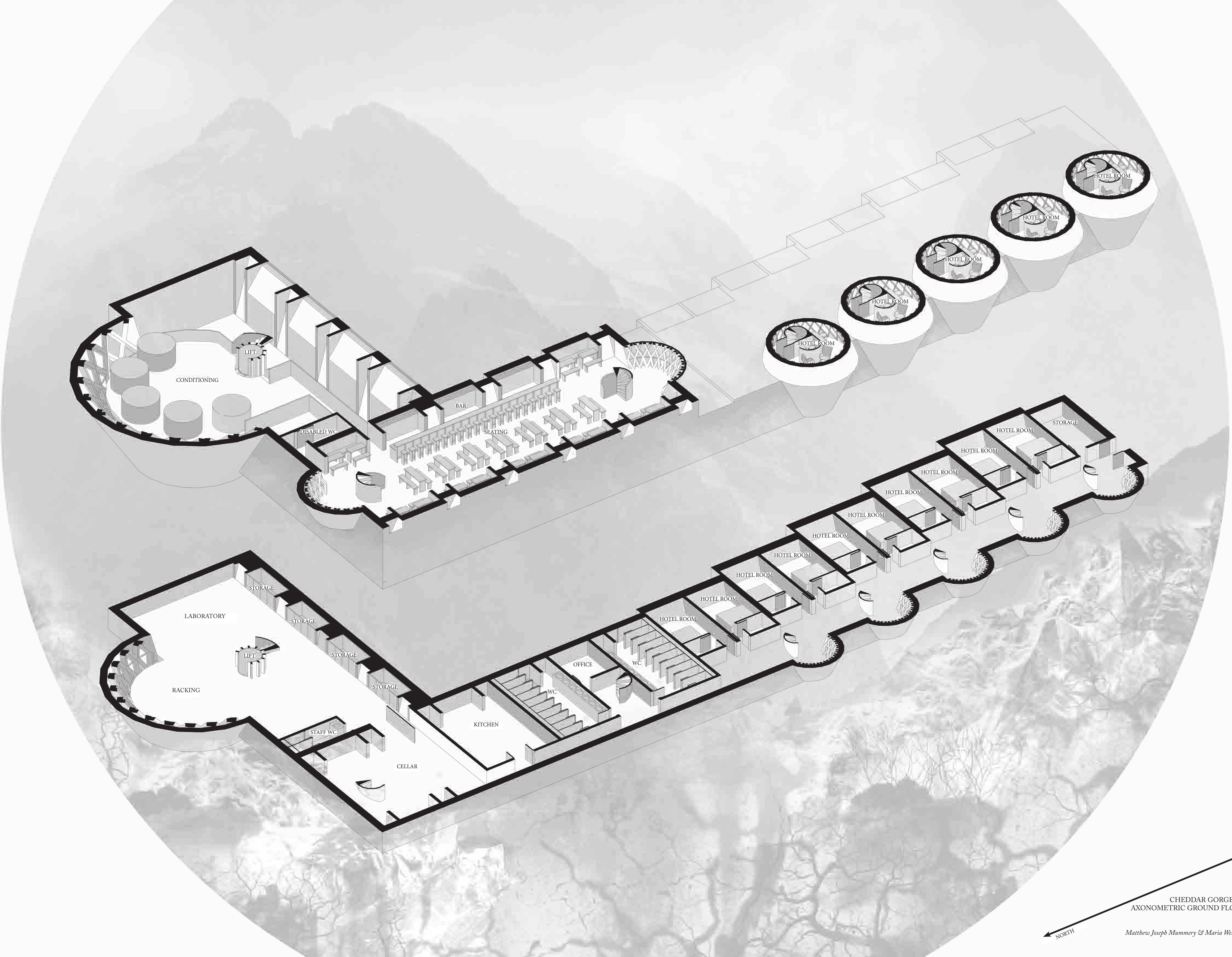


CHEDDAR GORGE BREWERY
AXONOMETRIC UPPER FLOOR PLANS
1:100 @ A1
25/05/2015
Matthew Joseph Mummery & Maria Westring Heilberg



CHEDDAR GORGE BREWERY
NORTH SOUTH GOING SECTION
1:100 @ A1
25/05/2015
Matthew Joeeph Mummery & Maria Westring Heilberg

CHEDDAR GORGE BREWERY
EAST WEST GOING SECTION
1:100 @ A1
25/05/2015
Matthew Joseph Mummery & Maria Westring Heilberg



CHEDDAR GORGE BREWERY
AXONOMETRIC GROUND FLOOR PLANS
1:100 @ A1
25/05/2015
Matthew Joseph Mummery & Maria Westring Heilberg

No5
PRESENTATION

Matthew Joeseph Mummery

Maria Westring Heilberg

The following images are intended to represent the project in its physical and emotional form. The primary medium employed is watercolour paint, which was chosen for its expressive qualities. The watercolour images have been combined with a rendered digital model to provide a well defined and accurate physical form. The images are presented in the order which a user would be likely to experience the spaces in the hope that it provides a sense of the journey to and through the building. The text is aimed at providing a link between the final project and our theoretical study.

TERRITORY, VISUAL RANGE & ESCAPE

A conflict arising in a social environment represents a hazard to our safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations through a clear demarcation of territory. This could be achieved with large open spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and movable properties, these properties extending to the larger space.

"It can now be observed that seeing and hiding have a unique complementary role to play in all these 'primitive' activities. But the spontaneous appraisal of the landscape can only be successful in safeguarding the observer if it is followed by the inducing of anxiety or restlessness which will prevent the creature from relaxing its attention to potential danger until it has found an environment which furnishes the conditions for protecting itself from such danger and, whatever these conditions may ultimately be, they are first apprehended in terms of the ability to see without being seen. Where these conditions are present their perception is attended with pleasure; anxiety is set aside and relaxation is possible. Where they are absent anxiety continues and there is no relaxation" (Appleton, 1975, p. 71)

The above quote, highlights the need for an understanding in the architectural design process of a biological basis for aesthetics is dependent on an environment meeting or seemingly meeting our survival needs, is crucial for designing architecture which allows the inhabitant to dwell. Should a conflict arise in a social environment such as the pub, this would represent a hazard to the visitor's sense of safety, as well as their actual safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the visitor is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. The pub is therefore designed as a large room with a high visual and locomotive permeability, allowing the visitors to immediately detect possible threats to their safety, and escape these at either end of the pub. Furthermore it is possible to minimize confrontations by clear demarcation of territory. This is done in the pub by employing the solid void theory of implying space. Along the walls of the pub, wooden niches have been tucked in to what seems to be the thickness of the walls. By drawing these niches in behind the roof light shafts we underline the demarcation of territory of space belonging to the niche. We have a vision of gloom in the pub, more specifically this vision arises from the notion of prospect and refuge or as Appleton puts it in the above quote, seeing and hiding complement each other in safeguarding the visitor as he dwells in the pub, when the condition of seeing without being seen are present, anxiety is set aside, and the visitor can immerse himself into dwelling. Light and darkness is also a high indicator of mystery and will according to the theory encourage the subject to explore as well as the darkness of the shadows and the gloom in the pub, also can be used as a retreat to sit and see without being seen, though always with the prospect of being able

APPROACHING THROUGH THE GORGE

Most visitors to the gorge travel from the east, gradually descending into the gorge and winding their way down to the caves. Due to the nature of the gorge, views are revealed suddenly, appearing as one turns the corners in between the steep cliff faces. The first encounter with the building is from this perspective and shows the pods perched on the rock. Their form is intended to evoke imagery of traditional oast houses, yet it also has a more organic quality and the softness, almost mushroom like quality of the form is thrown into relief by the jagged rocks.

to step into the light. In this project we have been working with the quality of light, creating spaces and encouraging exploration through light.

Therefore we created a large open space with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and locomotive properties, these properties extending to the larger space by means of implying space through the usage of light as well as the suggestion of a space through niches into one unified shape.

UNITY & UNIQUENESS

The underlying Habitat theory behind the principle of Unity and Uniqueness suggests that humans have had to develop their information processing ability of the environment in order to compete with other species. Environments that facilitate and stimulate the acquisition of knowledge will therefore be preferred as they are conducive to the preservation of the species.

To gain the initial interest of the viewer the architecture must contain a new variety of complexity, which will be the uniqueness of the architecture, but to maintain the viewers interest, this uniqueness must be derived from the context, which will be the unity.

In terms of architecture this suggests

SITE QUALITIES

This image represents the character of the site in a broad and abstract sense. The southern side of the gorge faces north and is covered in tall slender trees. The rocks are slick with rainwater running off the cliff and dark green moss covers the north facing surfaces. The path is uneven and meandering. As the visitor moves up the path towards the brewery views might be revealed, showing the destination before becoming lost again, only to be revealed once more from a different angle.

that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming part of a connected whole will stimulate us to a greater extent.

The unity between architecture and place offers the architecture its unique character and enables understanding of both the place and the architecture and the architecture thereby becomes the manifestation of place.

Using this knowledge consciously in the design process, the first step to creating architecture is to investigate its context and let the context do the legwork of deciding what foundation would be most suited to the terrain, which building materials would be best suited according to weather, supply and construction limits due to the location, which slope should the roof take to accommodate precipitation, Where should the openings in the building envelope be located according to views, terrain access, heat transmission, energy consumption and ventilation, and so on. The unique character of the design of the architecture should be derived from the context to create the unity with the place. In this way architecture can enrich the beauty of the place by enriching the understanding of the place for the viewer, reading the architecture will be reading the site.

ASCENDING TO ENTER

The path winds its way to the top of the plateau, where the building sits, partially hidden by the mass of the rock. The path continues to the top of the concrete base, which forms a space for the beer garden, bordered by the pods. Approaching the building the stairs become squeezed between the two pods and as one reaches the top of the stairs a view is revealed down the gorge to the west, to Cheddar reservoir and beyond. This view is framed through a series of frames which carry hop vines and define spaces in the beer garden in a way that resonates with the design of the pub below.

The need for an understanding in the architectural design process of a biological basis for aesthetics is dependent on an environment meeting or seemingly meeting our survival needs, which is illustrated in the theory crucial for designing architecture which allows the inhabitant to dwell. Gaston Bachelard (1994) considers the word dwelling; *"to dwell as in to reside, to dwell on a thought or a subject, in dwelling we create dwelling places"* (Bachelard, 1994, p. 4) by extension we could argue that it is not the dwelling that creates the place, but that it is the specific character of that place that allows for dwelling.

"The basic act of architecture is therefore to understand the "vocation" of the place. In this way we protect the earth and become ourselves a part of a comprehensive totality. What is here advocated is not some kind of "environmental determinism". We only recognize the fact that man is an integral part of the environment, and that it can only lead to human alienation and environmental disruption, if he forgets that." (Norberg-Schulz. 1980, p. 23)

We have immersed the architecture into its specific site of Cheddar Gorge, by being highly responsive to the context of the gorge, uncovering the meanings present in the environment by making the context the focus in the design, the design explains the context and makes

THE PUB
After descending the spiral staircase one finds oneself in a room that is layered with a tapestry of light and shadow. A series of light shafts allow sunlight to penetrate to the centre of the room, whilst niches carved from the walls hide from the sunlight. A warm light is reflected down at either end of the room, coloured by the copper cladding that directs it downwards. This creates anchor points where the pods rise up, activating the central space and providing a passage back to the beer garden.

its character manifest.

To intrigue and create an initial fascination for the architecture, a certain degree of unity with the specific location of a construction is needed, recognizing the fact that man is an integral part of the environment. This unity arises from the uniqueness of the location. By communicating and being sensitive to the uniqueness of a location, the architecture has become a manifestation of the place, where before there was only the wholeness off the gorge, a corner has now become a place, reflecting the specific character of that place and thereby allowing for dwelling.

More specifically we have in the design expressed the sensitive geology by carefully choosing the place to dwell within the gorge, one of the few plateaus of the north-facing cliff face, we have chosen the north-facing cliff face as it is the only one of the two gorge cliff faces that does not suffer from rock slippage. Furthermore the weather of the area is reflected in the inspiration taken from the vernacular architecture of the area, as well as the rhyme on the traditional and the character of the gorge engages the active system of exploration, the act of gathering further information about the environment. This rhyme on the traditional architecture nudges the

A VIEW TO THE BREWERY
The brewery is adjacent to the pub, beyond a tall, slender doorway illuminated by a light shaft. The passage frames the spiral staircase of the brewery but provides little information of the space in which it rises. This creates a sense of mystery and intrigue

relationship between human beings and the larger whole. Rather than being a rhyme that encourages the viewer to conduct further investigation by fascinating because its complexity is not yet classified, the architecture will not only be momentarily interesting as it is connected to the larger whole. We thereby create a highly preferred scene that facilitates understanding through coherence through exploration, an exploration initiated through the mystery created even as the visitors just arrive at the gorge.

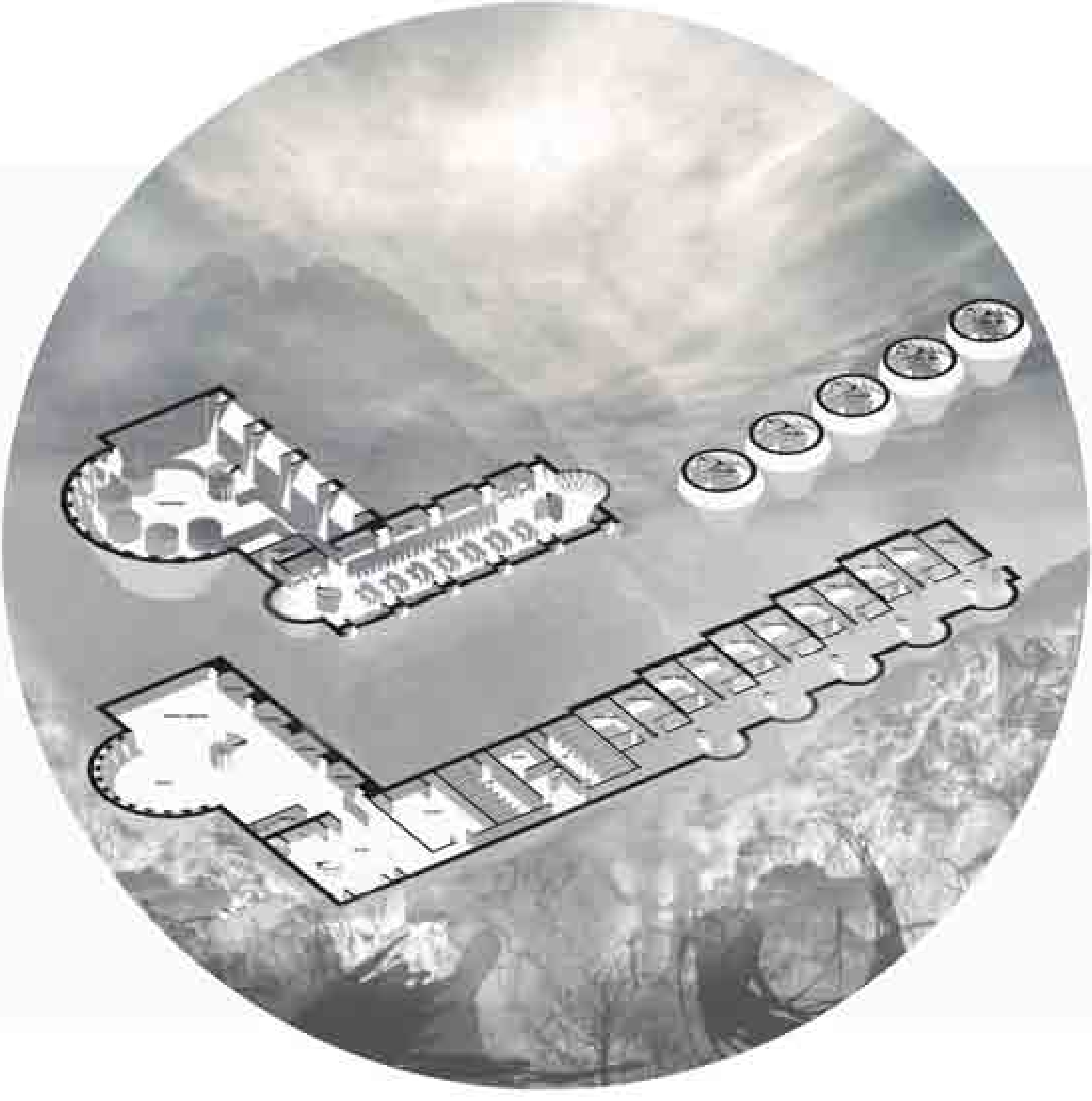
EXPLORATION

A conflict arising in a social environment represents a hazard to our safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations by clear demarcation of territory. This could be achieved with large open spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and movable properties, these properties extending to the larger space. An analysis of the social space is necessary to determine in which

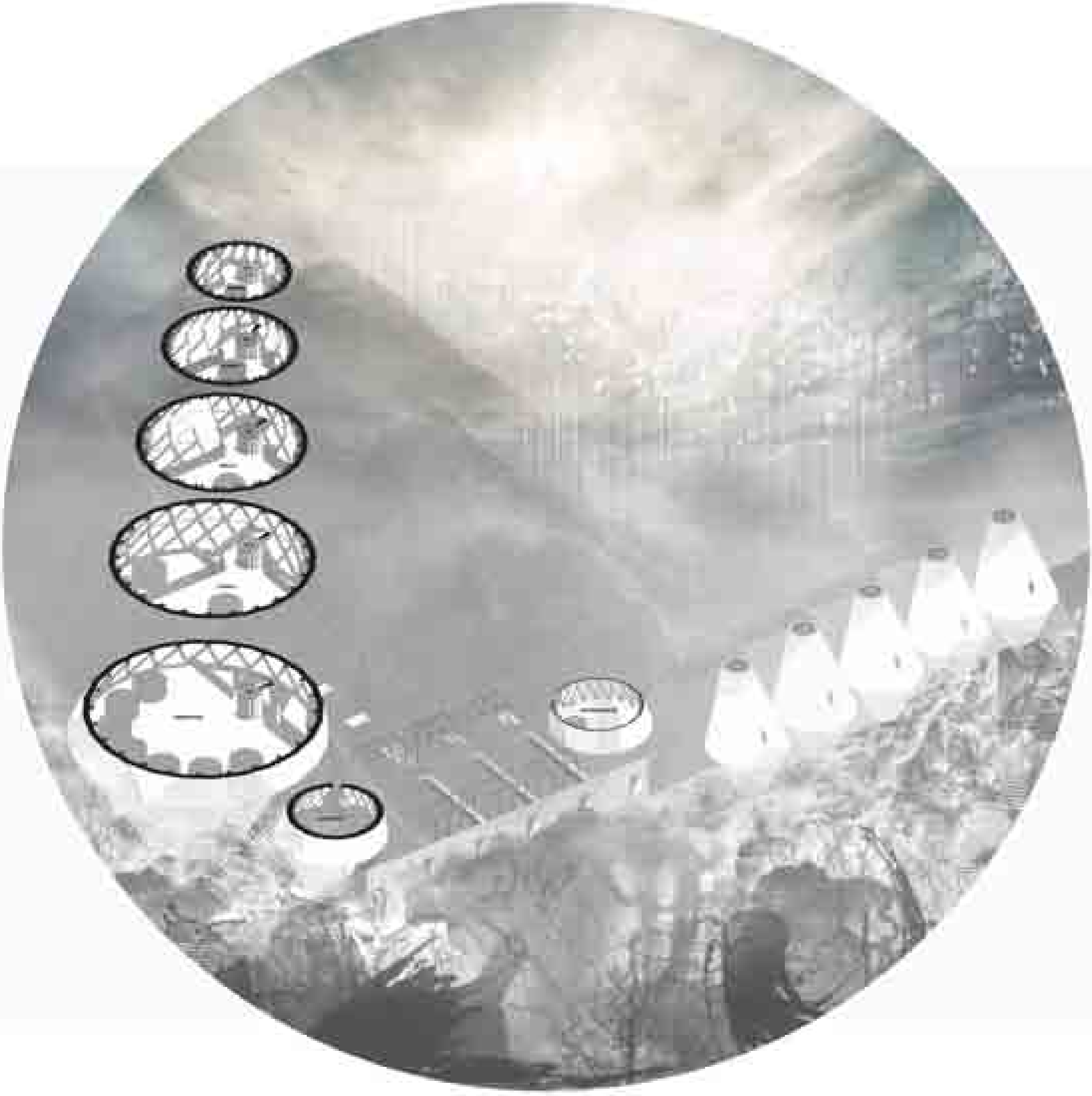
THE TOWER BREWERY
The tower brewery rises up from the double height racking hall. A central spiral staircase wraps up to the skylight, from which light is caught and reflected off the copper cladding. Each floor of the brewery contains a step of the process from milling to racking, before the casks are placed in the cellar ready for consumption.

direction it is wished to guide the social interaction. Is the social meeting between strangers or people very familiar to each other, is the activity of an extrovert or an introvert character or is it a place of transit or pause. Knowing the preference for space aids the understanding of how to achieve the appropriate mindset for the activity taking place within the architecture.
From all this information it is down to the skill of the architect, to connect the dots of all the gathered knowledge from the context and synthesizing it into one unifying shape.

As the user moves through the gorge and towards the site, they mentally connect visual cues from their surroundings to their needs and expectations. The satisfaction and richness of their experiences are largely the result of the ways in which these connections are made. By implementing denial and reward we encourage this formulation of a rich experience. By designing paths of travel, we at first present the visitor with a view of the brewery pods up upon the cliff plateau, which can be seen from the road as well as a path leading up towards it. As the visitor ascends the pods will momentarily be screened from view to then be revealed from a



AXONOMETRIC GROUND & FIRST FLOOR PLANS



AXONOMETRIC BREWERY PLANS

This render simply shows the view from the hotel rooms to the cliff face which looms above. Our intention was to create a sense of awe by highlighting the steep rise of the rock above the building. The sloped wall leads the eye upwards to an awe inspiring view which is visible even when the guests are lying in bed.

different angle. Rather than leading the visitor the shortest way up the cliff we divert the visitor onto an unexpected path to create additional intrigue or even momentary lostness by leading the visitor onto a path following the gentlest slope up the cliff side, to then reward them with other interesting experiences and views of both the gorge and the brewery. By having the visitors do this additional work, the journey becomes more interesting and intriguing, the arrival thus more rewarding.

To encourage and underline the sense of mystery rather than surprise, surprise that could involve danger, it is important to maintain a certain degree of coherence in the architecture that allows the visitor to hypothesize as to what he might discover. A continuity that creates inference to accompany exploration, without the inference, the mystery might be read as a possible surprise. It has therefore been key to this project to maintain a simple concept throughout the building. This is created through a simple concrete base partly submerged in the rock providing all horizontal circulation. Vertical circulation is handled through the spiral stairs within timber pods. All the pods are different to each other and yet all the pods are the same. They are a rhyme upon each other, but similar enough to be recognized as the same.

This section shows the connection between the pub, the brewery and the cellar. The brewery process occurs in the larger pod, with the brewing materials taken to the top before allowing gravity to do the work as the beer flows from floor to floor and finally into casks on the ground floors.

We thereby release all fear of surprise the visitor might have towards the vertical circulation of the compound by using the pods a main entrances to the pub.

The principle of exploration can be employed to guide the user in and around the environment. Using the principle of exploration, we direct the movement of the user, without giving the user the feeling of being herded like cattle as well as informing them of the functionality of the compound. Mystery is the guiding factor that makes the user want to go where they are meant to go, we lead the visitor from the point of which we know they will most likely visit when arriving at the gorge, the mouth of the caves all the way up and in to the heart of the pub, where its possibilities unfold to the visitor.

PERCEPTIBLE KNOWLEDGE

From the point of view of habitat theory, the quality of an environment being clear enough to read, furthers the survival of the inhabitant in the simple sense that it contributes to further understanding. This clarity can provide confirmation of the safety, resources or potential danger of the environment. The perceptible knowledge of a structure is not just the craftsman's ability to build a sustainable structure,

From left to right this section shows the pub room situated below the beer garden and above the cellar. The lower level is illuminated by light shafts that draw light and allow views in an area which is partly below ground level. The hop green house in the centre of the section houses a staircase that provides passage from the beer garden to the pub, to the service spaces and the hotel rooms. The

but also his ability to convey this skill. Crafting a structure that allows the viewer to read the knowledge of the specific means by which the crafter obtained structural stability. This quality is characteristic in the detailing of structure as well as the architecture as a whole, which can provide a reassurance that allows us to put our minds at ease and focus on satisfying other biological needs, or indeed do the exact opposite. This ease and reassurance is obtained through the design process of detailing the structure both in compliancy with the architecture as a whole, the certain properties of the specific material and the way in which the detail conveys the forces of the structure. Before choosing the construction material it is necessary to know what type of force there will be inflicted upon the material and equally important the architect will need to know what- and how much knowledge the viewer should gain from the construction. What is the feeling that is provoked by the architecture upon the viewer?

By communicating the conveying of forces as well as the material properties of the construction elements in a visible and perceptible method, we bring forth knowledge to both ensure the safety and understanding of the structure.
The quality of an environment being clear enough to read furthers the

survival of the inhabitant in the simple sense that it contributes to further understanding. This clarity can provide confirmation of the safety of the environment, resources or potential danger.

Besides from being a rhyme on the traditional and vernacular architecture the pods encompass the character of the place, carefully thought out in regards to the site, the context, its functionality, the structural system and the legibility or the perceptible knowledge of all this, such as: The material properties of the wood that the pods are constructed off are grown locally and are thereby highly suitable for the climate, the relative lightness of the wood allows for a tall and elegant structure, the responsive dimensioning of the timber elements, both conveys the internal forces as well as it plays with the perspective as the viewer looks up at the structure from within making the structure seem taller and the members more slender than they are. This perspective is also underlined from the exterior as the pods lean in toward the cliff face behind to make the pods seem taller than they actually are. Despite this manipulation of perspective, the scale of the pods is brought down to embrace and comfort the dweller via the small scale of all the building elements. Keeping all the building elements small in scale also eases the building process as nothing is prefabricated on a larger scale. The copper cladding underlines the warmth and comfort of the shelter within the pod as well as the reflective surface increases the light within the pod, reflecting the warm light down the winding stairs to underline the mystery and intrigue that stimulates exploration.

To contrast the experience of the pods and underline the ascent that the pods represent, the main pub room is situated partly underground. This is conveyed as perceptible knowledge, through the massiveness of the concrete walls, the mass of which is exaggerated by the niches and the design of the light intake. The light intake in the submerged parts of the compound are primarily designed as skylights with a sloping surface, both to increase the diffuse light as well as give the illusion of even thicker walls. Lastly the sloping surface guides the eye up and allows the viewer to look out without craning his neck. This frames the cliff tops all around the gorge, providing views that eliminates all manmade things in the gorge.

All these things give the architecture what we might call a unity with its environment, it makes the architecture seem as though it is a part of and have been developed out of the elements of its environment by means of forces at work within that environment.

The research by the Kaplans forms the basis for the necessity of the presence of all four principles of preference in an artificial environment of architecture: To engage higher order thinking or just to awaken interest for a building it must have at least a degree of Unity and Uniqueness, without it, the subject will feel no need to investigate the architecture in its immediate dimension. After catching the interest of the viewer the designer might require the subject to engage further with the architecture. To provide the viewer with enough confidence to do so the architecture should have a high degree of 'Territory, Visual Range and Escape' and 'Perceptible Knowledge'. These will assure the viewer about his ability to orientate himself and suggest that the setting will continue to be understandable, whereas 'Exploration' is the preference that encourages the viewer to further explore the scene, with its promise of more information.

No2
PROGRAM

CONTENTS

INTRODUCTION

PRELIMINARY INFORMATION

This report represents the work undertaken during the second half of the long masters thesis at Aalborg University. It documents the design of a brewery in Somerset, England, and our efforts to implement some theoretical ideas that are a product of the reseach phase of our thesis, which was completed during the first semester and documented in a separate report.

Our first semester work was an exploration of the theories and theorists that examine the idea of a biological preference for architecture. That instantaneous reaction to a space, where a split second decision determines how we feel about it, before a conscious and rational decision is made. This report is intended to document our own exploration of the subject through design, using some of the ideas that we have processed during the research phase.

The project itself is the design of a brewery in Cheddar Gorge, Somerset, England. Alongside the theoretical ideas we bring with us from the research phase, we have chosen to focus on tectonics rather than sustainability, although our building will of course meet the building energy standards. A brewery is a natural choice for such a project, albeit not an obvious one, as it will require us to balance the theoretical with the functional and will force us to reconcile an industrial process with the homeliness of a brewpub through a holistic and tectonic approach to design.

The selection of Cheddar Gorge as the site for the brewery was determined by a desire to build in a location that emphasised the comforts of a pub through contrast with the sublime terror which the sheer cliff faces of the gorge induce. The idea being that never has the warmth and comfort of being inside been more appealing than when we are observing it from an inhospitable landscape.

PRINCIPLES OF PREFERENCE

The principles of preference developed throughout this master thesis are not meant to be used merely as an analytical tool, but rather as a design tool. Maintaining an awareness of the principles of preference in the design process is the only way to consciously apply and therefore use the knowledge from the theoretical report in the artificial environment as a form finding tool.

The systematic and theoretical analysis of the methods applied through this design process will therefor be heavily guided by the theoretical part of this master thesis. According to the principles of preference the viewer of the architecture should, in abstract form, be capable of reading all the contextual data gathered and analyzed in the program and the design process in general. It is worth repeating at this stage that the principles of preference are rules only in the sense that the architect must know them before they can be broken.

The gathering of data, throughout the design process should therefore be linked back to the physical form of the architecture in question as well as the data's possible impact upon the principles of preference.

UNITY & UNIQUENESS

The underlying Habitat theory behind the principle of Unity and Uniqueness suggests that humans have had to develop their informational process ability of the environment in order to compete with other species. Environments that facilitate and stimulate the acquisition of knowledge will therefor be preferred as they are conducive to the preservation of the species.

To gain the initial interest of the viewer the architecture must contain a new variety of complexity, which will be the uniqueness of the architecture, but to maintain the viewers interest, this uniqueness must be derived from the architectures context, which will be the unity.

In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming part of a connected whole will stimulate us to a greater extend.

The unity between architecture and place offers the architecture its unique character and enables understanding of both the place and the architecture and the architecture thereby becomes the manifestation of place.
Using this knowledge consciously in the design process, the first step to creating architecture is to investigate its context and let the context do the legwork of deciding what foundation would

be most suited to the terrain, which building materials would be best suited according to weather, supply and construction limits due to the location, which slope should the roof take to accommodate precipitation, Where should the openings in the building envelope be located according to views, terrain access, heat transmission, energy consumption and ventilation, and so on. The unique character of the design of the architecture should be derived from the context to create the unity with the place. In this way architecture can enrich the beauty of the place by enriching the understanding of the place for the viewer, reading the architecture will be reading the site.

PERCEPTIBLE KNOWLEDGE

From the point of view of habitat theory, the quality of an environment being clear enough to read, furthers the survival of the inhabitant in the simple sense that it contributes to further understanding. This clarity can provide confirmation of the safety, resources or potential danger of the environment. The perceptible knowledge of a structure is not just the craftsman's ability to built a sustainable structure, but also his ability to convey this skill.

Crafting a structure that allows the viewer to read the knowledge of the specific means by which the crafter obtained structural stability. This quality characteristic in the detailing of structure as well as the architecture as a whole can provide a reassurance that allows us to put our minds at ease and focus on satisfying other biological needs, or indeed do the exact opposite. What and how much is the structure supposed to communicate, this will need to be answered in the design process, before the detailing of the architecture can commence.

This ease and reassurance is obtained through the design process of detailing the structure both in compliancy with the architecture as a whole, the certain properties of the specific material and the way in which the detail conveys the forces of the structure.

Before choosing the construction material it is necessary to know of what character the forces inflicted upon the structure will contain, where the forces will be applied and in what direction they will react. According to the principle of perceptible knowledge, the choosing and visual usage of the material will also rely on; what- and how much knowledge the viewer should gain from the construction. What is the feeling that is wished provoked by the architecture upon the viewer?

TERRITORY, VISUAL RANGE & ESCAPE

A conflict arising in a social environment represents a hazard to our safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential *confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations by clear demarcation of territory. This could be achieved with large open spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and movable properties, these properties extending to the larger space.*

EXPLORATION

To further engage the viewer in exploration of the architecture the presence of mystery is required, mystery is simply the promise that more information could profitably be acquired. This keystone in human functioning is recognised not to be a passive system, on the contrary human beings actively seek out additional information. Exploration and the act of gathering further information about the environment is an omnipresent human necessity in terms of broadening our perspective.

The insinuation of surprise, though it is a promise that more information could be acquired, is not the same as the insinuation of mystery, as the surprise does not allow the viewer to hypothesis within reasonable probability about the risks involved by gaining the information. Fear of the unknown is conducive to survival.

In the design process, surprise and fear of the unknown, can be developed and moulded into mystery through the insinuation of the architecture. This insinuation can be produced by perceptible knowledge in the structure, Territory, Visual Range and escape in the spatial enclosure and the overall faithfulness of the architecture to the principle of Unity and Uniqueness. These are the design tools that will provide a reassurance of continuity

From all this information it is down to the skill of the architect, to connect the dots of all the gathered knowledge from the context and synthesising it into one unifying shape.

Employing the principles of preference throughout the design process, can assist in the creation of a highly preferred artificial environments, evoking emotions appropriate to the given context.

DESIGN BRIEF

The project scope is to have a design proposal for a Tap house Inn ready to apply for planning permission located in Cheddar Gorge, Sommerset, England. The function of the Tap house inn will be that of a brewery with the capacity to brew 10.000-20.000 litres of beer a week, further specifics about the spatial requirements for the project can be found in the spatial program.

The expectations for this project is to raise awareness for Cheddar Gorge as a possible trip destination and to encourage visitors from further away to pay the gorge a visit. It is wished to create this encouragement both by highlighting mans roots and traditions associated to this place as well as the opportunity to stay at the gorge overnight.

Financially the brewery is meant to be self sustainable, with the potential for expansion, but by combining the brewery with its own tap house situated within the gorge, the brewery products lends on the massive exposure from the caves as well as its nearness to the local community.

The connection between the site and the architecture should aim to be associated as one. It is important that the tap house in becomes one with its setting, to achieve a maximum gain from the many tourists visiting the show caves, a trip to the tap house in should be almost as important as a visit to the caves, to say that you have visited Cheddar Gorge.

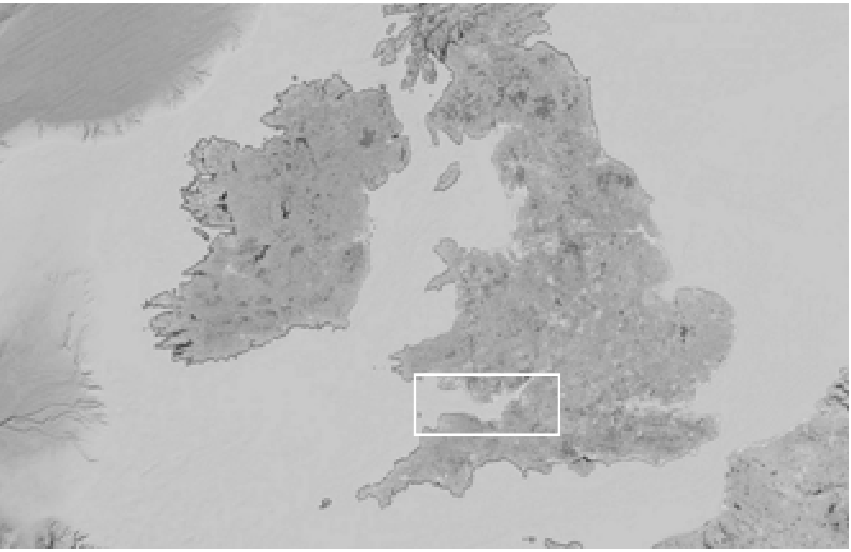
There is a challenge to be met in the user group, as this is a highly family oriented destination, for this purpose we wish to tap in to all the traditions surrounding the pub as a community hub, rather than a place to get drunk.

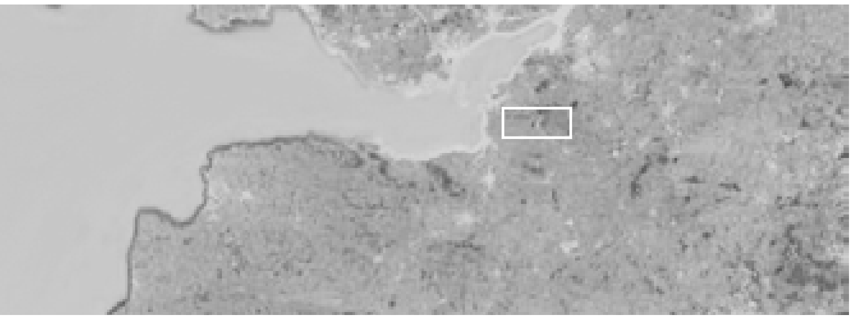
The largest part of the visitors to the gorge, comes either as a group of friends seeking to enjoy the outdoor adventures of the gorge or as families walking the hiking trails and visiting the show caves, what they all have in common is that almost all of the visitors to the gorge arrive by car, and therefore must leave by car. It is therefore important to create an environment encouraging responsible drinking or at least being capable of offering the visitors to stay overnight.

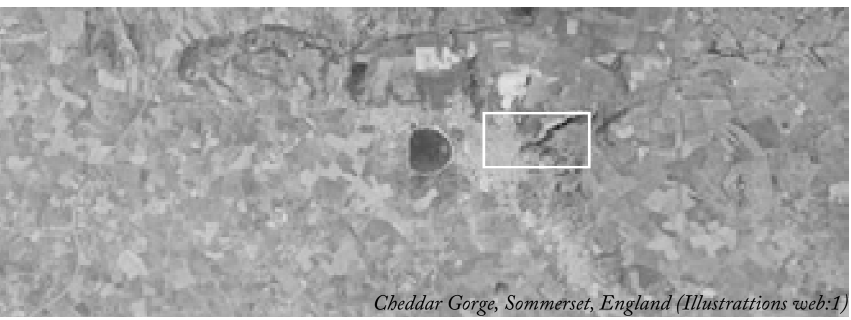
The budget for this project are to be considered only as large as the arguments for spending the money is good. The architecture should be worthy of the site and this project is therefore not considered to be a low budget project, on the other hand it is expected that any high cost decisions will have an equally good reasoning and argumentation behind it.


orge Inn
WORTH
TRADITIONAL BEERS
Accommodation

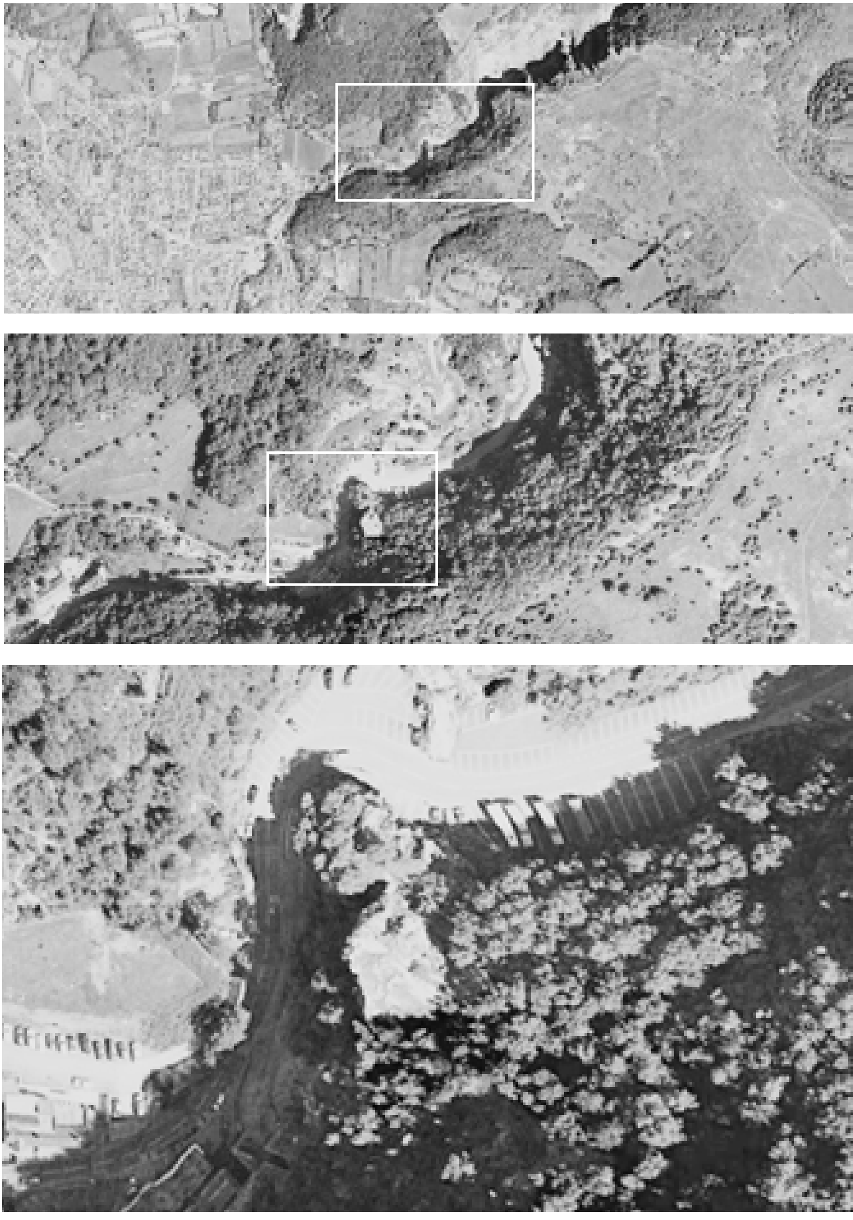
LOCATION







Cheddar Gorge, Sommerset, England (Illustrattions web:1)

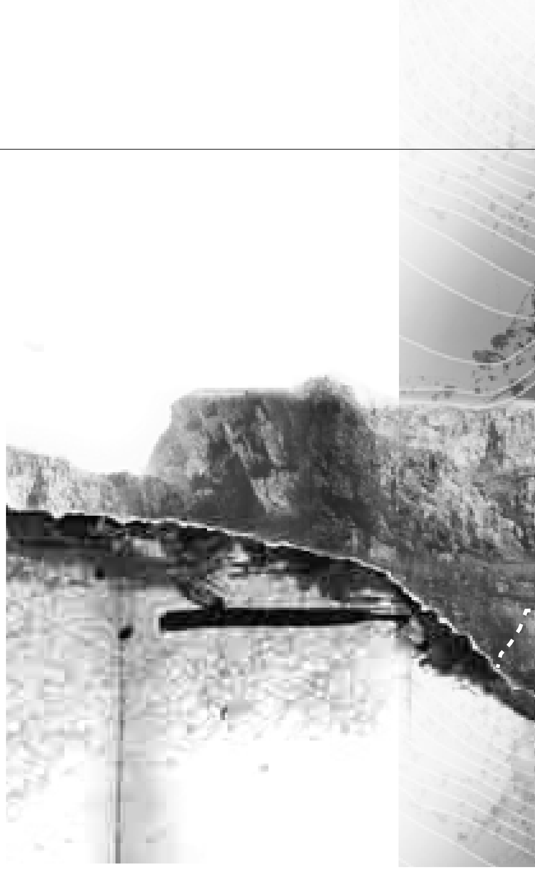


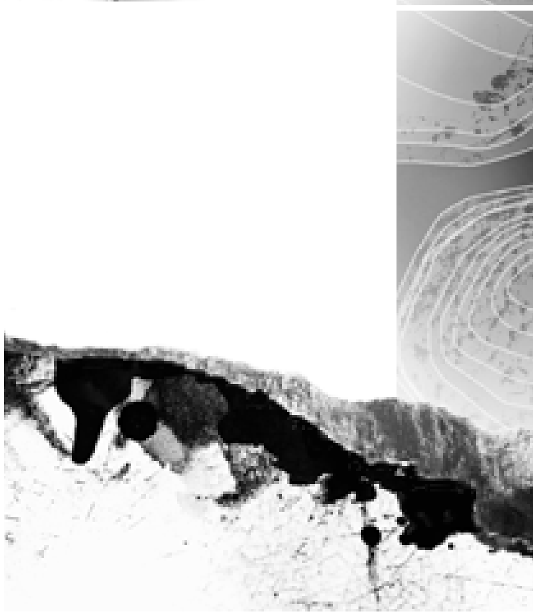
SITE SECTION

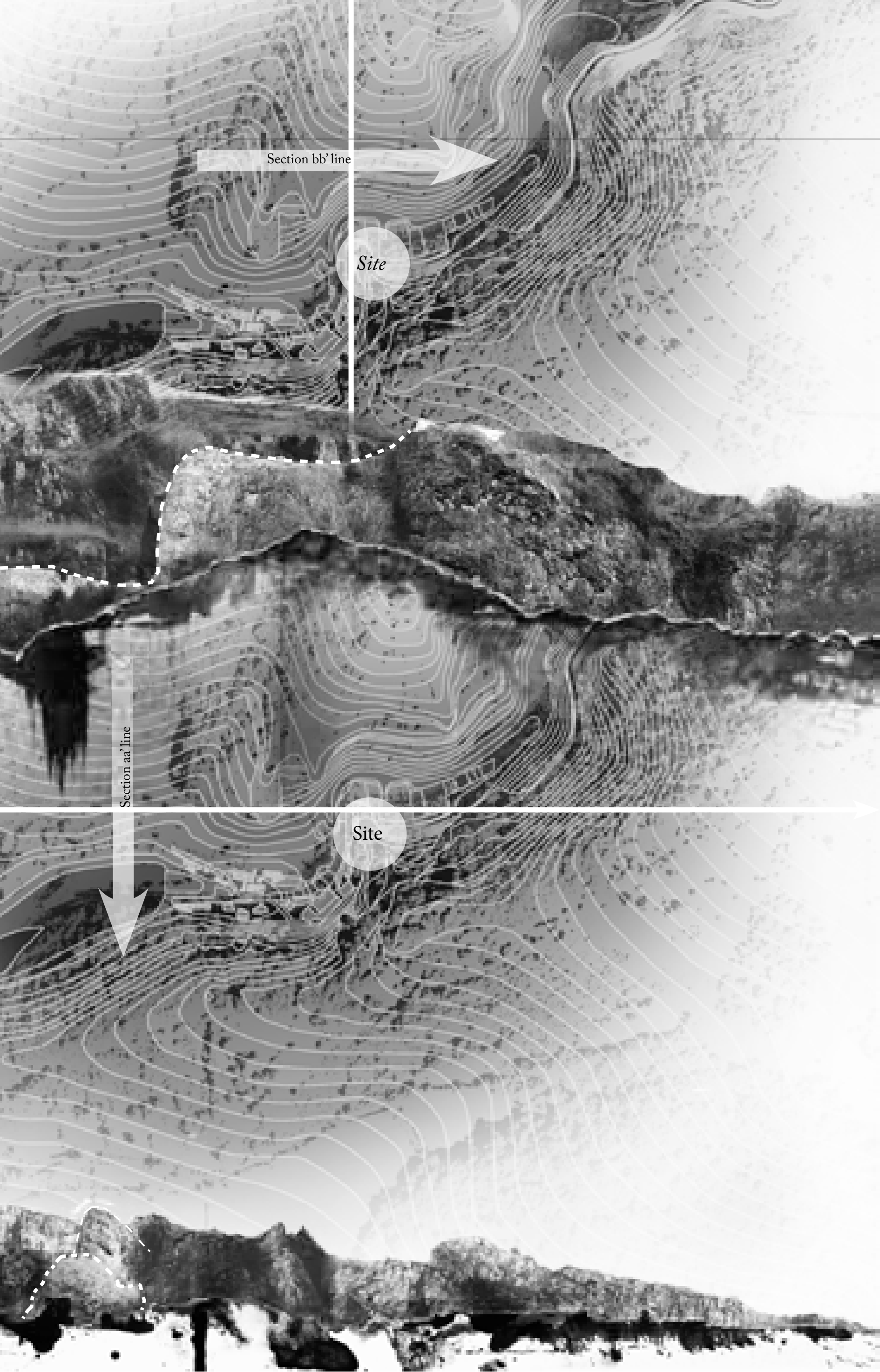
The site chosen is a rocky outcrop located at the lower end of the gorge, near to the entrance to Gough's cave. The site is bordered by a road and car park on its north, east and west sides, and by a cliff face to the south. However, due to the sheer cliff face the site is elevated 14m above the level of the road and therefore has a sense of separation from the traffic below. The site is essentially a plateau half way up the cliff face, which slopes gradually towards the entrance to Gough's cave.

The site clearly presents many challenges in terms of construction and access, however it also presents opportunities to meet these challenges with creative solutions. The elevation of the site allows excellent views up the gorge to the east and towards Cheddar in the west. The brewery will primarily be using gravity during the brewing process and so the height of the cliffs is beneficial, this will be discussed further later in the report.

These sections illustrate the character of the site. Section aa' illustrates the separation of the site from the road and pavement below, as well as showing the cliff faces rising behind the site. It also shows the line of sight from the site out to the lower end of the gorge and beyond to Cheddar reservoir. Section bb' illustrates the geology of the gorge with the north side sloping at 20° down to the road but the south side rising steeply above and sloping away from the road, creating the plateau that we intend to build on.







Section bb' line
Site
Section aa' line
Site

SITE PANORAMAS

1

This is the view that most visitors will have when they first arrive in the gorge. Having made their way down through the winding gorge, the cliffs will open up into a wider space and the site will sit directly in the centre of their view, flanked by sheer cliff faces on the left and the more gently sloping hills on the right.

2

This view is shown from a similar location in the gorge but shows more of the context and the way the winter sun highlights the tops of the cliffs whilst the road and pavement stays in shadow. This presents an opportunity as the brewery will be in the sun at this time of day, highlighted on the top of the cliff whilst the rest of the gorge remains in shade.

3

The third panorama shows the narrowest section of the site sloping upwards toward the plateau shown in the previous panoramas. The slope starts by the entrance to Gough's cave and rises at a 20° angle to meet the plateau.


1
2
3

SITE PANAROMAS

WIND AND PERCIPITATION

WEATHER DATA FROM THE GORGE

Because of the physical shape of the gorge, it is difficult to determine wind behaviour on the site. The weather data has been collected from a local weather station situated within the gorge, which should benefit the accuracy of the wind data. The data collection period chosen has been the most recent year between 31st of December 2013 until 1st of January 2015. The most recent year has been chosen due to the current weather changes seen all over the world, leaving earlier weather data less likely. Graphic presentations of the yearly weather data are presented on the next page.

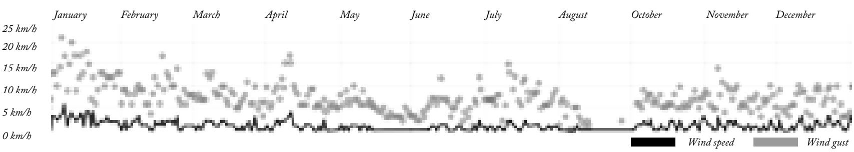
WIND SPEEDS AND DIRECTION

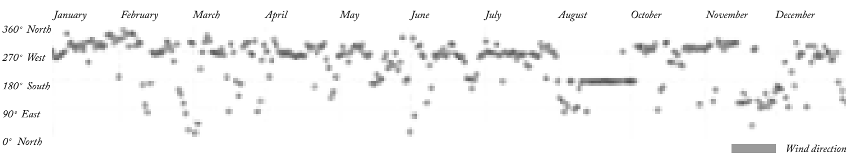
The prevailing wind in the Gorge comes from West-South-West leading the wind directly into the gorge with average wind speeds of 1.6km/h and record wind speeds of 25,7km/h (web:3)

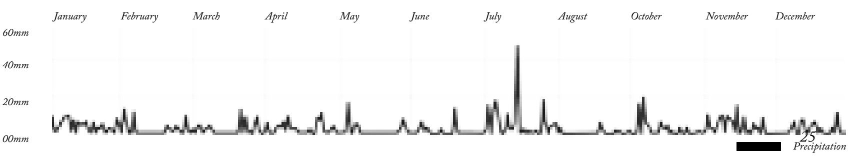
PERCIPITATION AND FLOODING

The average yearly precipitation in the timeframe was 943mm in comparison to the Danish average for the same period, which was 818mm. The geology of the Gorge and the Mendip Hills renders the whole area situated on the lower edge of the gorge prone to flooding. It is investigated which areas are considered in risk of flooding to determine whether this is a factor that needs to be considered in the design process. As the illustration to the right shows, our site is both raised and just outside the area considered in any risk of flooding. (web:2)


W
W.S.W.
S.W.
S.S.W.
S
S.S.E.
S b W.
S b E
S.W. b S.
Areas in risk of flooding


January
February
March
April
May
June
July
August
October
November
December
25 km/h
20 km/h
15 km/h
10 km/h
5 km/h
0 km/h
Wind speed
Wind gust


January
February
March
April
May
June
July
August
October
November
December
360° North
270° West
180° South
90° East
0° North
Wind direction


January
February
March
April
May
June
July
August
October
November
December
60mm
40mm
20mm
00mm
Precipitation

SUN AND SHADOW ANALYSIS

INTERNAL AND EXTERNAL HEAT GAINS
Conducting a sun and shadow analysis will enable us to gain an understanding of where to place spaces of different functions in agreement to internal and external heat gains. This to improve the exploitation of the passive heating and cooling according to the spatial functions internal heat gains or losses and thereby reducing the energy consumptions of the compound.

METHOD
The sun and shadow analysis has been conducted using a laser cut 1:2500 model of the site and the entire gorge context, which could have an impact on the shadow, cast on the site.

Using the model in the Heliodon the sun and shadow cast on the site is simulated.

Three time periods are investigated in each of the four seasons.

7-9 IN THE MORNINGS.
In this time period the kitchen will be serving breakfast and coffee for the guests staying at the B&B as well as early visitors to the Gorge.

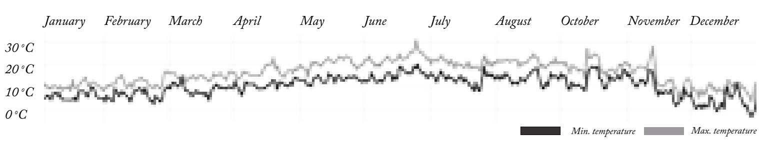
OBSERVATIONS
During summer and spring some sun reaches the east facing cliff side of the rock ass well as the main plateau of the site. During autumn and winter, no sun reaches the site until late afternoon and evening.

12-15 IN THE AFTERNOON
This is expected to be the busiest period for the pub and the internal heat gains are expected to be equally high.

OBSERVATIONS
During summer and spring the west facing cliff side as well as the main plateau will be fairly exposed to any potential sunshine. In autumn and winter only the main plateau is not over shaded by the opposite cliff side.

18-21 IN THE EVENING.
This is expected to be the busiest time for the pub kitchen and the internal heat gains from both the guests and the kitchen appliances are expected to be high.

OBSERVATIONS
During summer, spring and autumn this time period offers a fully exposed west facing cliff side with the following possibility of high external heat gains. During the season of winter the case will be the opposite as the sun sets before 18.00.



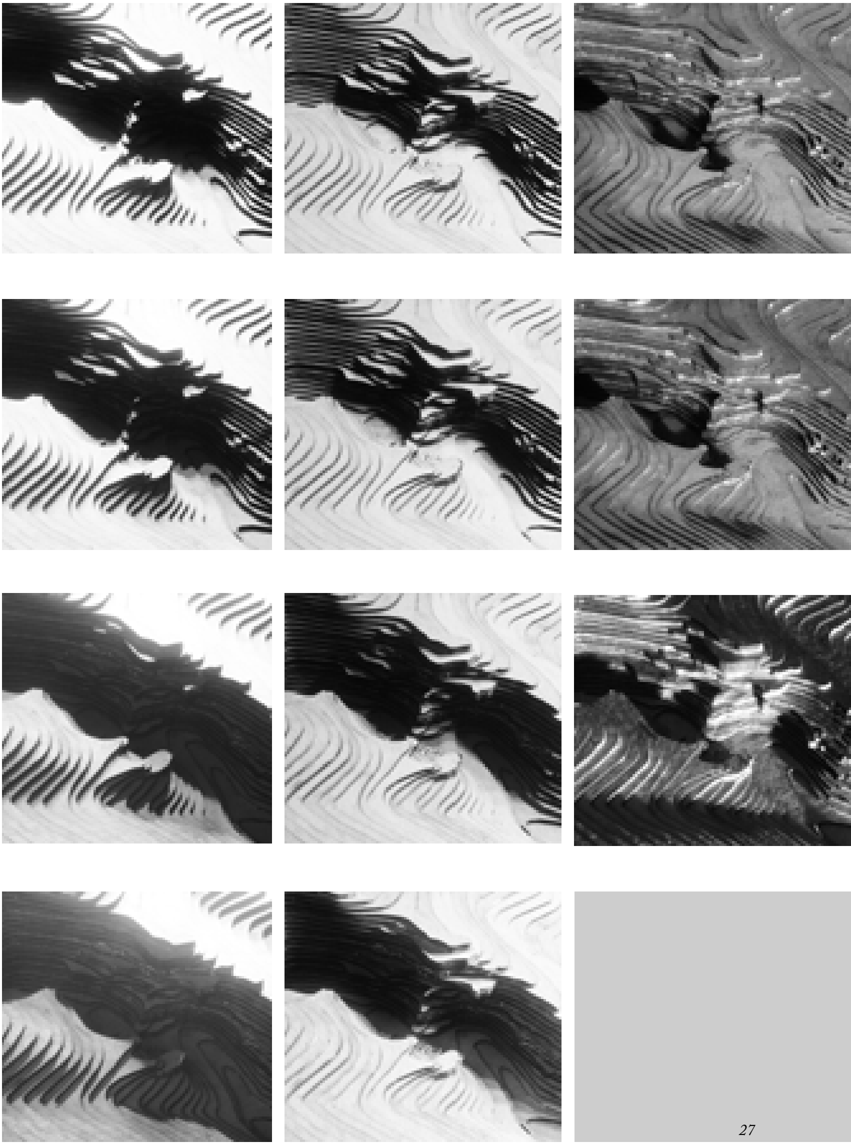
7–9 o' clock *12–15 a clock* *18–21 a clock*

Sommer

Spring

Autumn

Winter



GEOLOGICAL COMPOSITION

THE MENDIP HILLS

Before we engage in the design process, a study of the geology is in order to map the possible influences the geology can have on the construction.

BUILDING ON BEDROCK

There is an old children's song about a wise man that builds his house upon a rock. The bedrock of the Mendip hills from which Cheddar Gorge forms a part is an ideal foundation for a construction. Bedrock does not slide, shift or move and it is impermeable to water runoff and therefor-wont change shape and size in the presence of water, ensuring that the construction wont crack from settling. However some types of rock such as sedimentary rock, especially shale, are not always a safe option to build upon, as sedimentary rock can break apart in time.

GEOLOGICAL MAPPING OF THE GORGE

A geological mapping of the Cheddar Gorge area, show that the rock composition of the gorge consists of two dominating rock types; limestone and Oolite, which are both sedimentary rocks. These are rocks layered in strata which have ben formed by the deposition of mineral or organic particles.

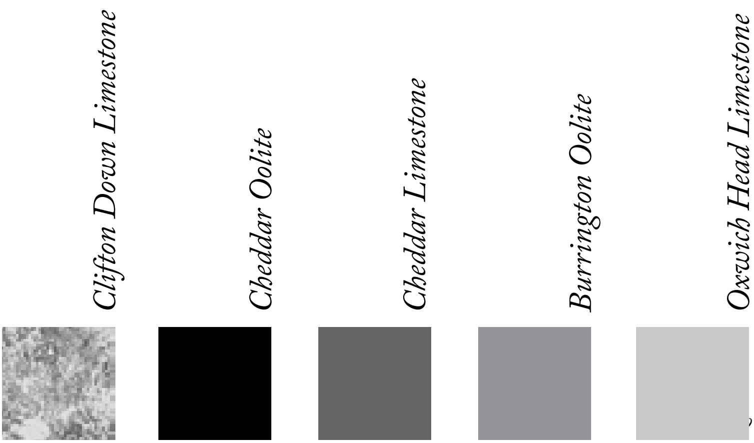
ROCK SLIPPAGE

This could potentially cause problems, both with the terrains ability to support a construction as well as the danger of rock slippage, both under and above the construction.

ROCK SLIPPAGE CAUSED AND PREVENTED BY THE SLOPE OF THE STRATA

The solution or the understanding lies in the shape of the gorge itself. The cliff side furthest to the south is steep, almost vertical, whereas the cliff side furthest to the north has a much gentler slope with clear signs of rock slippage. The explanation to the characteristic differences is to be found in the strata, which has a 20-degree slope to it. This inevitably causes rock slippage on the northern cliff side whereas gravity prevents any slippage from the southern side, explaining why this side has remained its steepness over the millennia. (web:4)


Strata Section Line
Site
Geological Mapping of the Cheddar Gorge Stone composition

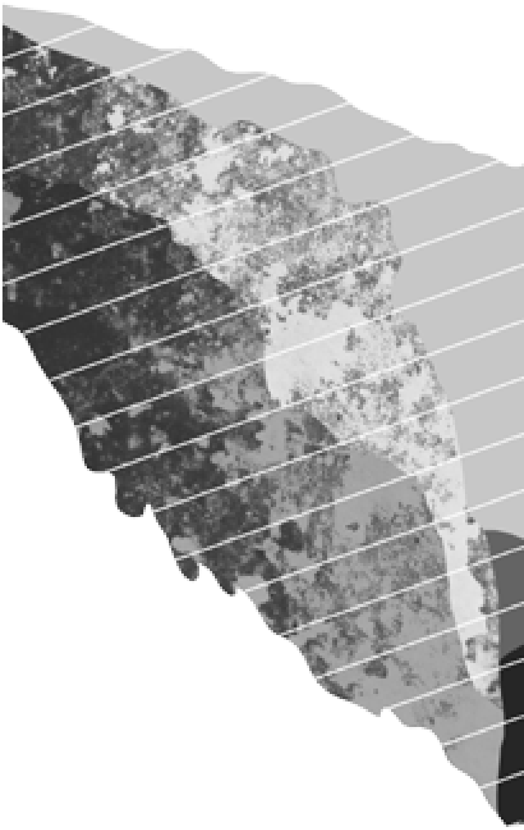

Clifton Down Limestone
Cheddar Oolite
Cheddar Limestone
Burrington Oolite
Oxwich Head Limestone

GEOLOGICAL IMPACT

The geology of the Cheddar Gorge bids us to place our construction on the southern cliff side, as rock slippage will prevent any possibility of building on the northern cliff side. The rock slippage also eliminates erecting a construction at the bottom of the gorge, as the size of the rocks falling from the northern cliff size can be immense.

Erecting a building on the almost vertical cliff without horizontal support could prove difficult if not impossible, as the limestone can be brittle in vertical layers as well as the strata layer, because of the rain filtering down through the stone. A building hanging on the side of the cliff could shift the balance of resting rocks.

One of the few areas of the southern cliff side with a plateau, offers the potential of a secure place to construct a building, easy access to the building, visibility, parking and as everywhere else in the gorge, beautiful views.

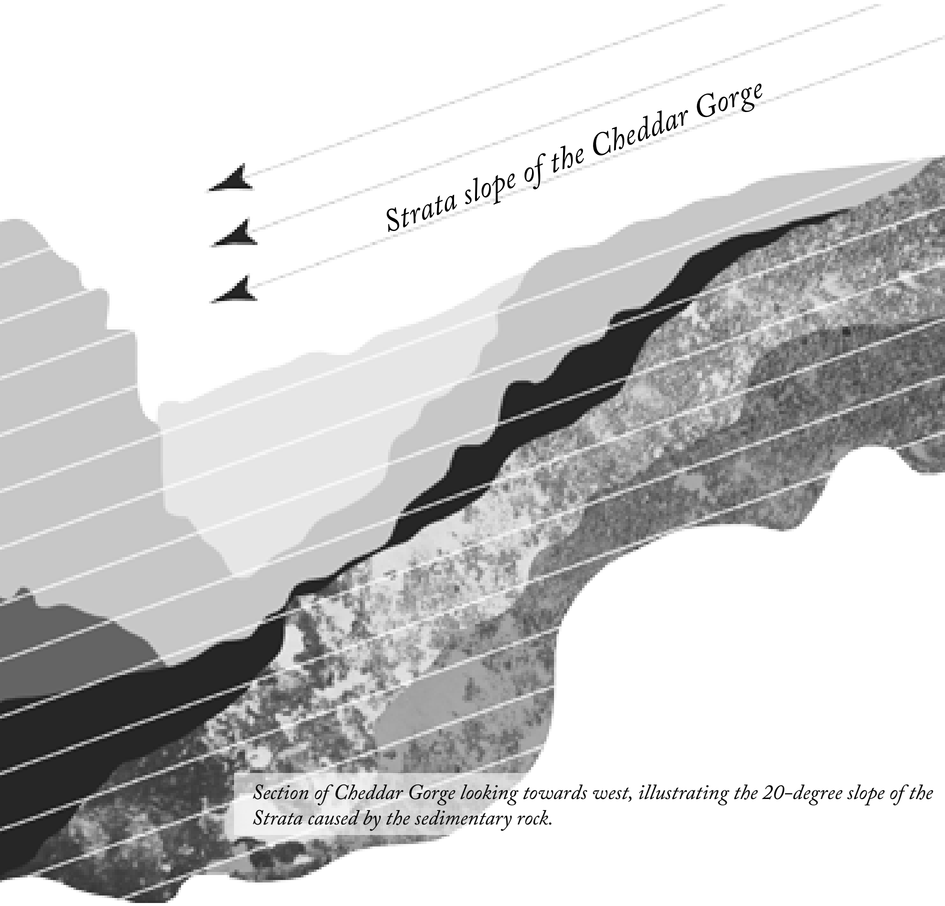


NON SLIPPAGE TO THE SOUTH

Rock slippage is prevented as the sedementary nature of the limestone makes rock break loose in its bed layers. Gravity lets the rock and its slippage lean in on itself, making slippage highly unlikely.

SLIPPAGE TO THE NORTH

The sloping strata of the limestone lets the rock slip off the cliff like books of a tilting shelf.



Section of Cheddar Gorge looking towards west, illustrating the 20-degree slope of the Strata caused by the sedimentary rock.

SITE FUNCTIONS

1 *The gorge is a very popular tourist destination and is organised accordingly.*

2 *The site is located to the east of the existing buildings in the gorge and the site boundary is illustrated here.*

3 *Only one road runs through the gorge, but splits when it reaches the lower end. The road is a single carriageway but becomes very busy in the summer and in some areas there is only room for one car to pass.*

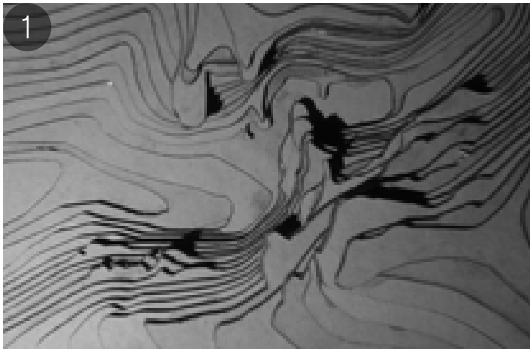
4 *The gorge is amply supplied with car parks, four public car parks are illustrated here, however there is further provision to the east and west.*

5 *A small village sits to the west of the site. The village is primarily comprised of small gift shops and several holiday cottages. The largest building is located outside the entrance to Gough's cave and contains a gift shop, information centre, offices and a coffee shop.*

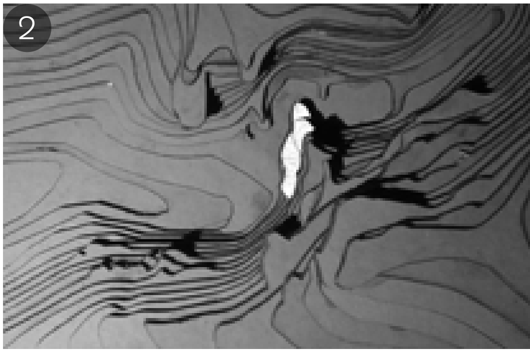
6 *The river springs from the mouths of the caves and runs east towards Cheddar via a millpond.*

7 *There are two cave entrances in this area of the gorge. The largest is Gough's cave to the east and the smaller is Cox's cave to the west.*

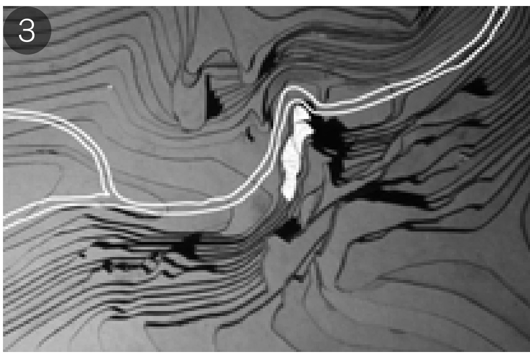
8 *There are two major hiking trails in this area although the two can be combined into a six mile loop.*



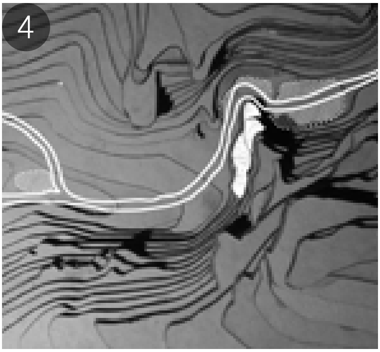
A scale model of the gorge



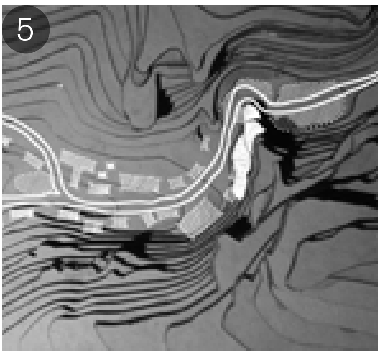
The site boundaries



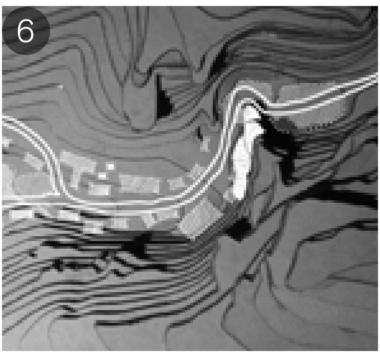
Roads in the gorge



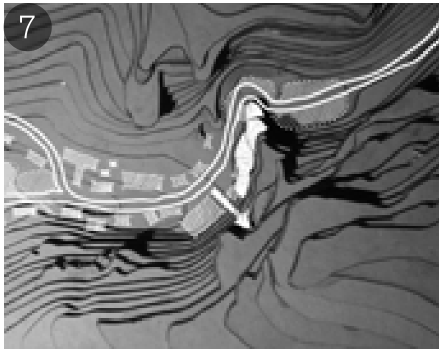
Car parks



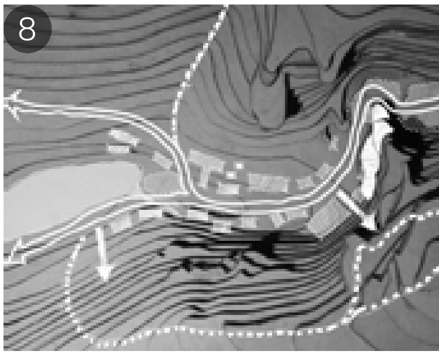
Buildings



The river



Entrances to the caves



Hiking trails

SITE SELECTION

USING ANALYSIS TO IDENTIFY A SITE

Having gained knowledge about the geology of the gorge, we rule out the possibility of attaching the construction on the vertical cliff surface as the force could pull the resting rock loose. We therefore start investigating the potential of the southern cliff side plateaus.

ACCESS

Transport, deliveries and access are a necessity for the brewery and pub to run as a business. Placing the pub and the brewery on one of the upper level plateaus could create a beautiful and remote setting for the architecture, but at the same time a substantial number of infrastructural issues arises as no roads leads to the upper parts of the gorge, only rough and muddy hiking trails.

This in it self contains a certain amount of charm. A remote pub could serve as a pits stop along the hiking route. It could also potentially ruin the point of a hiking trip as well as the ethical complications connected with giving drunken people vertical opportunities.

CONNECTIVITY

Choosing one of the lower plateaus closer to the main entrance gives the pub the advantage of connectivity. Competing with the costa coffee café, becomes easier as the choice between the two does not include a two mile hike up hill, as well as it doesn't exclude any of the many visitors to the gorge. The user groups of the gorge might set out in different directions, but they all start and end around the main entrance. The connectivity to the main entrance gives the pub the largest amount of exposure as possible.

VISIBILITY

The slightly raised plateau near the main entrance also offers visibility no matter what side of the gorge the visitor is arriving at.

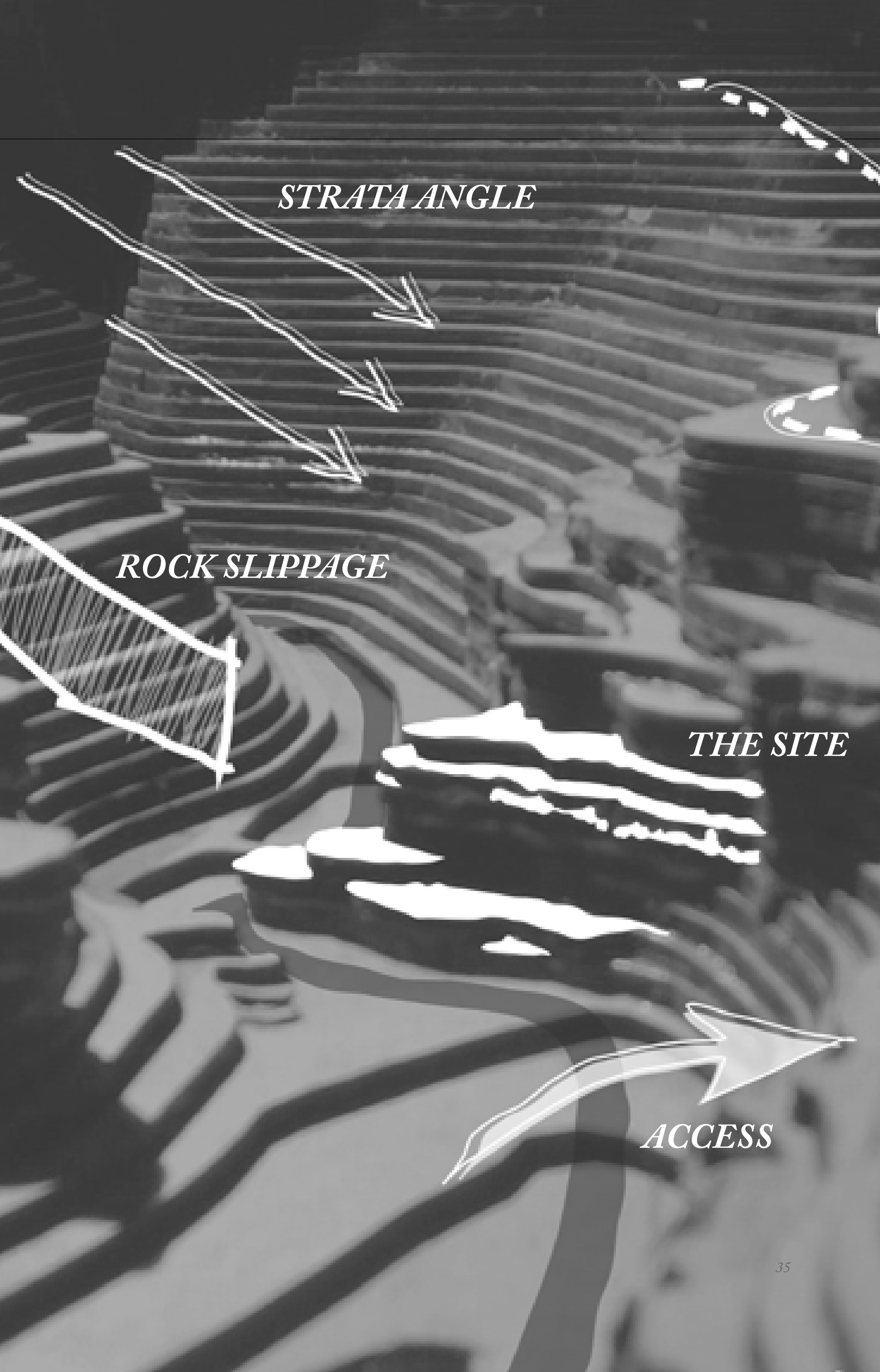
RESPECTING THE GORGE

Placing the brewery deep in the gorge, in a remote site untouched by humans, would contribute immensely to the architecture. On the other hand we believe that this is the wrong point of perspective, we should be asking what the architecture can contribute to the site and truth be told we believe that anything man made would steal away the natural wonder of the place, which is the reason for its 500.000 visitors a year.
Choosing to build in connection with the main entrance enables us to contribute to the site, without imposing on the natural beauty of the gorge, since this area of the gorge has been inhabited and moulded by humans for centuries.

PRECIPITATION

The Gorge is prone to flooding and does so often. Building on ground level would thereby demand for us to take precautions, such as raising the building. Using the natural raised plateau rather than building another seems much more straightforward.

The site finally chosen also offers the benefit of a natural slope from road level too the plateau, making access clear and easy.


STRATA ANGLE
ROCK SLIPPAGE
THE SITE
ACCESS

HISTORICAL CONTEXT

ROYAL BEGINNINGS

Cheddar gorge has historically been a place of great significance. The town was at one time the seat of royalty when King Alfred built a palace adjacent to a site of Roman occupation in the 9th century. However, in the 13th century royal favour for cheddar faded as the nearby town of Axbridge grew in local importance and cheddar faded once again into obscurity. The lands were subsequently owned by the church from the 13th to the 16th century. Following the reformation they were acquired by Sir John Thynne of Longleat and the south side of the gorge remains part of the Longleat estate to this day, while the north side is in the possession of the national trust. Despite its decline in importance Cheddar remained in the nation's collective memory through tales of a vast mystical cave chronicled by medieval writers.

CHEDDAR CHEESE: A COMMUNITY ENTERPRISE

The town's unfortunate decline was not mirrored by its most famous product; cheddar cheese, which enjoys an international reputation to this day. The cheese was traditionally produced communally using a common land for grazing cattle. Each livestock owner was paid a fair share for the amount of milk they contributed to the process. The pure spring water that issues from the foot of the gorge was ideal for watering the pastures that kept milk yields high. However, the Enclosures Acts of the 19th century put an end to the communal prosperity of Cheddar, which was replaced by private ownership and the town fell into poverty.

THE DISCOVERY OF THE SHOWCAVES

In the 19th century the fortune of the town were to rise once more, as the fame of the gorge and caves increased through the publications of prominent writers and journalists. In 1837 Cox's Cave was discovered by accident and the tourism potential was seized immediately by George Cox, who opened the cave to the public. In 1869 the town's fortunes took another turn for the better when it was connected to the Great Western Railway, by 1886 the line brought five trains full of passengers a day to the gorge, remaining in operation until 1963. The gorge rapidly became a popular tourist attraction, with no shortage of visitors there was clearly a market for further tourist attractions. In 1869, Richard Gough, George Cox's nephew retired in Cheddar and acquired the rights to open a new cave to the public, now known as Gough's Showcave. Gough invested heavily in the exploration of the cave, extending it and revealing new chambers.

PRESENT DAY CHEDDAR

In the 20th century other attractions such as Jacob's Ladder and a lookout tower were added to the gorge.

In 1927 the lease granted to the Gough family in 1877 expired and the Cheddar Caves and Gorge company, owned by the Marquess of Bath took over the running of the attractions in the Gorge. In 1934 a three hundred seat restaurant was opened at the entrance to Gough's Showcave. The building is uncompromisingly modern and the horizontal slab composition is designed to emphasise the verticality of the cliffs. The building now houses a coffee shop, gift shop and offices. Tourism in the gorge peaked in the 1950s and has since been declining. Efforts are being made to attract more visitors to the gorge primarily through the building of a cable car from the town to the top of the cliffs. However, planning permission has yet to be granted and the project remains in limbo.

Cheddar cheese has continued to be produced much in the same way as it was before the 19th century, minus the communal enterprise. The craft of making Cheddar cheese has long history and strong sense of tradition, the cheese is still matured deep inside Gough's cave.

THE IMPACT OF THE BREWERY

Cheddar Ales began its artisanal brewing in October 2006 and has grown to a brewing capacity of 30 000 pints a week, which is still considered to be brewing at a 'micro' scale. Much like the producing of Cheddar, the brewery has a strong sense of tradition and all the beer is hand crafted. The brewery is currently housed in a warehouse on Winchester Farm, 10 minutes drive from the Gorge. However, they are currently planning to expand into purpose built accommodation in the Gorge, the spiritual heart of Cheddar's craft industry.

The expansion of the brewery will include increasing the capacity to a weekly production of 43000 pints, with room for further expansion, whilst the premises on Winchester Farm will be retained and converted into a malthouse producing malts for Cheddar Ales and other local breweries. Alongside the brewery expansion Cheddar Ales will open their own brewery tap pub as well as Bed and Breakfast accommodation for visitors to the Gorge.

The brewery will bring jobs to the local area as well as tourists who wish to stay within the Gorge itself. Retaining a strong sense of the history of communal enterprise and artisanal craft traditions is a priority for the brewery. The site chosen is in the heart of the gorge and as such it is important to balance the need for a bold statement with the brewery with a sensitivity to the context, which is an area of outstanding natural beauty. (Carter:2014)

HISTORY OF THE PUB

A COMMUNITY HUB

The origins of the pub lie in the introduction of Tabernae or travellers inns first introduced in England during Roman occupation. Since its introduction the pub, in its many guises, has become a stalwart of community based values and a forum for democratic debate. Indeed, the pub has long been a cradle of democracy; Thomas Paine wrote The Rights of Man in the Old Red Lion in London, and Devlin's Bar in Dublin was a rallying point for Michael Collins and the fight to regain Ireland's independence. The working class of Wales, Scotland and England met in Chartist pubs to organize their protest to win the right to the universal vote. The pub has been influential in great works of literature from Chaucer's Canterbury Tales to the origins Shakespearian theatre. The pub remains the heart of democracy in the UK as one of the few places where people from all walks of life socialize as equals.

The pub facilitates companionship that can change ones attitude and relieve anxiety with its atmosphere, it can provide an escape from daily stress even though the pub does not provide privacy, on the contrary. Engaging others in conversation, whether acquainted or not is a right within the pub environment and it is viewed as a Duty to accept the engagement (Cavan:1966).

Sigmund Freud praised the pub as being indispensible for a healthy mind and as a setting for some of life's indispensables, discussion, friendship or romance, and a place to study the foibles of one's fellow humans. In its long history, the pub has developed many traditions, some more eccentric than others. When someone chooses to drink in a pub they forfeit their right to avoid having a conversation, it is common for strangers to buy each other drinks. The pub provides a clear set of services to those that use it, good beer and good company. (web:6)

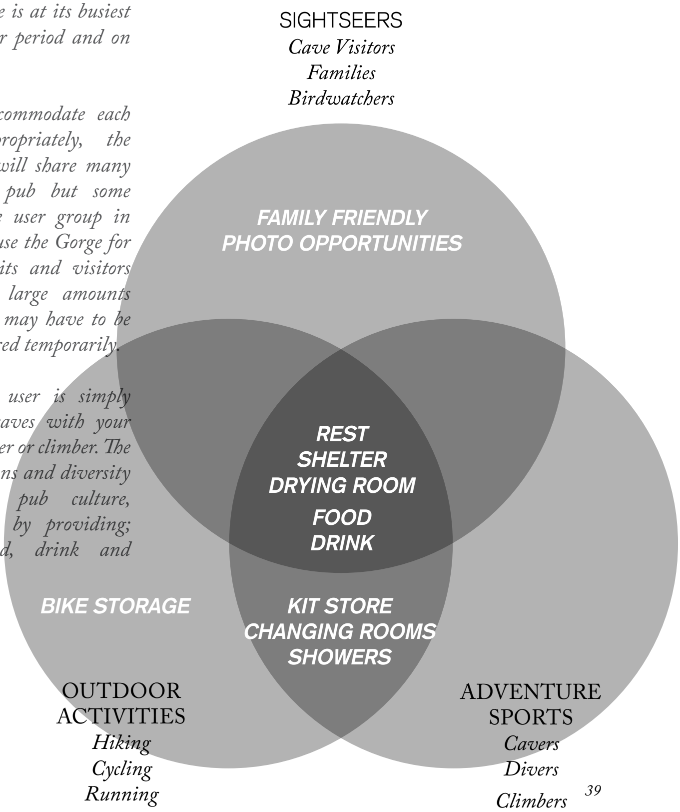
THE SOCIAL CONTEXT

THE VISITORS TO THE GORGE

Cheddar Gorge is visited by over 500 000 visitors every year, 80% of whom visit the show caves. The majority of the visitors are tourists, who are visiting the gorge for the first time and are staying within 30 miles of Cheddar, however there are also visitors from the local communities. Most visitors to Cheddar Gorge are between 25 and 44, often coming with their children. The Gorge is at its busiest during the summer period and on holidays. (web:5)

The pub must accommodate each user group appropriately, the different visitors will share many functions of the pub but some will cater for one user group in particular. Many use the Gorge for recreational pursuits and visitors often come with large amounts of equipment that may have to be dried or simply stored temporarily.

But whether the user is simply a tourist of the caves with your family, a hiker, caver or climber. The democratic traditions and diversity surrounding the pub culture, facilitates for all by providing; shelter, rest, food, drink and companionship.



BREWERY PRECEDENTS

THEAKSTONS AND BLACK SHEEP

Breweries by necessity contain industrialised processes, yet due to the long history of brewing beer, many breweries are housed in buildings that are centuries old and have to balance the demands of modern brewing with a respect for the historic fabric of their accommodation. Theakstons and Black Sheep are two such breweries that achieve this balance through slightly different methods. The two breweries share a long and interesting history together. Both located in the village of Masham, each brewery is run by different members of the same family, following a dispute over the takeover of Theakstons. As interesting as the history is, the design of the two breweries is more relevant to the task at hand.

THEAKSTONS

Being the older of the two, Theakston's appears to cling more strongly to its traditions, still brewing beer using the Victorian tower brewery model, where the ingredients are lifted to the top of the brewery using a steam engine, before gravity does the rest of the work, allowing the beer to trickle into fermentation tanks below. The brewery boasts many old industrial features and even employs a traditional cooper to build and maintain the wooden casks in which their signature beer, Old Peculier is stored. However, the brewery has also introduced many features to increase production, such as new fermentation tanks and racking equipment. The majority of the brewing equipment is housed in a tall building with steep steps leading to three floors, each one containing a part of the process. The tower is more or less open from bottom to top, with platforms to walk around the equipment, therefore there is a sense of spatial continuity from the bottom of the brewery to the top. The brewery has its own brewtap on the grounds, in a small stone and timber building full of character, next to the gift shop of course.

BLACK SHEEP

Black Sheep may be the younger of the two breweries but it has expanded rapidly and produces more beer than its rival. The brewery has taken advantage of its larger premises and the brewery has a large pub/restaurant and gift shop as well as a beer garden terrace outside. The brewing process itself is more industrialised than Theakstons, with newer and larger equipment. However, Black Sheep still retains some traditional buildings and equipment, brewing experimental beers in an old malthouse on the site in a copper kettle. There is also a collection of old brewing equipment for display purpose only, including a retired steam engine.

BALANCING INDUSTRY AND TRADITION

Theakstons and Black Sheep

illustrate two different ways to maintain a connection to traditional craft practices whilst meeting the needs of the market. Both of their approaches are borne out of conditions imposed upon them. In the case of Theakstons, the small grounds, existing buildings and equipment, and a desire to protect the traditions the brewery has maintained for generations. Black Sheep on the other hand has larger grounds and fewer existing buildings, all of the equipment was bought elsewhere and brought to the site, so there was less tradition to hold on to, an effort was made instead to showcase the traditions in a museum style and to keep a section of the brewery working under traditional conditions but only for experimental brews.

The new brewery of Cheddar Gorge should respect the craft and tradition of brewing, maintaining the Cheddar Ales ethos of hand-crafted, quality beer. However, as an expansion of an existing brewery it must also meet the industrial conditions required for producing an increased volume of beer. The brewery will be placed in an area of outstanding natural beauty, yet this must be balanced with the brewery's need to make a statement. In other words, in order to strike a balance between industry and tradition, the brewery must be modern, yet soulful and bold, yet sensitive.

TAP HOUSE INN

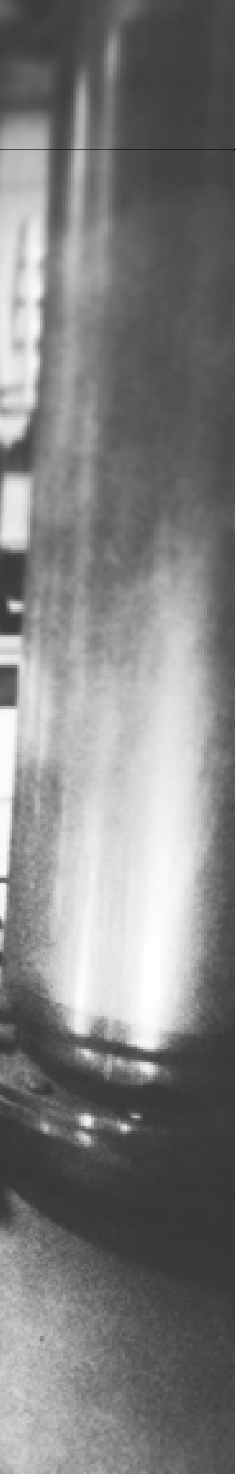
A PLACE TO EAT, DRINK AND REST

Many breweries have taphouses on their premises. A taphouse is a pub supplied by the brewery where the freshest of the day's produce can be served to customers, having been rolled out of the racking room and straight into the pub's cellar. The design for Cheddar Ales' new brewery will include space for a taphouse, as well as twenty five bedrooms for guests wishing to spend the night in the gorge on a bed and breakfast basis.

Creating a Taphouse Inn connected to the brewery is intended to juxtapose with the harsh and inhospitable conditions of the gorge. There is romance in the idea of a pub nestled in the rocky cliff face of the Gorge, this is connected to the theories reported earlier. In particular Prospect-Refuge theory, which implies that there must be a hazard in order to enhance our preference for a space. In the Gorge, the sheer cliff faces are the hazard and there is the prospect of reaching the refuge of the Taphouse to find beer, food and a clean bed.

There are also practical considerations for the inclusion of a Taphouse and accommodation. The first is that the majority of visitors to Cheddar Gorge are tourists coming and going on day trips, staying within thirty miles of the Gorge. Whilst there are several bed and breakfast hotels in the village there is still a lack of accommodation for the vast numbers that swarm into the Gorge every summer and therefore a market to be capitalised on. Many of the tourists come with specialised equipment for outdoor pursuits and the brewery would be conveniently placed to accommodate such activities.

With over 500 000 visitors to the Gorge each year it would be unwise to miss out on an opportunity to sell beer and food to tourists within the Gorge, which is currently under-catered for by a chain coffee store at the mouth of Gough's cave.



THE BREWING PROCESS

1 *THE GRIST MILL*
The malted grain is screened and processed through the grist mill in order to crack the grain. Cracking the grain increases the amount of water that it can absorb, therefore maximising the amount of starch that can be converted into sugar.

2 *THE MASHTUN*
The cracked grain is dropped into the mashtun full of hot liquor, the mixture is stirred in order to ensure that every grain is soaked thoroughly, maximising the conversion of the starches in the grain into sugar. Once the mixture has been stirred it is left to stand for two hours. The combined ingredients are known as wort. The wort is then run off into the copper, while more hot liquor is added to the mashtun to extract the remaining sugars from the grains at the bottom of the mashtun, this process is known as sparging.

The spent grains are collected by local farmers for cattle feed, making sure nothing is wasted.

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4 *THE HOPBACK*
True to its name the hopback acts as a filter, holding back the hops whilst the wort is strained through perforated plates. The hops themselves become matted on top of each other to create a secondary filter which helps to extract unwanted proteins which would otherwise result in hazy beer.

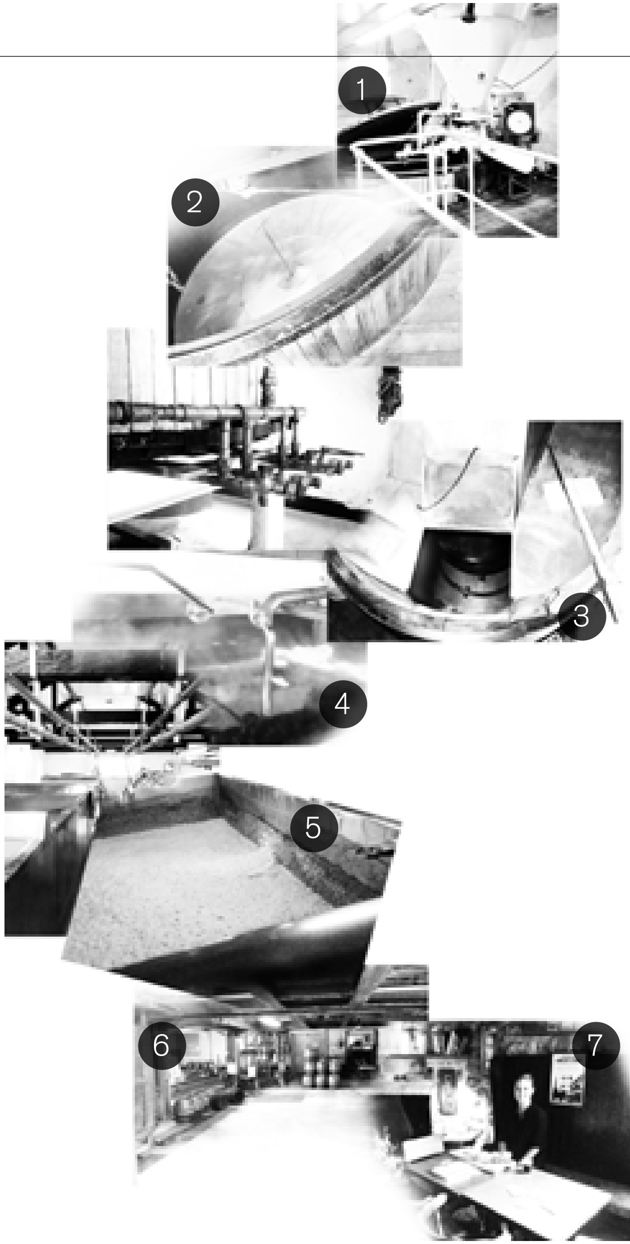
The leftover hops are collected to be recycled as a fertilizer.

5 *THE FERMENTATION TANKS*
The wort is cooled to 16.5°C it is drained into one of several fermenting tanks. Sterile liquor is added at this stage to adjust the brew to the desired strength. The yeast is then added and stirred to ensure that it permeates the entire brew. The fermentation process converts the sugars in the wort into alcohol and takes seven days. The temperature is regularly checked and must be carefully controlled throughout the process.

6 *THE RACKING ROOM*
The beer is run off from the fermentation vessels into tanks where it is allowed to settle for several hours before being put into casks. As each cask is filled a handful of dry hops is added which gives the beer an extra hoppy punch as well as extending its lifespan through the preservative qualities of the hops.

7 *THE PUB*
Once the casks have been filled and sealed they are ready for transportation to the pub. Once they arrive the casks will be stored in the cellar at a constant temperature of 10–12°C. This temperature ensures that the yeast in the casks remains inactive to prevent further fermentation. Before the beer is about to be served the cask must be vented in order to allow the CO_2 produced by the yeast to escape

Brewing begins with water. The water supply that runs through Cheddar Gorge is filtered through the layers of limestone resulting in relatively hard water, excellent for general brewing. The mineral content of the water has a dramatic effect on the beer produced as the balance of calcium, magnesium, carbonate and sodium alter the chemical reactions throughout the process. Water is known as liquor in the brewing process and is pumped into the cold liquor tank at the top of the brewery before being passed through a boiler, raising it to the required temperature to begin the brewing process proper.



RAW MATERIAL STORAGE

HOPS, MALT, YEAST AND WATER

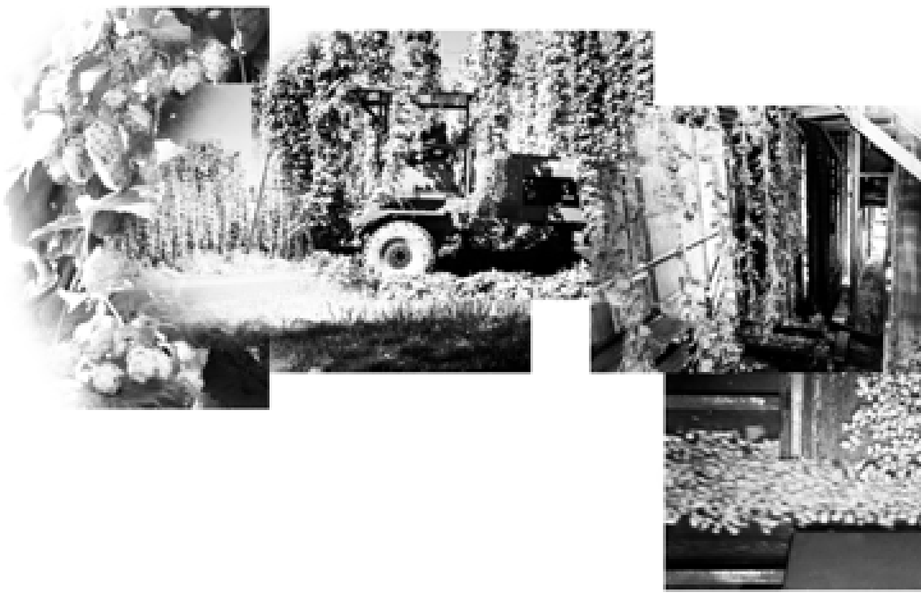
Each of the four main ingredients used in beer production has its own special requirements for storage conditions. Meeting these requirements is imperative to ensuring that the ingredients are in the optimum condition for imparting high qualities flavours, aromas, colours, and textures. Heat, light and oxygen are the main causes of the detereoration of the ingredients and steps should be taken to prevent exposure to these factors.

HOPS

Hops are delicate and care must be taken to keep them in an optimum condition. Exposure to heat, light, and oxygen can damage hops. Hops can be purchased in vacuum packed bags from producers who store them at sub-zero temperatures. A vacuum sealed bag can be stored for a year if it is kept refrigerated, however freezing the hops is ideal, the lower the temperature the better, so long as care is taken to avoid freezer burn. The hops leftover once the beer has been filtered can be removed and recycled as a fertiliser.

MALT

Malted barley must be protected from moisture and stored at a temperature between 10-21°C. It is advised that all quantities of grain should be stored in a container that



is airtight and dry. Uncrushed grain can be stored for up to a year under these conditions and crushed grain can bve stored for two to three months. The leftover grain in the lautertun will be collected and used as a livestock feed to ensure nothing is wasted.

YEAST

Yeast is the easiest ingredient to store and can be kept in a refrigerator at a temperature of 3-5°C. Because the quantity of yeast increases during the brewing process, it can be washed using sterilised water, increasing its longevity and recycled to be used in the next brew

WATER

The water used for the brewing process will be pumped from the fresh springs at the foot of the gorge, the water from these springs has been given the highest rating for chemistry and biology from the Envrionment Agency. The water issuing from these springs has been filtered through the limestone of the gorge and will contribute to the distinctive flavour of the brewery. The water must be pumped into cold and hot storage tanks where it is ready to be used at different stages during the brewing process.

SPATIAL PROGRAM

FUNCTION, SIZE, CONDITIONS

BREWERY

MILLING
30m^2
Room Conditions:
Dry, Unheated.

Grist mill
Malt storage: 14000kg/month = 5m2 Cold storage @ 10-21C

WATER STORAGE
20m^2
Room Conditions:
Insulation for HLT, ambient temperature for CLT, Dry, Unheated, Passively Cooled.

Cold Liquor Tank 3000l = 3m3 - Ambient temperature
Hot Liquor Tank 1500l = 1.5m3 - Constant temperature of 66°C

MASHING
20m^2
Room Conditions:
Insulation for Tun Stack, Dry, Unheated, Passively Cooled.

3500l Mashtun + 3500l Lautertun Stack = 5m2
The mashing must take place at a constant temperature of 66°C

BOILING
40m^2
Room Conditions:
Insulation for Copper Kettle, Dry, Unheated, Passively Cooled.

3500l Copper - Heated to a temperature of 85°C
Hop storage: 200kg/month = 5m2 Freezer @ <-10C
Cold storage =5m2

COOLING
30m^2
Room Conditions:
Dry, Unheated, Passively Cooled.

The wort must be cooled to 17°C ready for fermentation

FILTERING
30m^2
Room Condtions:
Dry, Unheated, Passively Cooled

3500l hopback = 5m2

FERMENTING
100m^2
Room Conditions:
Dry, Insulated, Sterile, Mechanical Heat/Cooling through Cave Heat Exchanger

Fermentation tank dimensions: 3500l x 8

The fermentation tanks must be kept at a constant temperature of 17°C

Following fermentation the beer must be cooled to 10°C for the yeast to become dormant.

RACKING
100m^2
Room Conditions:
Dry, Insulated, Cask Storage in Caves

3500l Racking tank
Cask maintenance
Cask storage
Delivery entrance

The casks must be kept at a constant temperature of 10-12°C

EXPERIMENTAL HOP LABORATORY
50m^2
Room Conditions:
Dry, Sterile, Insulated, Mechanical Heat/Cooling through Cave Heat Exchanger

PUB

PLANT ROOM
50m^2
Room Conditions:
Dry, Insulated, Heated

CELLAR
200m^2
Room Conditions:
Dry, Insulated, Maintained at a temperature of 10-12°C

KITCHEN
50m^2
Room Conditions:
Dry, Sterile, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and mechanical ventilation, temperature maintained between 21-24°C
25% seating area

OFFICE
15m^2
Room Conditions: Dry, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and ventilation, temperature maintained between 21-24°C

BAR
30m^2
Room Conditions:
Dry, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and mechanical ventilation, temperature maintained between 21-24°C

SEATING
200m^2
Room Conditions:
Dry, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and mechanical ventilation, temperature maintained between 21-24°C
Seating for 200 @ 1m2/person

BEER GARDEN
200m^2
Room Conditions:
Outside, Partially Covered
Seating for 100 @ 2m2/person

TOILETS
30m^2
Room Conditions:
Mechanical Heat/Cooling with heat recovery, passive cooling and mechanical ventilation, temperature maintained between 21-24°C
Maximum capacity=500
Male: 3 WCs + 5 Urinals + 3 Washbasins
Female: 10 WCs + 5 Washbasins
1 Disabled WC
Staff Toilets

SPATIAL PROGRAM

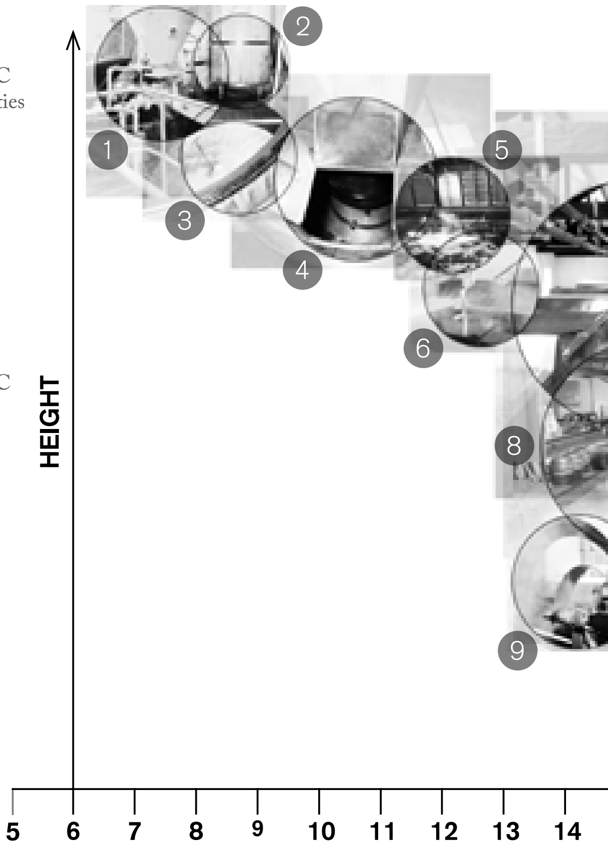
HOTEL

BEDROOMS
375m²
Room Conditions:
Dry, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and ventilation, temperature maintained between 21-24°C
25 rooms with ensuite facilities @ 15m2 each

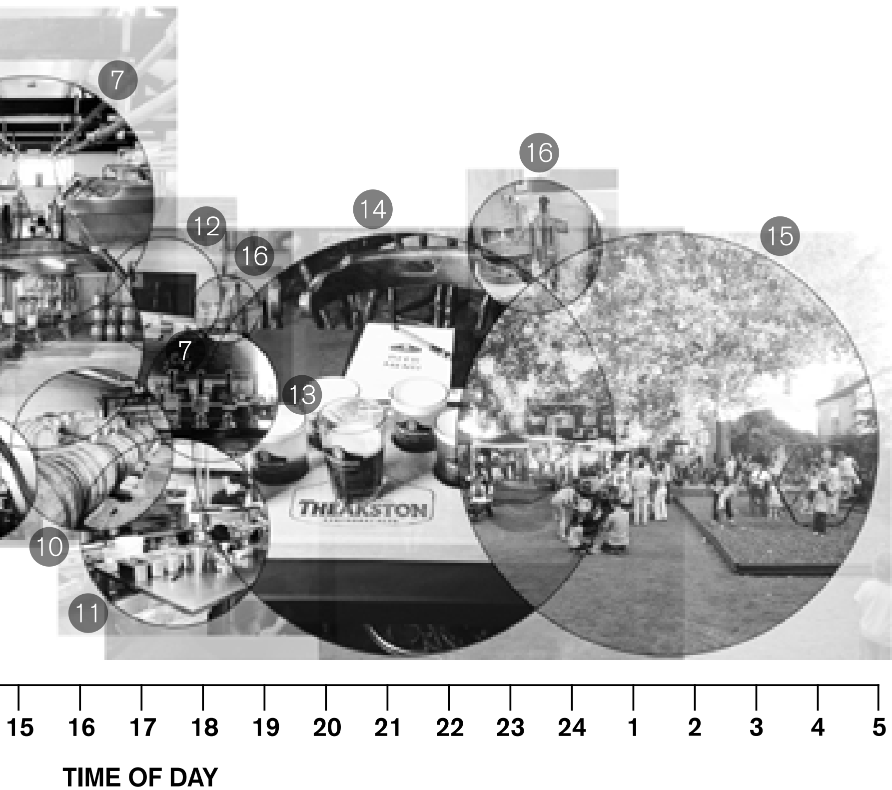
LAUNDRY ROOM\
CLEANING STORAGE
15m²
Room Conditions:
Dry, Insulated, Mechanical Heat/Cooling with heat recovery, passive cooling and ventilation, temperature maintained between 21-24°C

CIRCULATION
315m²
+20%

TOTAL
1890m²



TOWER BREWERY PROGRAM DIAGRAM



ENERGY REGULATIONS

ENGLISH AND DANISH ENERGY REGULATIONS

The english energy requirements state that reasonable provision shall be made for the conservation of fuel and power in buildings by limiting heat gains and losses through thermal elements and other parts of the building fabric, such as pipes, ducts and vessels used for space heating, space cooling and hot water services. This should provide fixed building services which are energy efficient, having effective controls and are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances. This is all very vague, and doesnt really say much about the actual compliances

DEMONSTRATING COMPLIANCE

In accordance with regulations, the calculated rate of CO_2 emissions from the dwelling (the Dwelling CO_2 Emission Rate, DER) must not be greater than the Target CO_2 Emission Rate (TER). Additionally, and in accordance with regulation 26A, the calculated Dwelling Fabric Energy Efficiency (DFEE) rate must not be greater than the Target Fabric Energy Efficiency (TFEE) rate.

The calculations for determining the TER/DER and TFEE/ DFEE rates are mandatory for demonstrating compliance

SHOULD WE FOLLOW THE DANISH OR THE ENGLISH ENERGY REGULATIONS?

We find that the Danish energy regulations for new buildings are more demanding than the current English, on those grounds we choose to follow the Danish regulations, as these will allow us to implement the knowledge gained through our education to create a much more energy efficient building that will live up to both the English and the Danish standards and energy regulations.

DANISH ENERGY REGULATIONS

The energy frame that we will be meeting as a minimum for the pub facilities as well as the hotel facilities are the 2015 low energy building regulation, but we will aspire to meet the strict 2020 regulations as a goal.

The energy classes are expressions of how many kilowatt-hours the building uses for heating, ventilation, cooling and hot water pr. Square meter pr. year

ENERGY FRAME 2015

For dwellings, dormitories, hotels and so on

30 + (1000/heated floor area) = kWh/m² pr. year

For schools, offices, institutions and so on

41 + (1000/heated floor area) = kWh/m² pr. year

ENERGY FRAME 2020

For dwellings, dormitories, hotels and so on

= 20 kWh/m² pr. year

For schools, offices, institutions and so on

= 25 kWh/m² pr. year

GRID LOSS

When conducting energy calculations for low energy class 2015, a district heat factor of 0,8 and an electricity factor of 2,5 should be used. This to take into consideration the losses suffered under transport through the grid. For 2020 regulations these factors are 0,6 for district heating and 1,8 for electricity

SPECULATIONS

There are no south facing facades of the building that will receive direct sunlight from south, as concluded from the shadow studies. This could very likely result in very limited window openings throughout the hotel and pub, to minimize heat losses. This could very well prove a good combination with the visions of gloom and the Zen view.

A positive effect of the lacking external solar gains from the south is the fact that cooling is more energy consuming than heating. Without the large glazing areas and no south facing facades receiving direct sunlight, overheating will become less of a problem.

The internal heat gains on the other hand are evaluated as sizable and as a product thereof a higher air change will most likely be needed. Heating the intake air in the winter and cooling it in the summer could prove to be a large part of the overall energy consumption.

By retrieving the intake air from one of the many underground caves, which holds a constant 11 degrees Celsius all year the intake air would only ever need to be heated before being introduces to the inside of the building, this could be done mainly with heat recovery and only a minimum of extra energy.

TACTILITY OF THE GORGE

SENSE OF PLACE
THE GORGE AS A WHOLE

Meeting the Gorge, vast panoramas of natural beauty, stern rock and menacing vertical cliff sides surrounds the viewer and swallows him whole. The sheer size and impact of the scenes waiting around each turn overwhelms in its totality in such a degree that the individual parts creating the whole can be hard to focus on.
Non-the less it is the individual tactility, of all the elements in the gorge that creates the sense of the scenery as a whole.

LIMESTONE EXPOSED TO THE ELEMENTS

The largest part consists of the characteristic limestone. Where it is exposed to the elements it is cold and hard and crumbling to look at, threatening to rain boulders at any time. Due to the orientation of the strata of the Mendip hills which slopes at 20 degrees, the north facing cliff side has been allowed to stand almost vertically and some places even growing out cantilevering high above the viewer standing on the narrow twisting road running in the bottom of the gorge.
Observing the Crumbling porosity of the south facing cliff side, as it deteriorates showing how porous the sedimentary bedrock really is only adds to the sense of ones own mortality and the sublime beauty of the forces at work on this site.

LIMESTONE PROCESSED BY WATER

As crumbling, porous, cold and rough as the exposed limestone, processed by wind, rain, vegetation and time, just as warm, smooth yet still porous the limestone of the caves occurs. Processed by the water filtering through the cracks and crevices riddling the Mendip Hills to gather in the tunnels of the many caves before running out to be collected in the great resovoir.
The tactility of the limestone within the cave shares the visual characteristic of skin, expecting it to be smooth, warm and soft to the touch. All but warm, the water has given the limestone a completely new character, humanising the insides of the gorge.

VEGETATION

On all the plateaus of the gorge nature has been allowed to grow wild, resulting in a dense growing thicket with bushes and small trees intertwining in a wooden web overflowing the edges of all the plateaus.
Unfortunately, some of the grass and bushes growing in the gorge are aiding the deterioration of the rock as their roots grow into the small crack expanding them and loosening the rock little by little.

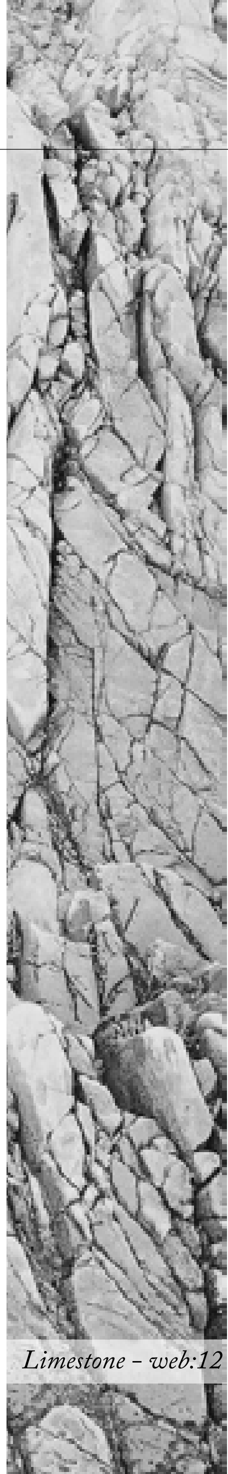
GOATS AND SHEEPS

To counteract this force the gorge has ben reintroduced to a flock of goats as well as a larger body of a breed of domestic sheep, descended from a population of feral sheep, called Soay Sheep. This breed of sheep exemplifies itself by being impeccable climbers much like the goat. Their climbing skills are necessary in performing their job, which is to graze the grassland and scrub, to reduce the deterioration of the cliffs.

Skin of the stone

Wool – web:8

Wood – web11



Limestone – web:12

HIGHLIGHTING SPECIFIC DETAILS

In a place of outstanding natural beauty like Cheddar Gorge it is easy to become overwhelmed by the quantity of stunning views in a way that can reduce their impact. Christopher Alexander asks the question, "How should we make the most of a view?". (Alexander et Al, 19??, pg 642) His answer is that by limiting the view through a small opening in a transition space, we can preserve the power of a view, rather than becoming overexposed to it. Alexander uses the example of a Buddhist monk's house.

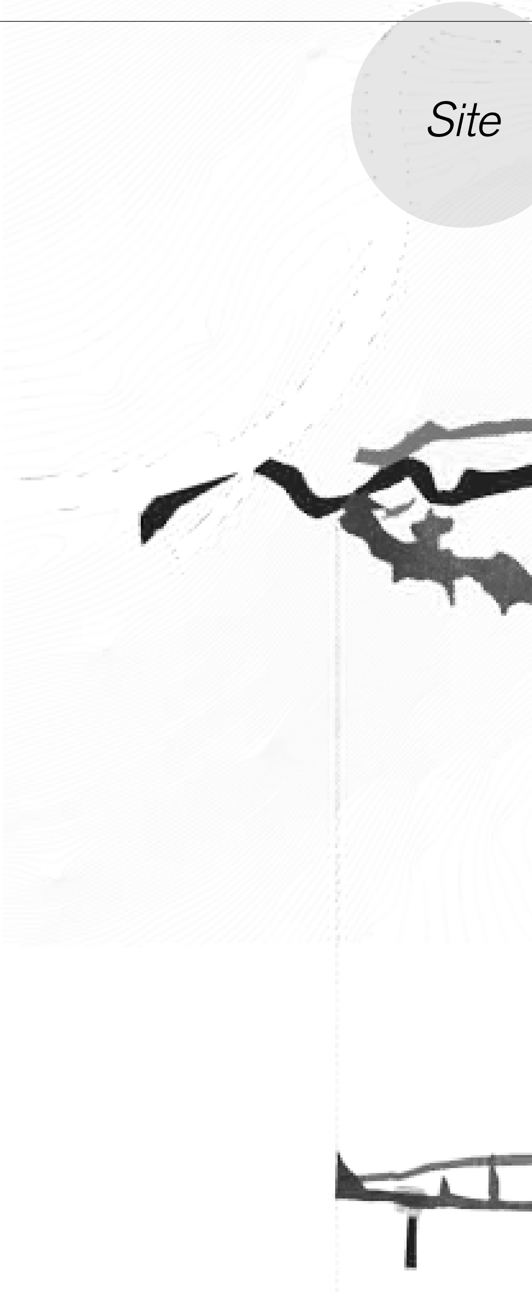
"A Buddhist monk lived high in the mountains, in a small stone house. Far, far in the distance was the ocean, visible and beautiful from the mountains. But it was not visible from the monk's house itself, nor from the approach road to the house. However, in front of the house there stood a courtyard surrounded by a thick stone wall. As one came to the house, one passed through a gate into this court, and then diagonally across the court to the front door of the house. On the far side of the courtyard there was a slit in the wall, narrow and diagonal, cut through the thickness of the wall. As a person walked across the court, at one spot, where his position lined up with the slit in the wall, for an instant, he could see the ocean. And then he was past it once again, and went into the house." (Alexander: 1977, pg 642)

Alexander's suggestion is that if there is something to look at we should not drown ourselves in it by placing expansive windows that expose us to it constantly. Instead the openings should be placed in transition spaces so that we are only exposed to it momentarily.

Architecture has a special power to create a world within the world, a space that is distinct and separate from its surroundings, connected only through chosen openings. This presents the architect with the opportunity to highlight specific features of a landscape. In Cheddar Gorge this might take the form of a long distance view to Cheddar reservoir, framed by the Gorge, or a striking cliff rising out of the landscape, or even the simple highlighting of the tactile qualities of the cliff face itself at short range.

web:7

CAVE ANALYSIS



GOUGH'S CAVE

A stonecast away from the site, the entrance to Gough's Cave is located. Following the principle of Unity and Uniqueness, there needs to be a certain degree of unity with the specific location of a building for it to intrigue and create an initial fascination for the architecture by the viewer. By being sensitive to the uniqueness of the specific context the architecture becomes a manifestation of place.

To achieve the initial fascination of Unity and Uniqueness, an intimate knowledge and understanding of the specific site and its identity is needed. The Caves of Cheddar Gorge form a big part of that identity and a further study of the caves are therefore conducted.

The subterranean drainage passages through the limestone are reactivated, when Frost thaws for progressively longer periods and greater depth each summer. This causes Ice-bound surface blockages to thaw and give way to vast quantities of mud that flush into the torrent of the cave systems. The oldest and highest caves (marked on the illustration in orange and grey) have become relatively dry, while the sumps of the lower caves near the water table (marked on the illustration in black) are a combination of dry and wet passages.

Eventually the stream reaches the local saturation level where the bedrock is permanently saturated and the water pressure causes

Plan

Section

CAVE ANALYSIS

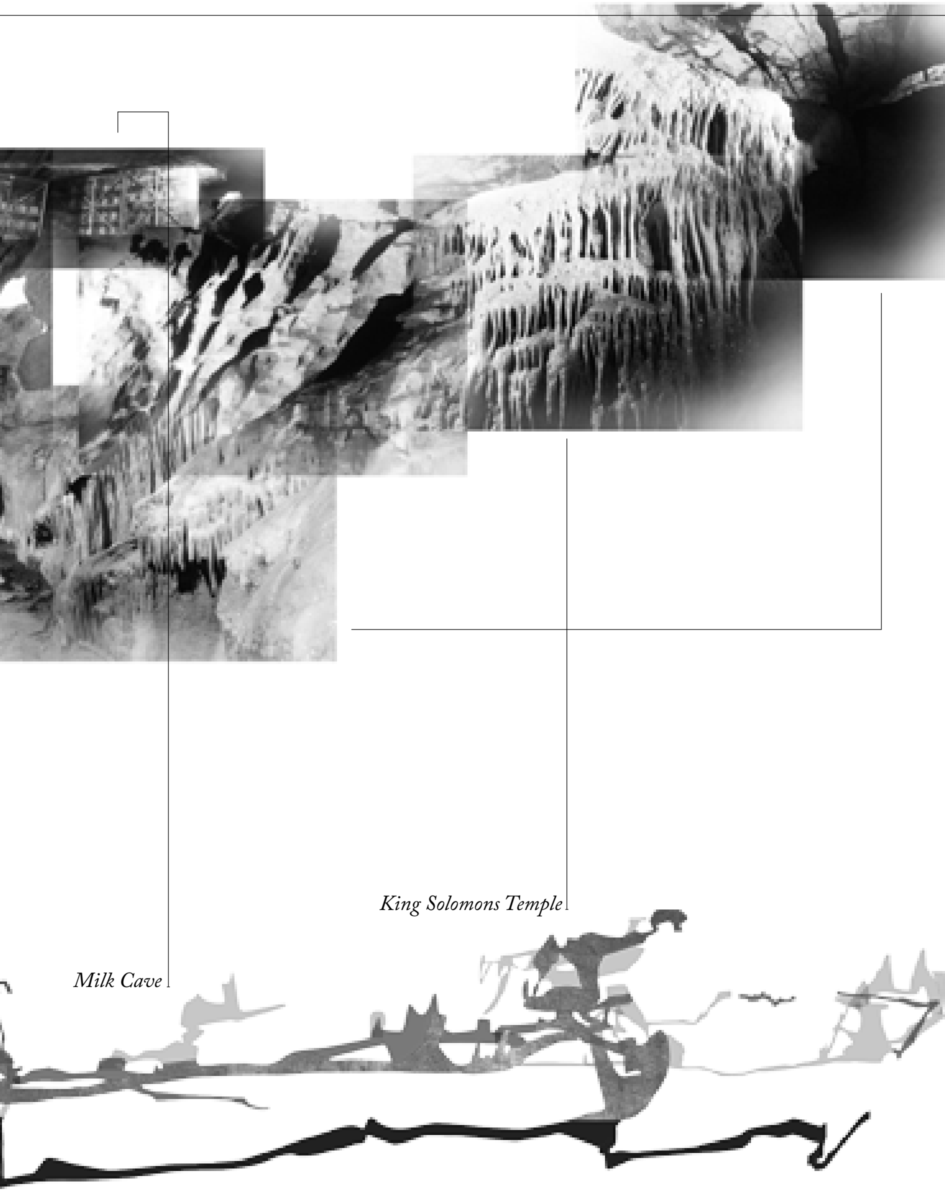
immensely powerful flows through the underwater passages. These are the youngest of the limestone caves, still being carved out at the deepest levels at which the groundwater flows today. This is where water continues to sculpt the caves in the exact same manner as the old and dry caves were created (Carter: 2014).

Carboniferous Limestone is brittle in structure and flawed by many vertical cracks and fissures caused by earth stresses, and as the slightly acidified rainwater carves its way through the innumerable passages that riddle the great Mendip it seeps down to the permanently saturated areas of the bedrock creating the enormous pressure that carved and still carves the lower and youngest caves today (Carter: 2014).

As water is the architect and sculpture of the caves, this leaves a great impact on the aesthetics of the cave. The path of the cave has been selected carefully by the water, carving out the most brittle oars of limestone, leaving the sturdier rock to form the walls of the cave. The process leaves the impact of walking through the veins of the Gorge, rendering this petrified natural phenomenon from the ice ages, alive. The Stone stirs, slowly, alive on another time scale.

THE SKIN OF THE CAVE

The skin of the cave further supports the feeling of being in the veins of a stone giant. At places the stone is textured, much like the skin of humans, other places like


King Solomons Temple
Milk Cave

the skin of elephants and in other you can even see the bobbling and splashing of water rushing through the cave sculpting the stone as it goes. This soft and organic shaping of the stone combined with the softer more porous properties of limestone, smoothed by the water like driftwood, line the inside of the cave with a soft skin, it's hard and unabsorbing character, by human measures, are only revealed by the acoustics of the cave.

THE ACOUSTICS OF GOUGHS CAVE

One of the most striking characteristics of the cave is its acoustics. The Acoustics of Gough's Cave allows us to hear the sounds of the world as our prehistoric ancestors did. This subterranean environment evokes emotions, if for no other reason than its sonic uniqueness.

For thousands of years humans have looked to nature as a source for sensory experiences and inspiration. Standing in the tall cave space of King Solomons Temple, listening to the distant irregular ringing of thin drips, combined with the occasional closer or bigger and louder deep plop of a droplet hitting the still water surfaces on the many ledges of the big space. It is the singing of the insides of the earth.

Even though the reverberation time is as long as in a Cathedral, around 6-8 seconds at middle frequencies, the acoustics are not that of a single large space. Because the space is a combination of multiple connected spaces, the onset of the reverberation is delayed and softened, reaching only a modest intensity. In addition with a relative humidity of 80-95%, the reverberation time of high frequencies is reduces and thereby removing any sense of harshness in the caves (Blesser: 2007) These acoustic conditions muffles the clarity of speech, but supports any kind of musical unfolding beautifully.

SPATIAL CONTINUITY, GUIDANCE AND DEPTH IN COMPLEXITY

There is a high degree of spatial continuity in the caves, even though many sub spaces, halls and corridors are clearly defined, they are linked together in a way that leads you ever forward, to see what is around the next bend, never questioning the path. The path becomes halls when the room suddenly shoots up in height, up into complete darkness, the vastness of the room given away by its change in acoustics.

The artificial lighting heavily supports the clear feeling of guidance through the cave. The monotony of the spatial continuity of pushing the visitor forwards and around the cave in a steady pace is stimulated by the complexity of the extra dimensions added by the artificial light upon ledges defining spaces overhead as well as underneath the path. It is the visual accessibility of these spaces that rewards the visitor with complexity and the cave with depth, despite the denial of locomotive accessibility.

THE PRINCIPLE OF UNITY & UNIQUENESS

Using the principles of preference as analytic tools in the cave analysis, the once inhabited spaces of the cave has emerged fully from the uniqueness of its context the unity between the locality and the caves are unquestionable and thereby the caves becomes a manifestation of place effortlessly.

THE PRINCIPLE OF PERCEPTIBLE KNOWLEDGE

The caves can be read letting the viewer visually understand that this space was carved by water. Water was the crafter and water left its clear marks; the softening of the stone, polished as much as the porous limestone permits, working its way through the oars of the most brittle parts of the subterranean Mendip Hills leaving the denser, more compact stone with a higher structural integrity to outline the cave. The water does what the water wants and the stone reacts the only way it can.

THE PRINCIPLE OF TERITORY, VISUAL RANGE & ESCAPE

The cave has one entrance and one exit and a relatively limited degree of locomotive accessibility compared to the very high degree of visible accessibility. This evokes a feeling of seemingly large spatiality with visual connections to smaller well-defined areas spaces above and below the path. The aesthetic satisfaction of the caves stems from a spontaneous perception of features of the natural environment, these are the visual attributes of which act as sign stimuli indicative of the safety of the environment and its ability to sustain life, whether they really are favourable or not. This creates a high degree of perceived safety in the caves.

THE PRINCIPLE OF EXPLORATION

The dynamic and asymmetrical composition of the cave encourages the eye to explore. The absolute faithfulness to the principle of unity and uniqueness and perceptible knowledge, allows the viewer to hypothesise with great probability about what comes next, eliminating the fear of surprises.

SUB CONCLUSIONS

Besides from the more functional and pragmatic information given by the brief, the brewing process and the spatial program, a more general concept emerges from the analysis of the site. Taking the information from the sun and shadow analysis and the energy regulations in combination with the notion of the zen view, we envision a much more introverted space, sending focus back towards the human interaction of the pub in small spatial continuities wrapping itself comfortingly around the inhabitants in clearly demarcated territories that still allow for a high visual range, In between these lower territories of spaces a tall space might separate itself from the others highlighting the function it entails.

From the geological composition of the site we realise that the meeting between the site and the architecture need be in compression. Looking at the site panoramas we see that the lower plateaus leans in towards the cliff face and it is easy to envision the architecture tucking itself on this shelf leaning towards the cliff face.

Furthermore we wish to take inspiration in the vernacular architecture in the area, both to deal with the local weather as it is, but also to ensure that the architecture submerges itself in its traditional and historic context as well as its physical context, we will go further into depth about the advantages of the vernacular shape in the tectonic brief of this project.

ILLUSTRATIONS

web:1
https://www.google.dk/maps/place/Cheddar+Gorge,+Cheddar,+Somerset+BS27,+UK/@51.2863889,-2.7602778,17z/data=!3m1!4b1!4m2!3m1!1s0x48721e6eef5fe6c7:0xce01166f458dd26b?hl=en

web:7
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web:9
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web:10
http://www.cheddargorge.co.uk/upload/homepage-slideshow/banner011.jpg

web:11
https://www.pinterest.com/pin/449797081507882452/

web:12
https://www.pinterest.com/pin/295759900499795218/

All illustrations not listed here, are of our own making.

All illustrations listed here have been modified to for the layout

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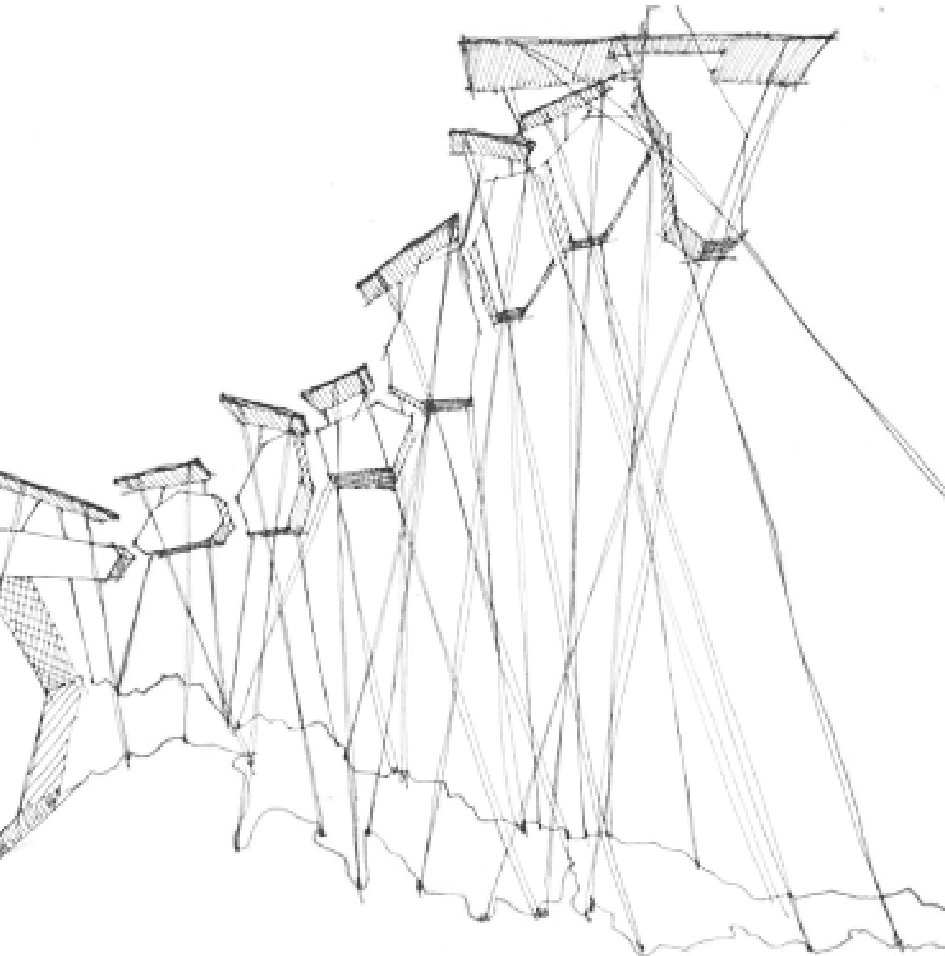
web:5
http://www.cheddargorge.co.uk/

web:6
http://en.wikipedia.org/wiki/Pub

No3
SKETCHES

THE DESIGN PROCESS IN SKETCHES



We have chosen to show our design process in sketches – rapidly executed freehand drawings, which are not intended as finished work – as these sketches have served a number of purposes to us.

Recording something we have observed or to develop an idea for later use or simply as a quick way of graphically demonstrate an image, idea or principle.

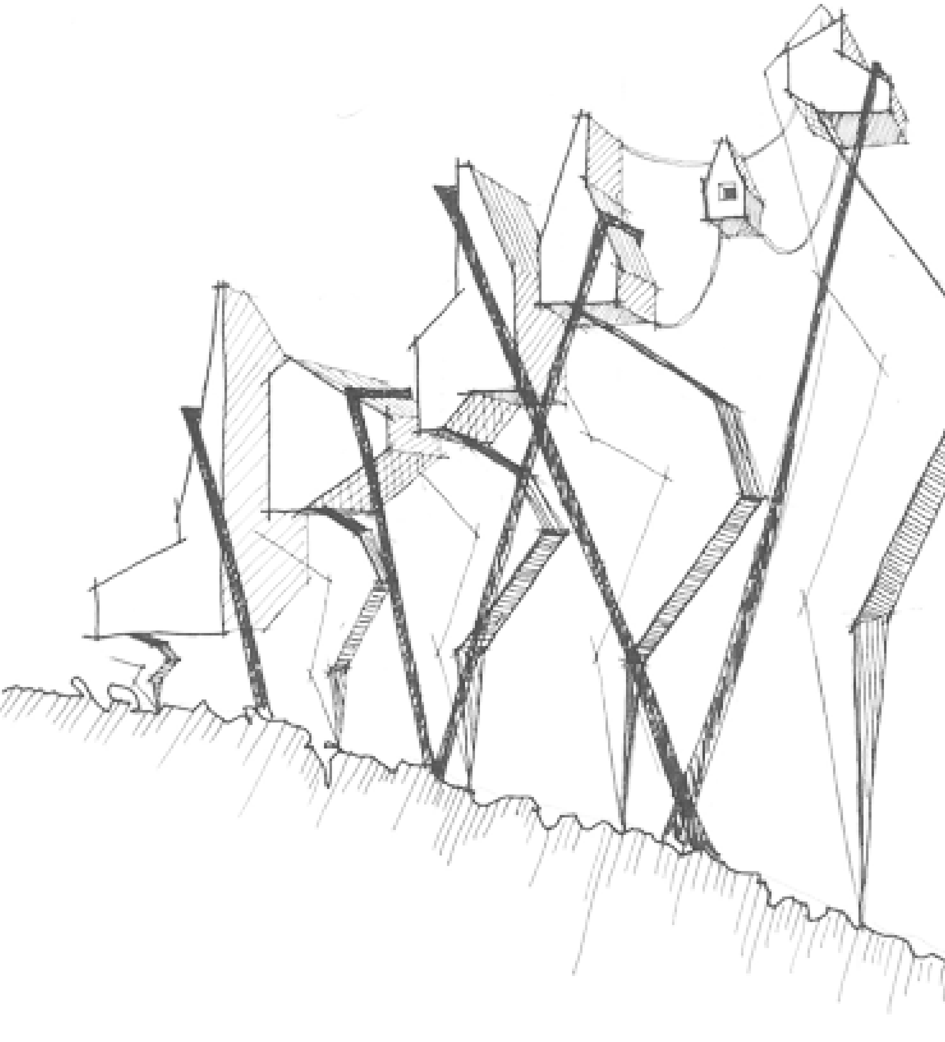
The sketch phase of this project has been ongoing to the very hand in, though used more vigorously in the start of the project and more specifically towards the end.

We have used sketching throughout the project as a method of recording or working out ideas and as a reliable way of communicating these ideas and visions to each other. To quote Le Corbusier:

"I prefer drawings to talking. Drawings leaves less room for lies"

The sketching phase of this project started during the development of the program, thereby letting the program – the analysis of the site – become the facilitator for the physical shapes and initial ideas emerging in this project.

Our earliest idea arises from both the analysis of the site in combination with our visit to the gorge. The caves left the biggest impression on us, with its spatial continuity, its warm and constant temperature



THE WALKING STRUCTURE

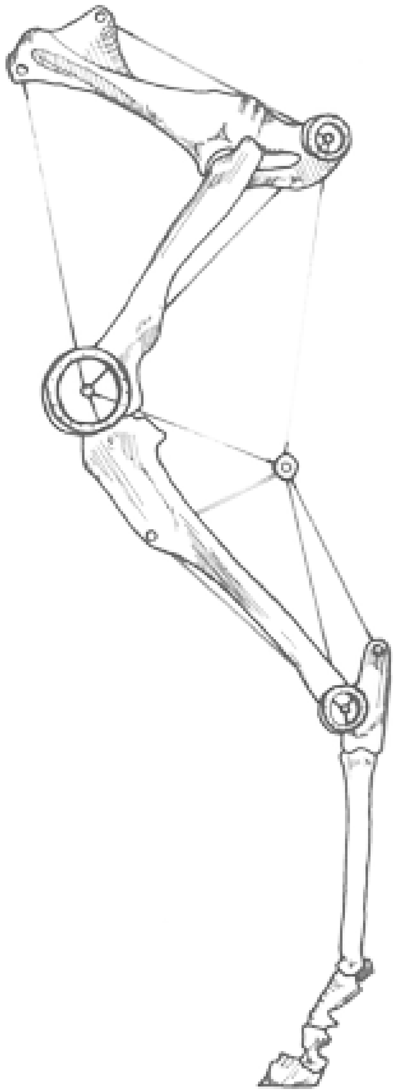
compared to the bitter cold winds of January and the introvert sensation of no views and the occasional endless room heights.

This gave us the an idea about an organic growth attached to the cliff side of varying sizes and skylights to recreate the spatial continuity of the caves.

As these ideas went hand in hand with the development of the program, we had to revaluate this idea when we realised that the bedrock of the gorge is sedimentary bedrock, meaning that it is extremely brittle when put in tension rather than compression. Hanging anything from the cliff side was therefore out of the question as we had to keep the rock in compression.

To keep the vegetation in chess on site, goats have been implemented throughout the gorge and seeing these goats fearlessly climb every inch of vertical surface in the gorge gave us an idea to have the individual spatial experiences in continuation after each other on stilts as a walking structure capable of adjusting to the varying surface of the site.

We therefore engaged shortly in an investigation into the anatomy of goats and quickly had to realise that the dynamic reactions of the anatomy would be unsuitable for what in the end is a static structure.

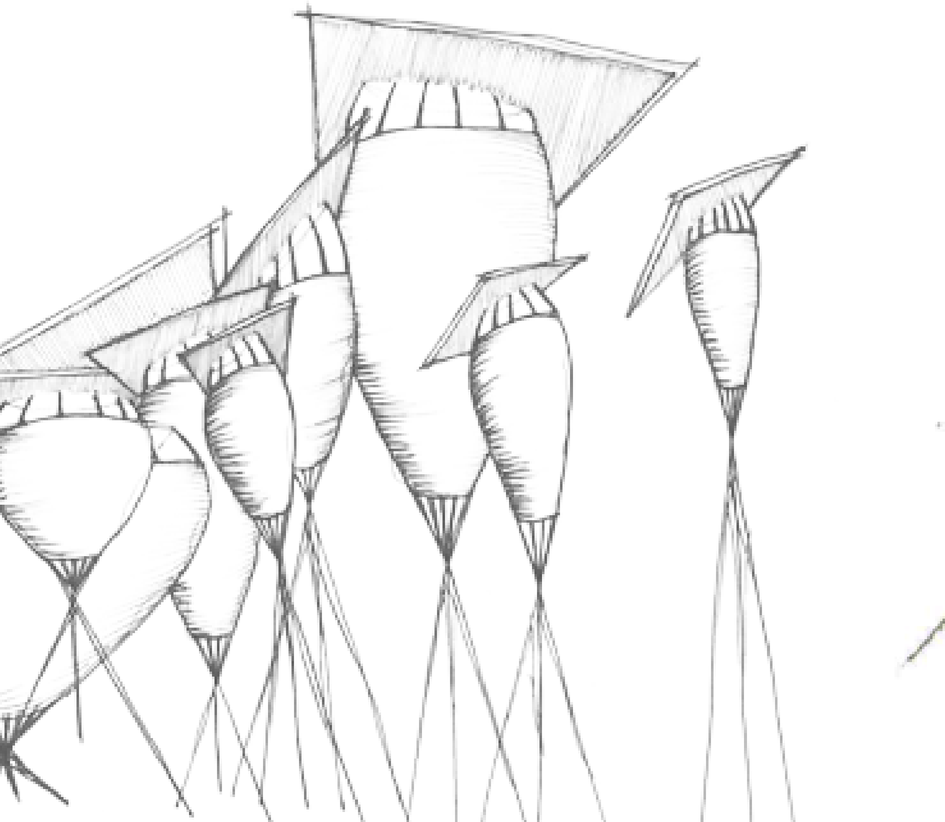


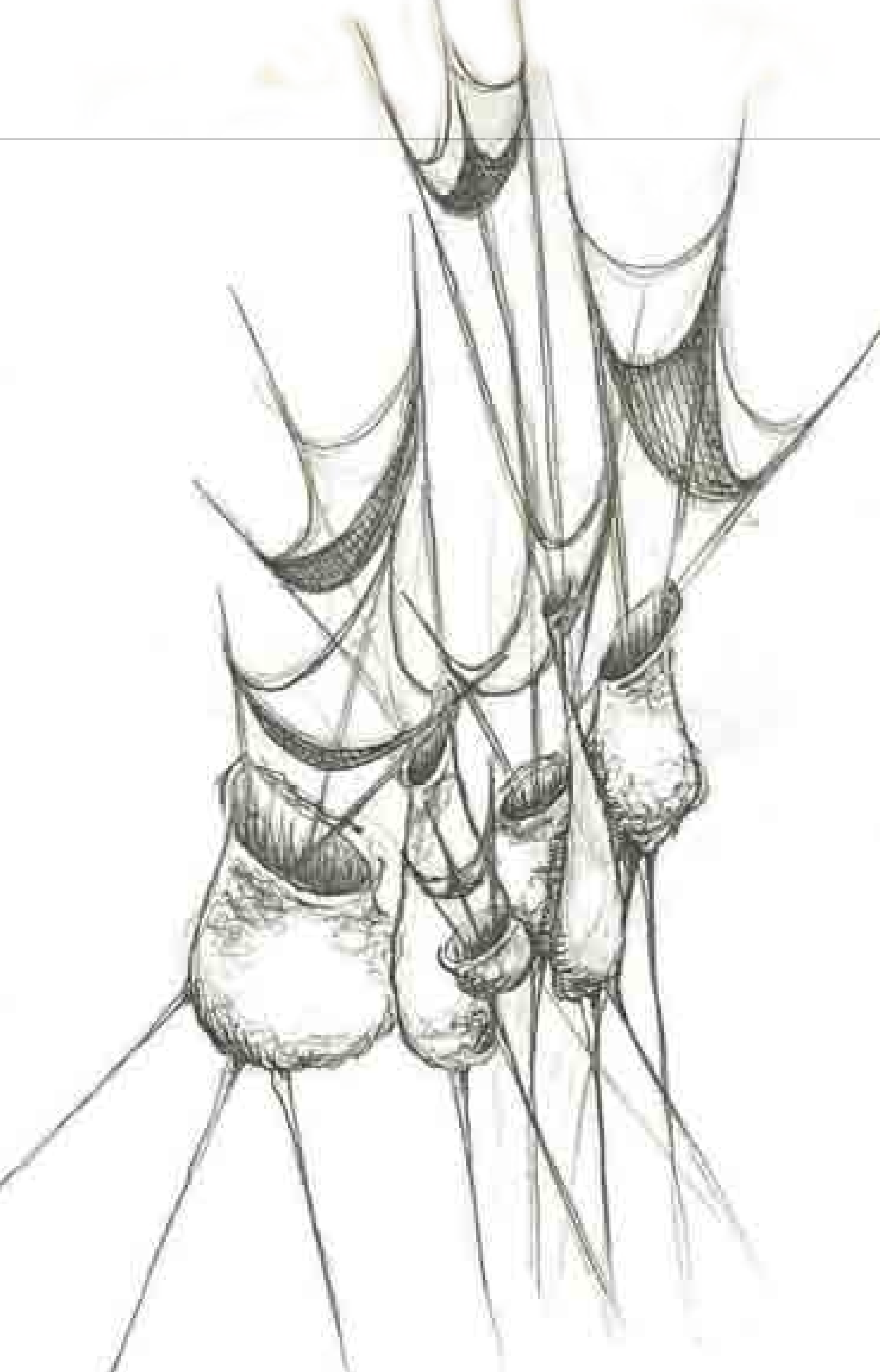
The investigation took a turn towards static structures, so rather than dynamic legs the structure would now be on stilts. To integrate the stilts with the inhabited structure the spatiality's, took the shape of woven pods, weaving themselves around the stilts.

A longer investigation into how this would work in practicality, with plans, floor area, furnishing, access, deliveries and disables access, lead us to restrict the structures on stilts to the tower brewery of the facilities.

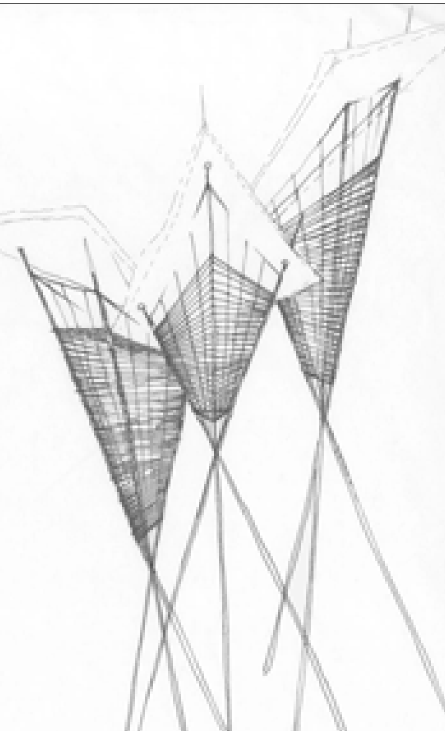
THE POD

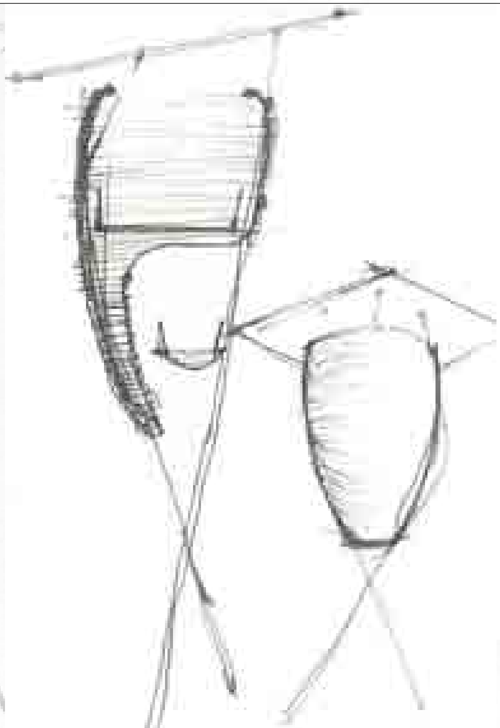
the pod shape which we in this phase found happiness in had both visual and functional qualities, less harsh and sharp, but soft plump woven sacks of comfort and protection that could embrace the user very intimately. Snug introvert structures for contemplation and engaging in conversation without external stimulation to disturb this human contact.

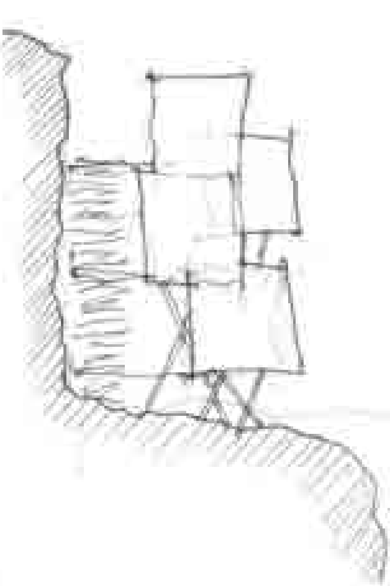


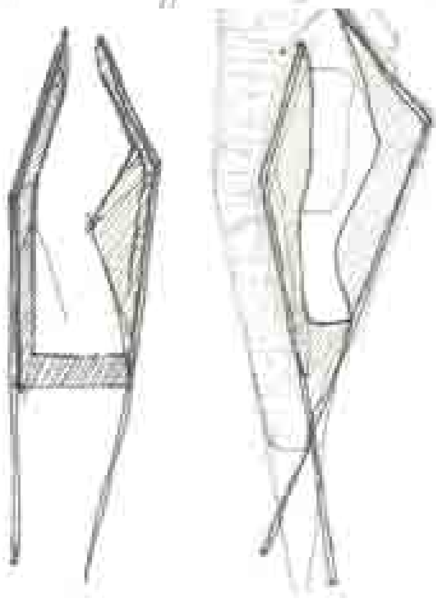


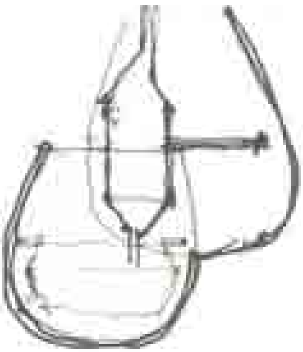
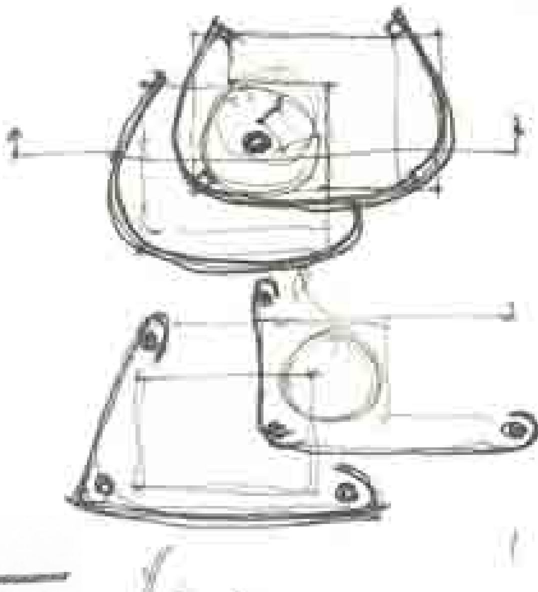
PODS ON STILTS

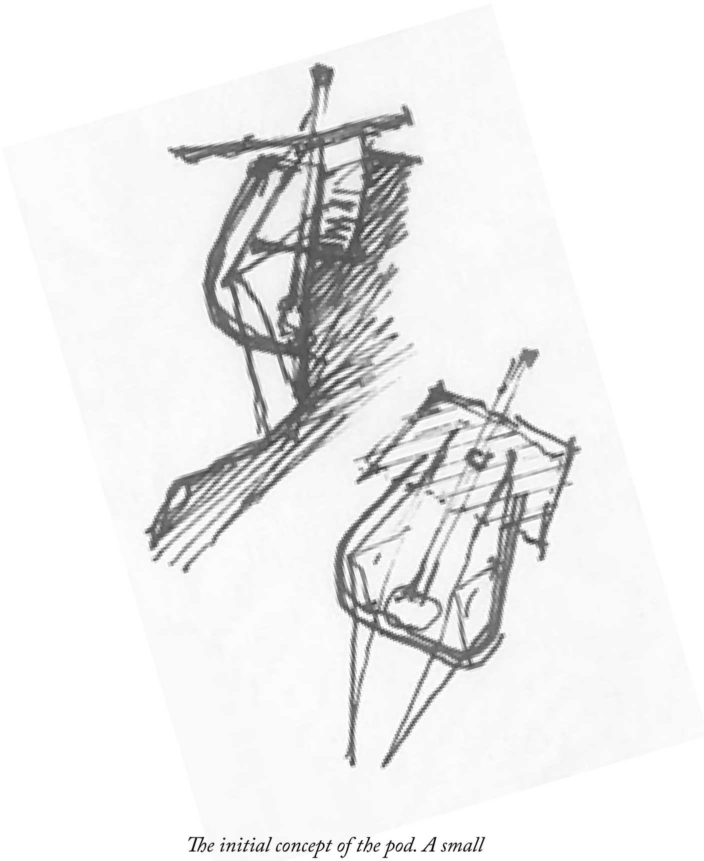




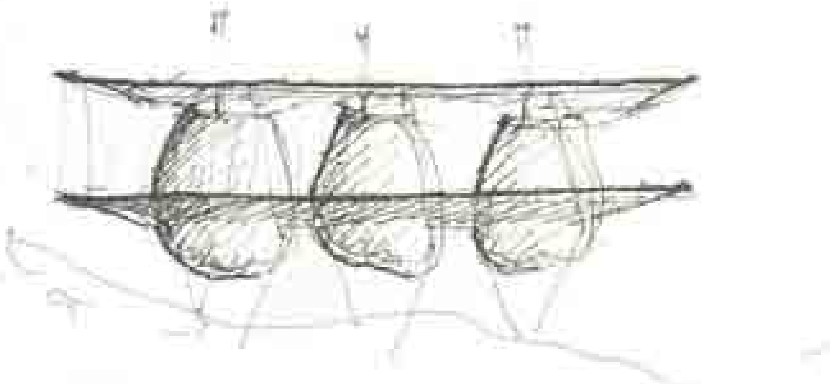


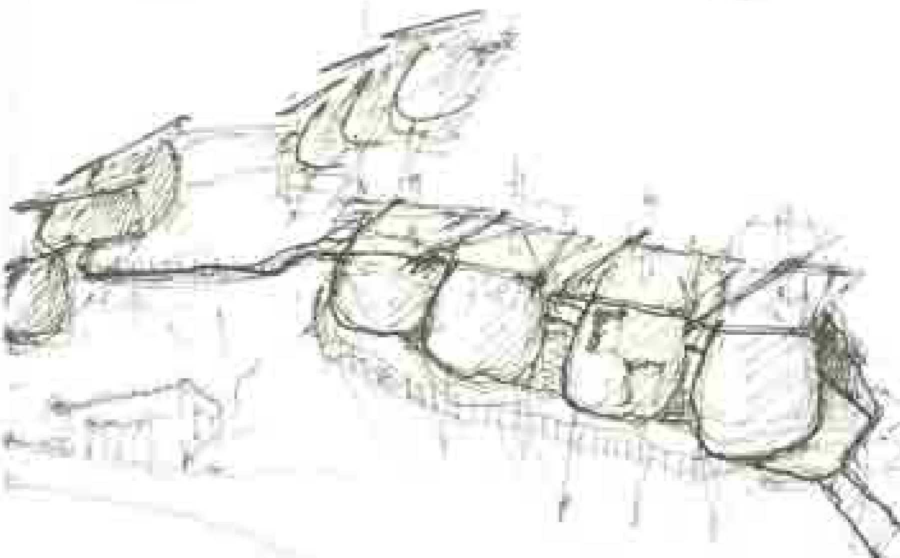


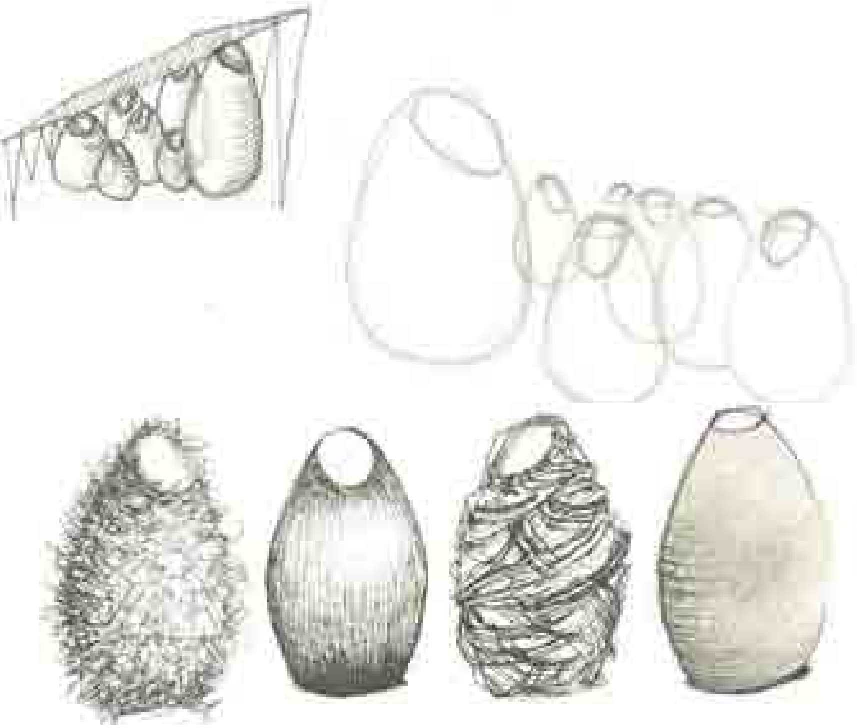


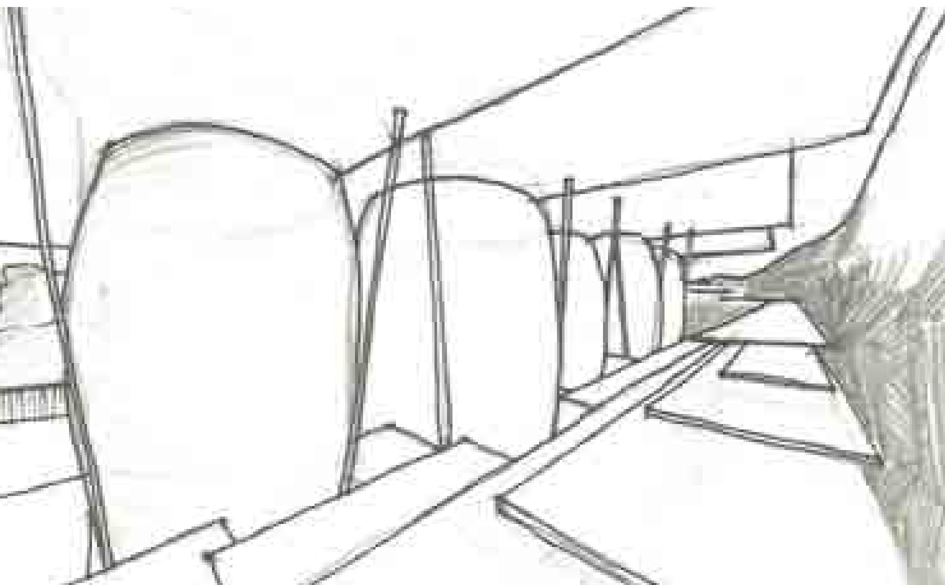
The initial concept of the pod. A small soft and sakcing structure of comfort, tucking in and up against the cliff side.

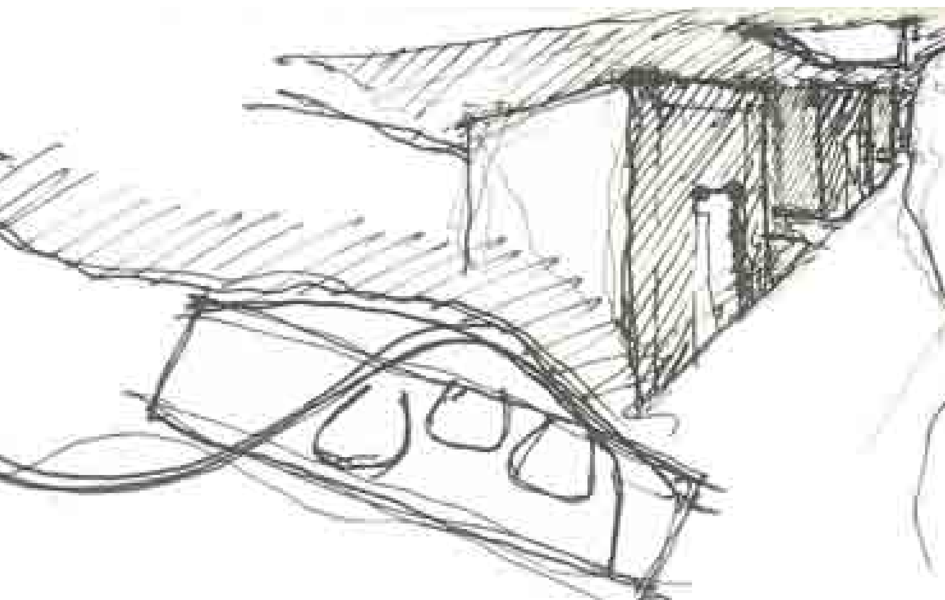




TACTILITY AND SPACIOUSNESS

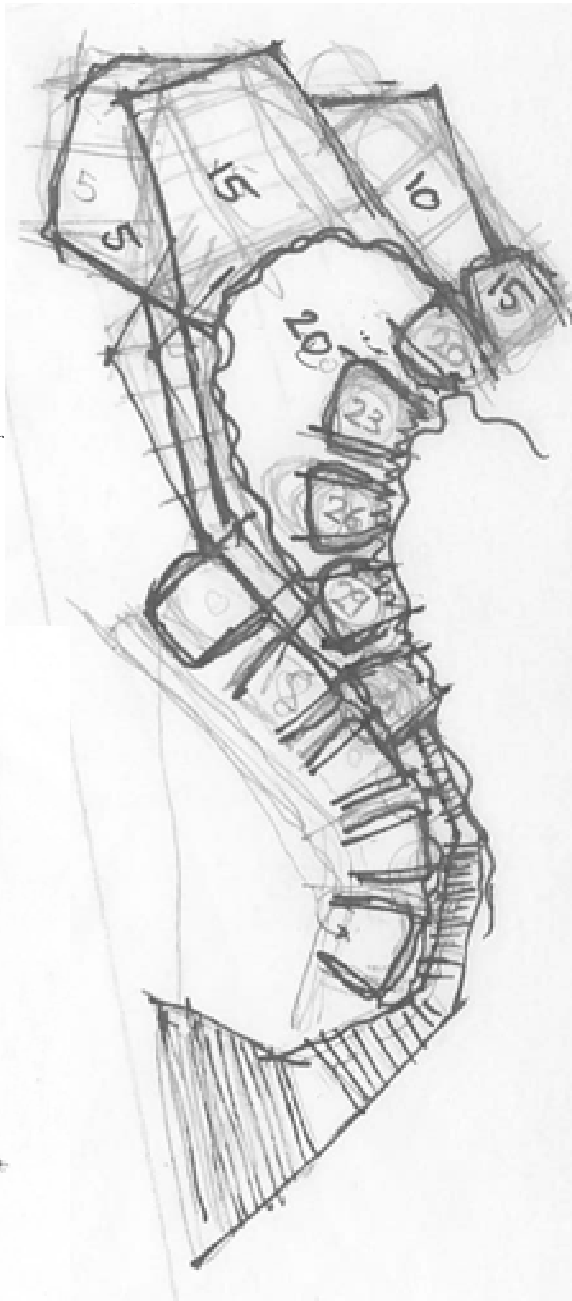


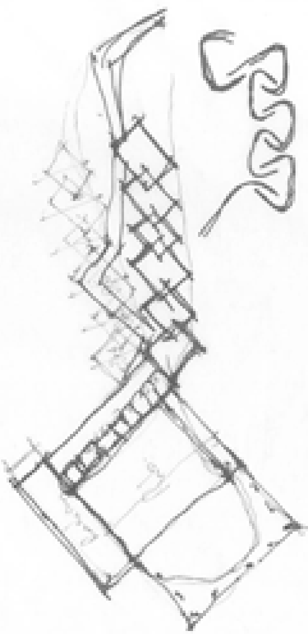


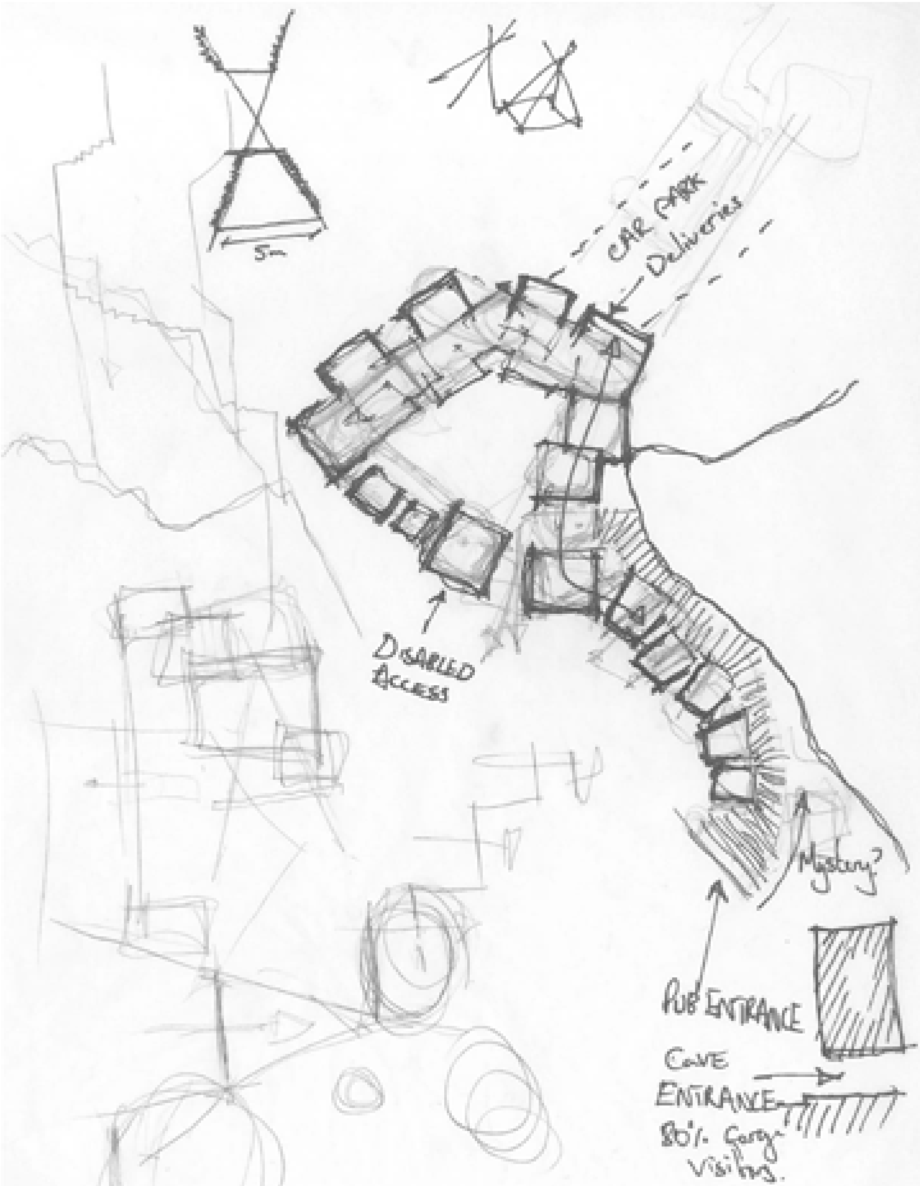


the general idea in the organisation of the spatial elements on the site, was to have the entrance to the tap house in, right next to the entrance to the caves, to get maximum exposure to the visitors of the gorge. Leading the visitor up behind the hotels sleeping pods only offering occasional views out between the pods.

Arranging the main bodies of the site around an internal courtyard, introverted by having the it surrounded by building elements on all sides, focusing the view towards the tactility of the cliff side. With the tower brewery snailing up against the cliff side, creating a canopy over the entrance behind the sleeping pods.



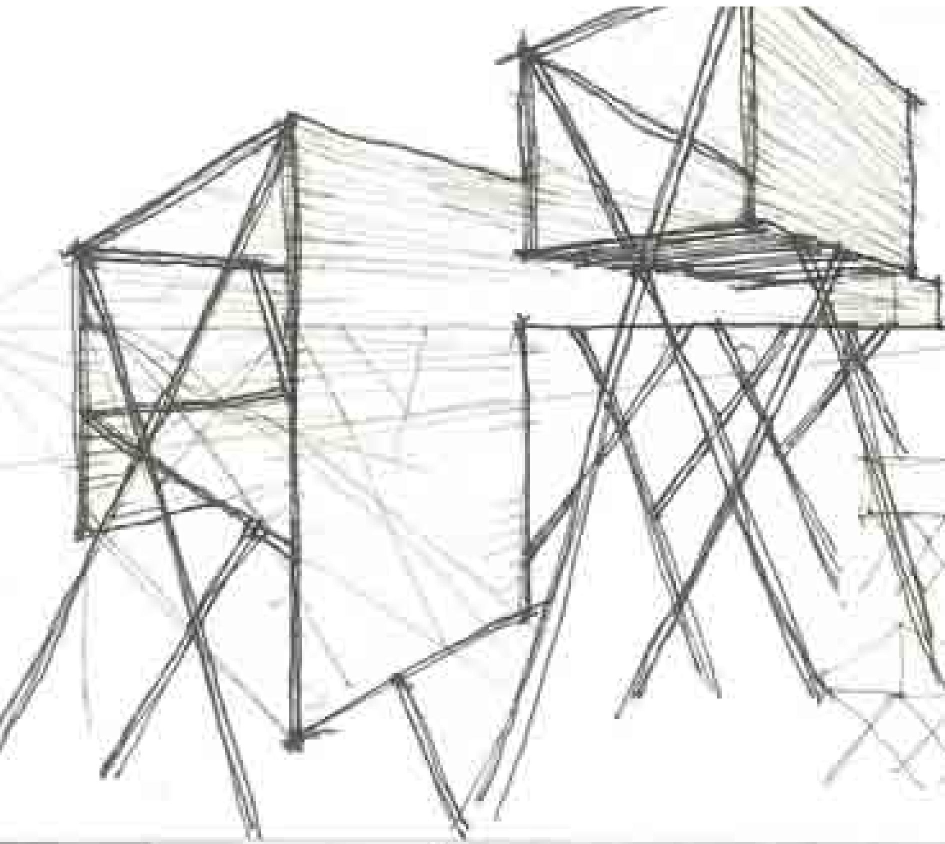


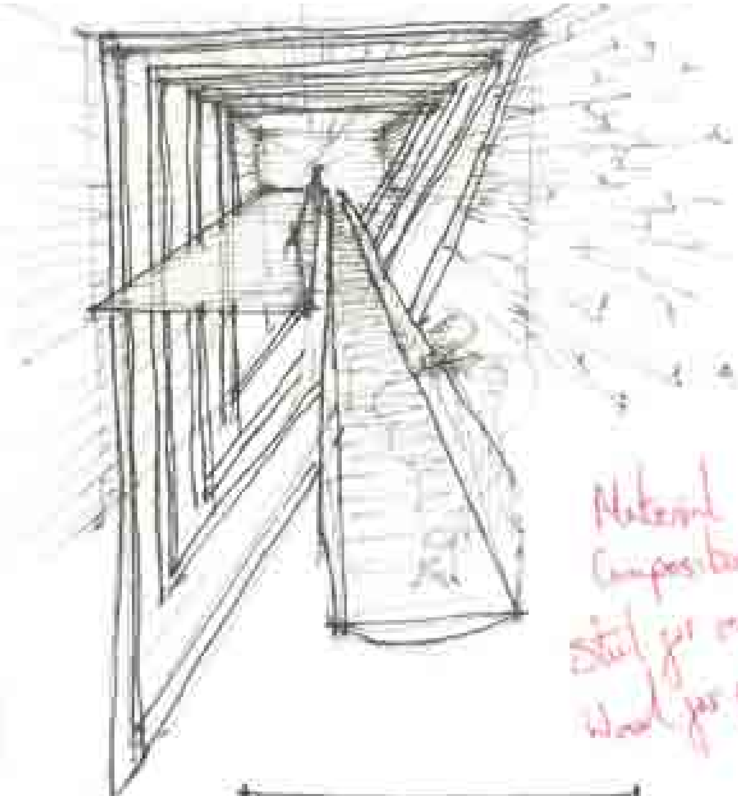

5m
CAR PARK
Deliveries
DISABLED ACCESS
Mystery?
PUB ENTRANCE
CAVE ENTRANCE
80% Cong. visitors.

ELEVATED WALKWAYS

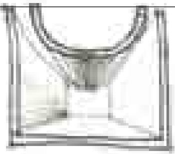
As these very specific and conceptual ideas took hold of us, very very early in the process of the project we, either out of a lack of self confidence or a lack of argumentation for our choice, felt the need to investigate some of these ideas from a more functional, practical and pragmatic view point, to thereby question the wilfulness of this concept, could the same experiences be created through simpler means?

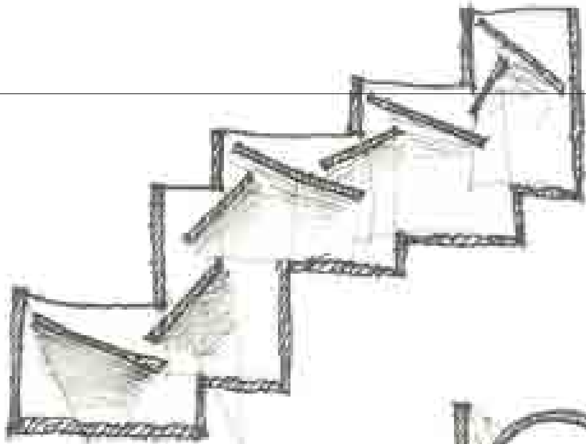
In answer to this we started working with the spatial arrangement and flow on the site as elevated walkways, rather than pods on stilts, simplifying the concept, but also letting circulation overpower the pauses in the compound. This specific investigation into the different ways of having elevated walkway, letting light in and creating enclosure, lead to a more industrial and functional conceptual visualisation.

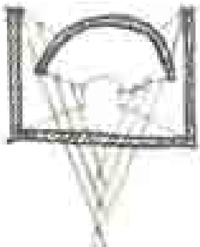


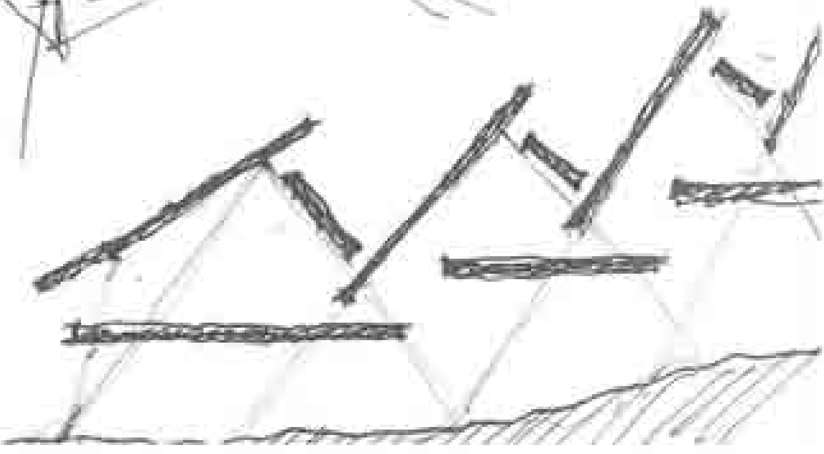


Material Composition.
Steel for members
wood for guards.

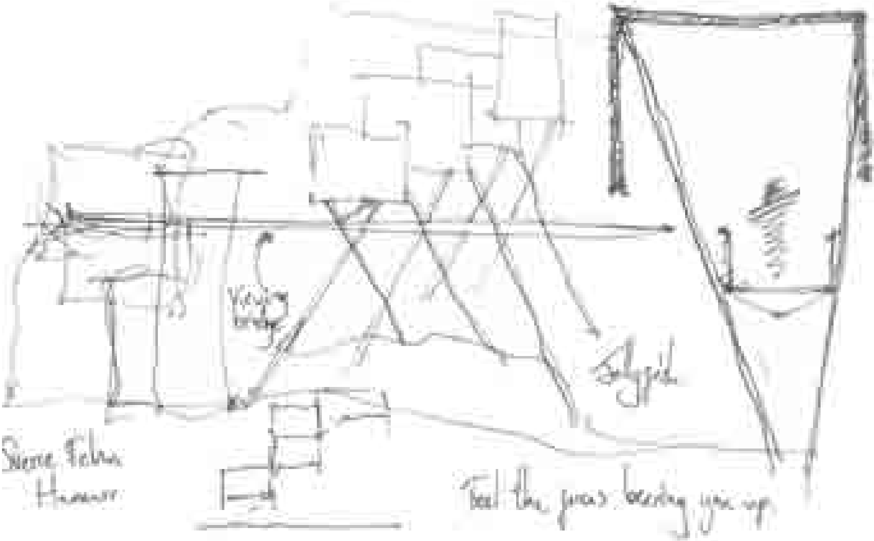


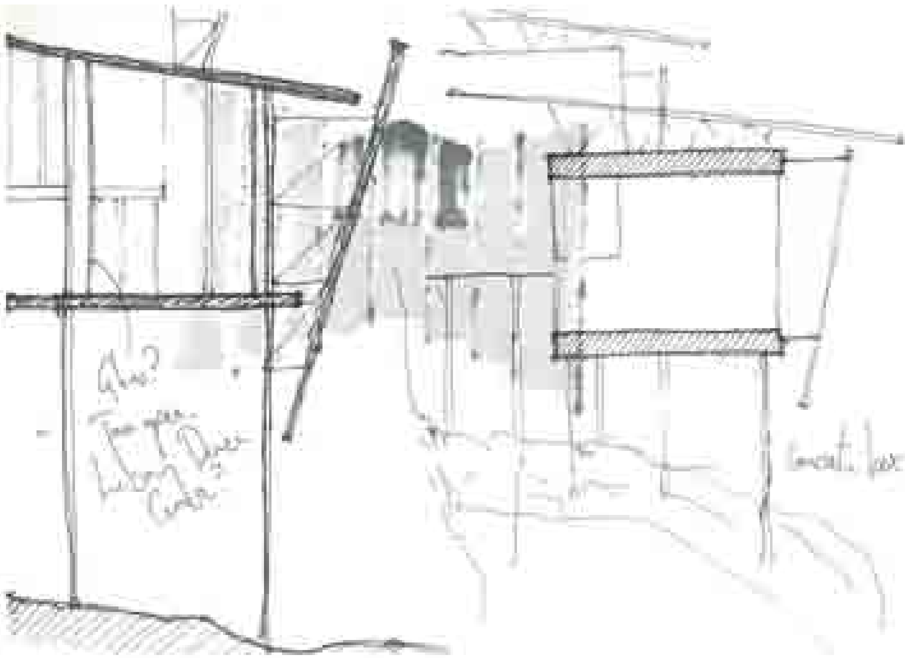


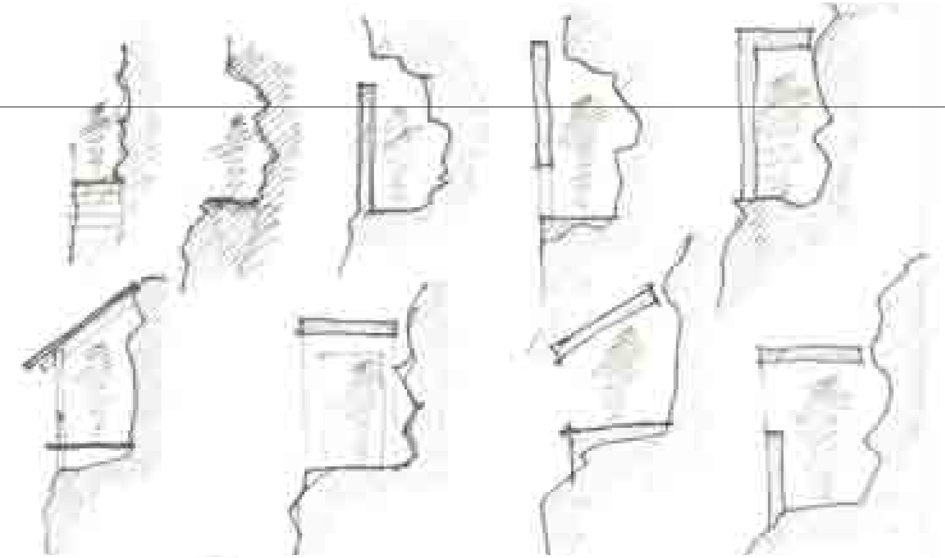


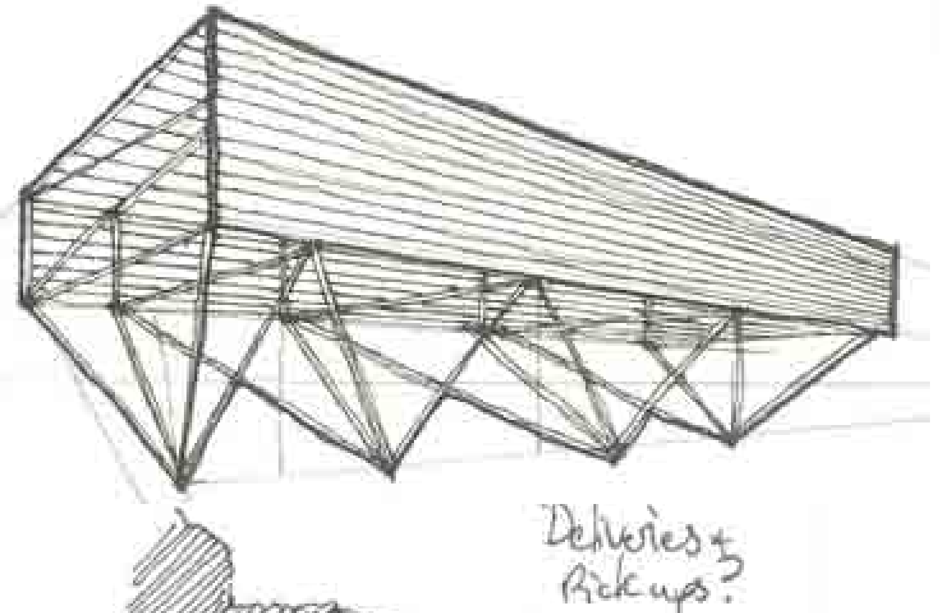


ELEVATED WALKWAYS

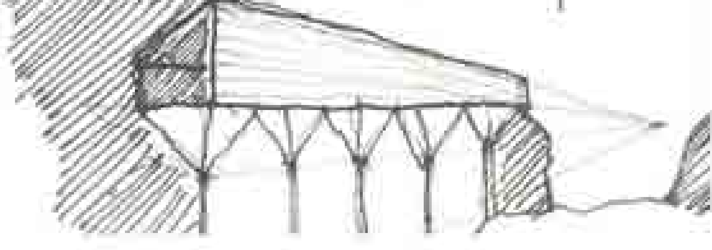


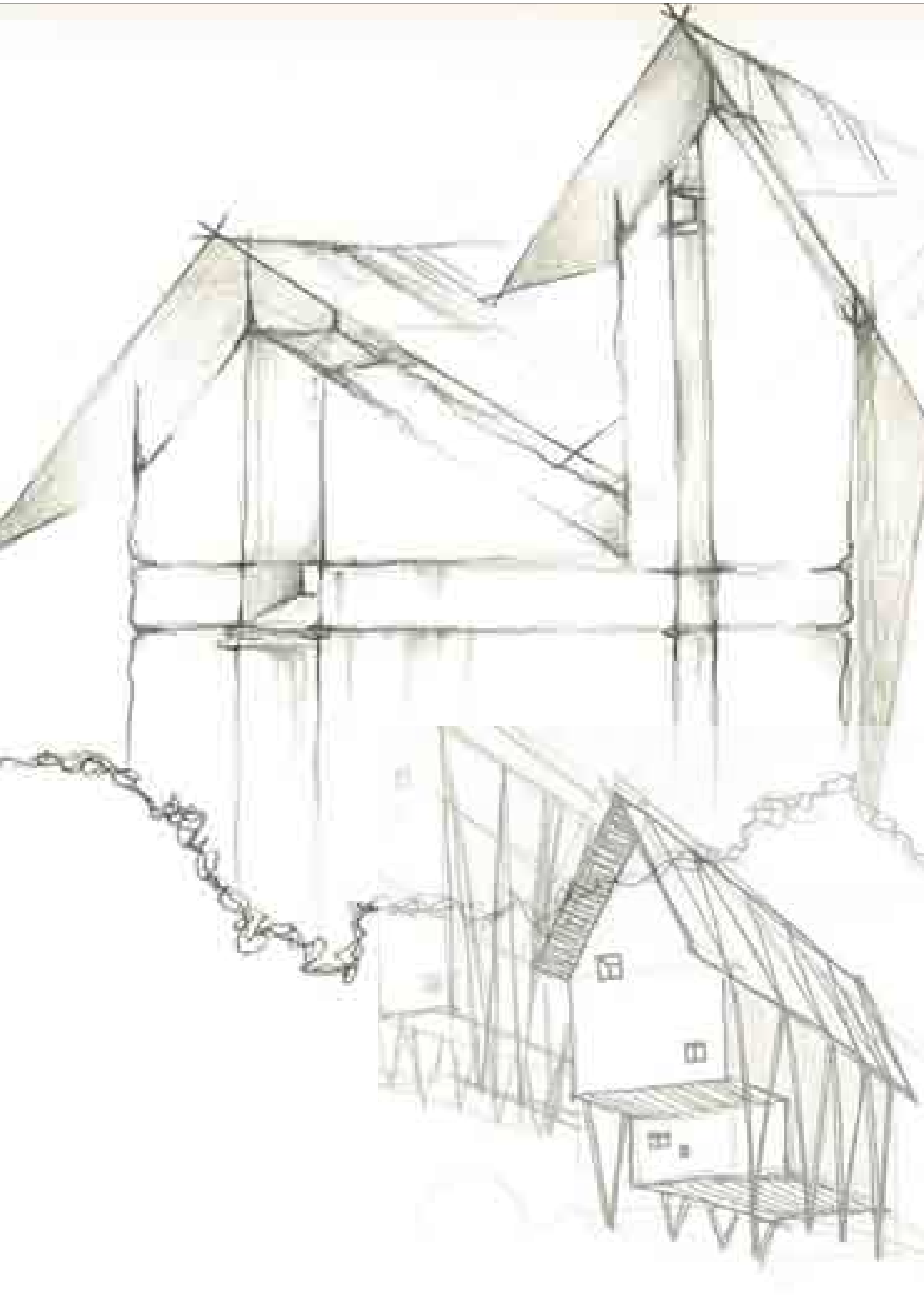




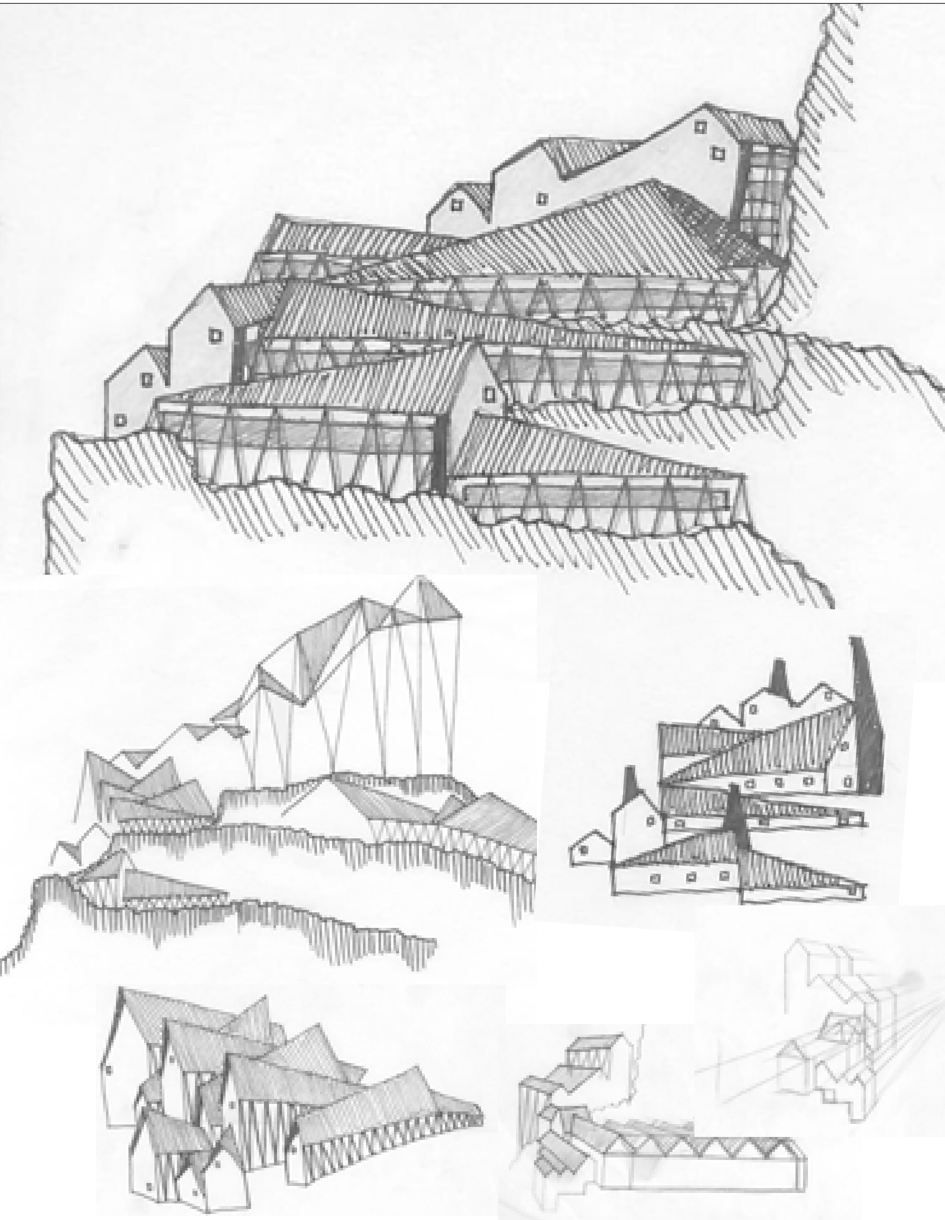


Deliveries + Pickups?



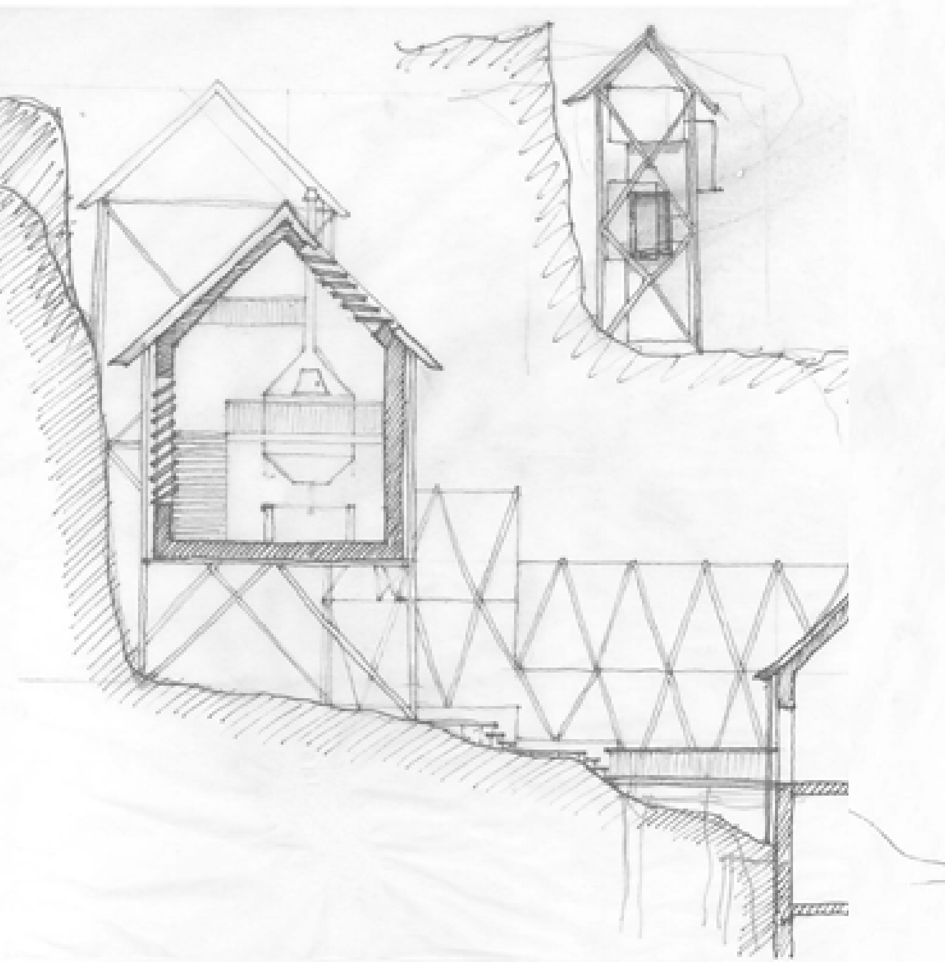


FUNCTIONAL INDUTRIALISM

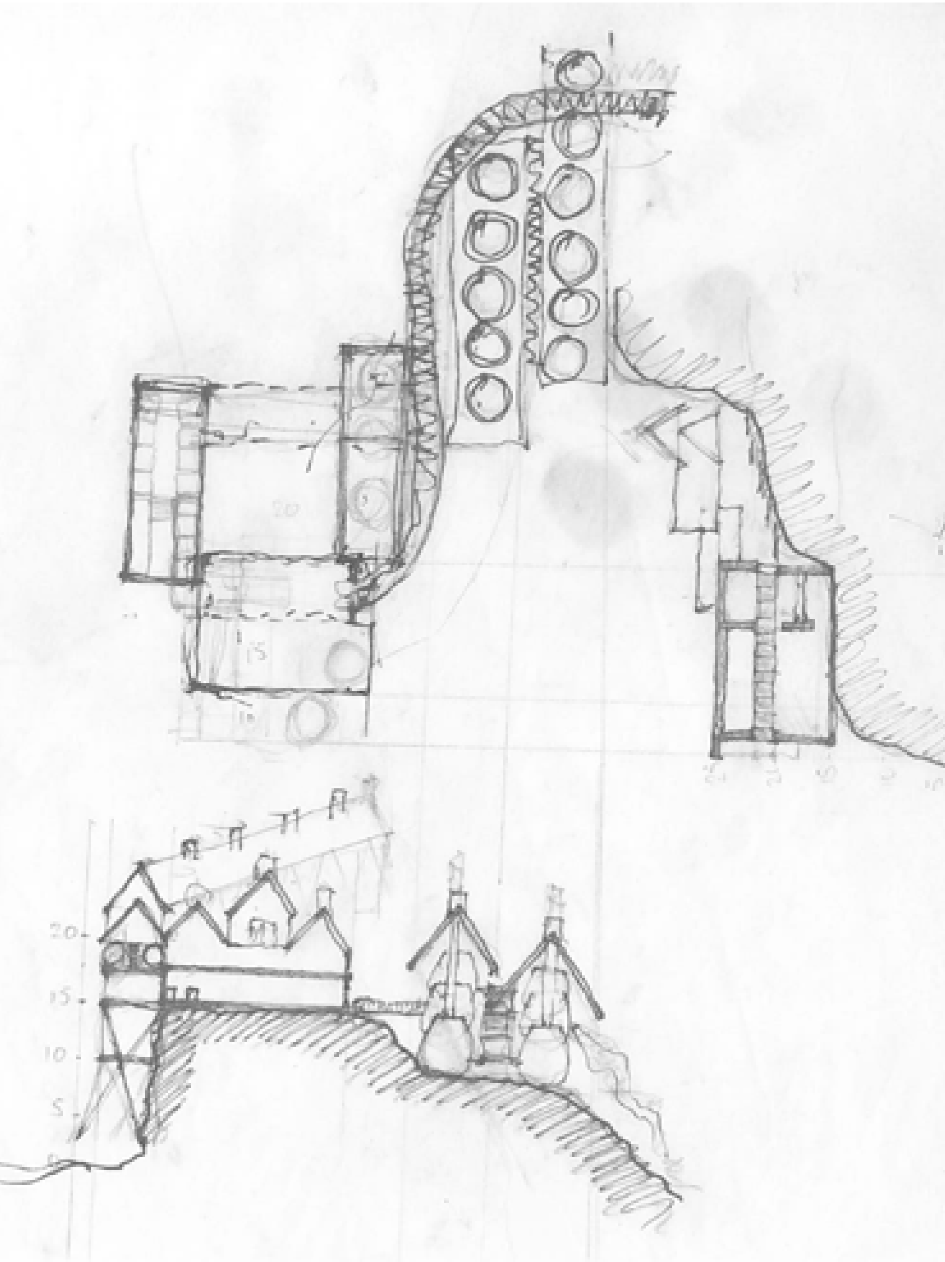


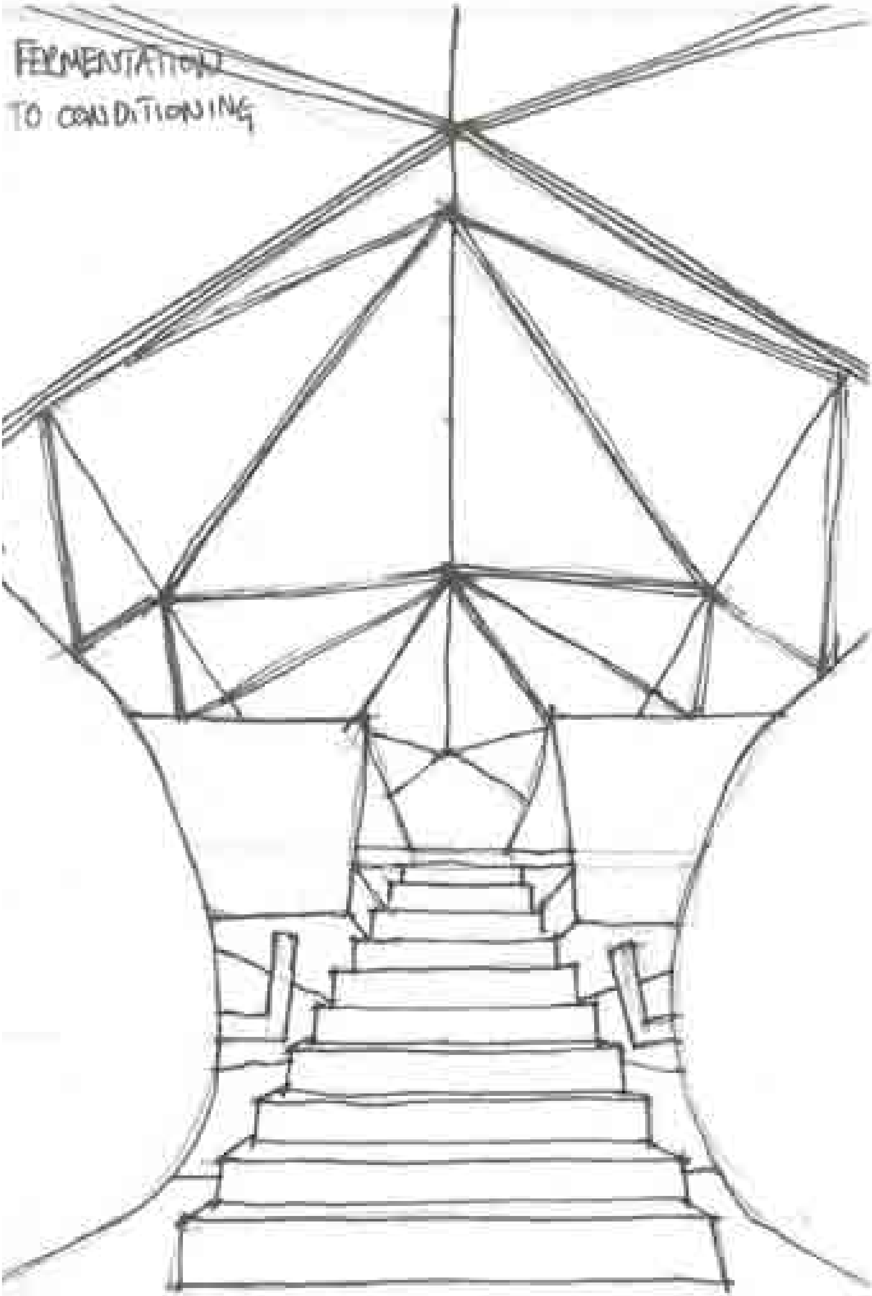
Even thought his more functional and industrial exterior visually looks very different from the pods, we conserved many of the spatial qualities that we loved from the pods, the way that the structure meets the ground of the site is still in the form of stilts, so to avoid leaving a lasting impact on the cliff.

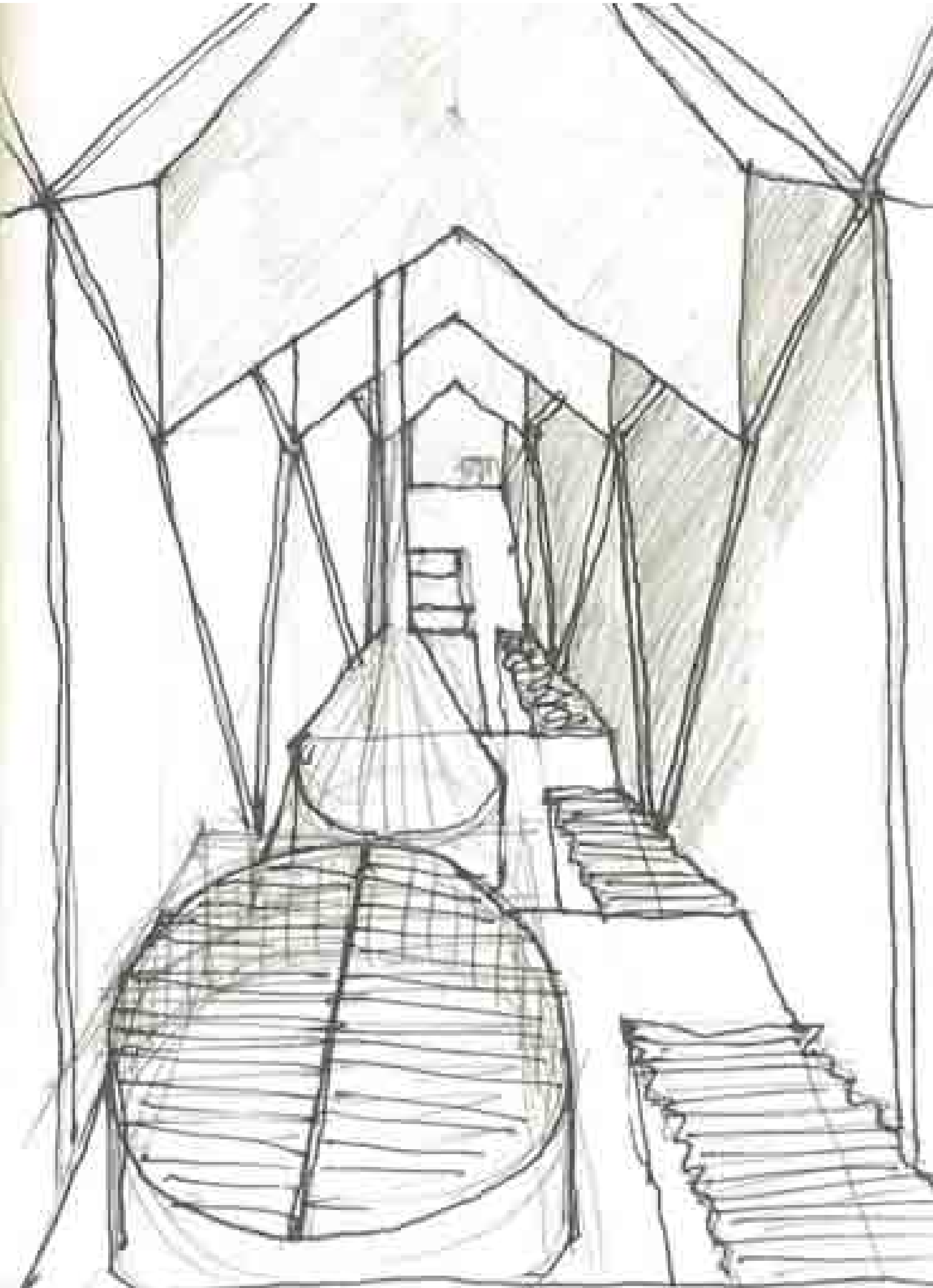
This more traditional look fits very well into the context of the area and cheddar town and the construction culture of England in general. In terms of our biological principles derived from the thesis theory, a vernacular approach was defendable and sensible.



FUNCTIONAL INDUSTRIALISM



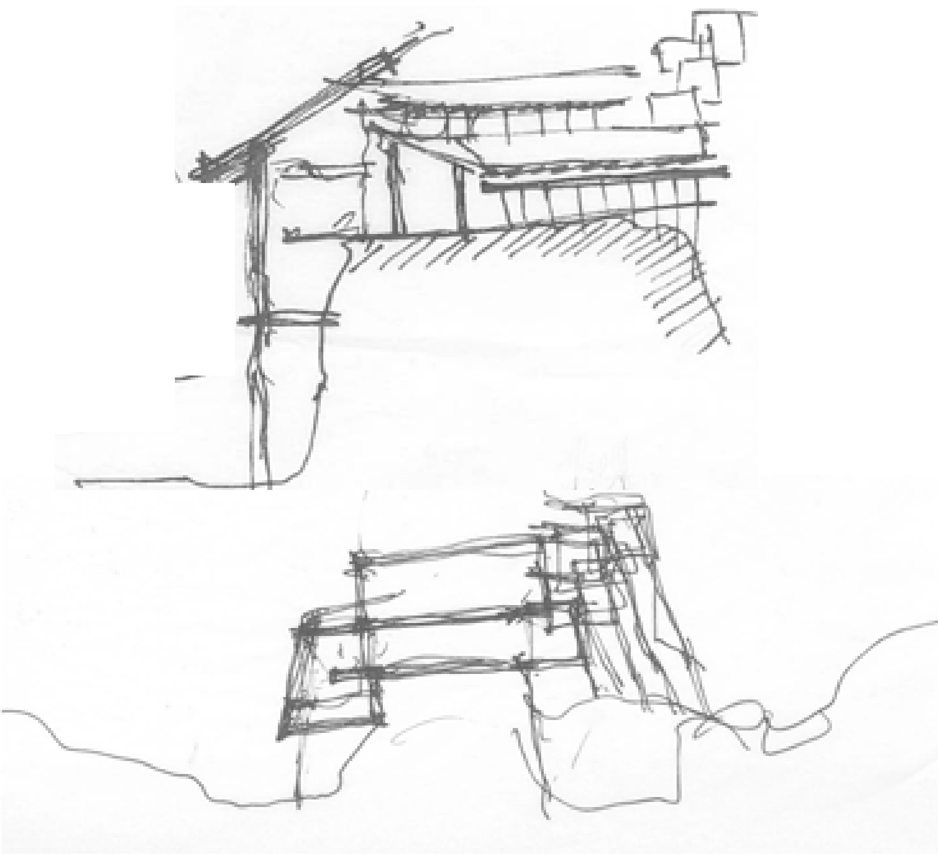

FERMENTATION
TO CONDITIONING

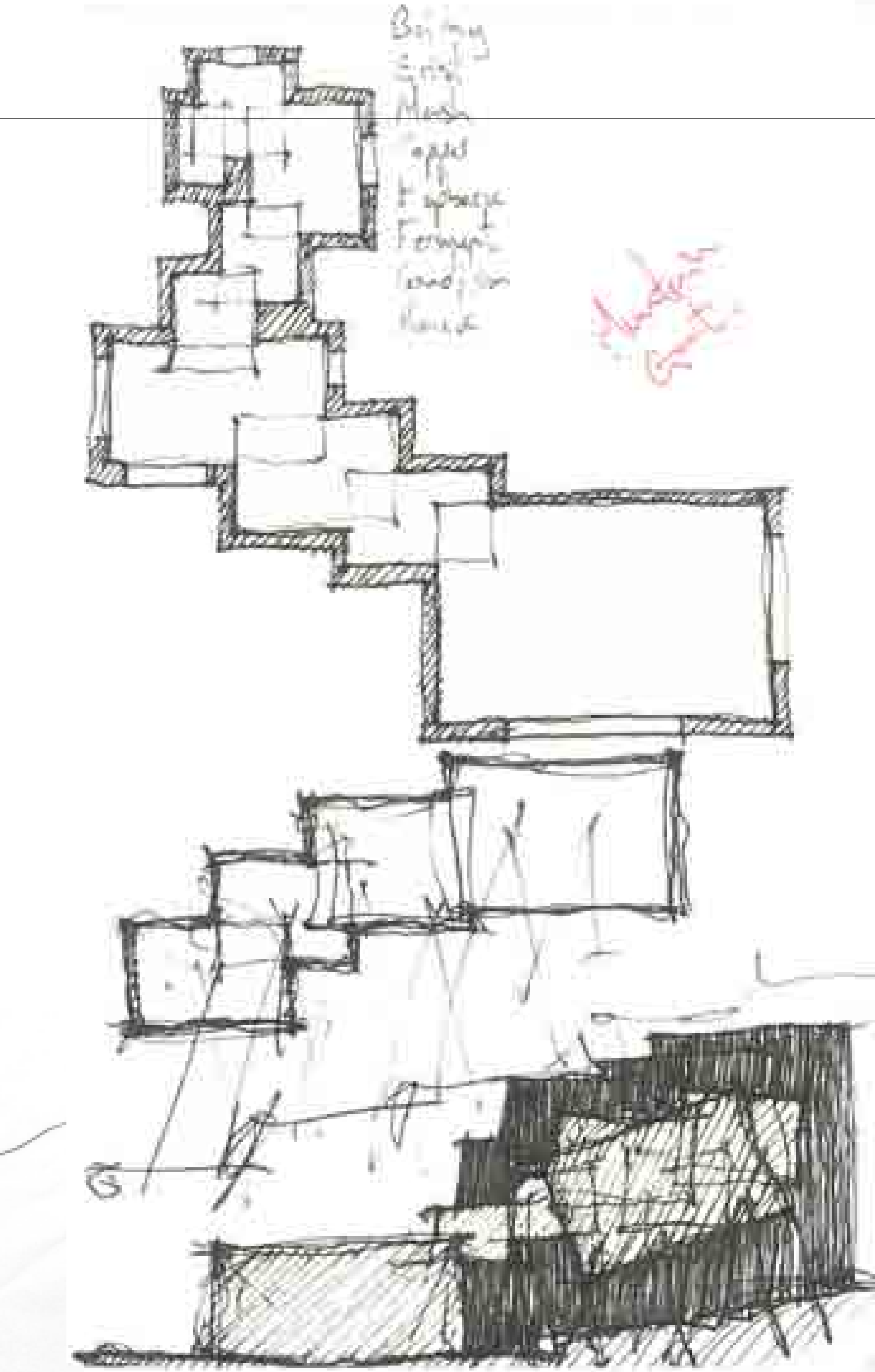


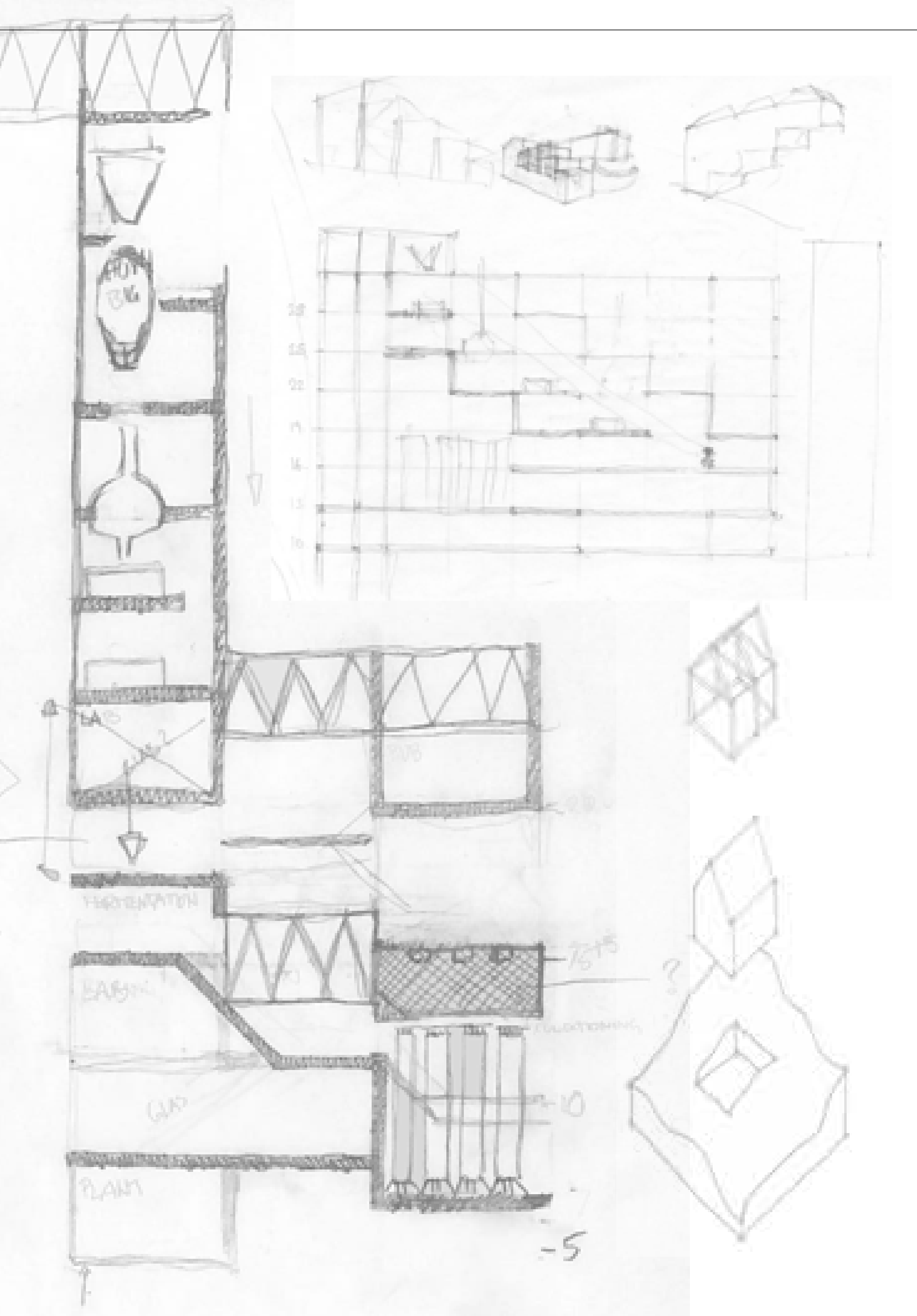
WORKING WITH THE SITE

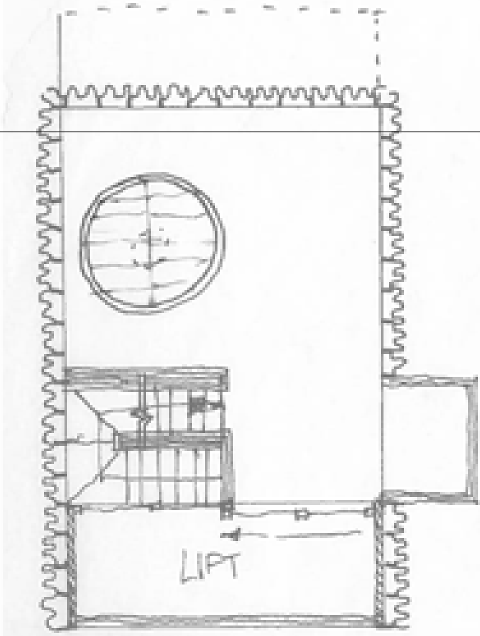
As we approach midway through the project we found it important to become specific at an early stage so we would have time to remove ourselves from this rigidness again and move into the beauty of conceptualism, with a sound mind of knowing what demands the specifics craves from the structure and how to satisfy these, allowing us to be playful again within a set of functional boundaries.

For this purpose we sketched out specific floor plans, sections, exterior visualisations and a master plan. We again questioned everything wilful about the plans to come up with the simplest and most pragmatic solutions to the problems at hand. Two of the more noticeable changes this approach brought was the vertical stacking of the tower brewery and the creations of two clear journeys, the journey of the beer and the journey of the visitor, their interaction and more intuitive advance, eliminating any doubling back onto the path.

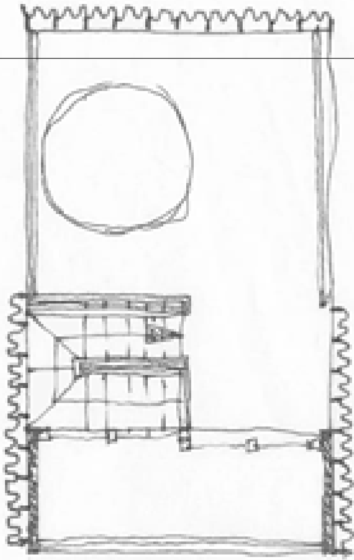




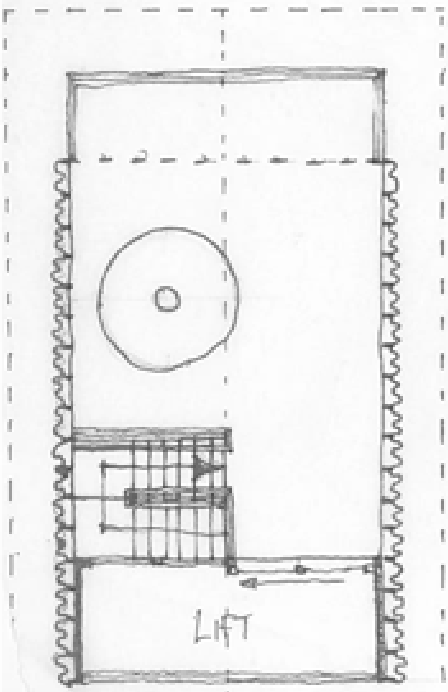




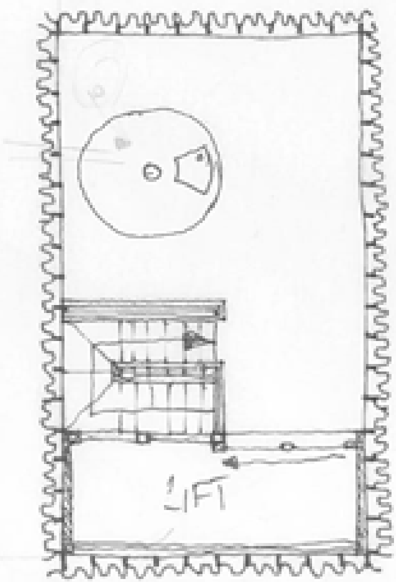
MASHTUN



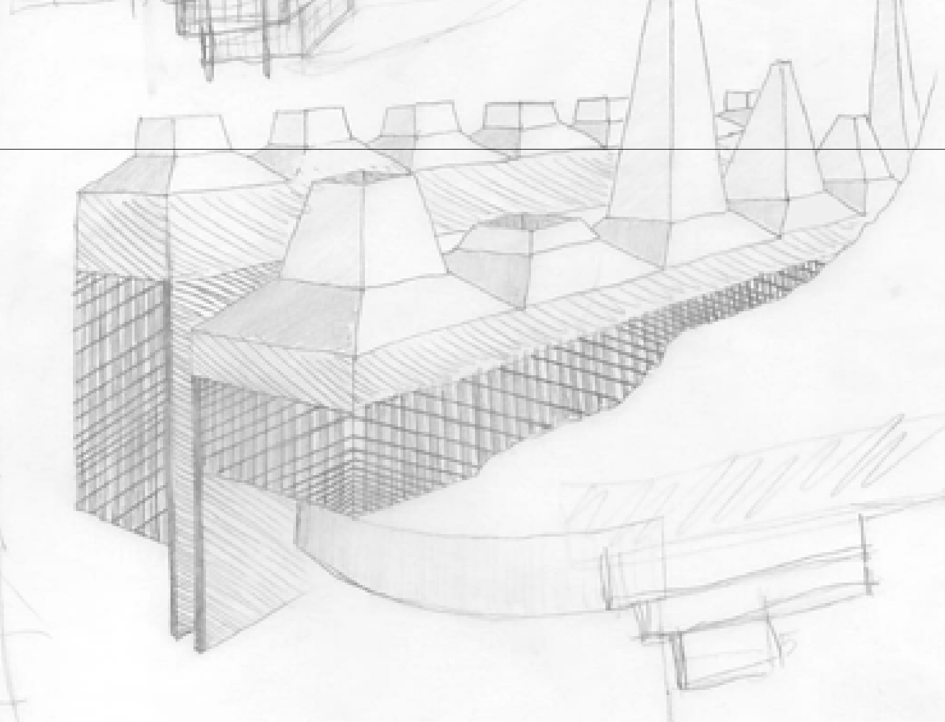
FILTERING

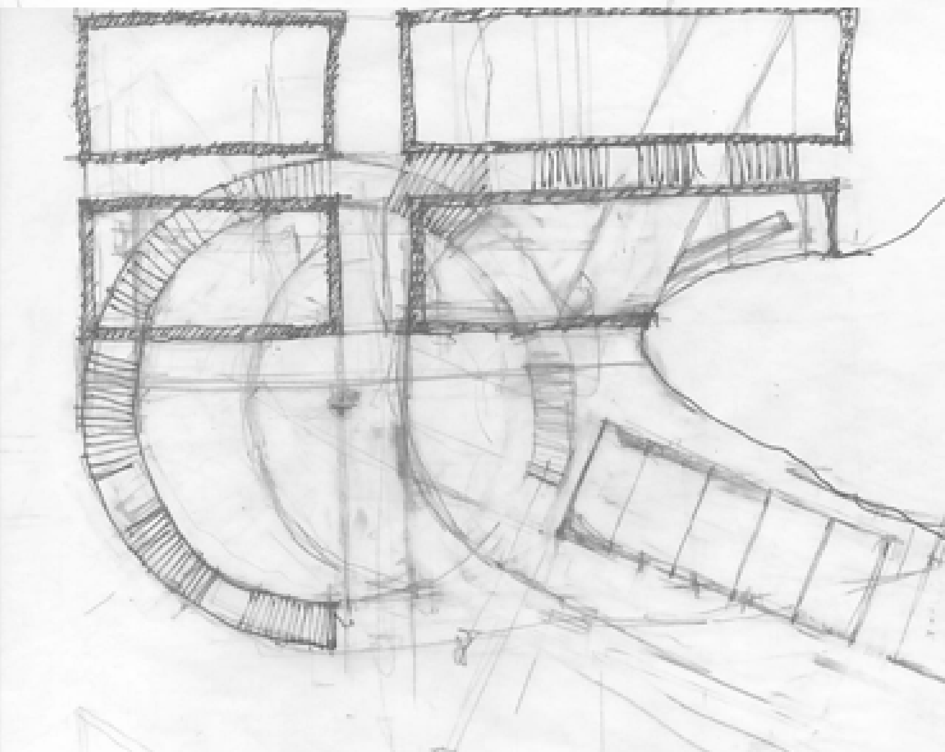


GRIST MILL

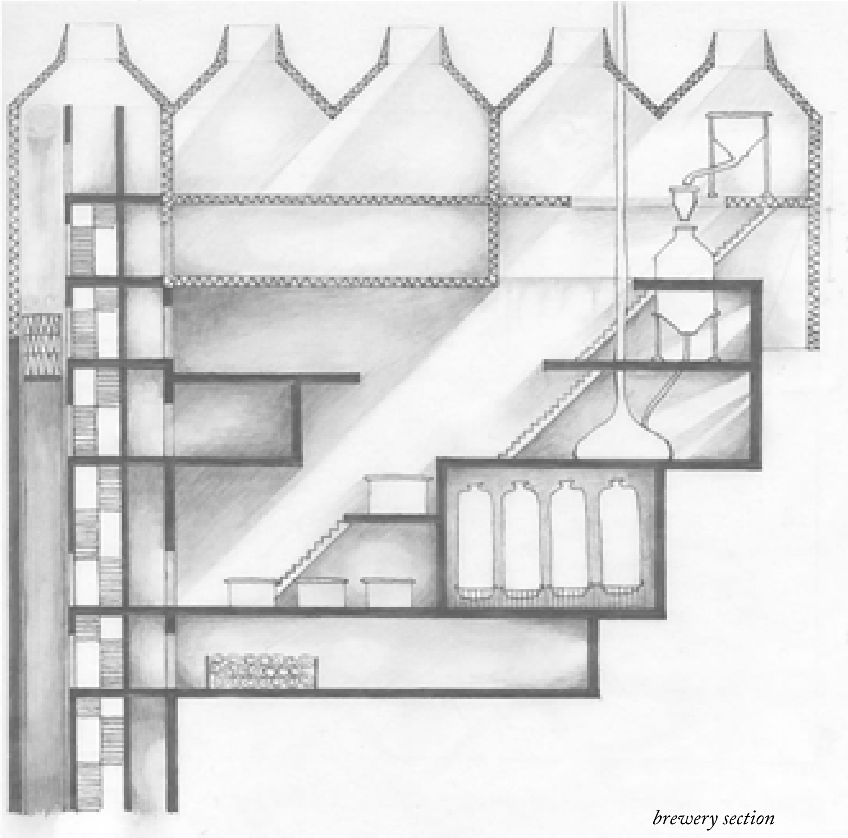


COPPER

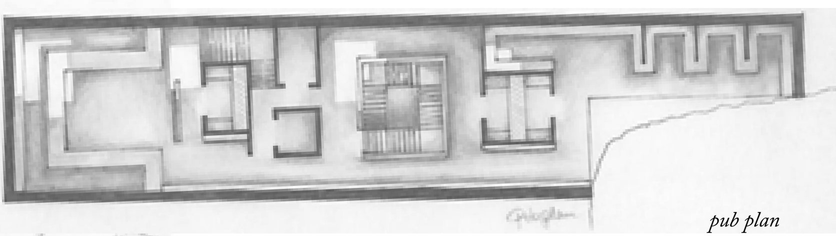




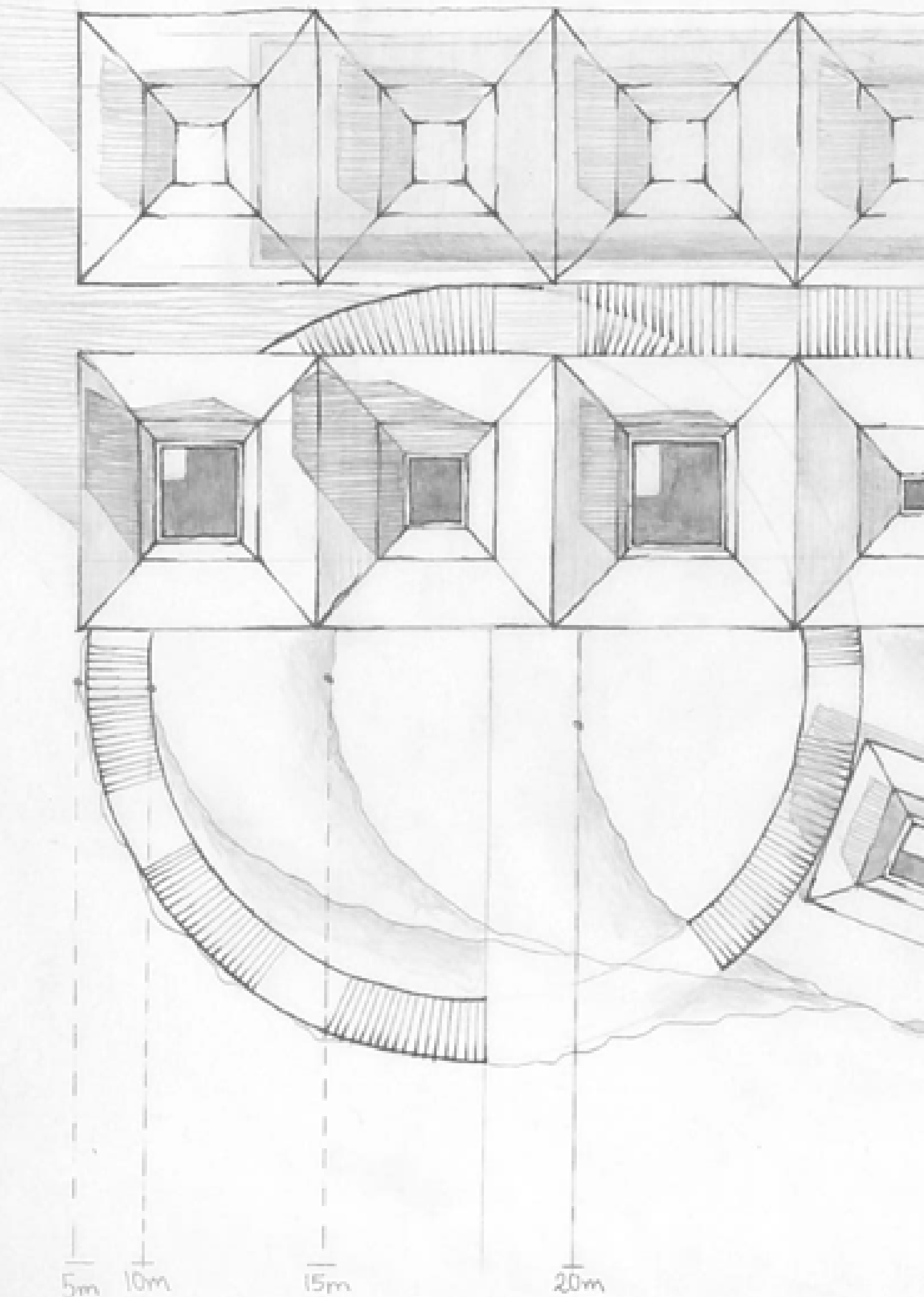
MIDWAY SECTIONS AND PLANS

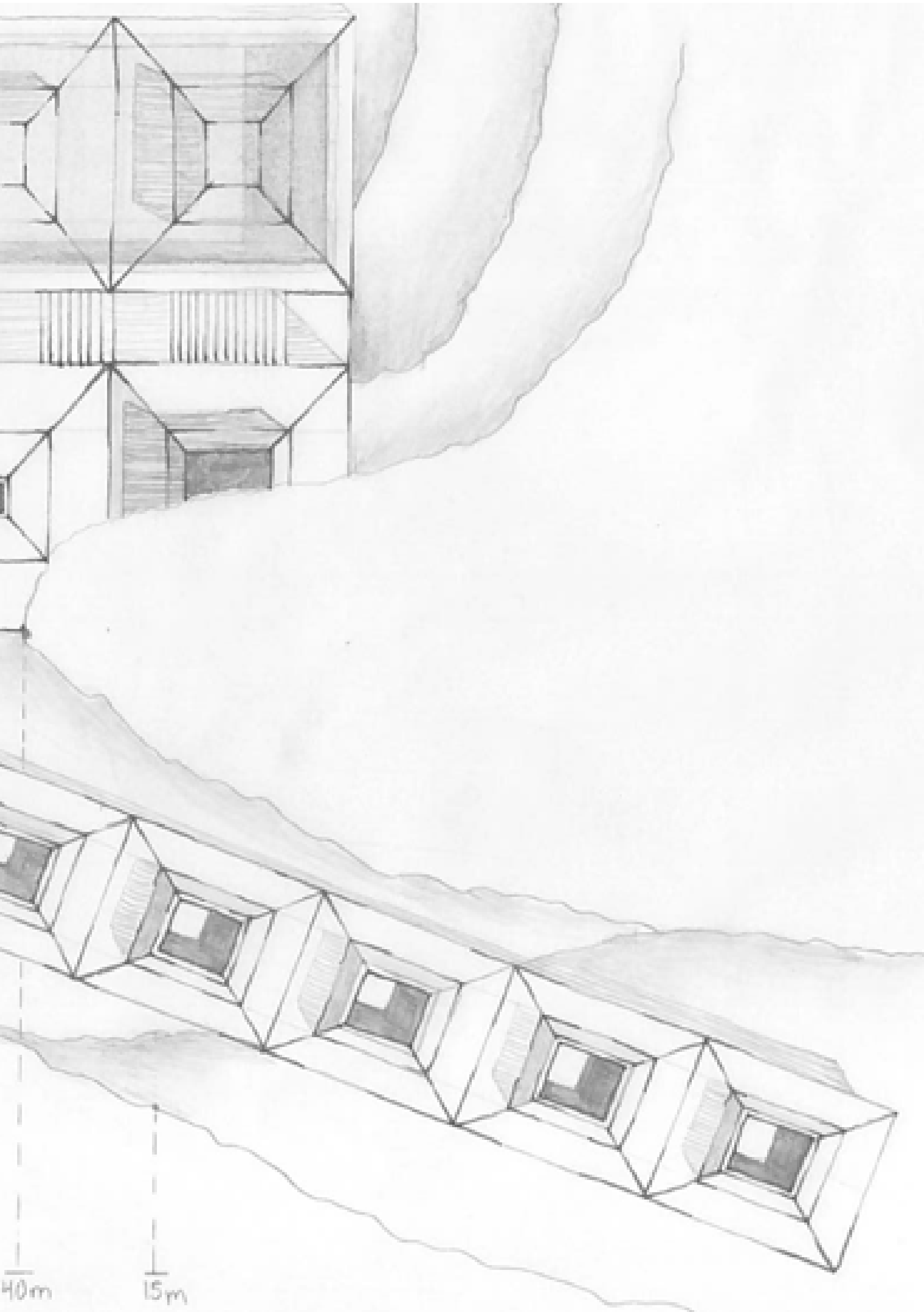


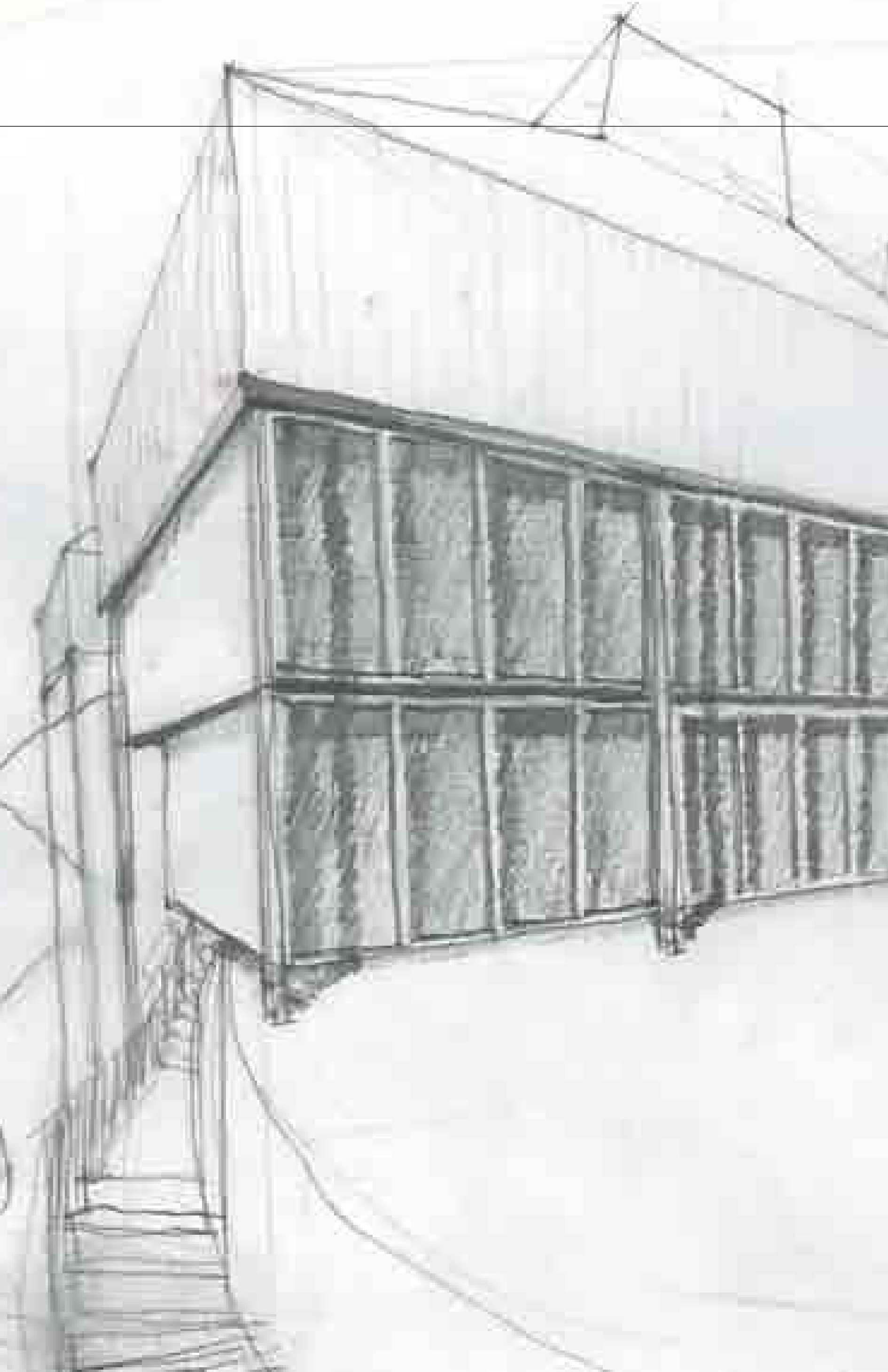
brewery section



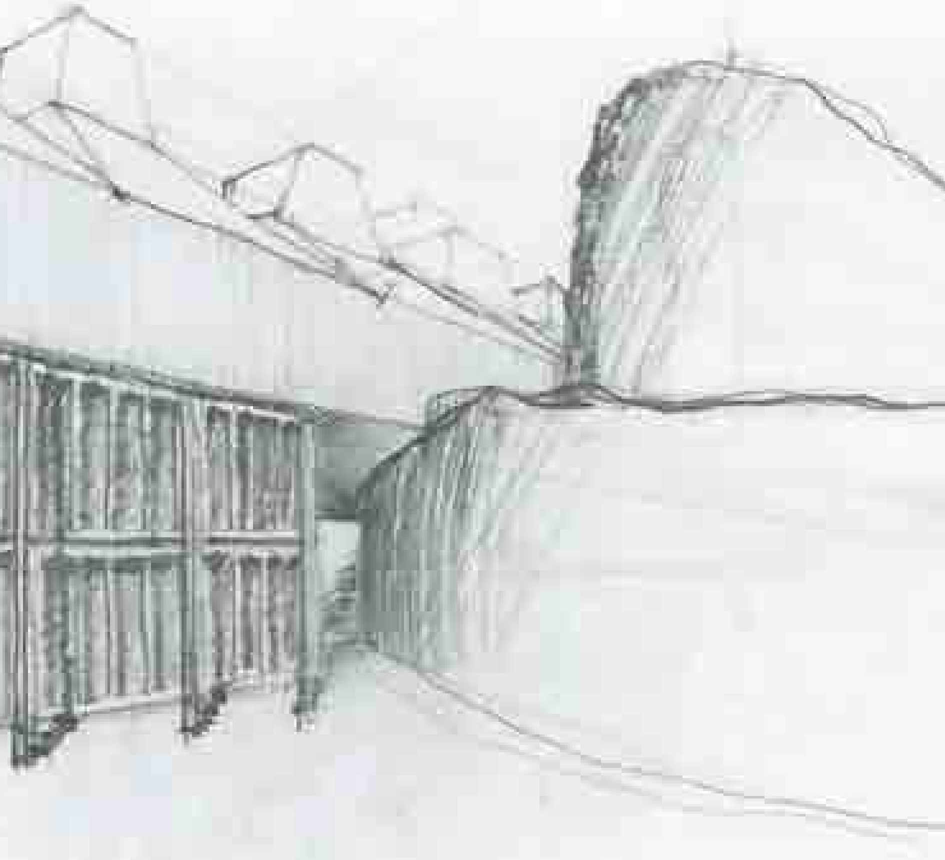
pub plan

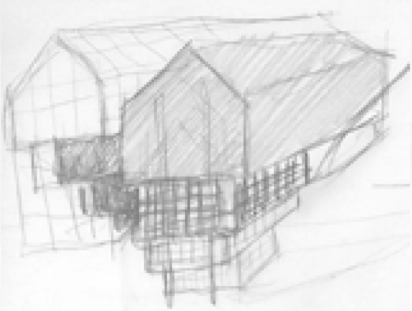

5m
10m
15m
20m

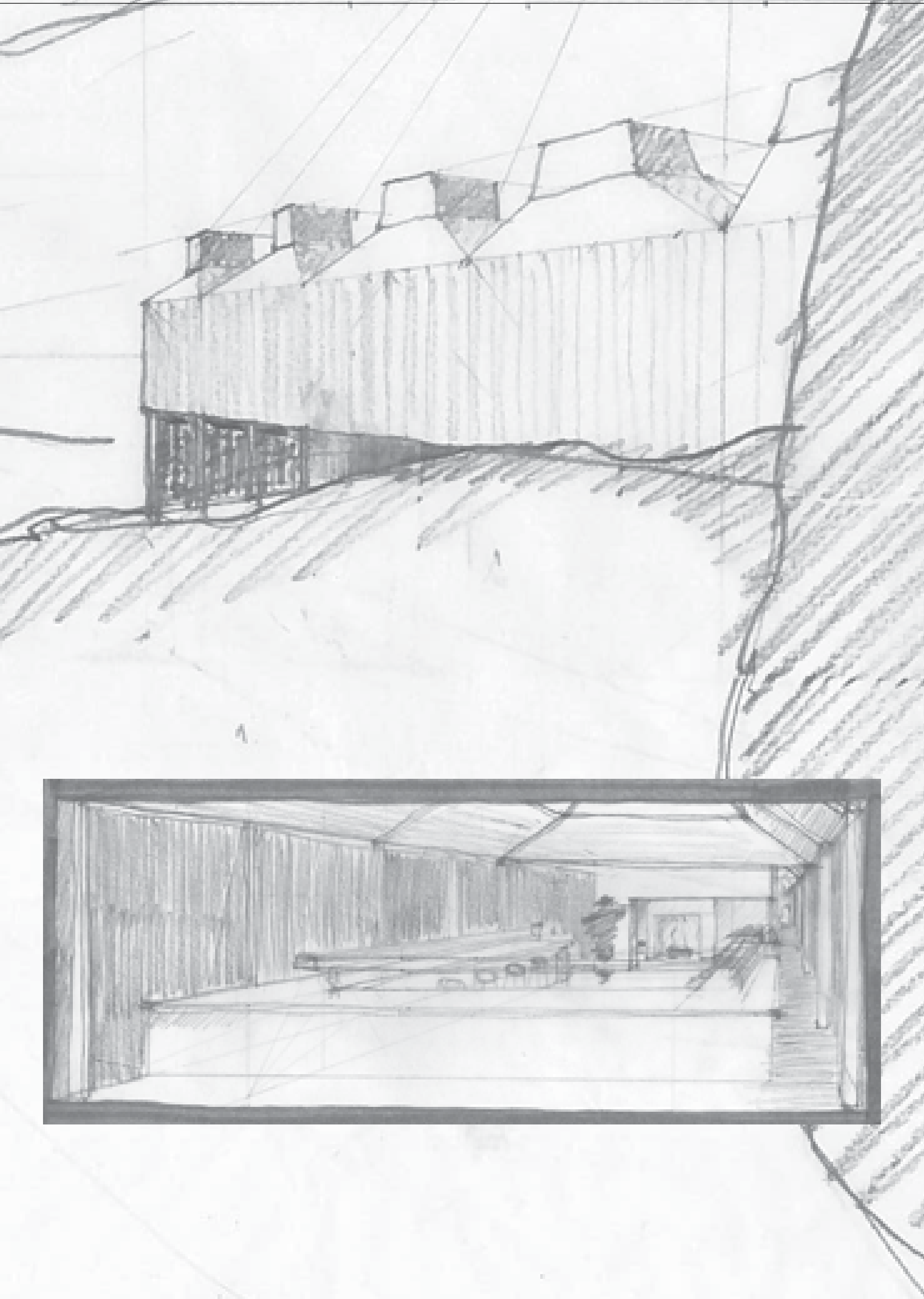

40m
15m

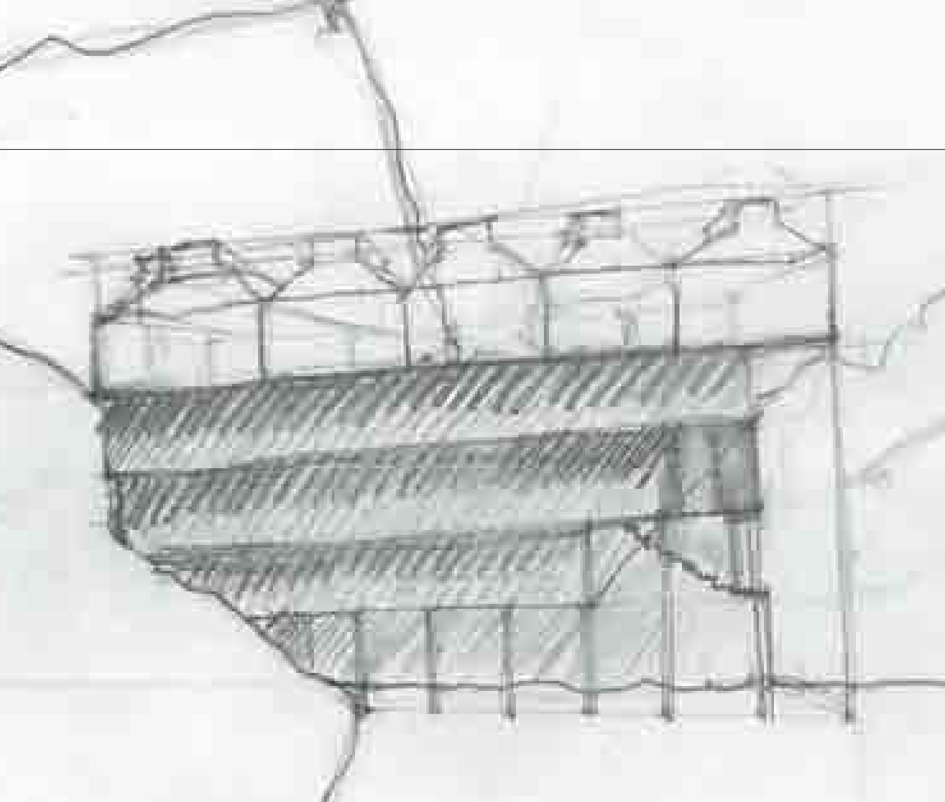


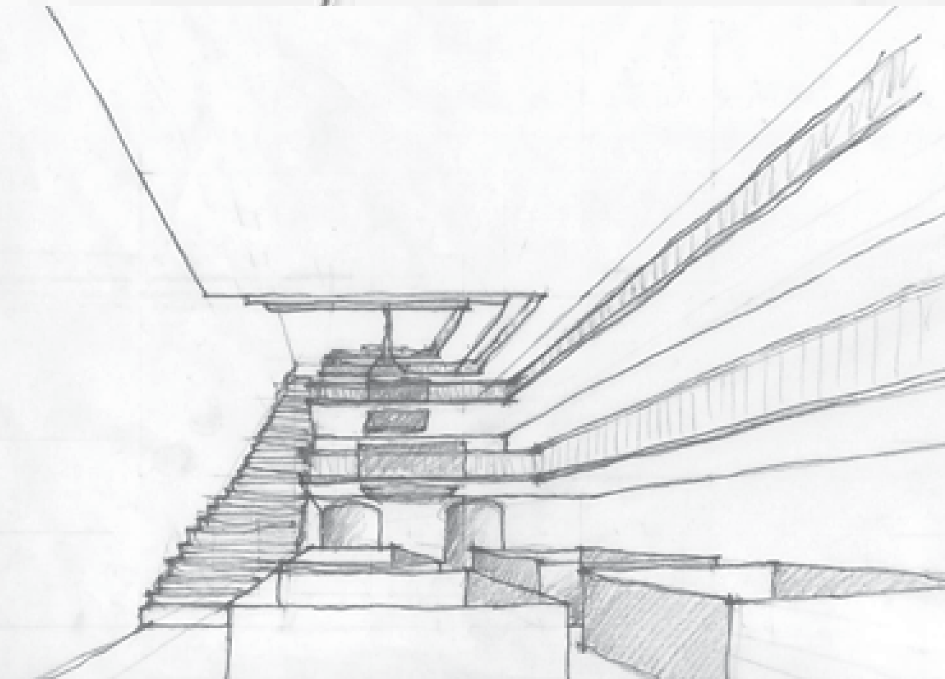
MIDWAY EXTERIOR PROPOSAL

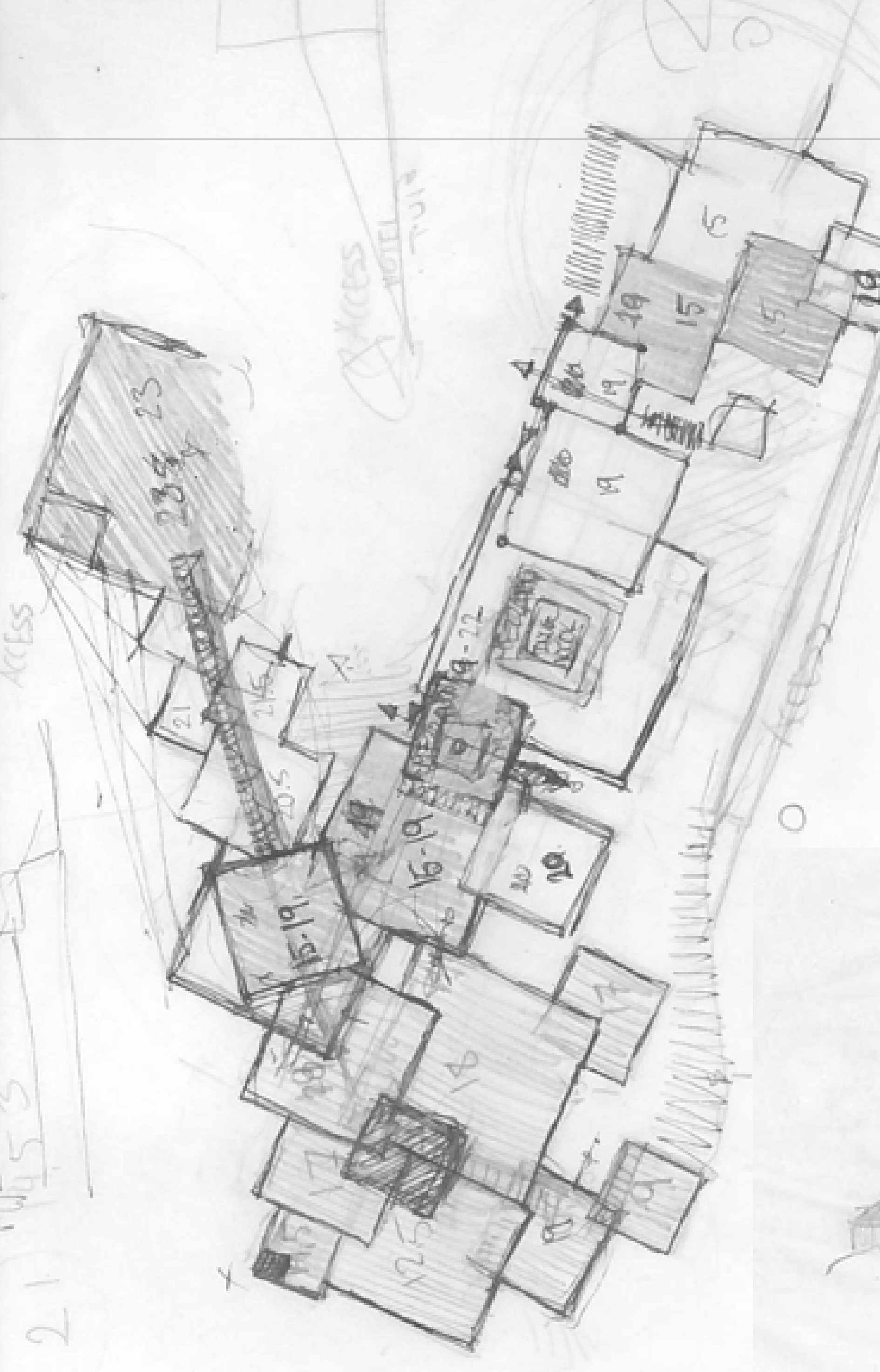










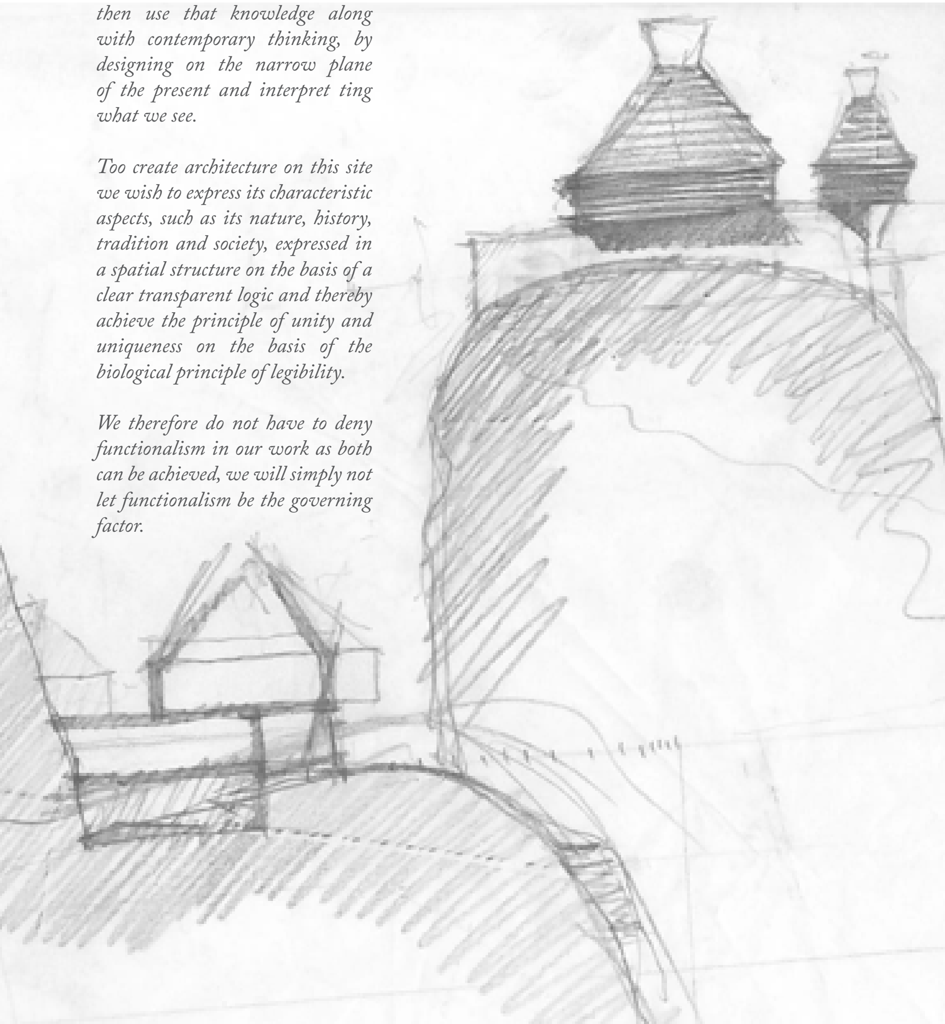


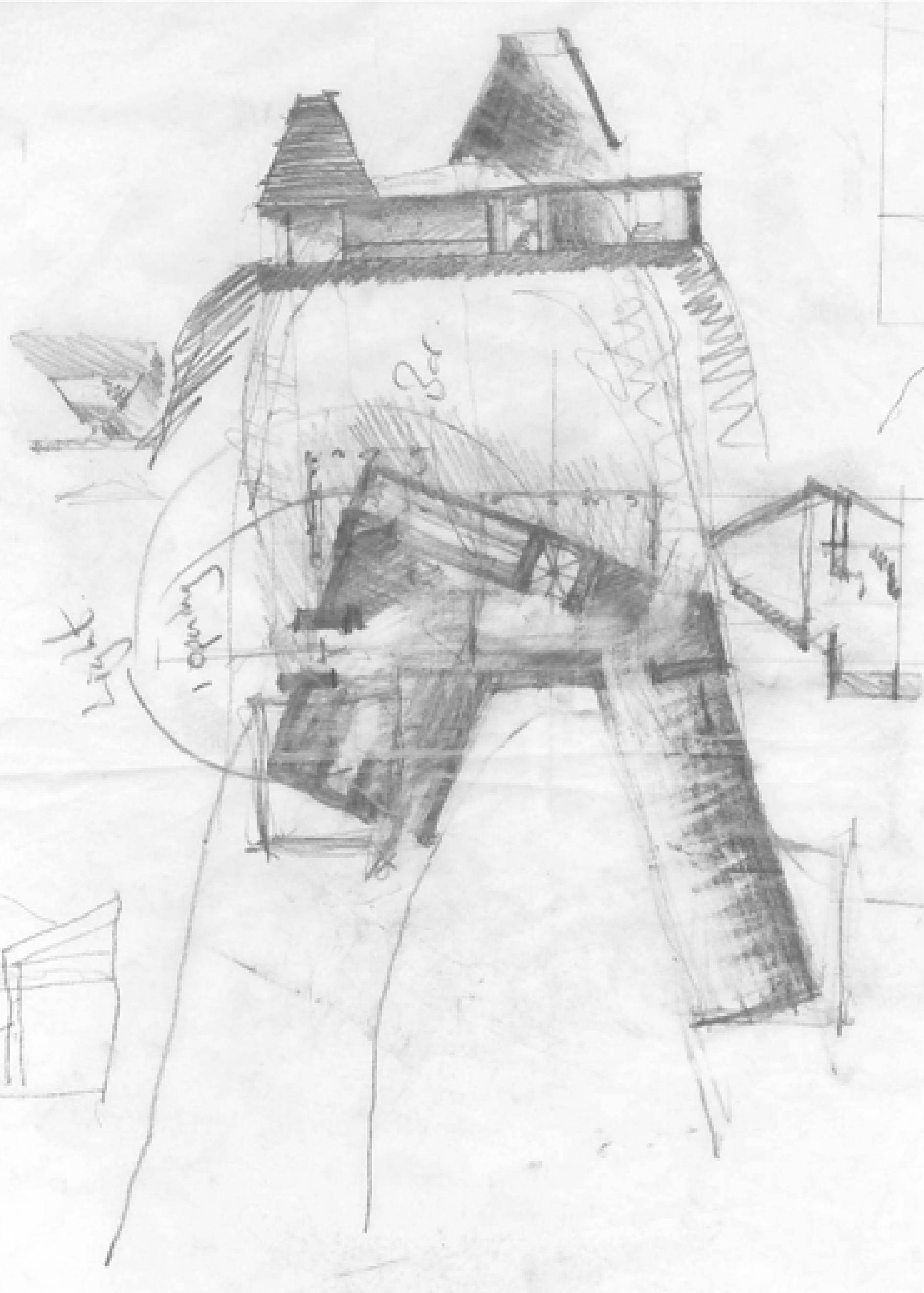
REGAINING PLAYFULLNESS

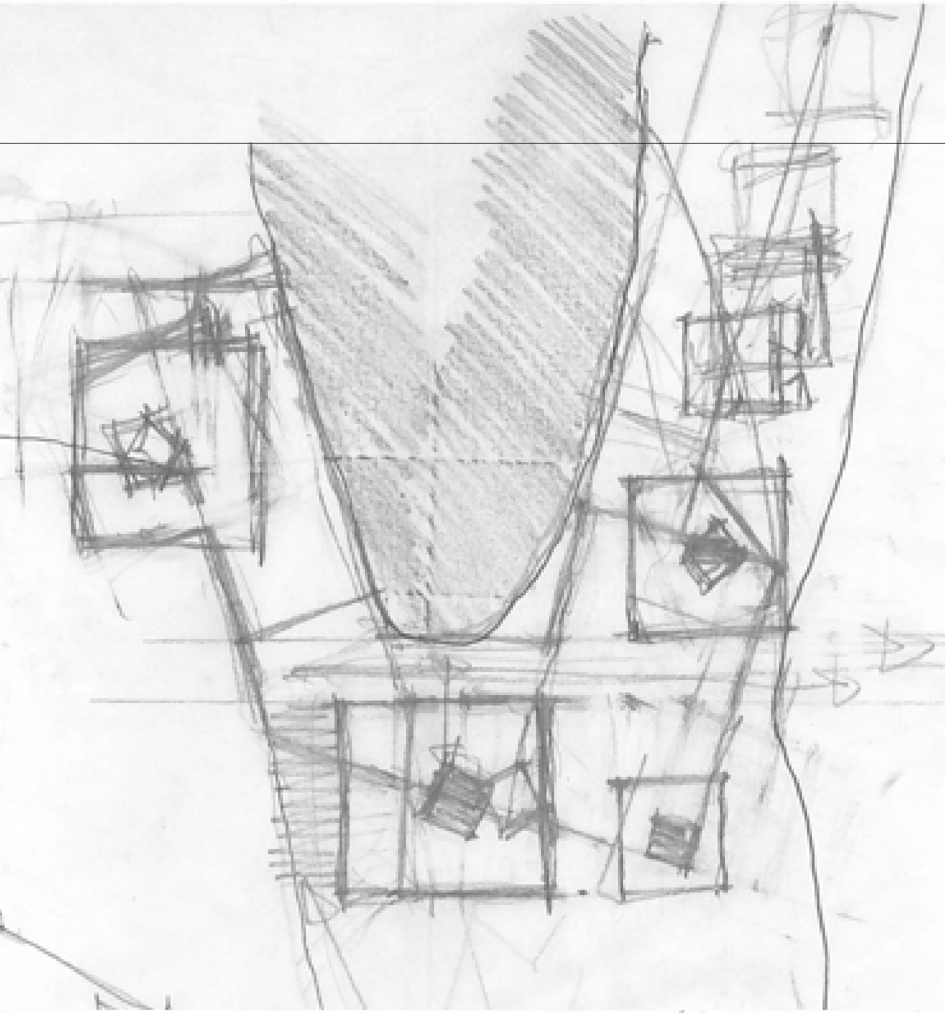
Our reasoning for not letting functionalism dominate and overrule all decision making in this project are that we do not believe that we can simply put something new into any place and especially not one so characteristic as this. We wish to absorb the surroundings of what already exists in this place and makes it unique and then use that knowledge along with contemporary thinking, by designing on the narrow plane of the present and interpret ting what we see.

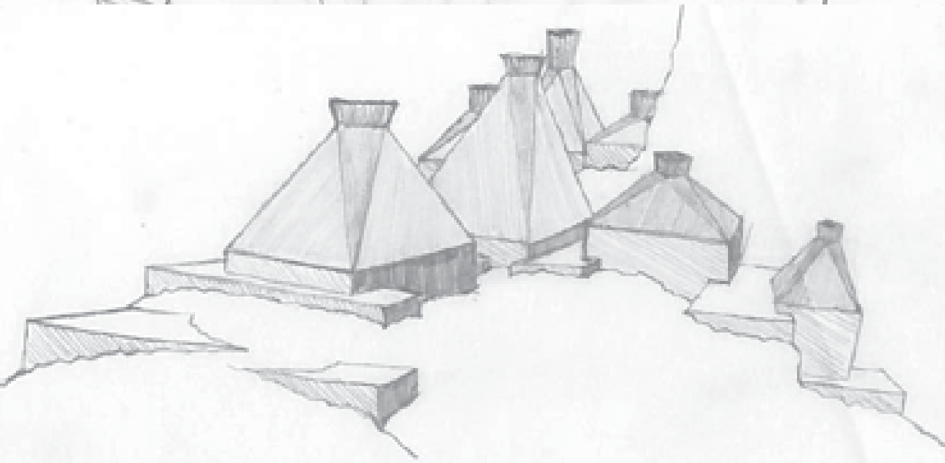
Too create architecture on this site we wish to express its characteristic aspects, such as its nature, history, tradition and society, expressed in a spatial structure on the basis of a clear transparent logic and thereby achieve the principle of unity and uniqueness on the basis of the biological principle of legibility.

We therefore do not have to deny functionalism in our work as both can be achieved, we will simply not let functionalism be the governing factor.

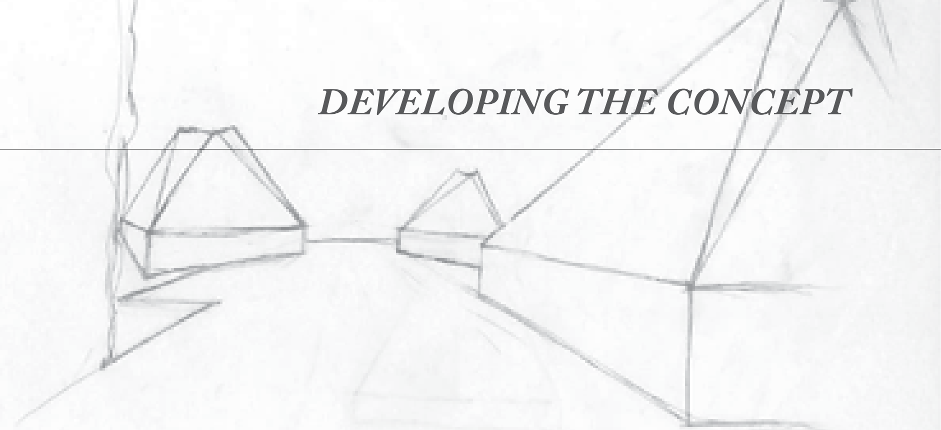


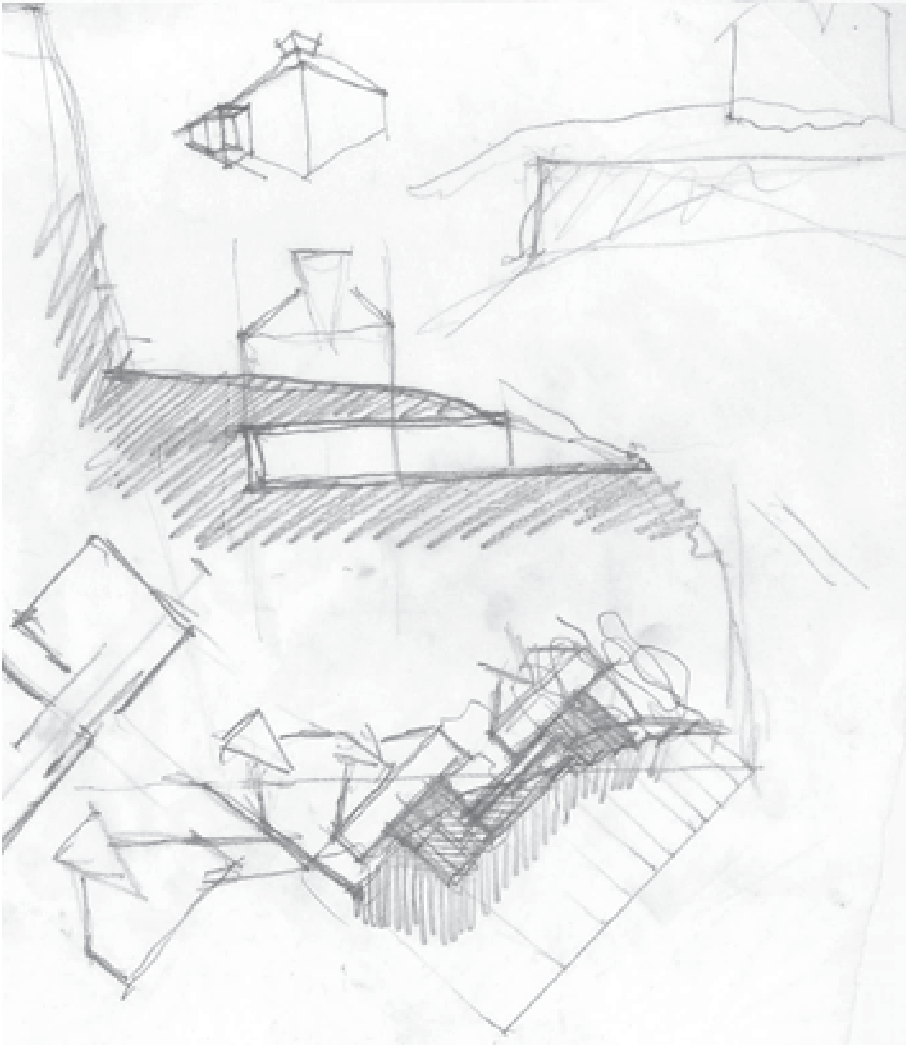




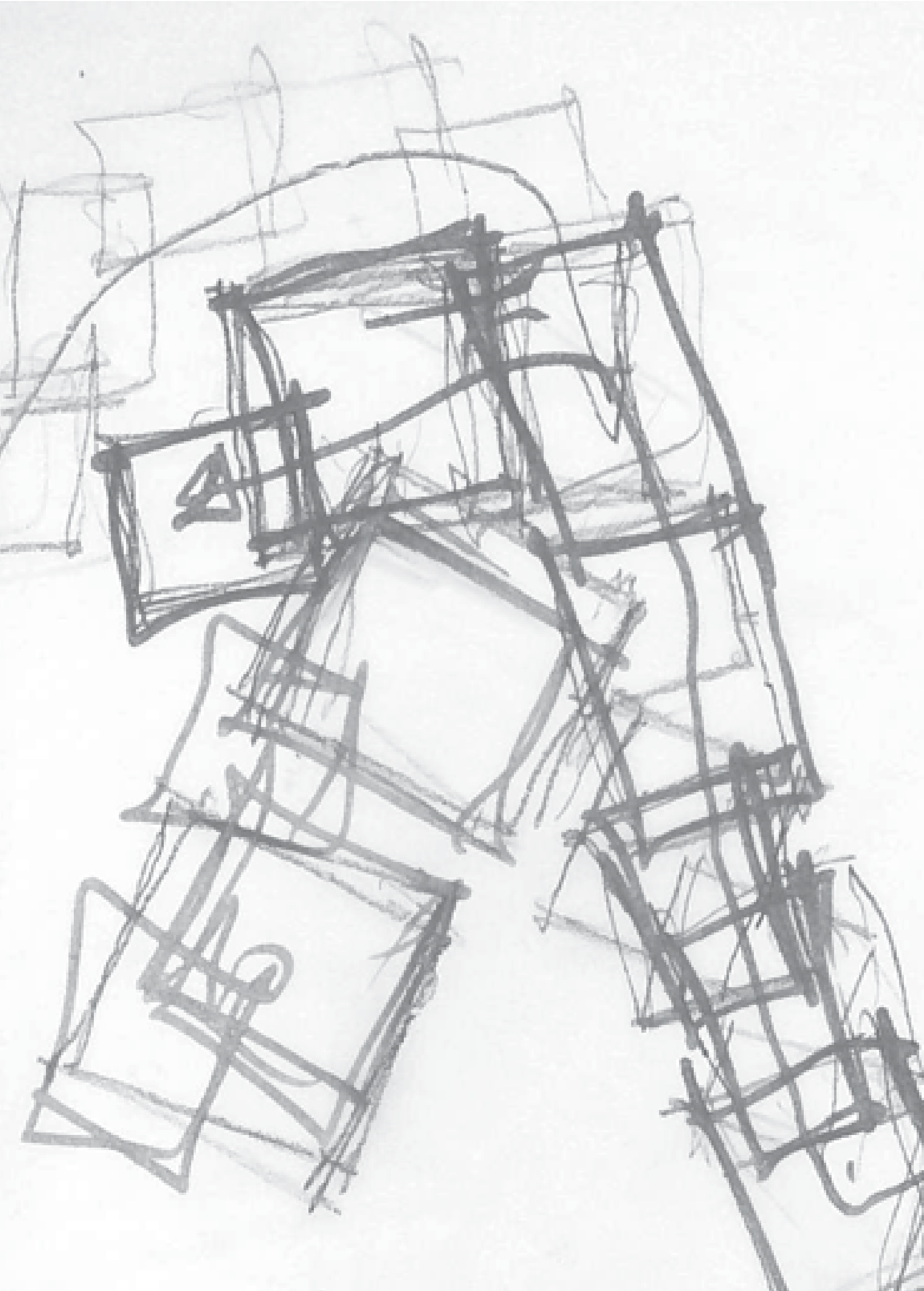


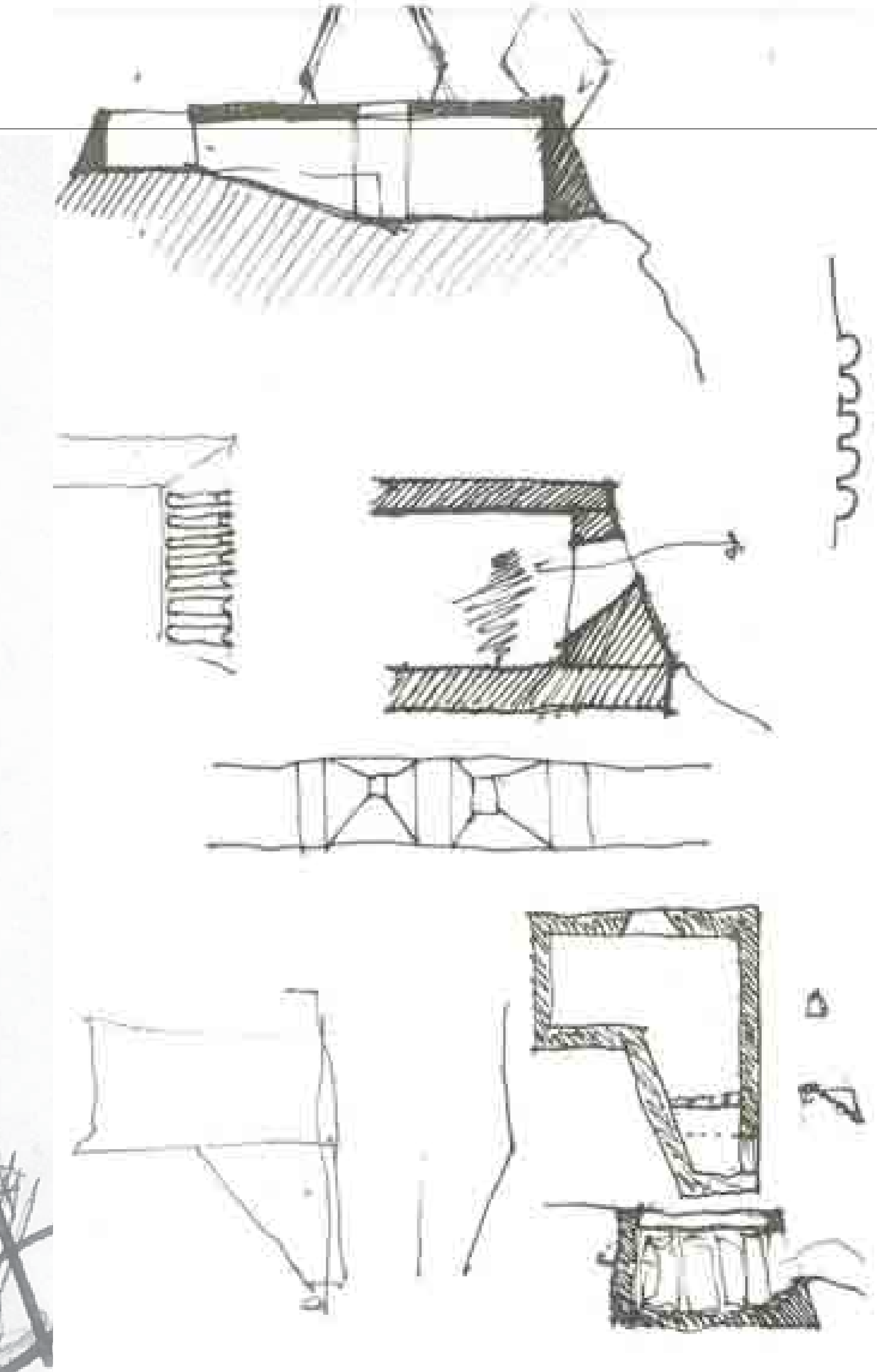
DEVELOPING THE CONCEPT

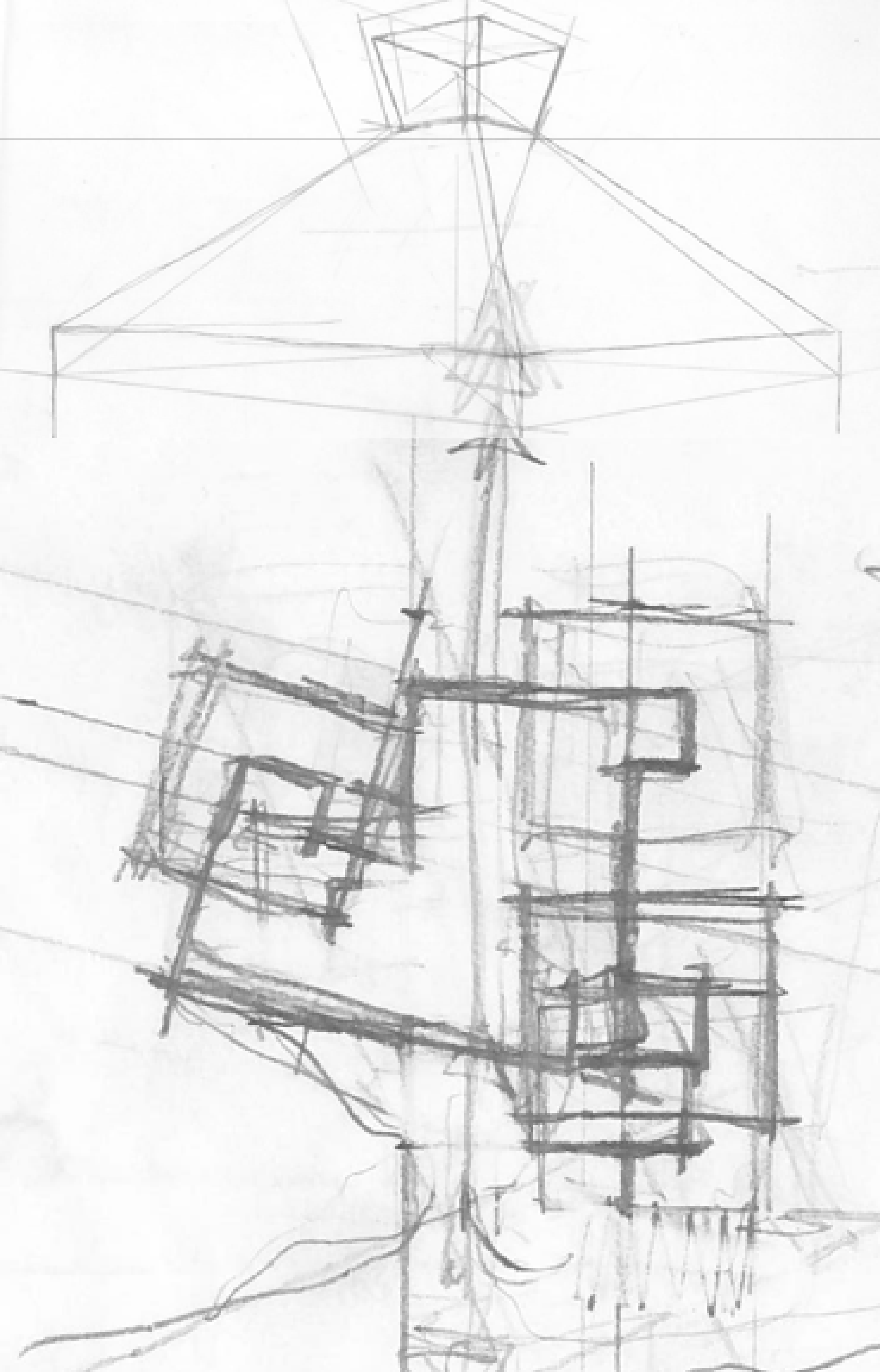




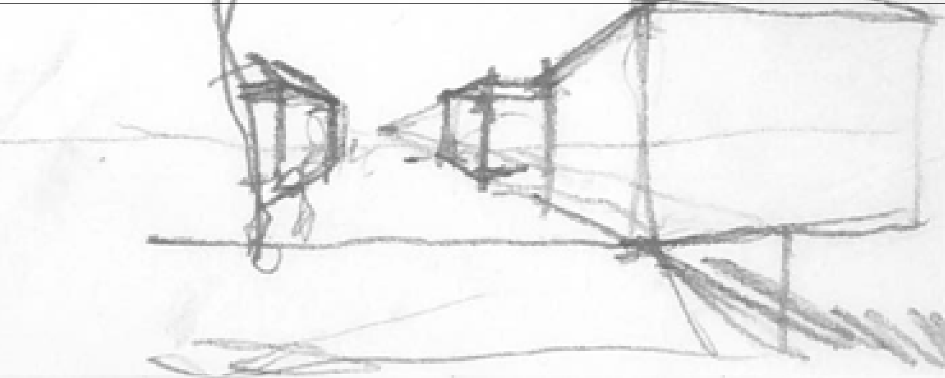
DEVELOPING THE CONCEPT

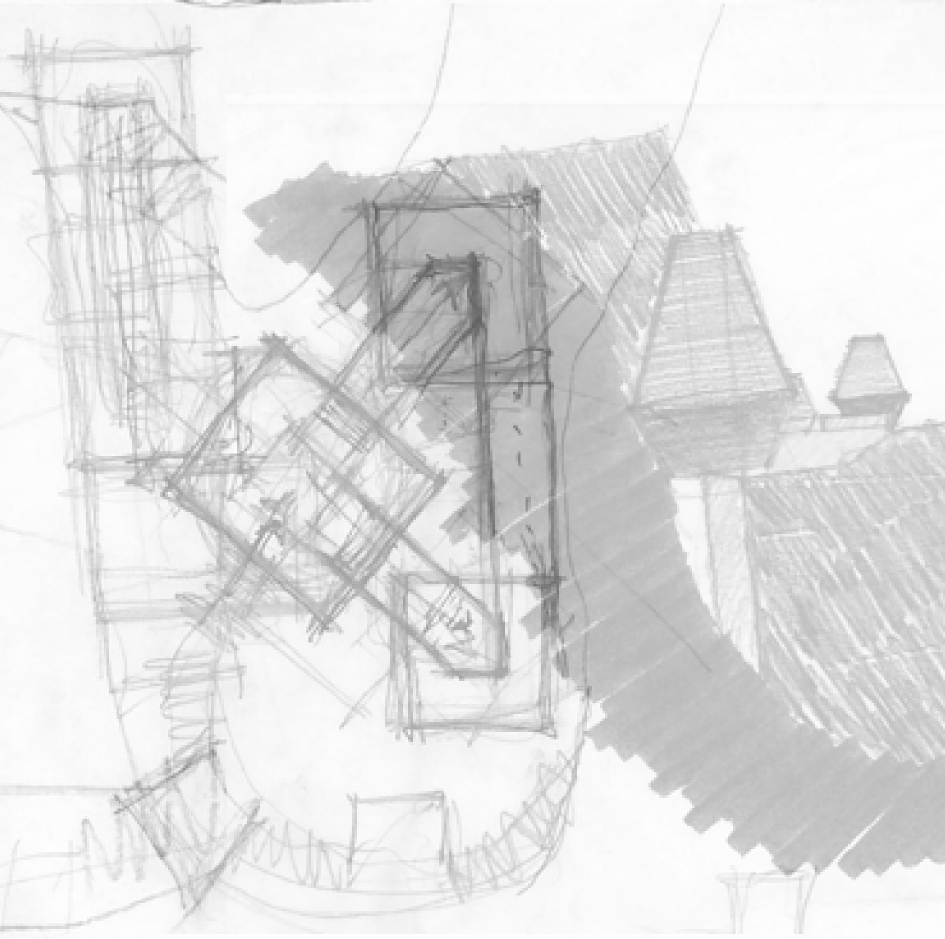




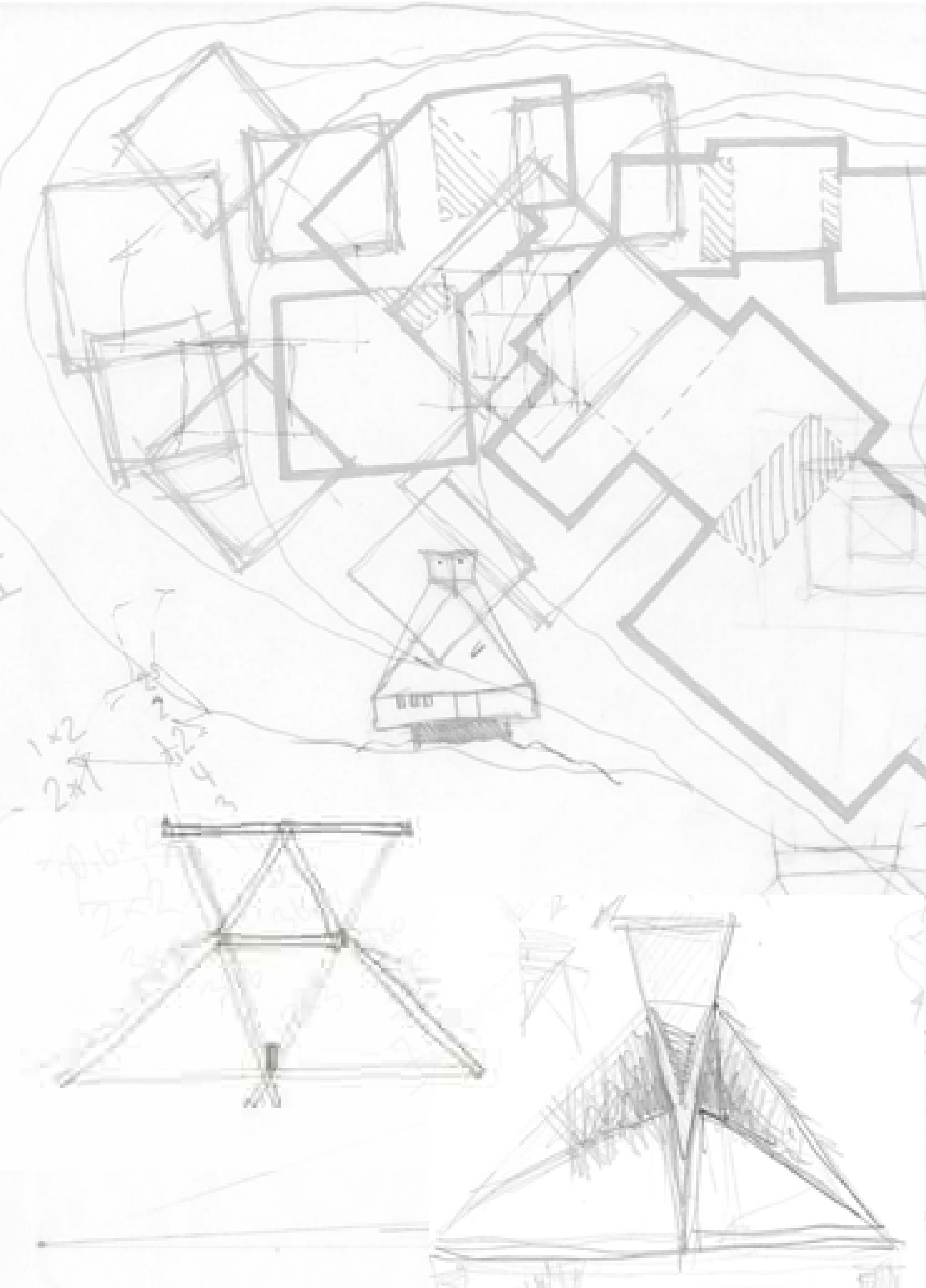


HORIZONTAL MASS LOAD

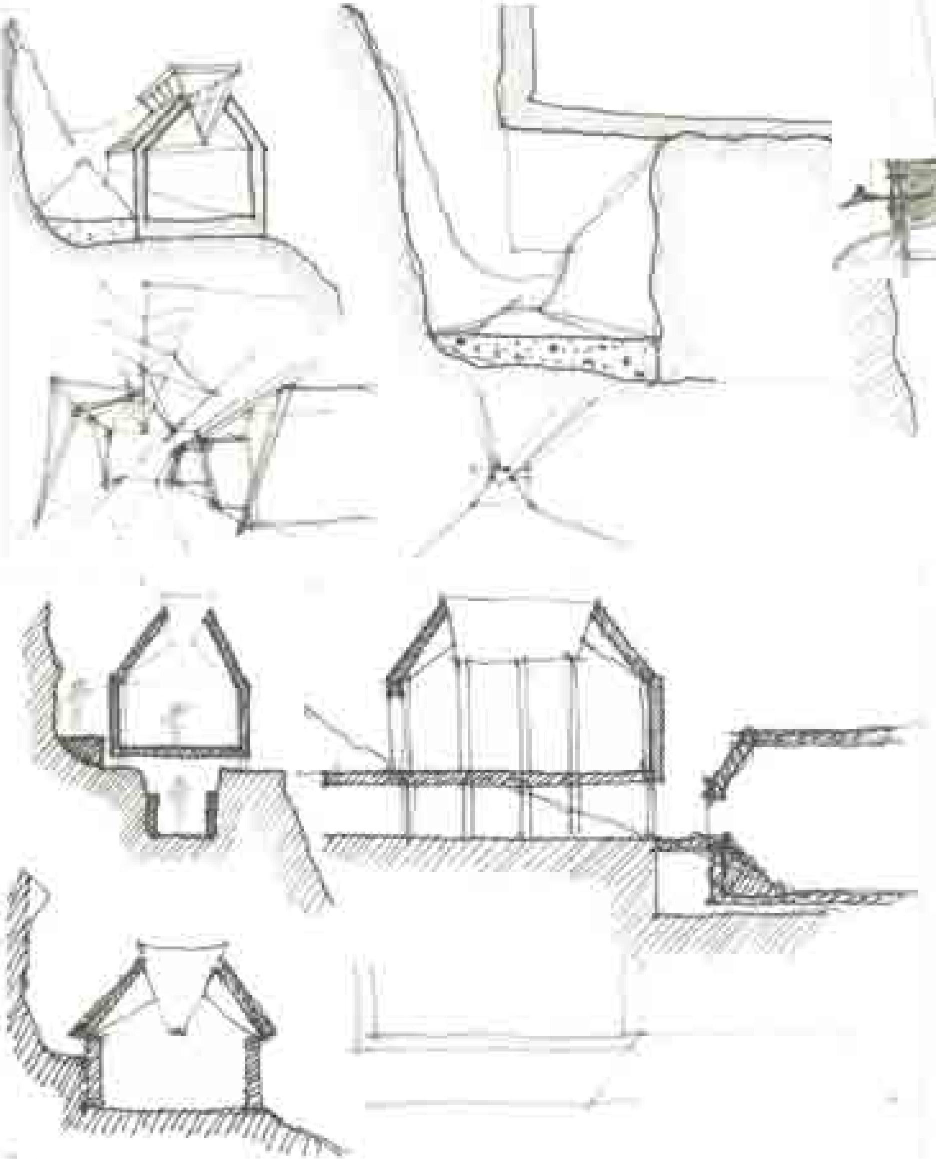




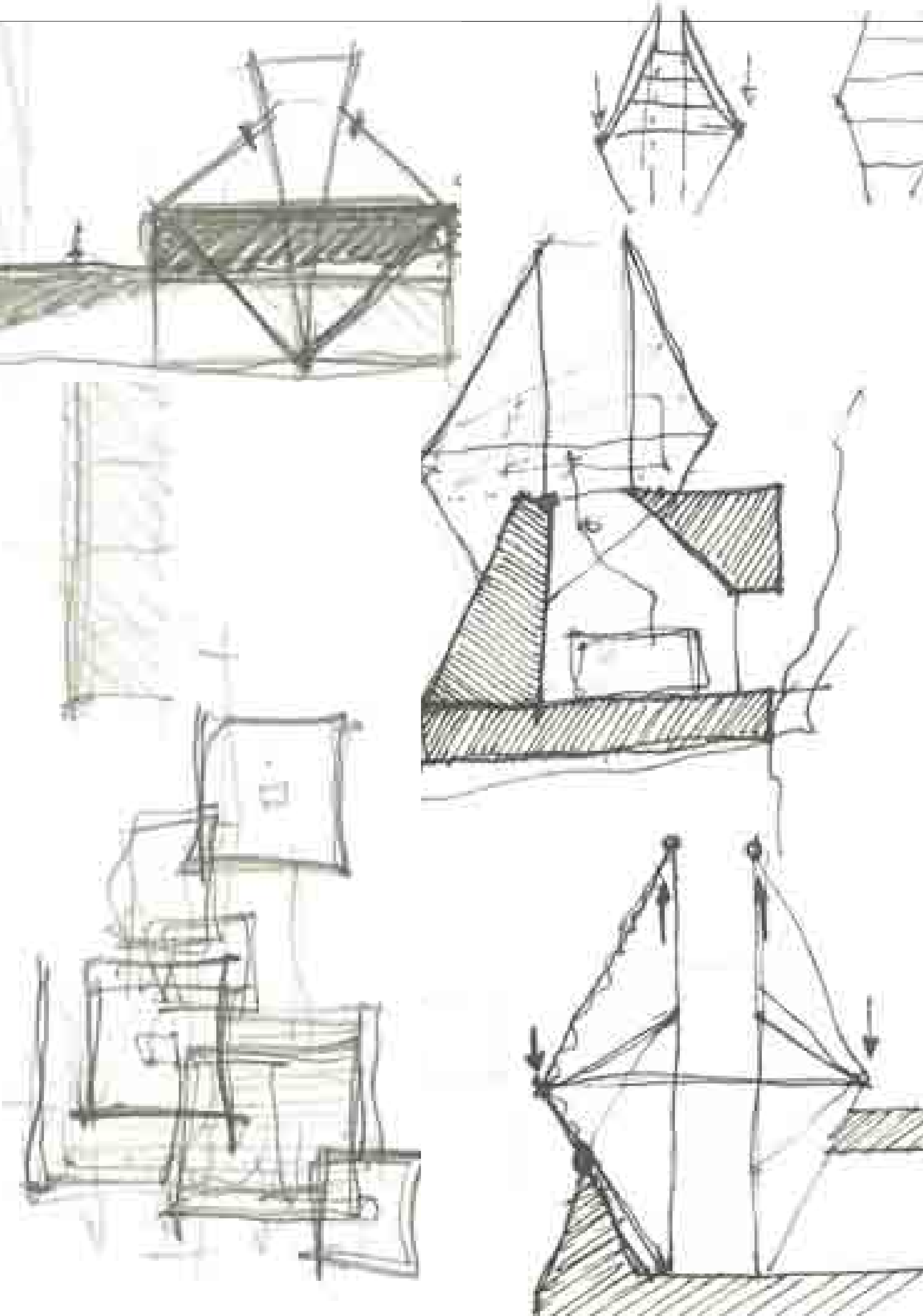
HORIZONTAL MASS LOAD



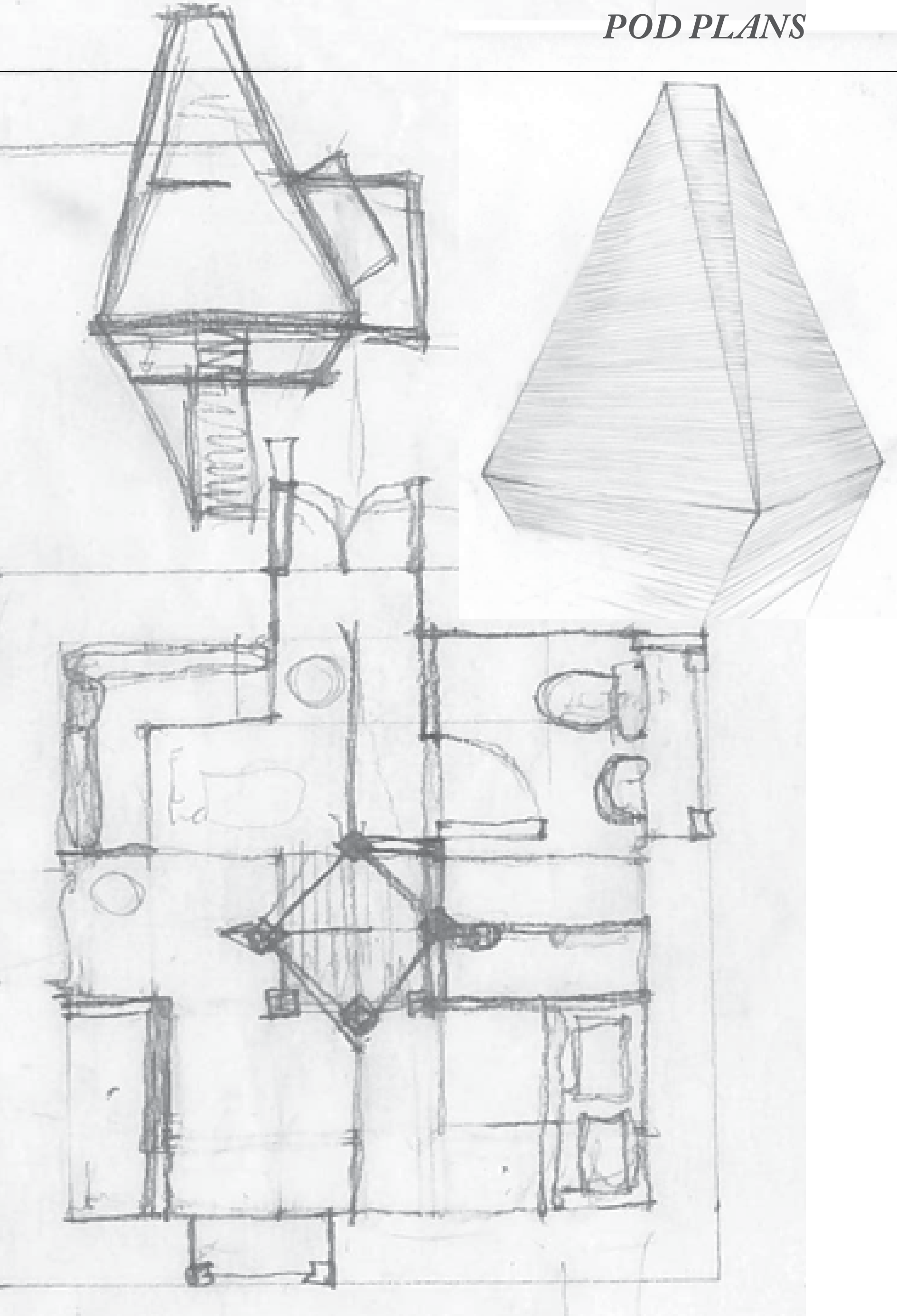

M
More space for brewery.
Connection to the cellar
Down step to Plateau is for pub
2m

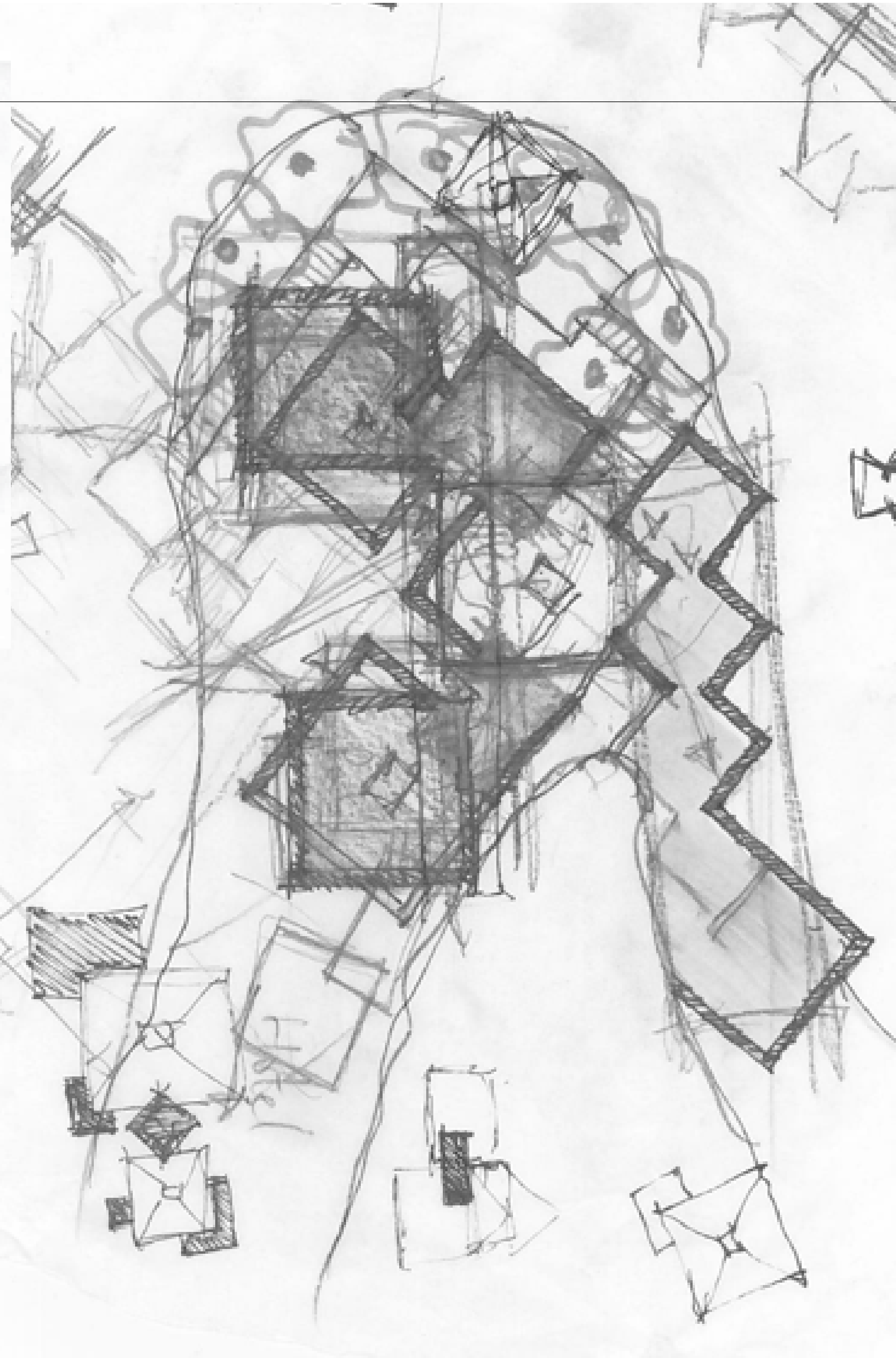


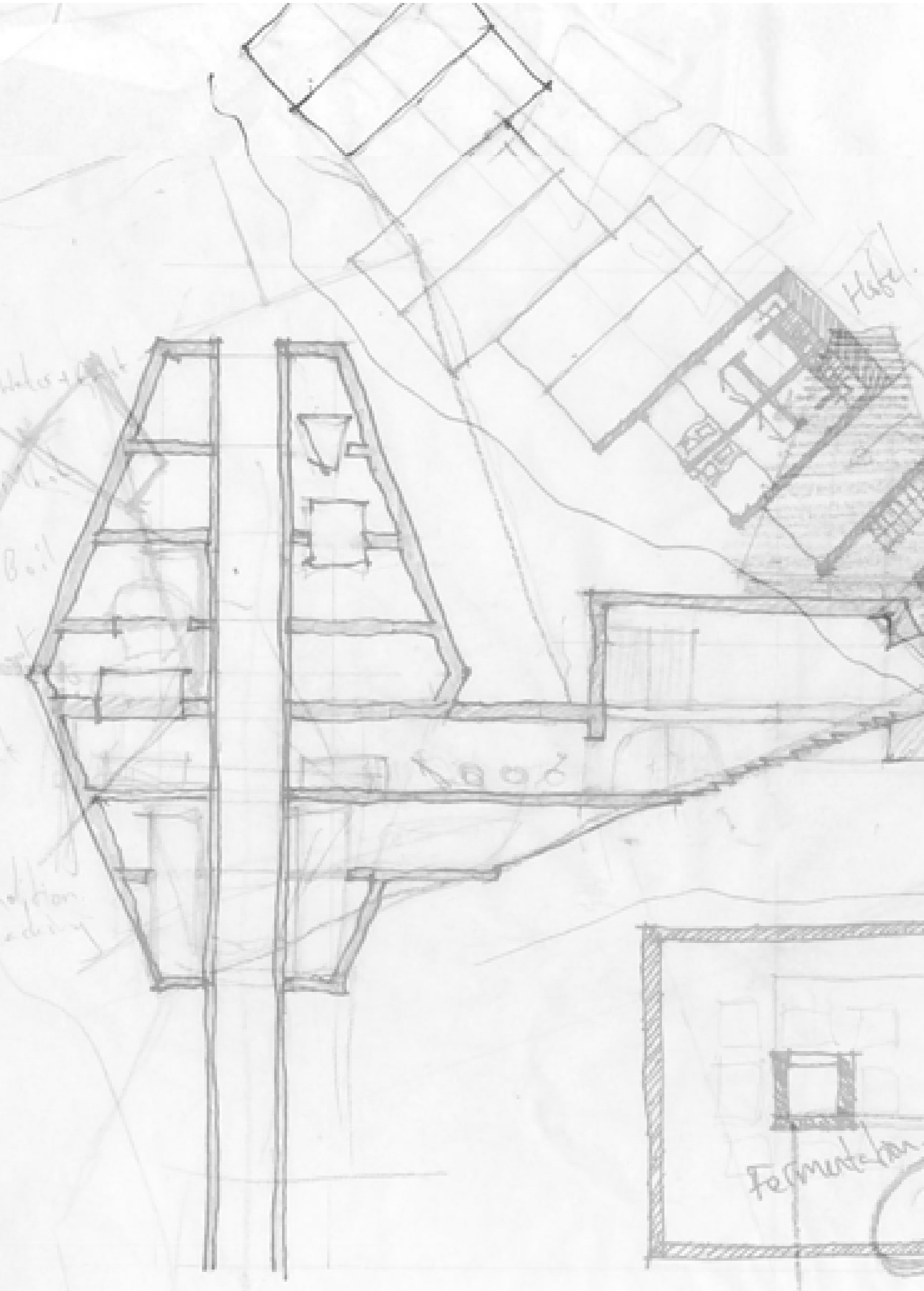
CONSIDERING LIGHT AND STRUCTURE

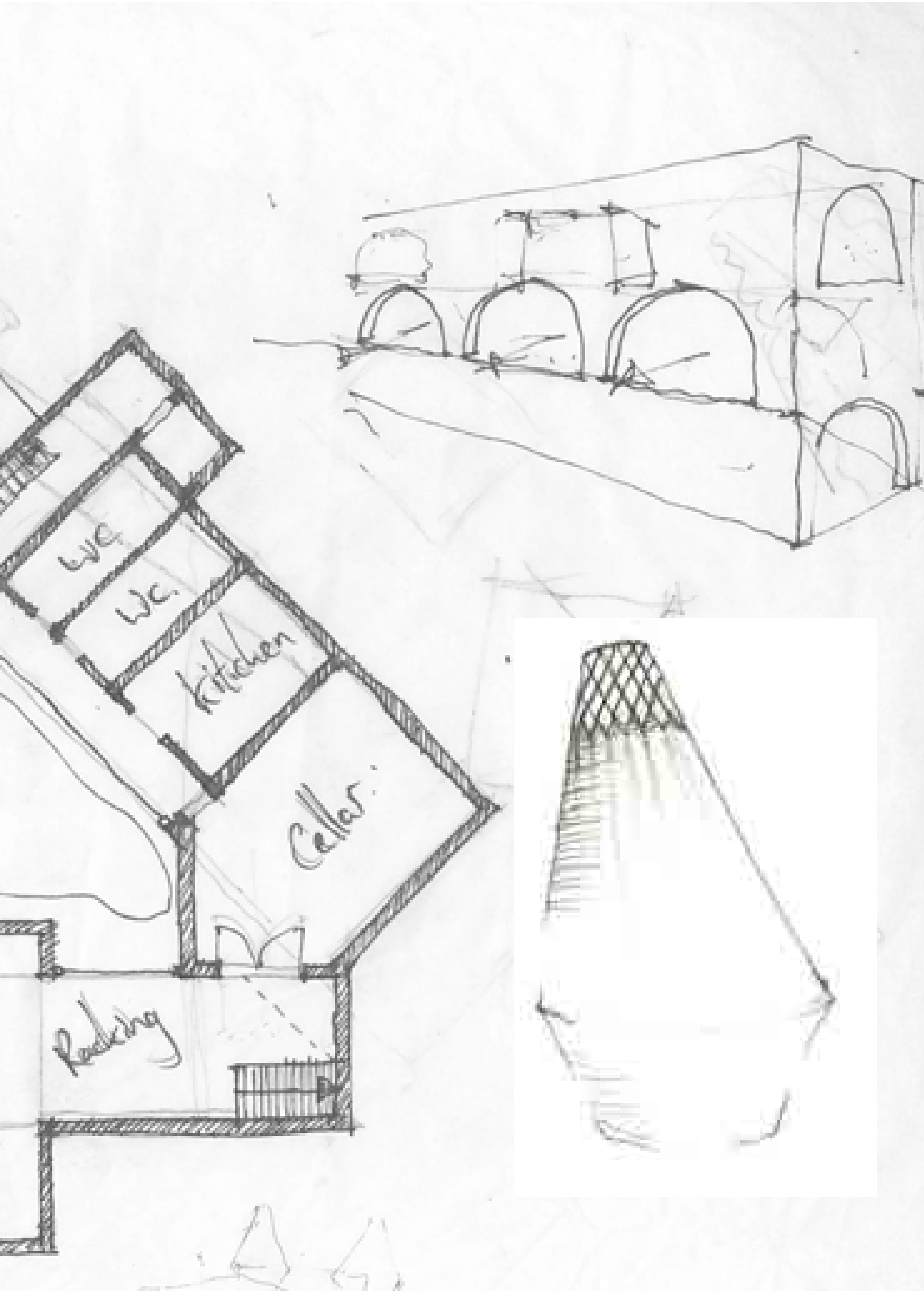


POD PLANS

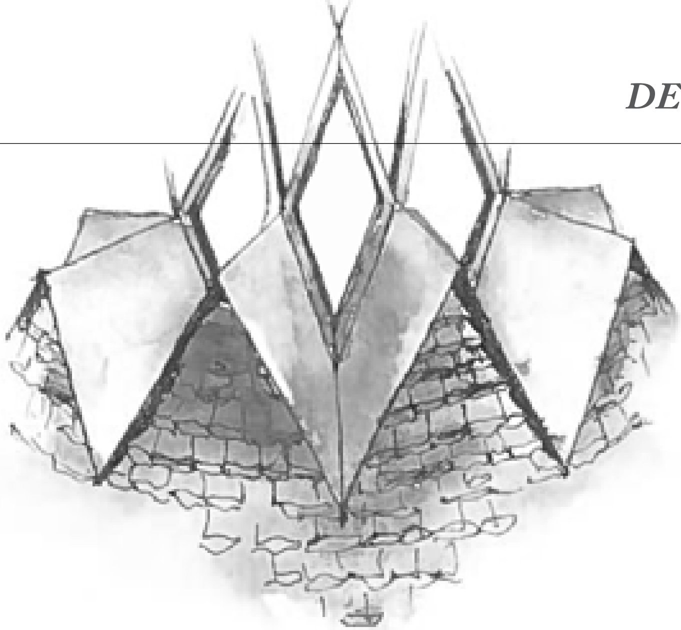


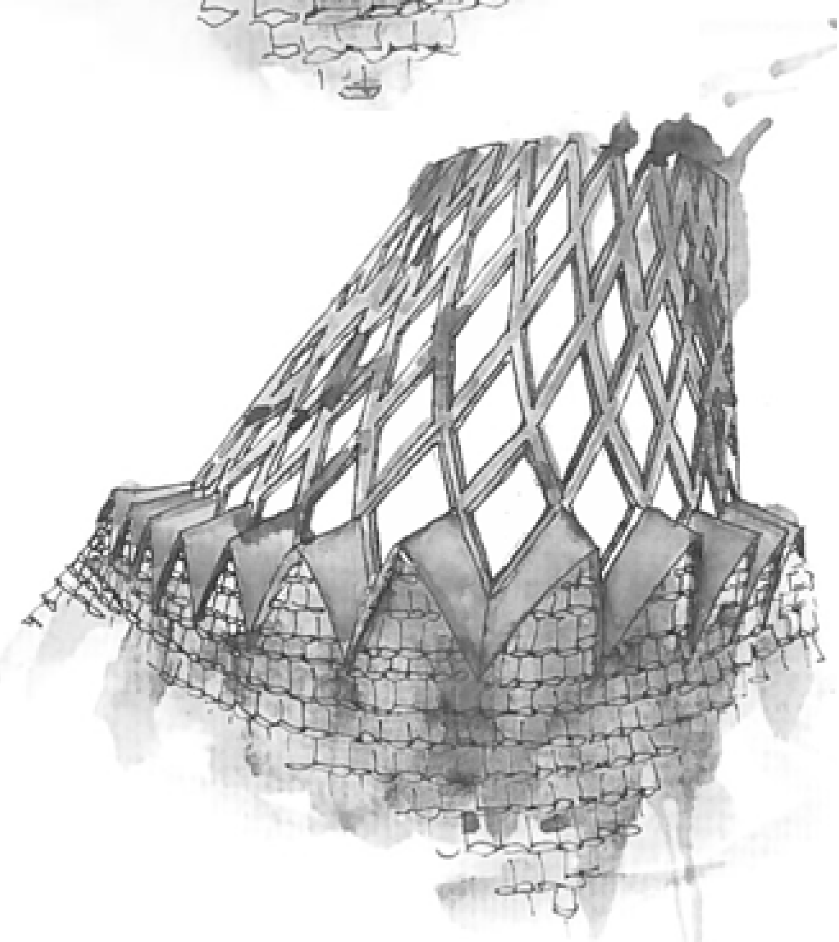


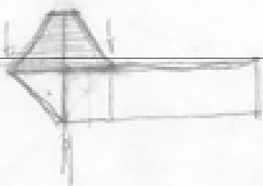


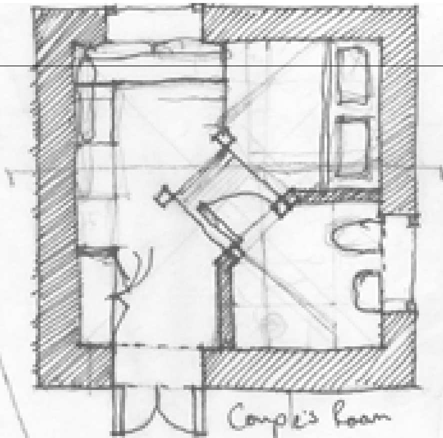


Wc
Wc
Kitchen
Cellar
Racking



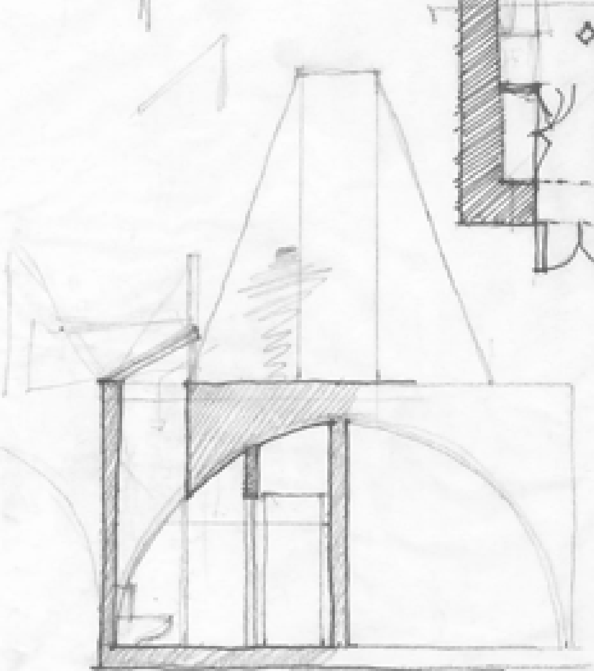




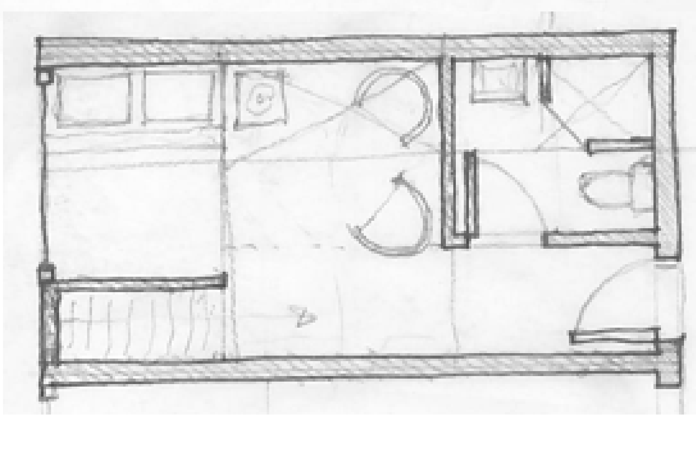


Couple's Room
1:50

—oN

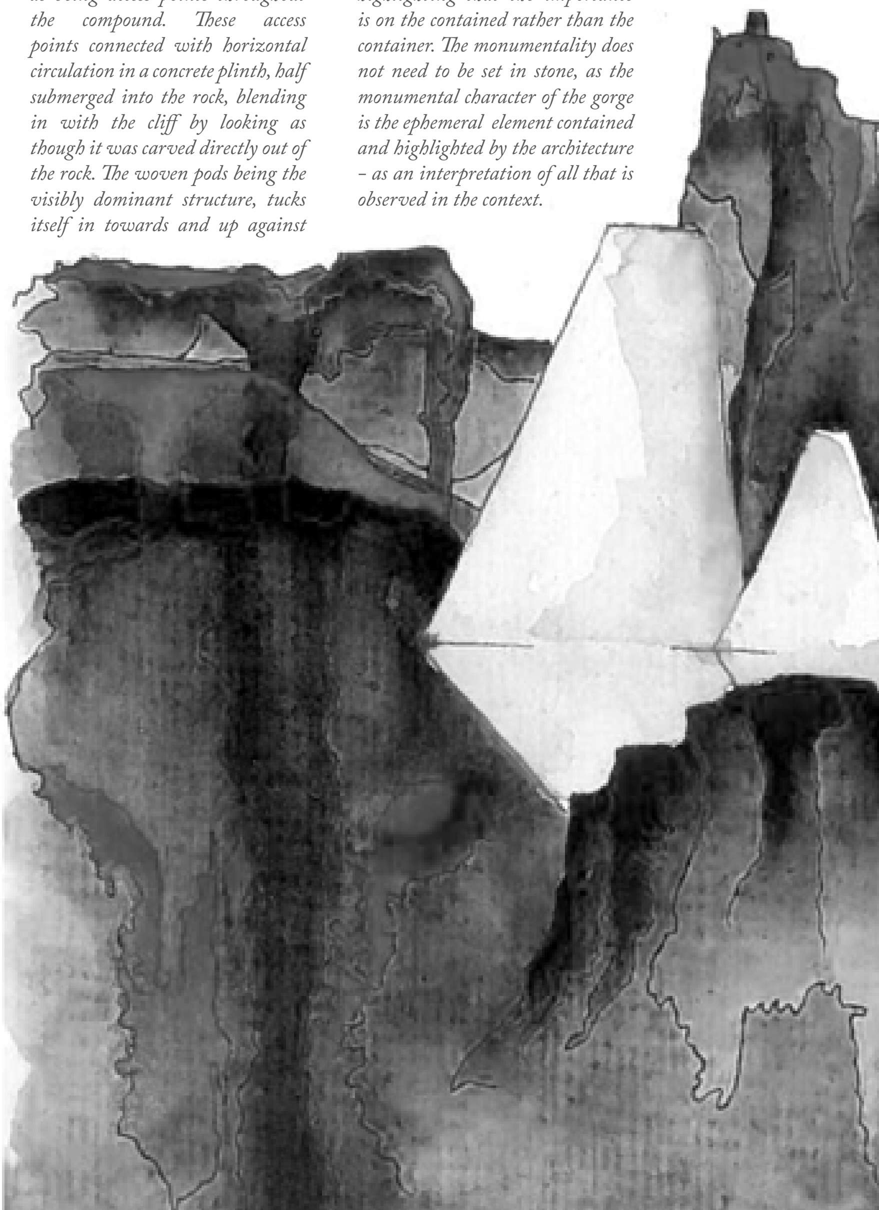


Family Room Section 1:50.



FINAL EXPRESSION

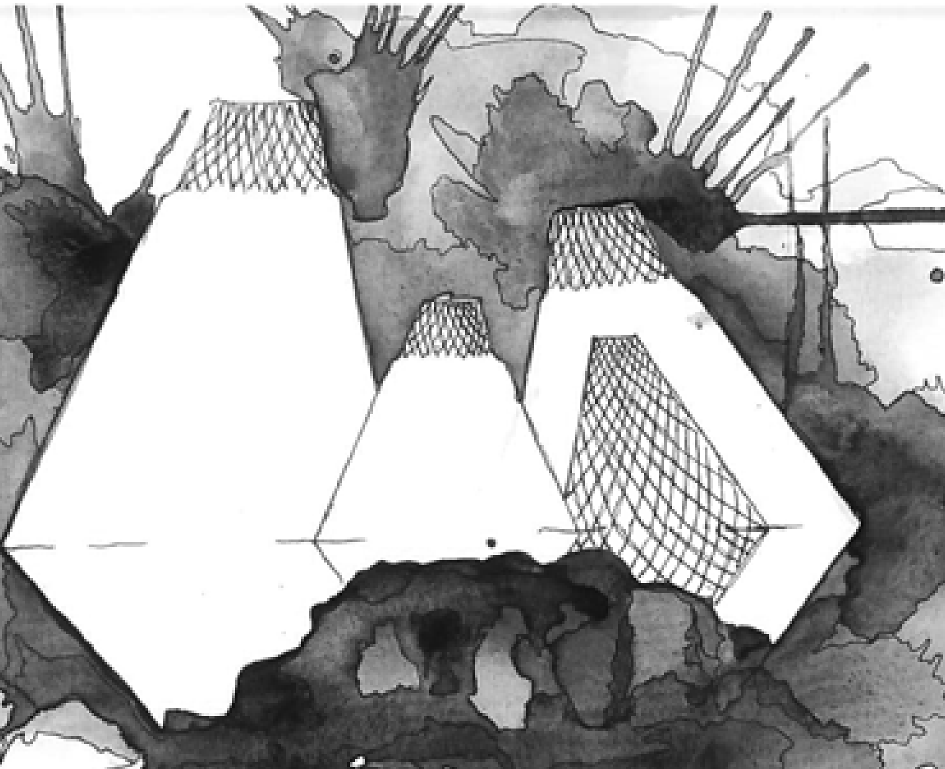
The pods represent the only vertical circulation in the compound as well as being access points throughout the compound. These access points connected with horizontal circulation in a concrete plinth, half submerged into the rock, blending in with the cliff by looking as though it was carved directly out of the rock. The woven pods being the visibly dominant structure, tucks itself in towards and up against the organising and orientating cliff face as fragile wooden monuments, highlighting that the importance is on the contained rather than the container. The monumentality does not need to be set in stone, as the monumental character of the gorge is the ephemeral element contained and highlighted by the architecture – as an interpretation of all that is observed in the context.

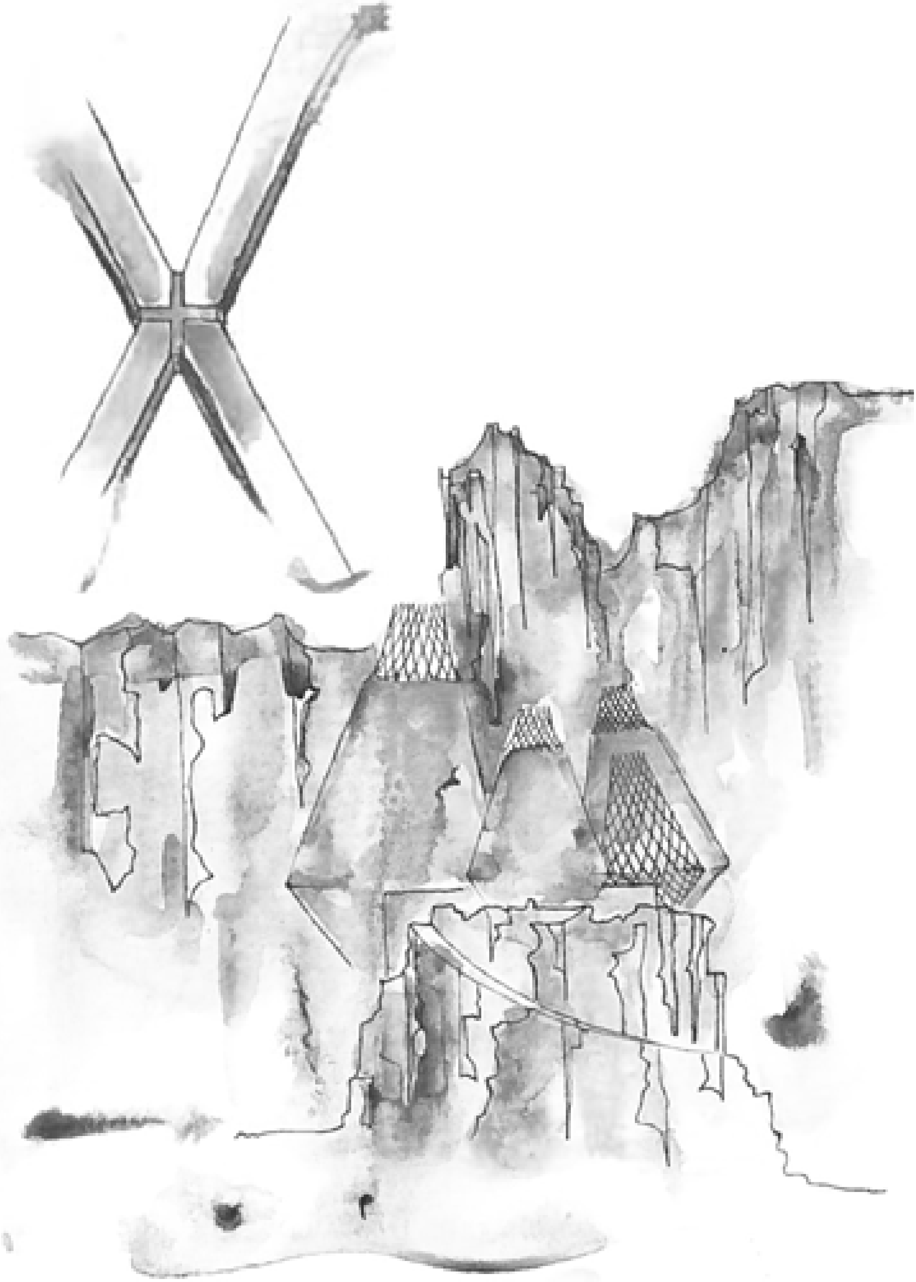


after defining the concept, the sketch phase was slowly phased out, to give way for the advances of performance aided design, the process of which can be read in the tectonic report of this project.

We have been balancing the use of computer technology to optimize the structure, our intuitive poetic creativity through sketching and composition as well as the knowledge gained from the derived biological principles to achieve a holistic architecture working sensibly with its context through a logical, transparent and legible structure.

The result is a playful but integrated functional structure, with spatial qualities inspired from the caves and highlighted through the use of materiality, tactility and the human conception of the properties of these materials, the specifics of which will be obtainable in the presentation report of this project.





No4 TECTONICS

QUALITIES OF THE VERNACULAR

Illustration 1

According to our theory on the biological preferences for artificial environments such as architecture, the unity of the architecture with its context arises from the uniqueness of location. By communicating and being sensitive to the uniqueness of the location, the architecture can become a manifestation of place.

Vernacular architecture has been nurturing and perfecting this unique relationship between the natural and the artificial environment for thousands of years by evolving over time to reflect the environmental, cultural, technical and economic context in which it exists. In accordance to the theory vernacular architecture represents the biological principle of preference for unity and uniqueness on a local geological and climatic scale.

Working with a vernacular shape such as the oast house – a building designed for kilning or drying hops as part of the brewing process – allows us to structurally optimize a shape already recognized as being rooted in its larger context to create a rhyme reflecting the unique characteristics of the gorge.

The oast house – a reminder of Britain's once thriving brewing industry is one of the more familiar sights of architecture in southeast England.

Ale has been brewed in England for nearly two millennia, but it was not until 1400 that hops were introduced to the process, turning ale into beer and in the 15th century hops were being grown in England. By 1840 over 50.000 separate breweries where brewing beer in England. (Web: Brittainexpress)

The distinctive roof of the oast house creates a good draught for the fire at the bottom of the building. The drying floors are thin and perforated to permit the heat to pass and escape through the cowl. The cowl can be pivoted to create the appropriate airflow for the kiln fire to draw properly.

Although most hops are now imported to Britain and the hop industry has lost most of its former economic influence, the oast house remains a symbol of Britain's cultural heritage.

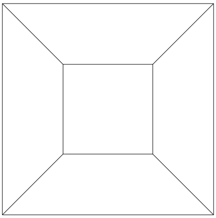
The power of the vernacular and traditional architecture is described by Juhani Pallasmaa in his book; The Embodied Image.

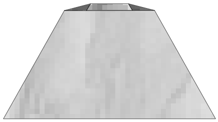
"The power of poetic and architectural images lies in their ability to condition the existential experience directly without conscious deliberation. In its very structure, the primary architectural image is akin to CG Jung's notion of the archetype that he developed on the basis of Sigmund Freud's idea of archaic remnants´ which are part of the constitution of the human psyche. We still retain in our bodies psychological remnants of our aquatic life, a reminder of the horizontally blinking eyelid of our evolutionary reptilian phase, and the tail of our arboreal past. The archetypes are similar ancient mental or neural remnants. In accordance with Jung's definition, an archetype is not a specific meaning but a tendency of an image to give rise to certain types of emotions, reactions and associations. In the same manner, architectural images do not project specific meanings, but give rise to certain experiences, feelings and associations." (Pallasmaa; 2011: page 128)

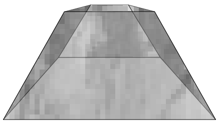
In this sense the archetype shape of the oasthouse, does not project a specific meaning to the brewery, but gives rise to certain experiences, feelings and associations, lending the architecture a sense of belonging to the historic context of this specific area.

THE TRADITIONAL STRUCTURE

TOP VIEWS | *ILLUSTRATIONS & FORM DIAGRAMS* | *FORCE POLYGONS*







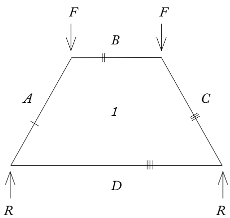
In these early stages of the design we engage the method of graphic statics to gain a preliminary and quick understanding of the structure and the forces that affect it.

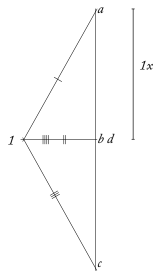
The graphical method of designing and analysing a structure contributes to intuitive understanding, providing a visualisation of structural behaviour, and has significant advantages over numerical methods in terms of simplicity, transparency, speed and ability to generate efficient forms for most structural devices.

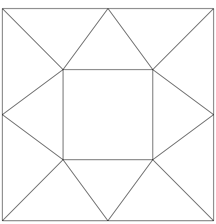
This does not necessarily render the graphical approach less precise or correct than the numerical methods as the graphic statics approach are the source of most of the mathematical expressions used in structural analysis, and give the same answers (Allen:2010)

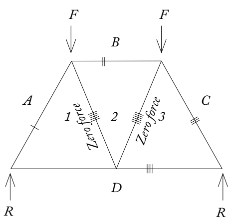
The basic shape of the load carrying structure of the oast house roof consists of four trapezoidal sides, and possibly a tension ring at the bottom and a compression ring at the top.

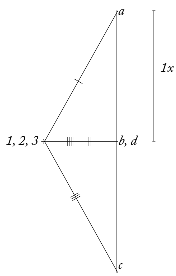
Conducting a graphic statics exercise with forces only acting in a vertical direction we see that the structure handles the forces in the same manner as





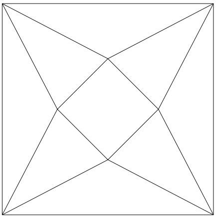






OPTIMIZING THE STRUCTURE

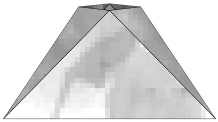
TOP VIEWS | *ILLUSTRATIONS & FORM DIAGRAMS* | *FORCE POLYGONS*

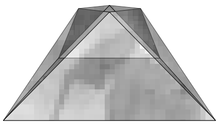


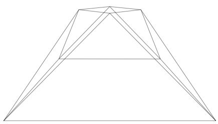
a triangle might. Though we know intuitively that this structure would perform poorly when inflicted with external forces acting in a horizontal direction, such as wind loads.

To gain horizontal stability, this structure would either have to utilize the cladding as bracing or add additional structure for bracing, as for example shown in the illustration on the bottom of the previous page. The graphic statics exercise in this additionally braced structure shows that the bracing elements are zero force members in a dead, live and snow load situation.

In our opinion, the additional bracing is therefore not utilized to its full potential and performs more in the lines of damage control, adding more structure to the existing imperfect structure rather than trying to optimize the dead, live and snow load carrying structure to naturally deal with wind load as well.



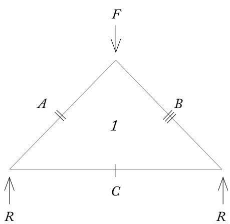


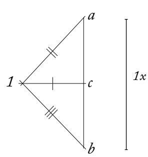


Simply by rotating the upper compression ring 45 degrees and connecting the compression ring with the tension ring in triangles we achieve horizontal stability as well as reducing the internal forces in the members nearly by half as shown by the reduction of length of the members in the force polygon belomgimg to the form diagram of the triangle.

Although this shape is now triangulated it still conserves that chamfered chimney shape which, especially the southern part of England, associates itself with the traditional shape of the oast house.

To gain a more intimate knowledge of the forces at work within this structure, we will conduct a small graphic statics investigation into the triangle.

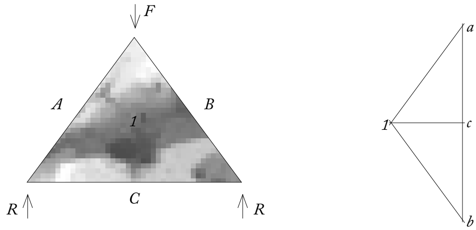




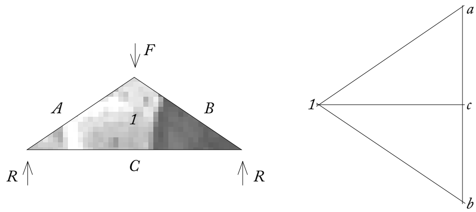
INVESTIGATING THE TRIANGLE

ILLUSTRATIONS & FORM DIAGRAMS | *FORCE POLYGONS*

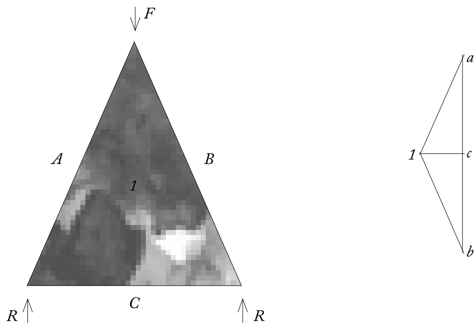
In order to continue in an informed manner regarding the structure, we start by looking at the simple triangular truss which forms one of the sides of the chamfered chimney structure.



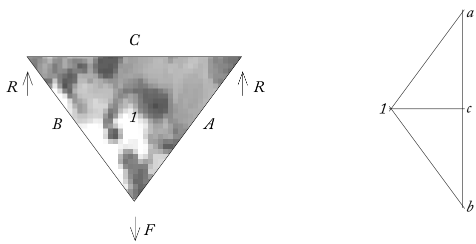
By looking at the first three examples of triangular trusses and reading their internal forces in each member from the force polygon we see that the member forces vary inversely with the depth of the truss. Meaning that if we want a slender and elegant structure we need to increase the height of the structure or/ and the amount of members.



In the three first triangles we can read from the force polygon that the members A and B are compression members and C is a tension Member. Even though the force polygon of the last triangle truss looks exactly like the force polygon of the first triangle truss, the important distinction lies in the nature of the internal forces.



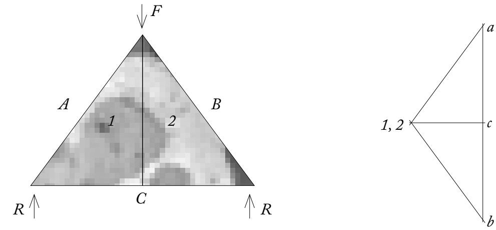
By inverting the truss but keeping the direction of the external forces we thereby invert the nature of the internal forces, leaving members A and B in tension and C in compression.



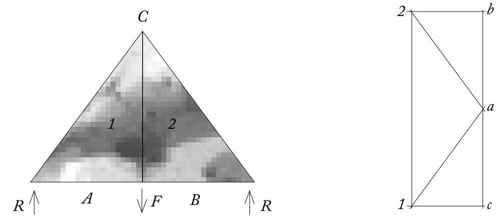
INVESTIGATING THE TRIANGLE

ILLUSTRATIONS & FORM DIAGRAMS — *FORCE POLYGONS*

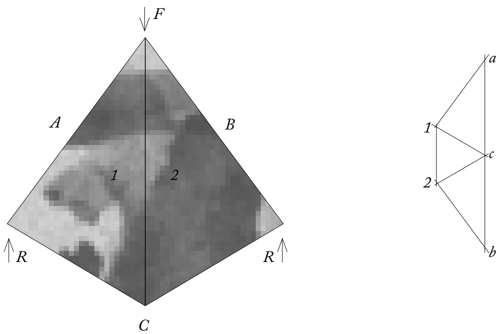
By adding a kingpost to the triangular truss, we can read from the force polygon that the distance between compartment 1 and 2 is zero, meaning the king post is a zero force member or perhaps just a member keeping the bottom chord from sagging.



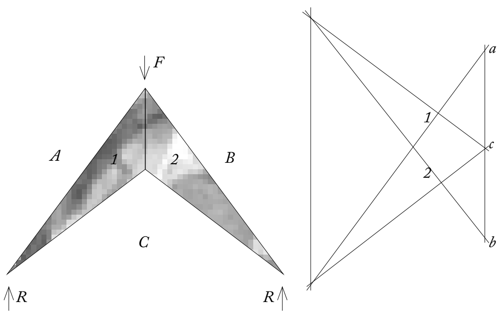
Another reason for adding a kingpost in a triangular truss could be to apply the external load to the bottom of the king post rather than the top. Moving the external load in its line of action to the bottom, using the kingpost to transmit the load back up to its apex, whilst the forces in the other members remain the same.



From the previous page we saw that the member forces vary inversely with the depth of the truss, we did this by increasing the height of the top chord. With the kingpost we have the ability to increase the depth of the truss by moving the bottom chord and thereby reducing the forces in the truss.

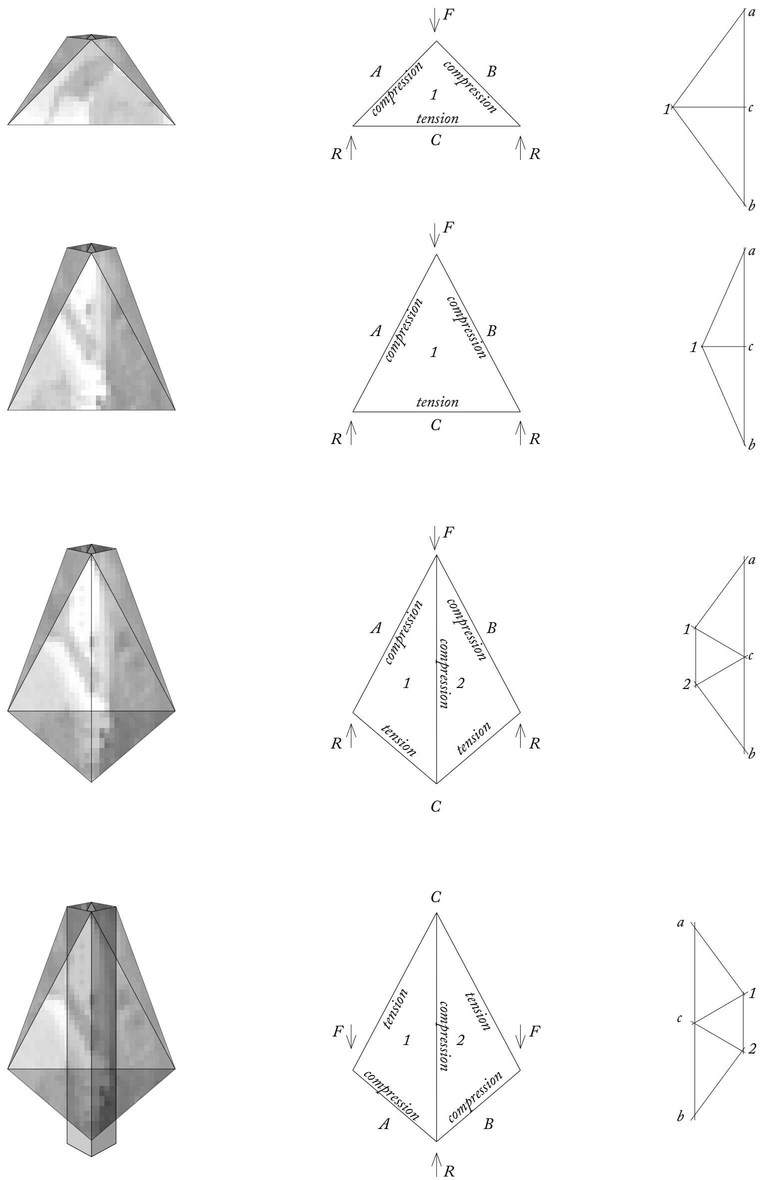


Likewise, pushing the bottom chord up, and thereby making the truss shallower we increase the forces in the members.



OAST HOUSE GRAPHIC STATICS

ILLUSTRATION *FORM DIAGRAMS* *FORCE POLYGON*



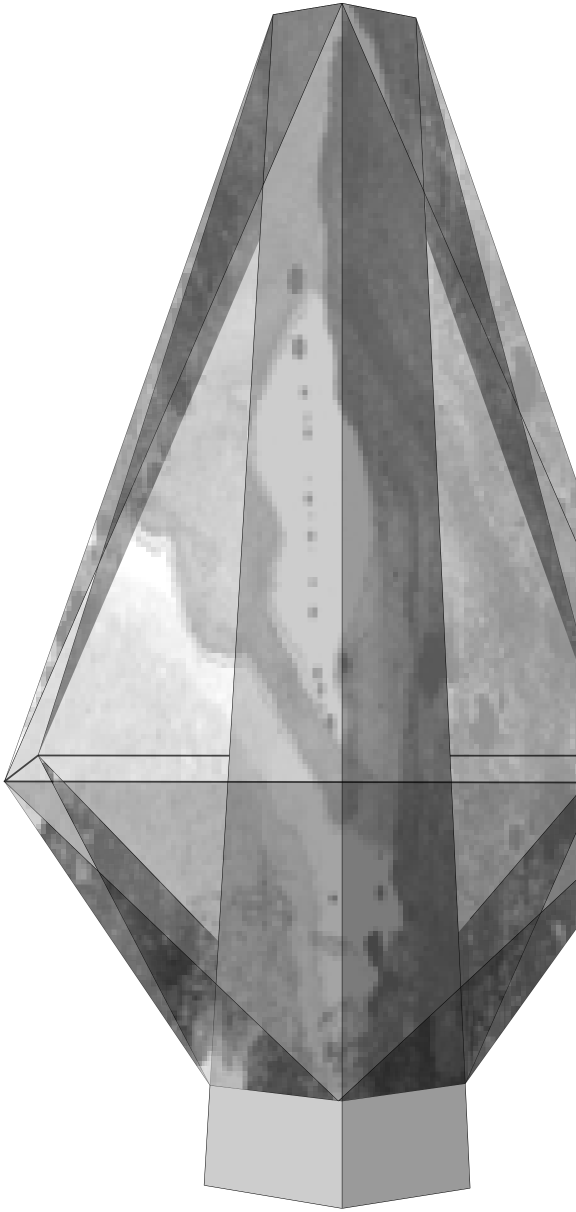
On the opposite page, we engage the knowledge gained from studying the triangle truss through graphic statics.

Firstly, by increasing the depth of the truss simply by moving the top chord up, thereafter by inserting a kingpost allowing us to increase the depth of the truss further by moving the bottom chord down.

As a part of the design, each pod has a central core, the function of which is both to allow for circulation between the levels of the compound, as well as drawing light down to the lower levels of the pub.

By engaging this core structurally in the pod with the function of the kingpost, we create a compression core, furthermore we lighten the visual effect of the building by using this core as the support of structure.

In doing so we also ensure to move the external load of the building down to where the supports where situated earlier, this we do to activate the diagonal members of the truss as load bearing in a dead, live and snow load situation, rather than just being bracing for the core that elsewise would function structurally as a column.



PARAMETRIC AIDED DESIGN

Now that we have gained an understanding of the structure in a two dimensional environment via graphic statics, we wish to confer this knowledge as well as apply it to a three dimensional structure.

To take advantage of the finite element method, which allows us to see how our design changes affects the structure in real time by looping information we construct a parametric model in Grasshopper. Grasshopper is a program which allows for efficient data exchange with integrated analysis tools in a parametric environment, such as Karamba. Thereby achieving an intuitive understanding of the structural behaviour of the initial structural system with real time feedback loops from geometric exploration of forms and performativity.

Parametric modelling allows us to embed in the geometrical model the tectonic of construction and thereby include early considerations upon detailing the construction in the design process.

Our initial model are created by line elements connected in hinges, allowing only for rotation, the same goes for the support nodes. We allow for variable parametric changes such as, width, height, compression core thickness, cross section dimensions of the elements and materials.

New ideas can be triggered from new understanding of the relationship between form, performance, material and fabrication acquired from the evaluation process. By means of parameters we define the meaningful geometric relations to reduce arbitrariness and make informed design decisions, this makes for a more performance-aided design.

All this being said, we want to underline that performance goes alongside an essentially intuitive and creative process. The design is not based solely on performance criteria, but performance criteria aid the design.

"Engineering is not a science. Science studies particular events to find general laws. Engineering design makes use of these laws to solve particular problems. In this it is more closely related to art or craft; as in art, its problems are undefined; there are many solutions, good, bad or indifferent. The art is by a synthesis of ends and means to arrive at a good solution. This is a creative activity, involving imagination, intuition and deliberate choice."(Ove Arup quote from Form & Forces, Allen:2010 page 97)

In this stage of the design we are establishing knowledge of structure, in order to allow this knowledge to influence the design process. The aim is an integrated design with respect for materials, structure and fabrication.

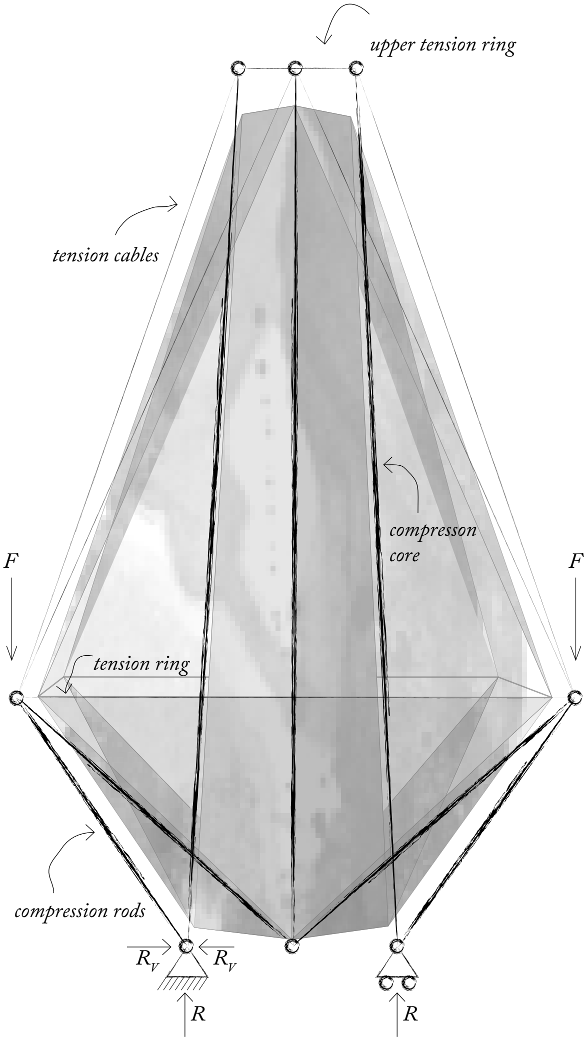
Our initial investigation through this parametric model, is to verify our 2D static graphic understanding of the structure on a 3dimensional model.

The free body diagram illustrates the structural concept in the state of which it has parametrically been designed. The thicker lines illustrates compression members, where the thin lines illustrate tension menbers.

The support for this structure is a pinned connection, which means that it takes horizontal and vertical forces, but no moments.

This preliminary investigation is conducted on a wooden structure affected only by a vertical load. A 1000kN are dispersed equally on the four load points of the structure. The diameter is set to 10m

The diagram table shows 16 examples of pods of different heights ranging from 5-20m from the tension ring and up, and 2-8m from the tension ring and down. This in combination with a compression core between 1-4m.

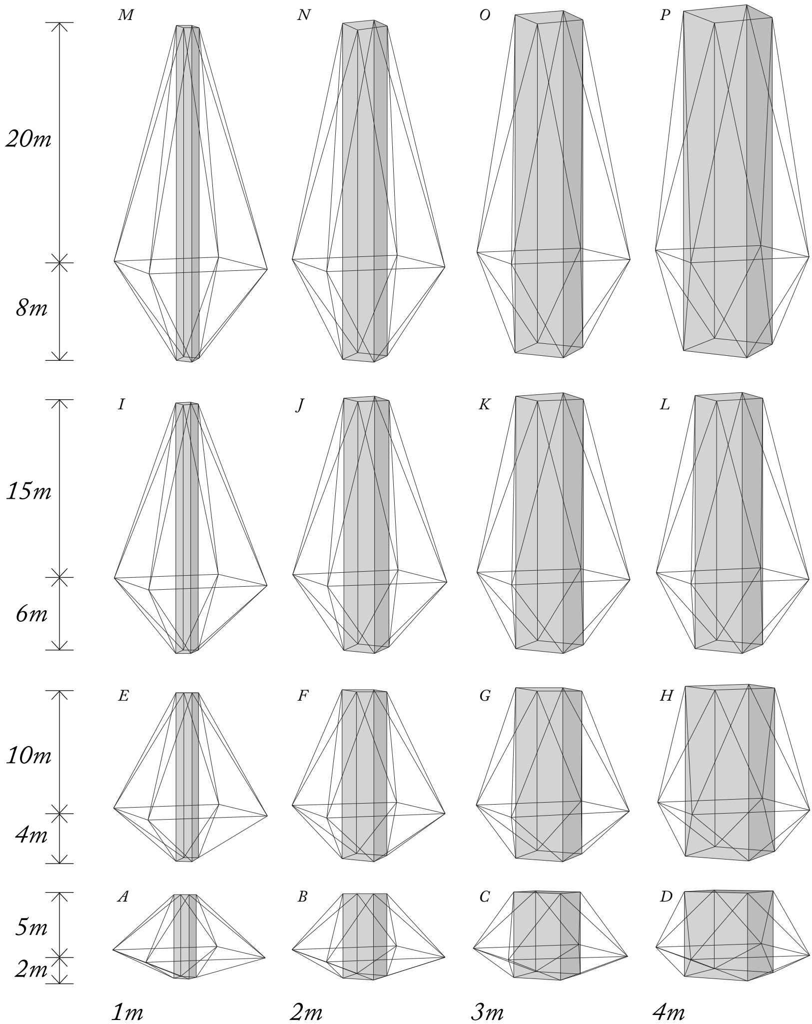


Free body diagram

KARAMBA INVESTIGATION

Reading the internal forces on the chart upon the next page, the tendency is clear and in compliance with the expectations. The taller we make the structure, the deeper the truss and the lower the internal normal forces. In combination with this result we also see that the internal normal forces are reduced by increasing the diameter of the compression core.

The next step will be to add a horizontal force such as a wind load, to ascertain the structures capacity to deal with such moments.



INTERNAL NORMAL FORCES

The effect of these changes on the individual elements internal normal forces, can be read on the table below, for identifying which structural elements are which we refer to the free body diagram on the previous spread.

	Upper tension ring {kN}	Tension cables {kN}	Tension ring {kN}	Compression rods {kN}	Compression core {kN}
A	95,5	137,2	30,9	-136,3	-168,8
B	68,9	124,7	45,4	-135,1	-162,4
C	44,6	115,8	51,6	-132,8	-157,5
D	21,8	110	51,6	-131,4	-154
E	30,4	63,7	112,2	-134,7	-107,3
F	20,6	56,3	113,9	-135	-97,2
G	12,5	50,2	110,4	-135,5	-88,5
H	5,7	45,6	102,2	-136,8	-81,9
I	12,5	36	118	-134,5	-66,2
J	8,4	31,8	111,5	-133,1	-59,2
K	5	28,4	102,2	-132,1	-53,4
L	2,3	25,9	90,6	-131,8	-49,2
M	6,6	24,5	103,9	-130,2	-46,6
N	4,5	22	95,4	-128,5	-42,3
O	2,8	20,2	85,5	-127,2	-38,9
P	1,3	18,8	74,6	-126,6	-36,5

Illustration 2

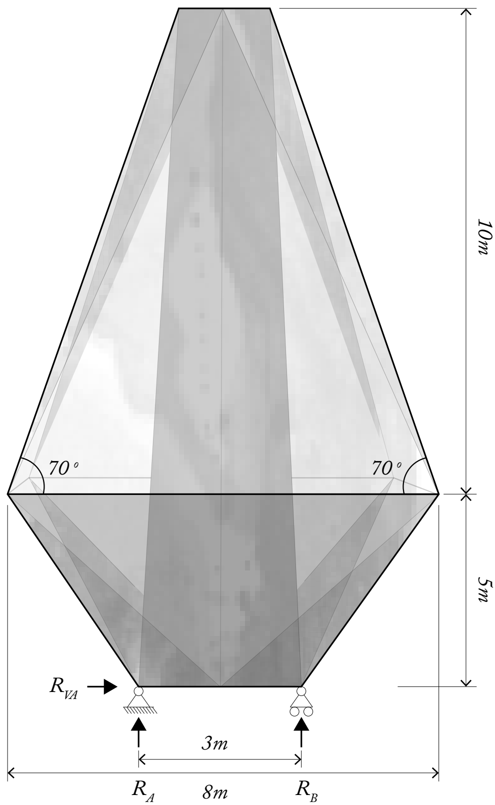
The characteristic and margin of design dead loads, live loads, wind loads and snow loads are determined and the margin of design support reactions calculated.

The example calculated on will be the pub pod, measuring 8x8 in width and 15m in height.

The buildings height above terrain and the building use means that the structure is to be attributed to the high consequences class CC3 where any failure involves high risk of loss of life. The K_{FI} factor is therefor set to 1.1 which has importance for the determination of the partial factors on unfavourable permanent and variable loads, used to find the margin of design load values for permanent and temporary dimensioning situations.

The live load is added as 2,5kN/m² classified as C1; common rooms; areas with tables etc. eg areas in schools, cafes, restaurants, diced dining halls, reading rooms and receptions.

Since the form factor of the saddle roofs above 60 degrees is zero, the snow load is nonexistent upon this construction and will therefore not be calculated in the following.



CHARACTERISTIC DEAD LOAD

The characteristic dead load actions (G) is assumed as following surface loads:

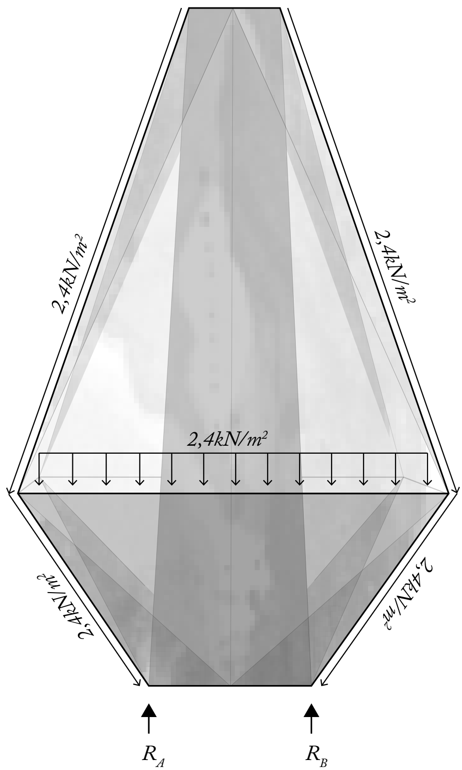
$g_{roof} = 2kN/m^2$

$g_{deck} = 2,4kN/m^2$

$g_{core} = 2,6kN/m^2$

The surface area of the construction, which is built up in the same way as a roof structure, amounts to approximately 325m². The interior floor slabs constitute 64m². The above characteristic dead loads are divided into four supporting points, thus giving the characteristic support reactions listed in the table on this page.

Vertical support reaction	{kN}
R_A	318
R_B	318



CHARACTERISTIC LIVE LOAD

As mentioned earlier the live load is added as 2,5kN/m² according to the classification of C1; common rooms.

According to its classification, the last combination factor used is 0,6

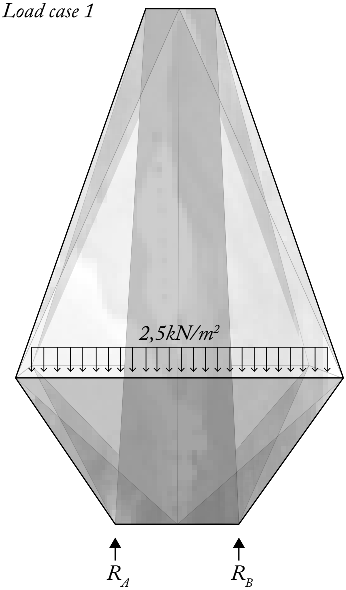
The live load (N) is counted as a free load, which gives the relevant load cases illustrated on this page and the corresponding support reactions are listed in the two tables below.

Support reactions, load case 1	
R_A {kN}	40
R_B {kN}	40

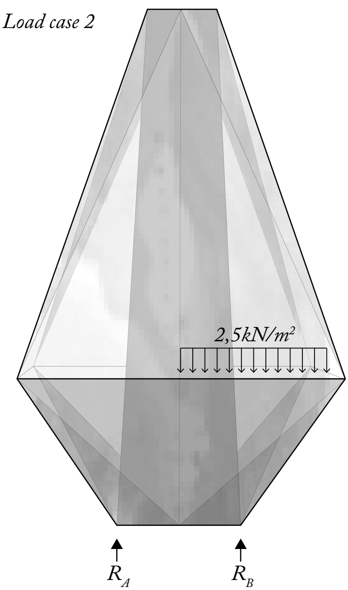
Support reactions, load case 2	
R_A {kN}	-8,2
R_B {kN}	40

The negative outcome of R_A in load case 2 gives rise to an upward force. Though this could suggest that we should establish an anchor in the supoort nodes it seems the upward force will be counteracted by the dead load at all times.

Load case 1



Load case 2



CHARACTERISTIC WIND LOAD

The terrain west and east of this pod is considered equivalent to terrain category IV; area where at least 15% of the surface is covered with buildings whose average height is above 15m. Read from the technical ståbi 22 edition, Table 4.9: terrænkategorier og terræn parametre, page 147.

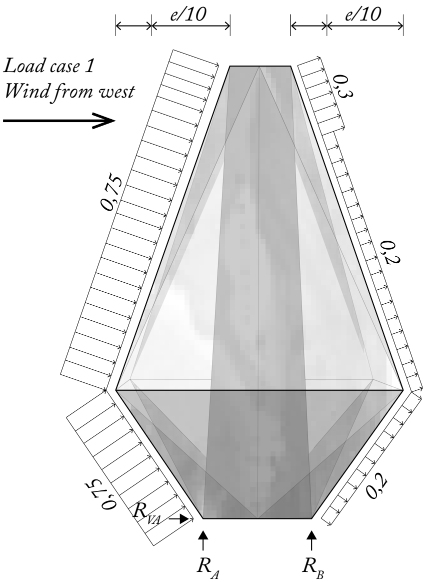
This is done to take into account the effect the gorge may have on the wind conditions on the site. Roughness length (ruhedslængden) thereby becomes 1m.

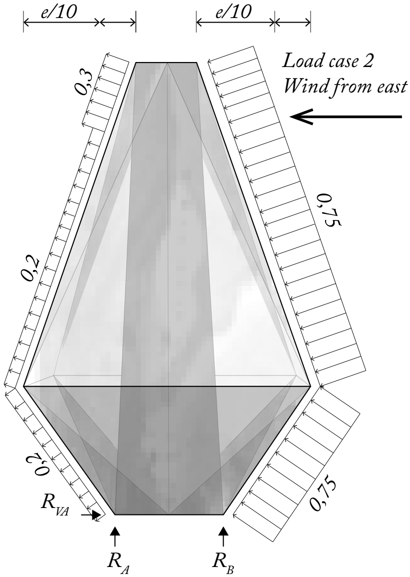
The basic windspeeds used are headed 27m/s rather than 24m/s, this is to cater for the increased wind speed in the mouth of the gorge.

The form factors $C_{pe,10}$ for wind loads are illustrated on this page and read from technical ståbi 22 edition, Table 11.4: formfaktorer for udvendige tryk på sadeltage, page 149.

As the roof slope exceeds + 45 ° it is only necessary to examine two load cases for wind.

e = 2h





V_{bo} = value for basic windspeed
V_{bo} = 27m/s

$C_{års}$ = directional factor
$C_{års,west}$ = 1
$C_{år,east}$ = 0,8

V_b = basic windspeed
$V_b = C_{års} \times V_{bo}$
$V_{b,west}$ = 27m/s
$V_{b,east}$ = 21,6m/s

p = air density
p = 1,25kg/m^3

q_b = basic rate equation
q_b = 0,5 x pkg/m^3 x V_b^2 m/s
$q_{b,west}$ = 455,6N/m^2
$q_{b,east}$ = 291,6N/m^2

z = construction height
z = 15m

z_o = roughness length
z_o = 1m

$z_{o,II} = z_o$ for terrain category II
$z_{o,II}$ =

k_t = terrain factor
$k_t = 0{,}19 \times (z_o/z_{o,II})^{0{,}07}$
k_t = 0,23

C_r = roughness factor
$C_r = k_t \times \ln(z/z_o)$
C_r = 0,62

q_m = 10 minute average velocity term
$q_m = C_r^2 \times q_b$
$q_{m,west}$ = 282,5N/m^2
$q_{m,east}$ = 112,1N/m^2

I_v = turbulens intensity
$I_v = 1/\ln(z/z_o)$
I_v = 0,37

q_{max} = characteristic max. rate equation
$q_{max} = (1+7 \times I_v) \times q_m$
$q_{max,west}$ = 1014,175N/m^2
$q_{max,east}$ = 402,44N/m^2

A = the area of the surface in question

$C_{pe,10}$ = the form factor of the roof

F_w = The characteristic exterior wind load
$F_w = q_{max} \times C_{pe,10} \times A$

Load case 1: wind from west

Vertical	
R_A {kN}	-156,6
R_B {kN}	156,6
Horizontal	
R_{VA} {kN}	-22,75
R_{VB} {kN}	22,75

Load case 2: wind from east

Vertical	
R_A {kN}	69,5
R_B {kN}	-69,5
Horizontal	
R_{VA} {kN}	12,05
R_{VB} {kN}	-12,05

POSSIBLE LOAD COMBINATIONS FOR HIGHEST R_A AND HIGHEST R_B

(a)
1,1 x 1,0G + 1,1 x 1,5 x 0,6N + 1,1 x 1,5 x 0,3V

(b)
1,1 x 1,0G + 1,1 x 1,5 x 0,6N + 1,1 x 1,5 x V

POSSIBLE LOAD COMBINATIONS FOR LOWEST R_A AND LOWEST R_B

(c)
1,1 x 1,0G + 1,1 x 1,5 x 0,6N + 1,1 x 1,5 x 0,3V

(d)
1,1 x 1,0G + 1,1 x 1,5 x 0,6N + 1,1 x 1,5 x V

RESULTING LOAD COMBINATIONS - COMBINATION OF FACTORS

	G	N	V	dominant variable load
(a)	1,1 x 1,0	1,1 x 1,5 x 0,6	1,1 x 1,5 x 0,3	N
(b)	1,1 x 1,0	1,1 x 1,5 x 0,6	1,1 x 1,5	V
(c)	1,1 x 1,0	1,1 x 1,5 x 0,6	1,1 x 1,5 x 0,3	N
(d)	1,1 x 1,0	1,1 x 1,5 x 0,6	1,1 x 1,5	V

The margin of design values are based on the formula 6.10b for STR; power failure or very large deformation of the structure or structural elements, including findings counties, piles, basement walls, etc., where the strength of structural materials is decisive.

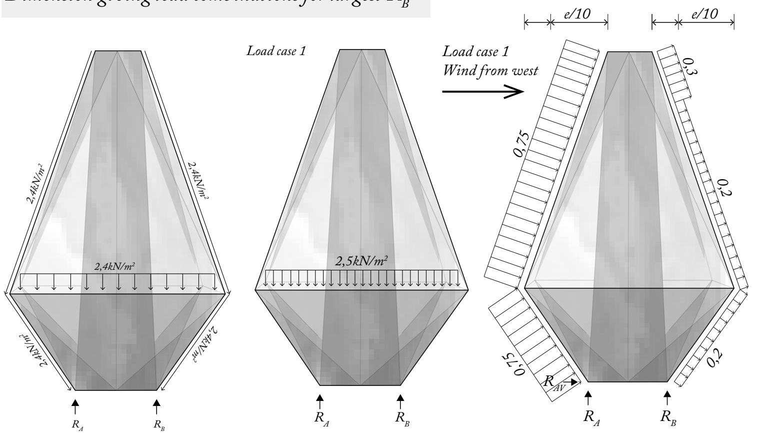
the dimension giving reactions are highlighted in the table of Margin of design support reactions

DIMENSION GIVING LOAD COMBINATIONS

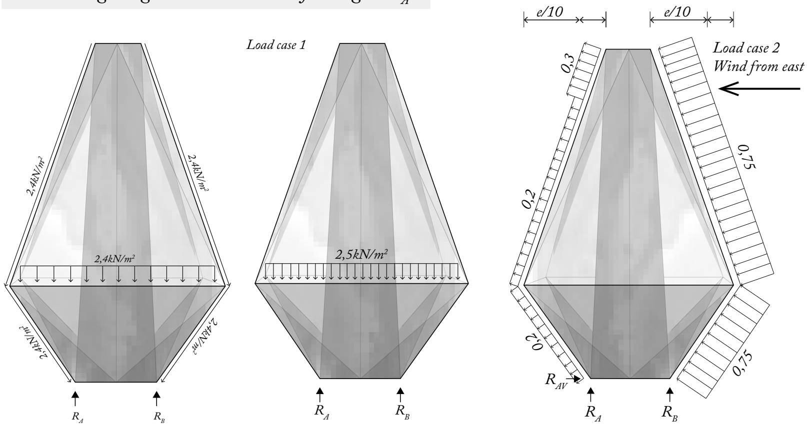
Margin of design support reactions	R_A {kN}	R_B {kN}
(a)	423,8	466,9
(b)	**504,1**	**647,8**
(c)	264,2	307,3
(d)	83,3	227

Despite the upwards reactions created by the load case 2 live load and the wind loads, these reactions are thwarted by the dominant permanent load.
The dimension giving load combination is the combination of the largest R_A and R_B with the windload as the dominant variable (b).

Dimension giving load combinations for largest R_B



Dimension giving load combinations for largest R_A



HORIZONTAL MASS LOAD

Horizontal mass load is the load that the vertical action gives rise to on a construction part, which is arranged eccentrically or out of plumb.

The horizontal mass load is the smallest horizontal load that a structure should be counted affected by. It has its application point in the centre of gravity for the associated vertical loads and is assumed to be capable of acting in any horizontal direction. The mass load is 1,5% of the vertical margin of design load. A horizontal mass load is a bound load and is rated only to occur simultaneously with the associated vertical loads, i.e., it can not be considered at the same time as the horizontal wind loads.

It should be examined whether the horizontal mass load works more unfavourably on the construction than the wind load.

The mass load is thereby determined as:

$$A_d = 1{,}5\%\ (1{,}1 \times 1{,}0G + 1{,}1 \times 1{,}5 \times 0{,}6N)$$

For largest R_A and R_B this results in a mass load of 5,85kN

This action is well below the calculated horizontal actions of the wind loads and will thereby easily be absorbed by the supports.

Illustration 3

Illustration 4

PERFORMANCE AIDED DESIGN

Conventional CAD – Computer Aided Design, either works at a very low semantic level or presents a higher but predefined level.

The low semantic approach does not constrain expression, but nor does it capture a lot of meaning and is therefore only acceptable as a substitute for hand drafting.

The low semantic approach, based on primitive shapes is insufficient, whereas the high semantics based on construction conventions, such as walls, windows and doors, forces the designer to think in a specific and detailed way about the design before having established the design concept or overall configuration.

PAD – Performance Aided Design works with a parametric structure allowing us to rigorously handle complex geometries and to effortlessly generate potentially infinite design variations and to test these design variations against various performance criteria in real time and thereby assist us in making informed decisions during the design process.

Performance aided design admits rapid change of design dimensions and enhances the search for designs that are better adapted to the context. It facilitates the discovery of new forms and even new ways of form making.

A performance aided design allows us to keep a better control and management of data, information, knowledge and complexity, with more learning from the feedback available.

INCREASING THE SIDE COUNT

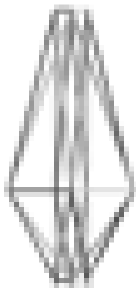
ELEVATION *TOP VIEW*

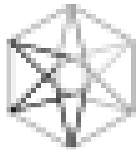
When thinking about the structure parametrically, the first parameter that seems obvious to adjust, would be to increase the member count, so to disperse the dead load of the construction envelope on more members and thereby reduce the member dimensions.

The illustrations on the right hand side of this page shows four cases of increased side counts. From the original four sides, we here illustrate the structure in elevation and plan view with six, eight, 16 and 24 sides. To get a sense of the proportions, this pod is 15m tall and 8m in diameter at its widest. The member dimension in this particular illustration is 150x150mm

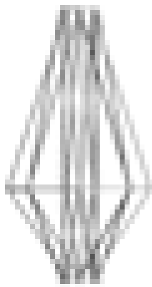
The impact the increase of the member count has on the shape of the construction is at first to create a Hexagonal floor plan and then an octagonal floor plan. But as the side count reaches 16, the floor plan is perceived as a circle.

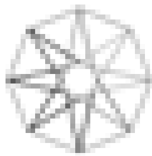
The conical shape hereby created is also a very traditional oast house shape, in addition to the dispersal of loads achieved by the increased member count, we find that this parametric change is a necessary iteration for the parametrically aided design process.



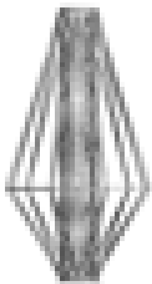


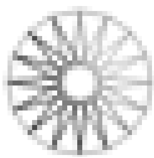
side count six



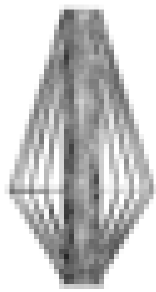


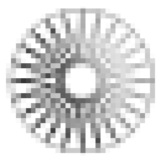
side count eight





side count 16





side count 24

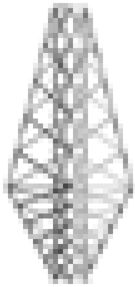
LACING THE STRUCTURE

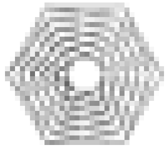
ELEVATION *TOP VIEW*

This next iteration seems a natural step in order to deal with the instability caused by buckling and lateral buckling in the longest structural members. This could be achieved by reducing the member lengths. In order to do so we shift the node connections of the members five sides over and breaking the length of the member into five in order to wrap around the conical shape and intersect with the other members, creating a lattice structure.

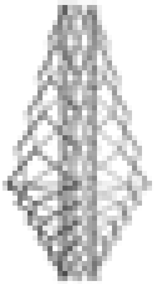
The illustration on the right hand side of this page shows lattice structures with side counts of six, eight, 16 and 24, illustrating a more smooth conical shape the higher the side count.

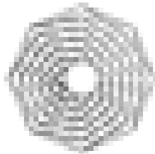
The conical shape too, is a very traditional oast house shape and for the sake of form clarity we will choose to go with either the square or the conical shape. The conical shape with its parametrical structural optimization towards reducing the member dimensions and achieving an elegant structure, this shape seems the obvious choice to take forward.



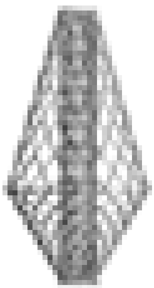


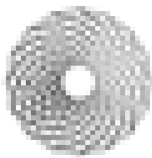
side count six



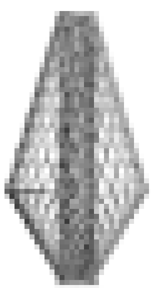


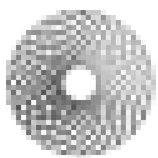
side count eight





side count 16





side count 24

NORMAL FORCES

The normal force is the support force exerted upon an object that is in contact with another stable object.

The distributions of normal forces in the structure are not uniform, but especially highly concentrated on the lower part of the structure, around the supports as well as the central tension ring and the top nodes in the upper tension ring.

The normal forces are generally higher in the compression core, and only getting higher toward the supports at the bottom of the structure.

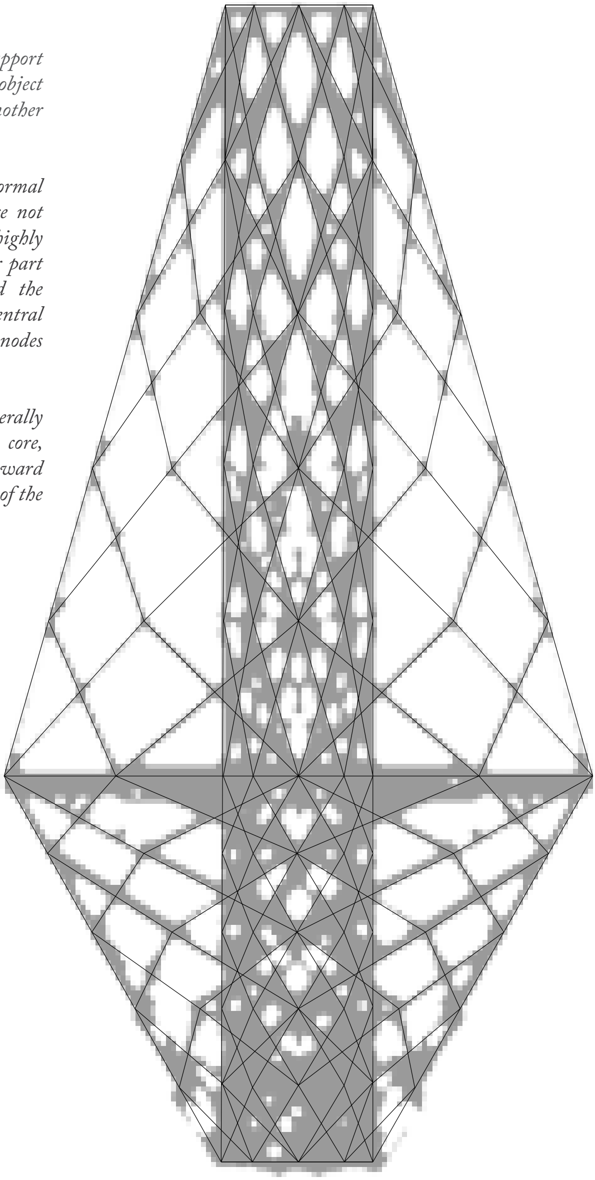


illustration of the distribution of the normal forces

MOMENT DISTRIBUTION

Moment is a combination of a physical quantity and a distance. Moments are usually defined with respect to a fixed reference point or axis; they deal with physical quantities as measured at some distance from that reference point or axis. For example, a moment of force is the product of a force and its distance from an axis, which causes rotation about that axis.

The concentration of the moments in the structure, acts very similarly to the normal forces.

The moments are concentrated in the compression core and around the top and the bottom of the structure

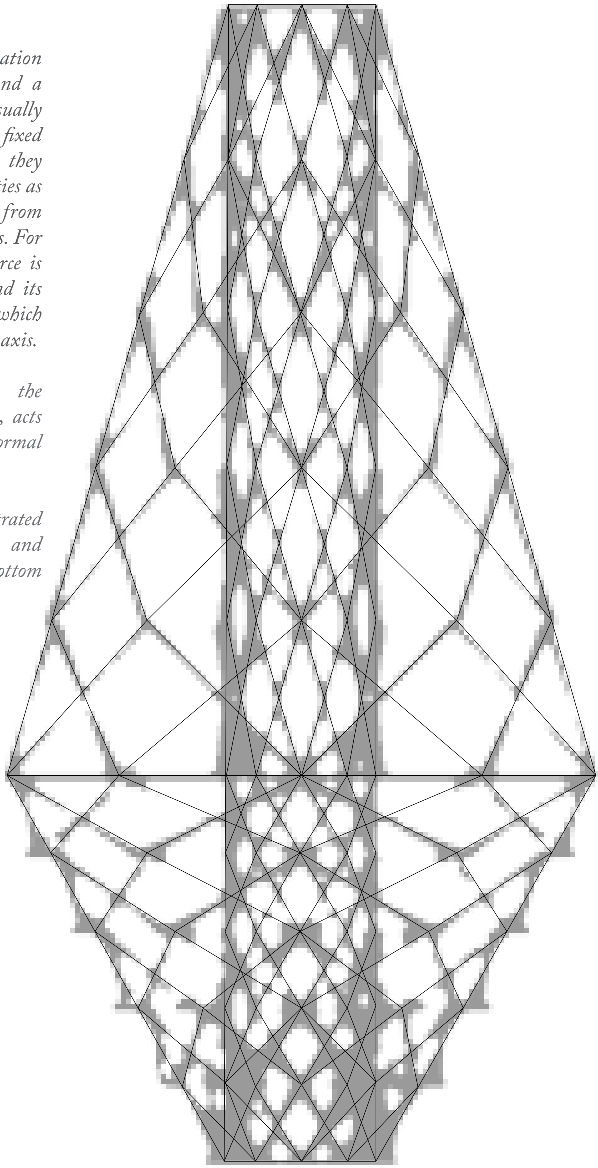


illustration of the distribution of moments in the structure

SHEAR STRESSES

Shear stress is a stress state where the stress is parallel to the surface of the material, as opposed to normal stress when the stress is vertical to the surface. A shear stress is defined as the component of stress coplanar with a material cross section. Shear stress arises from the force vector component parallel to the cross section.

The shear stress of the structure is concentrated mainly in the compression core of the structure, increasing toward the support at the bottom of the structure as well as generally occupying the members around the bottom and the top of the structure.

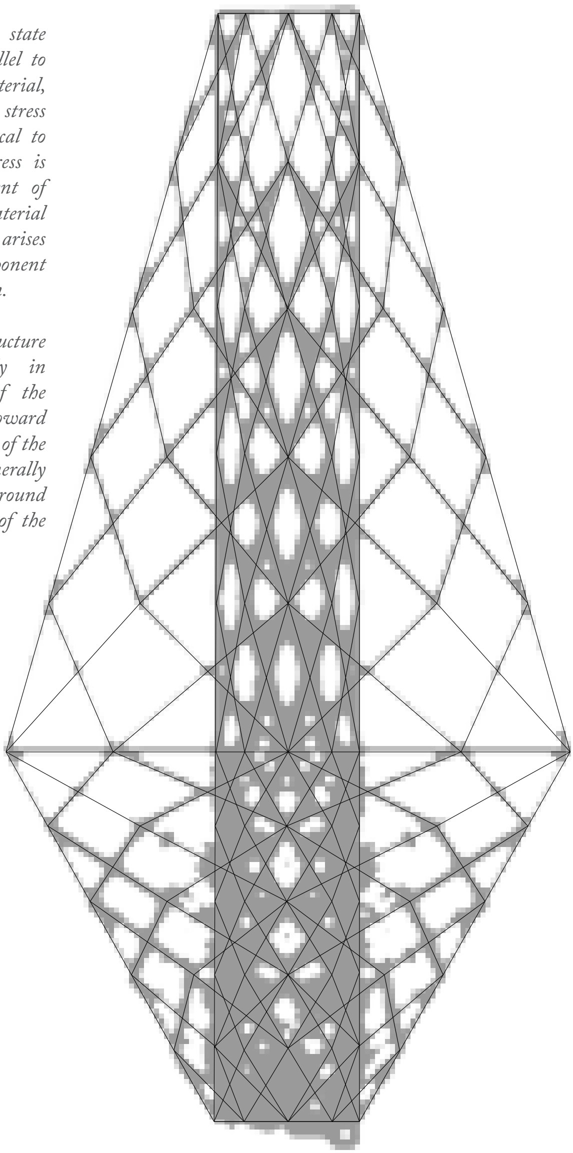


illustration of the distributionof the shear stress

DEFORMATION

In materials science, deformation refers to any changes in the shape or size of an object due to an applied force

As deformation occurs, internal inter-molecular forces arise that oppose the applied force. If the applied force is not too great these forces may be sufficient to completely resist the applied force and allow the object to assume a new equilibrium state and to return to its original state when the load is removed.

The deformation of the structure is as modest, as can be expected, when the member lengths have been reduced to their current sizes, as well as it can be expected that the deformation is located in the same areas as the other forces working on the structure.

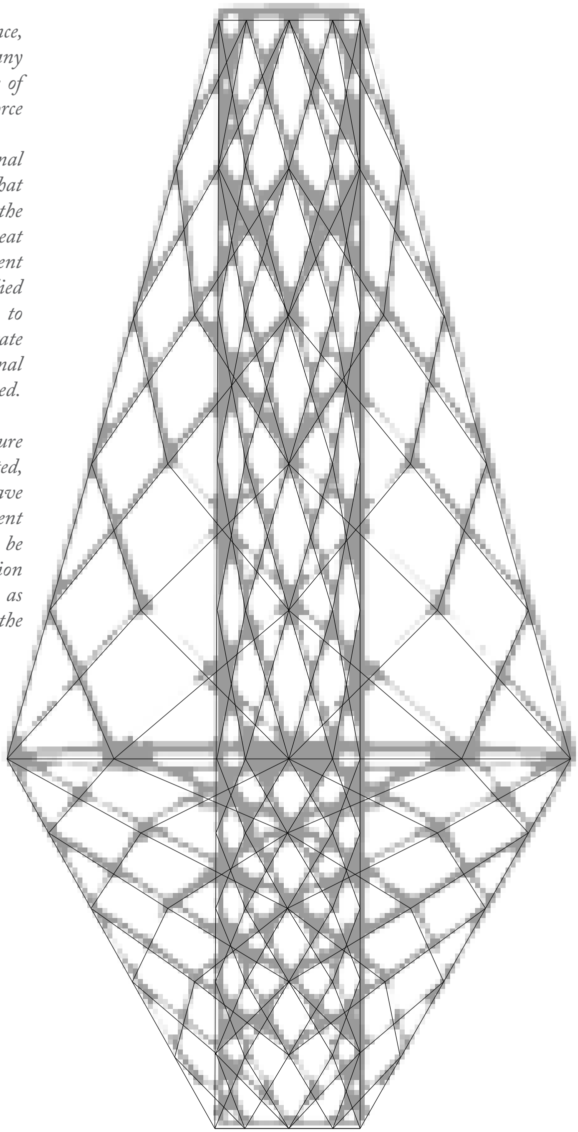


illustration of the deformation of the structure

ROBOT STRUCTURAL ANALYSIS

To confirm the knowledge we have gained so far about the construction and to acquire new knowledge about the structural behaviour, we apply the finite element method FEM to the structure in the program Robot – Structural Analysis.

Finite element modelling is a method to determine stress and strain in structures. The finite element method is a technique for solving partial differential equations by first discretizing these equations in their space dimensions. This discretisation is carried out locally over small regions of simple but arbitrary shape – the finite element.

This results in matrix equations relating the input in specified points or subregions in the elements. In order to solve equations over large regions, the matrix equations for the smaller subregions can be added node by node, resulting in global equations or global matrices.

In a complex structure, the most unfavourable load combination might not be the same load combination for all the elements in the structure. With the finite element method we can, in a short period of time, investigate the strains and stresses and their behaviour on the structure under different conditions, such as load cases, member dimensions and member count.

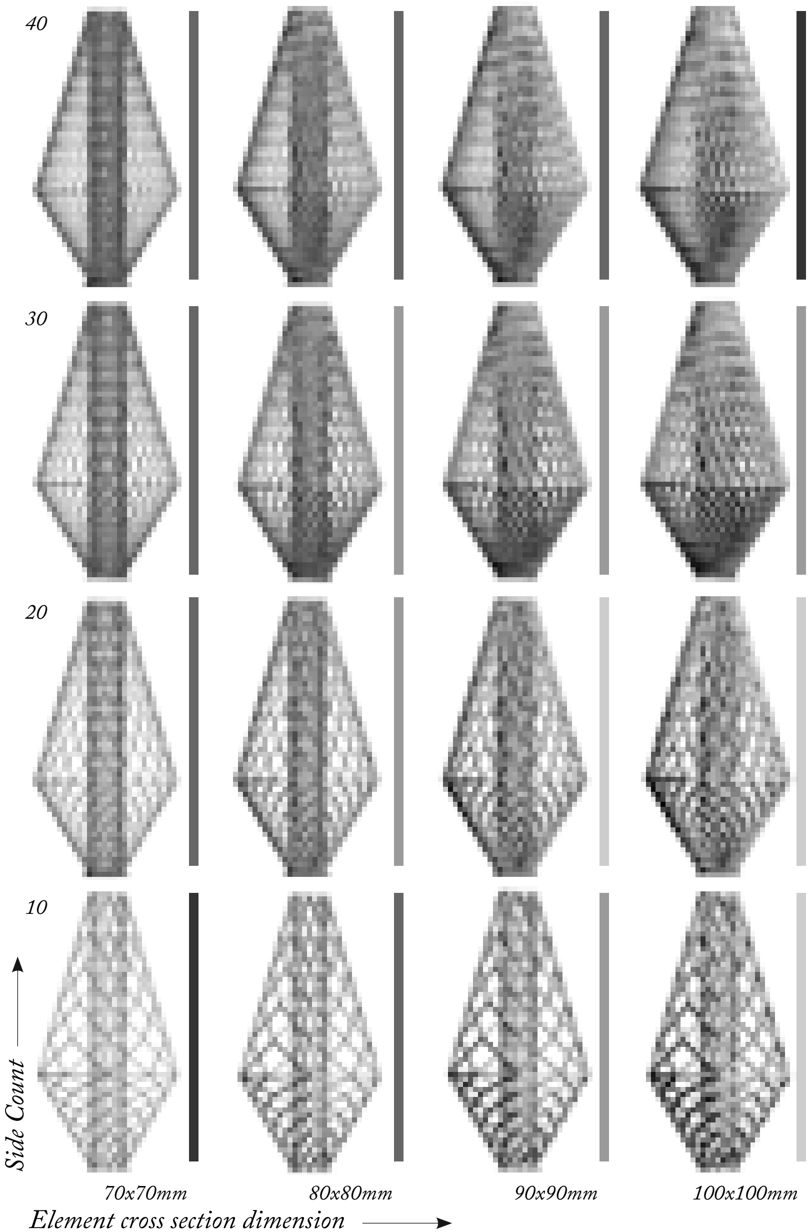
On the opposite page; 16 combinations of side counts and element dimensioning have been conditioned for the finite element method, and the results have been ranked from good to bad.

The results shows that there is a fine balance to be struck, between a structure with elements too fragile and few and elements so large and dense that the dead load of the structure becomes overpowering.

The best results are thereby achieved with a side count set around 20 sides constructed with elements in the high end of the set dimensional domain of 70x70 – 100x100mm

From our investigations in the structure so far, there seems to be room for optimizing. The lower part of the structure as well as the compression core is suffering from the most internal forces.

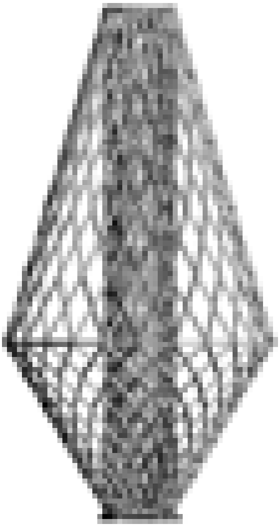
The dead load of this construction is the main contributor of forces and the minimizing of this load should therefore be in focus, by for example avoiding over dimensioning whenever possible.

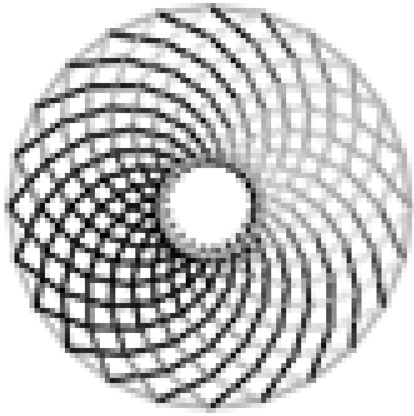

40
30
20
10
Side Count
70x70mm
80x80mm
90x90mm
100x100mm
Element cross section dimension

OPTIMIZING THE STRUCTURE

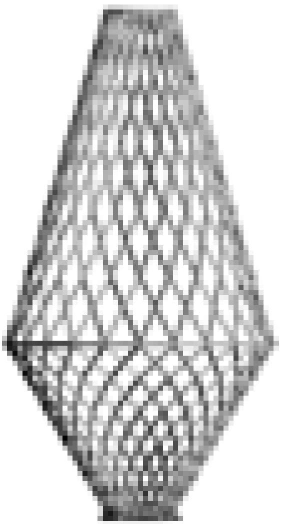
ELEVATION

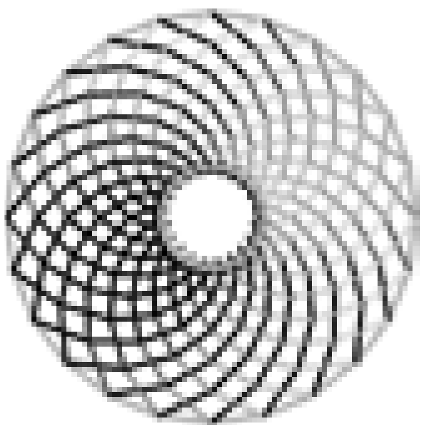
TOP VIEW



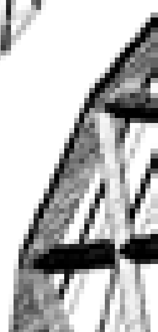


the structure with the core





the structure without the core



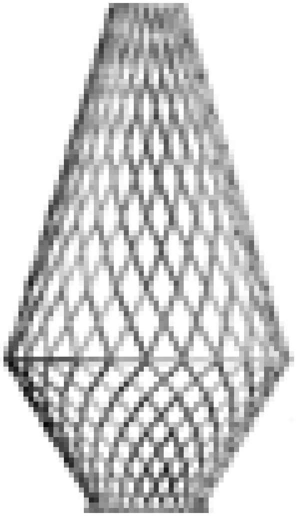
If we endeavour to dimension our way out of the high internal forces generally created in the core and the bottom of the structure, we will end up having a completely solid and dense wood construction. Dimensioning our way out of it therefore does not seem the optimal way of solving these problems.

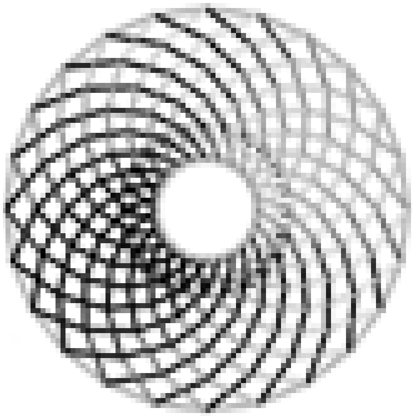
Looking at the structure with fresh and critical eyes we come to realise that the core is a remnant from a time where we wished for the core to transfer the forces of the structure down to the foundation. The structure is more than capable of doing that on its own.

We therefore remove the core from the structure completely.

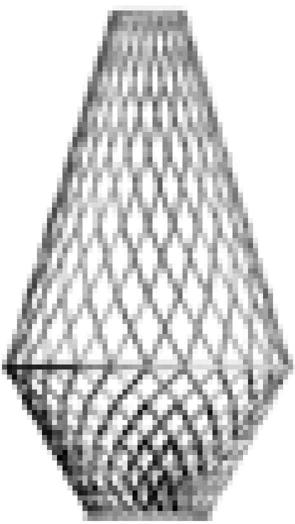
OPTIMIZING THE STRUCTURE

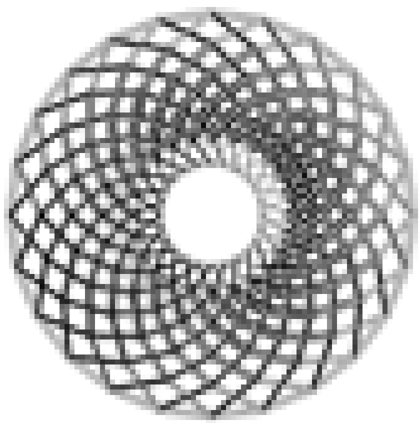
ELEVATION *TOP VIEW*





the structure with a wider base

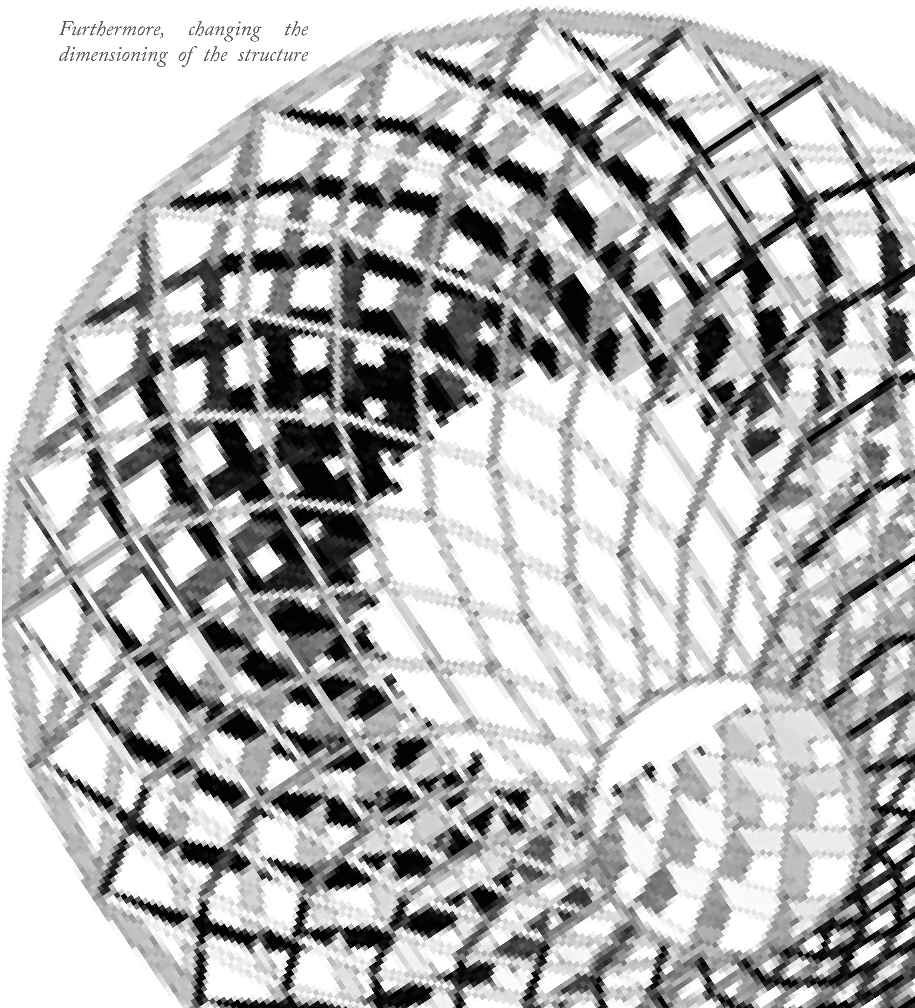




the structure with responsive dimensioning

Removing the core, removes a few restrictions created by the core, such as; the top and the bottom of the structure does not need to be aligned, they don't even have to be the same size any more. Increasing the radius of the support circle, lowers the internal forces in the bottom half of the structure.

Furthermore, changing the dimensioning of the structure from uniform to be in coherency with the loads affecting the different parts of the structure lowers the structures own dead load. The result is a pod structure with a heavier base, becoming lighter and more elegant as it works its way up.



OPTIMIZING THE STRUCTURE

On a more internally functional and conceptual note, we have been working with the concept of having all vertical circulation in the compound restricted to the cores of the pods.

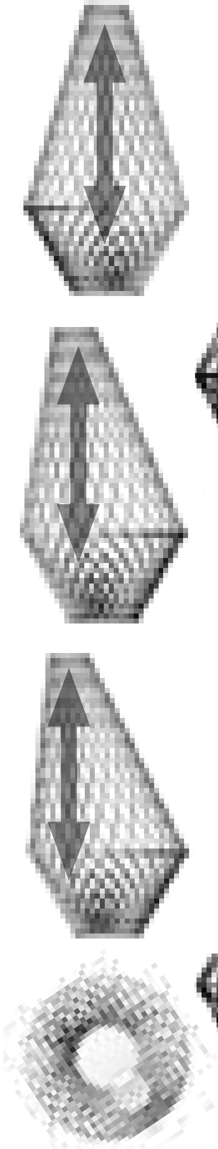
Having the vertical circulation in the middle of the pod poses a problem in connection with the furnishing and functionality of the pods as this requires a lot of space for horizontal circulation an thereby gives very little space for pause, furnishing, storage, brewery equipment and so on.

Simply by moving the vertical circulation to one side the space becomes more pause and less transit.

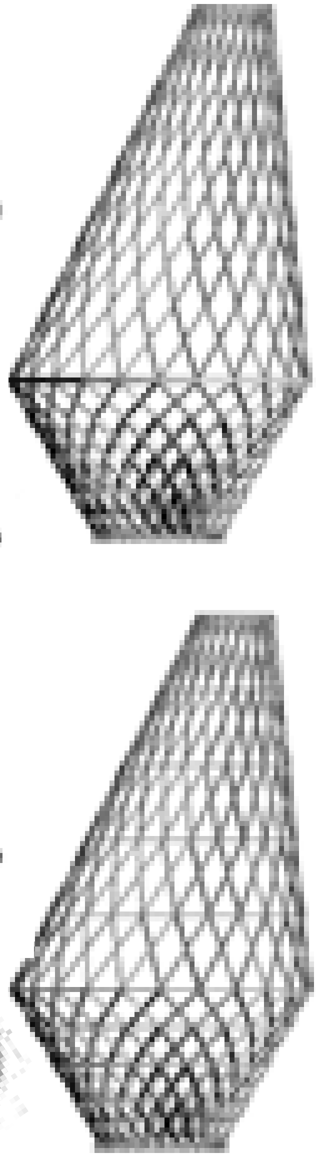
Using the finite element method on this structure we quickly realise that we are still unable to dimension our way out the stresses upon this structure and that the problem lies elsewhere.

The high dimension sections of the elements, results from the structure not being triangulated anymore. The individual trusses of this structure are rhombuses, which demand a fixed joint connection of the elements to ensure the structure does not simply collapse.

This could be avoided simply by introducing a series of connecting tension and compression rings, and thereby changing the joints to hinge connections.



moving the vertical circulation



triangulating the structure

MATERIAL PROPERTIES

Before we are able to get any finite element method results, we need to feed the structural analysis program some basic information, such as the material properties and service classes.

The characteristic strength and stiffness figures for C24 construction timber can be read of the table on the upper right hand side of this page.

The margin of design strength figures are decided as $f_d = k_d \times f_k$ where k_d is a conversion factor dependent on load duration and service class. This conversion factor can be read off the table on the lower right hand side of this page.

The construction in question is categorized under service class 1:

Indoor constructions in dry facilities. The relative humidity seldom exceeds 65% equivalent to equilibrium moisture content of softwood about 12%.(Teknisk Ståbi: page 304)

The material properties such as strength and stiffness figures are loaded into the parametric model set up in the graphical algorithm editor; grasshopper, which is tightly integrated with Rhino's 3-D modeling tools.

After the export to Robot structural analysis, the configuration of the service classes and the load duration in combination with the load types are set before calculation.

characteristic strength and stiffness figures

		{MPa}
E_0	Young modulus	11000
G	Shear modulus	690
$f_{m,k}$	Bending resistance	24
$f_{t,0,k}$	Axial tension resistance	14
$f_{t,90,k}$	Transversal tension resistance	0,5
$f_{c,0,k}$	Axial compression resistance	21
$f_{c,90,k}$	Transversal compression resistance	2,5
$f_{v,k}$	Shear resistance	4

conversion factor from characteristic strength figures to marging of design strength figures.

Load duration	Service Class 1 "Indoor" construction timber & mechanical connections
Permanent	0,444
Long term	0,519
Medium term	0,593
Short term	0,667
Instantatious	0,815

LIMIT STATE DESIGN

When verifying each member through the finite element method we verify the performance of each element up against its ultimate limit state ULS and its service limit state SLS.

The limit state of a design is in general a condition of a construction beyond which it no longer fulfils the relevant design criteria.

The ultimate state US involves either excessive deformations approaching collapse. This involves considerable plastic behaviour of the structural scheme and remaining deformations.

On the other hand the ultimate limit state ULS is an agreed computational condition that must be fulfilled among other additional criteria, in order to comply with the engineering demands for strength and stability under design loads.

The ULS limit is located at the upper part of its elastic zone approximately 15% lower than the elastic limit, rendering the ULS a purely elastic condition, with no lasting deformations in the structure. This is far below the Ultimate point which is located deep within the plastic zone.

The ULS is therefore a design criterion that ensures that the structure will behave in the same way under repetitive loadings guaranteeing a high level of safety and reliability. A structure is deemed to satisfy the ULS if all factored bending, shear and tensile or compressive stresses are below the factored resistance calculated for the section under consideration. (Web: Wiki – limit state design)

As with the ULS, the SLS is not a physical situation, but rather a computational check. The aim is to prove that the structural behaviour complies with, and doesn't exceed, the Service Limit State design criteria values.

To satisfy the serviceability limit state criterion, the structure in question must remain functional for its intended use subject to routine loading, without causing occupant discomfort such as; deformations, deflection, rotations, curvature or vibrations under routine conditions.

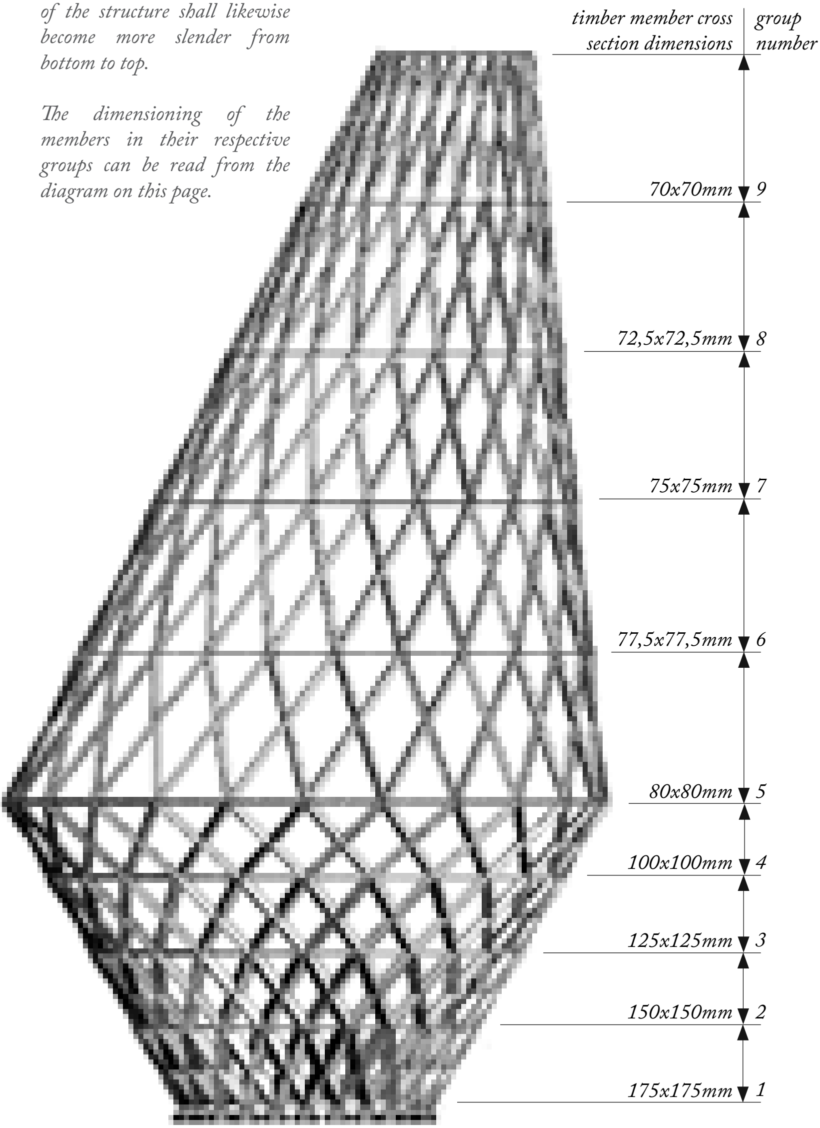
In the structural analysis program we set up the calculation to verify both the service and the ultimate limit state up against its related most unfavourable load combination, which are also generated automatically for both SLS and ULS.

Furthermore the serviceability displacement values for final member deflection is set to; the length of the member divided by 200 = l/200, whereas deflection from live loads are set with a lower tolerance as these are conditions where the user of the structure are in direct contact with the possible discomfort of member deflection and the deflection from live loads are therefore set to; the length of the member divided by 400 = l/400.

RESPONSIVE DIMENSIONING

As the members in the lower part of the structure are exposed to larger forces than those of the top part, the dimensioning of the structure shall likewise become more slender from bottom to top.

The dimensioning of the members in their respective groups can be read from the diagram on this page.



FEM RESULTS

GROUP NUMBER	*ULS RATIO*	*MOST UNFAVORABLE LOAD COMBINATION*	*SLS RATIO FINAL MEMBER DEFLECTION*	*SLS RATIO LIVE LOAS DEFLECTION*
4	00.50	4 ULS /1/	00.03	00.09
3	00.21	4 ULS /1/	00.01	00.01
2	00.38	4 ULS /12/	00.01	00.01
1	00.21	4 ULS /12/	00.01	00.04
5	00.52	4 ULS /1/	00.21	00.26
6	00.44	4 ULS /1/	00.21	00.24
7	00.36	4 ULS /1/	00.25	00.22
8	00.37	4 ULS /12/	00.21	00.19
9	00.48	4 ULS /12/	0,04	00.26
4	00.48	4 ULS /1/	00.03	00.09
3	00.19	4 ULS /1/	00.01	00.01
2	00.48	4 ULS /12/	00.01	00.01
1	00.18	4 ULS /12/	00.01	00.04
5	00.52	4 ULS /1/	00.17	00.30
6	00.45	4 ULS /1/	00.19	00.27
7	00.39	4 ULS /1/	00.22	00.25
8	00.42	4 ULS /1/	00.19	00.21
9	00.46	4 ULS /12/	00.55	00.28
4	00.50	4 ULS /12/	00.03	00.09
3	00.18	4 ULS /1/	00.01	00.02
2	00.54	4 ULS /12/	00.01	00.00
1	00.24	4 ULS /12/	00.01	00.04
5	00.52	4 ULS /1/	00.13	00.33
6	00.46	4 ULS /1/	00.15	00.30
7	00.42	4 ULS /1/	00.18	00.28
8	00.51	4 ULS /1/	00.15	00.23
9	00.52	4 ULS /1/	00.46	00.34
4	00.50	4 ULS /12/	00.04	00.09
3	00.16	4 ULS /1/	00.01	00.02
2	00.53	4 ULS /12/	00.01	00.01
1	00.30	4 ULS /12/	00.02	00.04
5	00.52	4 ULS /1/	00.08	00.37
6	00.48	4 ULS /1/	00.11	00.32
7	00.45	4 ULS /1/	00.13	00.31
8	00.57	4 ULS /1/	00.11	00.26
9	00.52	4 ULS /1/	00.37	00.44
4	00.45	4 ULS /12/	00.05	00.10
3	00.18	4 ULS /9/	00.01	00.02

Running a member verification for both Ultimate Limit State and Service Limit State on each member, the group that the member belongs to can be read off the column, group number, to identify the group we refer to the diagram on the previous page.

The ULS ratio is that between the calculated stresses and the allowable stresses in the specific element. The closer the ratio is to one the more optimal or suitable the dimensioning is compared to the allowable stresses.

The same is the case with the two SLS cases, here the SLS ratio is an expression of the relation between the allowable deflection and the calculated deflection.

The ratio is in many cases far below 1, as the dimensioning is done from the groups weakest element member.

FEM RESULTS

GROUP NUMBER	ULS RATIO	MOST UNFAVORABLE LOAD COMBINATION	SLS RATIO FINAL MEMBER DEFLECTION	SLS RATIO LIVE LOAS DEFLECTION
2	00.48	4 ULS /12/	00.02	00.02
1	00.35	4 ULS /12/	00.02	00.04
5	00.52	4 ULS /1/	00.04	00.40
6	00.49	4 ULS /1/	00.06	00.35
7	00.49	4 ULS /1/	00.07	00.35
8	0,041	4 ULS /1/	00.07	00.29
9	00.45	4 ULS /1/	00.28	00.52
4	00.39	4 ULS /1/	00.06	00.11
3	00.23	4 ULS /9/	00.01	00.01
2	00.39	4 ULS /12/	00.02	00.02
1	00.39	4 ULS /12/	00.02	00.04
5	00.52	4 ULS /1/	00.05	00.47
6	00.49	4 ULS /1/	00.02	00.38
7	00.49	4 ULS /1/	00.03	00.38
8	0,041	4 ULS /1/	00.06	00.33
9	00.47	4 ULS /1/	00.21	0,04
4	00.37	4 ULS /1/	00.06	00.12
3	00.26	4 ULS /9/	00.01	00.01
2	00.26	4 ULS /12/	00.02	00.02
1	00.38	4 ULS /12/	00.01	00.04
5	00.51	4 ULS /1/	00.06	00.43
6	00.49	4 ULS /1/	00.03	00.39
7	00.47	4 ULS /1/	00.04	00.41
8	00.59	4 ULS /1/	00.05	00.35
9	00.50	4 ULS /1/	00.23	0,05
4	00.34	4 ULS /1/	00.06	00.12
3	00.27	4 ULS /9/	00.01	00.01
1	00.33	4 ULS /12/	00.01	00.03
5	00.50	4 ULS /1/	00.08	00.42
6	00.49	4 ULS /1/	00.07	00.40
7	00.46	4 ULS /1/	00.06	00.42
8	00.55	4 ULS /1/	00.06	00.36
9	00.53	4 ULS /1/	00.24	0,055
4	00.32	4 ULS /1/	00.07	00.12
3	00.27	4 ULS /9/	00.01	00.00
2	00.09	4 ULS /9/	00.01	00.01
1	00.19	4 ULS /12/	00.01	00.02
6	00.48	4 ULS /1/	00.09	00.39
7	00.45	4 ULS /1/	00.08	00.41
8	00.53	4 ULS /1/	00.08	00.35
9	00.54	4 ULS /1/	00.23	0,058
4	00.32	4 ULS /1/	00.06	00.12
3	00.25	4 ULS /9/	00.01	00.00
2	00.12	4 ULS /9/	00.03	00.02
1	00.20	4 ULS /12/	00.02	00.00
5	00.49	4 ULS /1/	00.13	00.37
6	00.48	4 ULS /1/	00.11	00.36
7	00.44	4 ULS /1/	00.10	00.39
8	00.53	4 ULS /1/	00.10	00.32
9	00.55	4 ULS /1/	00.20	0,058
4	00.40	4 ULS /9/	00.06	00.11
3	00.22	4 ULS /9/	00.01	00.01
2	00.18	4 ULS /9/	00.04	00.02
1	00.33	4 ULS /9/	00.05	00.03
5	00.48	4 ULS /1/	00.14	00.33
6	00.47	4 ULS /1/	00.12	00.32
7	00.42	4 ULS /1/	00.12	00.35
8	00.53	4 ULS /1/	00.12	00.27
9	00.56	4 ULS /1/	00.17	0,056
4	00.52	4 ULS /9/	00.06	00.11
3	00.21	4 ULS /9/	00.02	00.02
2	00.26	4 ULS /9/	00.03	00.02
1	00.25	4 ULS /9/	00.02	00.04
5	00.48	4 ULS /1/	00.16	00.29
6	00.46	4 ULS /1/	00.13	00.27
7	00.41	4 ULS /1/	00.14	00.29
8	00.52	4 ULS /1/	00.14	00.21
9	00.55	4 ULS /1/	00.15	0,052
4	0,04375	4 ULS /9/	00.05	00.10

FEM RESULTS

GROUP NUMBER	ULS RATIO	MOST UNFAVORABLE LOAD COMBINATION	SLS RATIO FINAL MEMBER DEFLECTION	SLS RATIO LIVE LOAS DEFLECTION
3	00.20	4 ULS /9/	00.03	00.03
2	00.33	4 ULS /9/	00.02	00.01
1	00.25	4 ULS /9/	00.01	00.04
5	00.48	4 ULS /1/	00.16	00.25
6	00.46	4 ULS /1/	00.14	00.23
7	00.41	4 ULS /1/	00.15	00.24
8	00.51	4 ULS /1/	00.17	00.17
9	00.53	4 ULS /1/	00.19	0,046
4	0,048	4 ULS /9/	00.06	00.09
3	00.18	4 ULS /9/	00.03	00.03
2	00.36	4 ULS /9/	00.01	00.00
1	00.26	4 ULS /12/	00.03	00.03
5	00.48	4 ULS /1/	00.16	00.22
6	00.44	4 ULS /1/	00.14	00.23
7	00.39	4 ULS /1/	00.16	00.20
8	00.48	4 ULS /1/	00.19	00.16
9	00.54	4 ULS /12/	00.23	00.59
4	0,047	4 ULS /9/	00.06	00.08
3	00.21	3 Wind Load	00.03	00.03
2	00.34	4 ULS /9/	00.00	00.00
1	00.47	4 ULS /12/	00.04	00.03
5	00.47	4 ULS /1/	00.15	00.20
6	00.43	4 ULS /1/	00.15	00.21
7	00.37	4 ULS /1/	00.17	00.19
8	00.44	4 ULS /1/	00.20	00.14
9	00.50	4 ULS /1/	00.26	00.52
4	00.58	4 ULS /9/	00.06	00.08
3	00.40	4 ULS /12/	00.02	00.02
2	00.30	4 ULS /9/	00.01	00.00
1	0,048	4 ULS /12/	00.05	00.02
5	00.46	4 ULS /1/	00.13	00.18
6	00.41	4 ULS /1/	00.14	00.19
7	00.45	4 ULS /12/	00.16	00.18
8	00.48	4 ULS /12/	00.20	00.10
9	00.44	4 ULS /1/	00.28	00.45
4	00.41	4 ULS /9/	00.05	00.08
3	00.54	4 ULS /12/	00.02	00.01
2	00.23	4 ULS /9/	00.01	00.01
1	0,059	4 ULS /12/	00.05	00.02
5	00.46	4 ULS /12/	00.09	00.20
6	00.48	4 ULS /12/	00.13	00.18
7	00.50	4 ULS /12/	00.15	00.17
8	00.54	4 ULS /12/	00.20	00.08
9	00.51	4 ULS /12/	00.27	00.38
4	00.35	4 ULS /1/	00.05	00.08
3	0,043	4 ULS /12/	00.01	00.01
2	00.15	4 ULS /12/	00.01	00.01
1	0,064	4 ULS /12/	00.04	00.02
5	00.48	4 ULS /12/	00.04	00.23
6	00.51	4 ULS /12/	00.10	00.18
7	00.53	4 ULS /12/	00.12	00.18
8	00.55	4 ULS /12/	00.18	00.08
9	00.53	4 ULS /12/	00.24	00.36
4	00.39	4 ULS /1/	00.05	00.08
3	0,043	4 ULS /12/	00.01	00.01
2	00.11	4 ULS /1/	00.01	00.01
1	0,062	4 ULS /12/	00.03	00.02
5	00.57	4 ULS /12/	00.06	00.25
6	00.51	4 ULS /12/	00.06	00.20
7	00.49	4 ULS /12/	00.06	00.20
8	00.52	4 ULS /12/	00.15	00.11
9	00.57	4 ULS /12/	00.17	00.43
4	00.44	4 ULS /1/	00.04	00.08
3	00.54	4 ULS /12/	00.01	00.02
2	00.18	3 Wind Load	00.02	00.02
1	0,0541	4 ULS /12/	00.01	00.02
5	00.59	4 ULS /12/	00.12	00.25
6	00.54	4 ULS /12/	00.06	00.21
7	00.51	4 ULS /12/	00.05	00.22
8	00.55	4 ULS /12/	00.09	00.16

FEM RESULTS

GROUP NUMBER	*ULS RATIO*	*MOST UNFAVORABLE LOAD COMBINATION*	*SLS RATIO FINAL MEMBER DEFLECTION*	*SLS RATIO LIVE LOAS DEFLECTION*
9	0,042	4 ULS /12/	00.11	00.50
4	00.48	4 ULS /1/	00.03	00.07
3	00.40	3 Wind Load	00.02	00.02
2	00.23	3 Wind Load	00.02	00.03
1	0,043	4 ULS /12/	00.02	00.03
5	00.55	4 ULS /12/	00.17	00.24
6	00.50	4 ULS /12/	00.09	00.21
7	00.47	4 ULS /12/	00.11	00.22
8	00.53	4 ULS /12/	00.04	00.18
9	00.51	4 ULS /12/	00.27	00.49
4	00.51	4 ULS /1/	00.03	00.08
3	00.33	3 Wind Load	00.02	00.01
2	00.23	3 Wind Load	00.01	00.01
1	00.42	4 ULS /12/	00.05	00.03
5	00.54	4 ULS /1/	00.21	00.22
6	00.42	4 ULS /12/	00.16	00.20
7	00.39	4 ULS /12/	00.18	00.20
8	00.45	4 ULS /12/	00.10	00.18
9	00.42	4 ULS /9/	00.46	00.41
4	00.52	4 ULS /1/	00.02	00.08
3	00.28	3 Wind Load	00.02	00.01
2	00.22	3 Wind Load	00.03	00.02
1	00.19	4 ULS /12/	00.02	00.02
5	00.54	4 ULS /1/	00.18	00.21
6	00.43	4 ULS /1/	00.11	00.20
7	00.38	4 ULS /12/	00.13	00.18
8	00.47	4 ULS /9/	00.05	00.15
9	0,043	4 ULS /12/	00.42	00.26
2	00.13	4 ULS /1/	00.01	00.01
1	00.31	4 ULS /12/	00.02	00.00
5	00.53	4 ULS /1/	00.15	00.21
6	00.44	4 ULS /12/	00.09	00.19
7	00.43	4 ULS /12/	00.11	00.18
8	00.51	4 ULS /12/	00.05	00.14
9	00.58	4 ULS /12/	00.36	00.34
4	00.47	4 ULS /1/	00.03	00.07
5	00.51	4 ULS /1/	00.11	00.22
6	00.46	4 ULS /12/	00.07	00.20
7	00.45	4 ULS /12/	00.08	00.20
8	00.52	4 ULS /12/	00.05	00.17
9	00.49	4 ULS /12/	00.24	00.46
4	00.44	4 ULS /1/	00.04	00.07
3	00.43	4 ULS /12/	00.01	00.01
2	00.12	4 ULS /1/	00.01	00.02
5	00.50	4 ULS /12/	00.08	00.23
6	00.47	4 ULS /12/	00.06	00.22
7	00.44	4 ULS /12/	00.05	00.23
8	00.48	4 ULS /12/	00.06	00.19
9	00.46	4 ULS /12/	00.11	00.53
4	00.40	4 ULS /1/	00.05	00.08
3	00.47	4 ULS /12/	00.02	00.01
2	00.11	4 ULS /1/	00.01	00.02
5	00.47	4 ULS /1/	00.04	00.24
6	00.42	4 ULS /12/	00.04	00.24
7	00.43	4 ULS /12/	00.03	00.26
8	00.47	4 ULS /12/	00.10	00.21
9	00.47	4 ULS /12/	00.16	00.53
4	00.36	4 ULS /1/	00.06	00.09
3	00.48	4 ULS /12/	00.02	00.02
2	00.13	4 ULS /12/	00.01	00.02
5	00.44	4 ULS /1/	00.02	00.25
6	00.45	4 ULS /12/	00.04	00.26
7	00.47	4 ULS /12/	00.06	00.27
8	00.47	4 ULS /12/	00.14	00.22
9	00.46	4 ULS /12/	00.25	00.50
4	00.35	4 ULS /9/	00.06	00.09
3	00.43	4 ULS /12/	00.03	00.02
2	00.17	4 ULS /12/	00.01	00.02
5	00.44	4 ULS /1/	00.05	00.24
6	00.43	4 ULS /12/	00.08	00.26

FEM RESULTS

GROUP NUMBER	*ULS RATIO*	*MOST UNFAVORABLE LOAD COMBINATION*	*SLS RATIO FINAL MEMBER DEFLECTION*	*SLS RATIO LIVE LOAS DEFLECTION*
7	00.45	4 ULS /12/	00.11	00.27
8	00.47	4 ULS /12/	00.18	00.21
9	00.58	4 ULS /12/	00.29	00.45
4	00.45	4 ULS /9/	00.06	00.08
3	00.33	4 ULS /12/	00.03	00.03
2	00.21	4 ULS /12/	00.01	00.01
5	00.46	4 ULS /1/	00.09	00.23
6	00.41	4 ULS /1/	00.11	00.25
7	00.43	4 ULS /12/	00.14	00.25
8	00.43	4 ULS /12/	00.19	00.19
9	00.57	4 ULS /12/	00.29	00.45
4	00.51	4 ULS /9/	00.06	00.08
3	00.23	4 ULS /12/	00.02	00.02
2	00.24	4 ULS /9/	00.01	00.01
5	00.47	4 ULS /1/	00.12	00.22
6	00.43	4 ULS /1/	00.14	00.24
7	00.37	4 ULS /1/	00.16	00.22
8	00.44	4 ULS /1/	00.20	00.16
9	00.49	4 ULS /1/	00.26	00.52
4	00.52	4 ULS /9/	00.05	00.09
3	00.14	3 Wind Load	00.01	00.01
2	00.23	4 ULS /9/	00.01	00.01
5	00.48	4 ULS /1/	00.14	00.23
6	00.44	4 ULS /1/	00.16	00.21
7	00.39	4 ULS /1/	00.17	00.19
8	00.48	4 ULS /1/	00.20	00.11
9	00.50	4 ULS /1/	00.23	00.59
4	00.50	4 ULS /9/	00.05	00.10
3	00.13	4 ULS /9/	00.01	00.01
2	00.19	4 ULS /9/	00.02	00.01
5	00.48	4 ULS /1/	00.15	00.25
6	00.46	4 ULS /1/	00.17	00.21
7	00.41	4 ULS /1/	00.18	00.24
8	00.51	4 ULS /1/	00.19	00.14
9	00.53	4 ULS /1/	00.20	0,046
4	00.47	4 ULS /9/	00.06	00.11
3	00.14	4 ULS /9/	00.02	00.01
2	00.17	4 ULS /9/	00.01	00.01
5	00.48	4 ULS /1/	00.16	00.29
6	00.46	4 ULS /1/	00.17	00.26
7	00.41	4 ULS /1/	00.18	00.29
8	00.52	4 ULS /1/	00.18	00.20
9	00.55	4 ULS /1/	00.18	0,052
4	00.44	4 ULS /9/	00.06	00.11
3	00.20	4 ULS /9/	00.01	00.01
2	00.18	4 ULS /9/	00.00	00.01
5	00.48	4 ULS /1/	00.17	00.33
6	00.47	4 ULS /1/	00.16	00.31
7	00.42	4 ULS /1/	00.17	00.34
8	00.53	4 ULS /1/	00.16	00.26
9	00.56	4 ULS /1/	00.17	0,056
4	00.42	4 ULS /9/	00.07	00.12
3	00.28	4 ULS /9/	00.01	00.01
2	00.20	4 ULS /9/	00.01	00.02
5	00.49	4 ULS /1/	00.17	00.37
6	00.48	4 ULS /1/	00.14	00.36
7	00.44	4 ULS /1/	00.14	00.39
8	00.53	4 ULS /1/	00.13	00.31
9	00.55	4 ULS /1/	00.20	0,058
4	00.38	4 ULS /9/	00.07	00.12
3	00.36	4 ULS /9/	00.01	00.02
2	00.19	4 ULS /9/	00.01	00.02
5	00.49	4 ULS /1/	00.15	00.40
6	00.48	4 ULS /1/	00.10	00.39
7	00.45	4 ULS /1/	00.10	00.41
8	00.53	4 ULS /1/	00.09	00.35
9	00.54	4 ULS /1/	00.23	0,058
4	00.35	4 ULS /1/	00.06	00.12
3	00.41	4 ULS /9/	00.01	00.01

FEM RESULTS

GROUP NUMBER	ULS RATIO	MOST UNFAVORABLE LOAD COMBINATION	SLS RATIO FINAL MEMBER DEFLECTION	SLS RATIO LIVE LOAS DEFLECTION
2	00.16	4 ULS /9/	00.01	00.02
5	00.50	4 ULS /1/	00.12	00.42
6	00.49	4 ULS /1/	00.05	00.40
7	00.46	4 ULS /1/	00.05	00.42
8	00.55	4 ULS /1/	00.04	00.36
9	00.53	4 ULS /1/	00.24	0,055
4	00.37	4 ULS /1/	00.06	00.12
3	00.40	4 ULS /9/	00.01	00.01
2	00.24	4 ULS /12/	00.01	00.02
5	00.51	4 ULS /1/	00.07	00.43
6	00.49	4 ULS /1/	00.03	00.40
7	00.47	4 ULS /1/	00.04	00.41
8	00.58	4 ULS /1/	00.04	00.35
9	00.50	4 ULS /1/	00.24	0,050
4	00.45	4 ULS /12/	00.05	00.11
2	00.45	4 ULS /12/	00.02	00.01
5	00.51	4 ULS /1/	00.05	00.42
6	00.49	4 ULS /1/	00.09	00.38
7	00.49	4 ULS /1/	00.10	00.38
8	0,041	4 ULS /1/	00.10	00.33
9	00.47	4 ULS /1/	00.32	0,043
4	00.58	4 ULS /12/	00.05	00.10
3	00.24	4 ULS /9/	00.01	00.01
2	0,041	4 ULS /12/	00.02	00.01
5	00.52	4 ULS /1/	00.07	00.40
6	00.49	4 ULS /1/	00.13	00.35
7	00.49	4 ULS /1/	00.15	00.35
8	0,041	4 ULS /1/	00.15	00.30
9	00.47	4 ULS /12/	00.42	00.53
4	0,044	4 ULS /12/	00.04	00.09
3	00.16	4 ULS /1/	00.01	00.02
2	0,047	4 ULS /12/	00.01	00.02
5	00.52	4 ULS /1/	00.13	00.37
6	00.47	4 ULS /1/	00.17	00.32
7	00.45	4 ULS /1/	00.19	00.31
8	00.57	4 ULS /1/	00.18	00.26
9	00.51	4 ULS /1/	00.49	00.43
4	0,043	4 ULS /12/	00.03	00.09
3	00.18	4 ULS /1/	00.01	00.03
2	0,048	4 ULS /12/	00.01	00.02
5	00.52	4 ULS /1/	00.18	00.33
6	00.46	4 ULS /1/	00.18	00.30
7	00.41	4 ULS /1/	00.20	00.28
8	00.51	4 ULS /1/	00.17	00.23
9	00.52	4 ULS /1/	00.52	00.34
4	00.53	4 ULS /12/	00.03	00.09
3	00.20	4 ULS /1/	00.01	00.03
2	0,043	4 ULS /12/	00.00	00.01
5	00.52	4 ULS /1/	00.21	00.30
6	00.45	4 ULS /1/	00.17	00.27
7	00.39	4 ULS /1/	00.20	00.25
8	00.42	4 ULS /1/	00.15	00.21
9	00.44	4 ULS /1/	00.52	00.28
4	00.51	4 ULS /1/	00.03	00.09
3	00.22	3 Wind Load	00.01	00.02
2	00.50	4 ULS /12/	00.02	00.00
5	00.52	4 ULS /1/	00.22	00.26
6	00.44	4 ULS /1/	00.14	00.24
7	00.36	4 ULS /1/	00.18	00.22
8	00.41	4 ULS /9/	00.11	00.19
9	00.41	4 ULS /9/	00.50	00.23
4	00.52	4 ULS /1/	00.03	00.09
3	00.25	3 Wind Load	00.01	00.01
2	00.34	4 ULS /12/	00.03	00.02
5	00.53	4 ULS /1/	00.20	00.23
6	00.44	4 ULS /1/	00.12	00.22
7	00.35	4 ULS /9/	00.15	00.20
8	00.45	4 ULS /9/	00.07	00.17
9	00.55	4 ULS /9/	00.46	00.22

LIGHT STUDIES

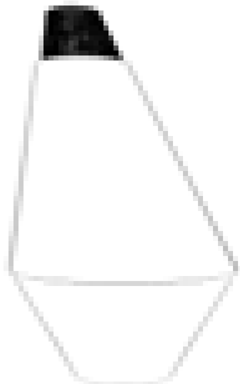
For the daylight considerations and visualization, we use the daylight visualizer from Velux. This is a professional simulation tool created for the analysis of daylight conditions in architectural structures.

Its purpose is to promote the use of daylight in architecture in an early phase, so to aid the design by predicting and documenting daylight levels and appearance of space prior to realisation of the building design.

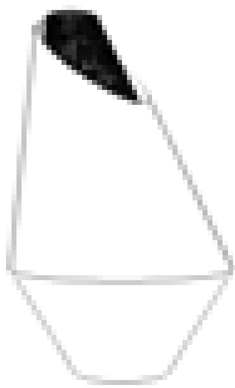
The reasons for using the daylight visualizer compared to standard CAD programs is that it permits us to accurately simulate and quantify daylight levels in the interior in contrast to the average CAD programs which only perform 3D renderings without information about the quantity of daylight in the space. The daylight visualizer thereby allows us to make informed decisions about daylight performance in our architectural design.

We have a vision of gloom in the pub room. So rather than working with the quantity of light we wish to work with the quality of light, as well as employing the principle of territory, visual range and escape as well as the principle of Exploration, or more specifically the notion of prospect and refuge.

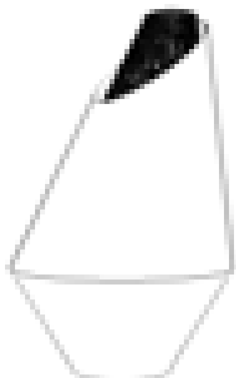
Light and darkness is a high indicator of mystery and will according to the theory encourage the subject to explore. On the other



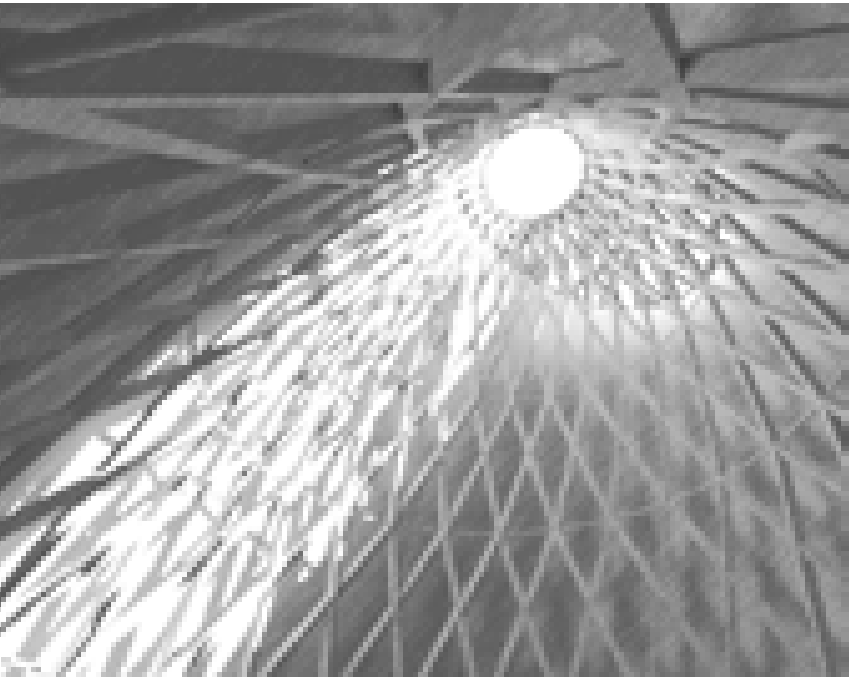
Light Case 3: Lighting from all directions

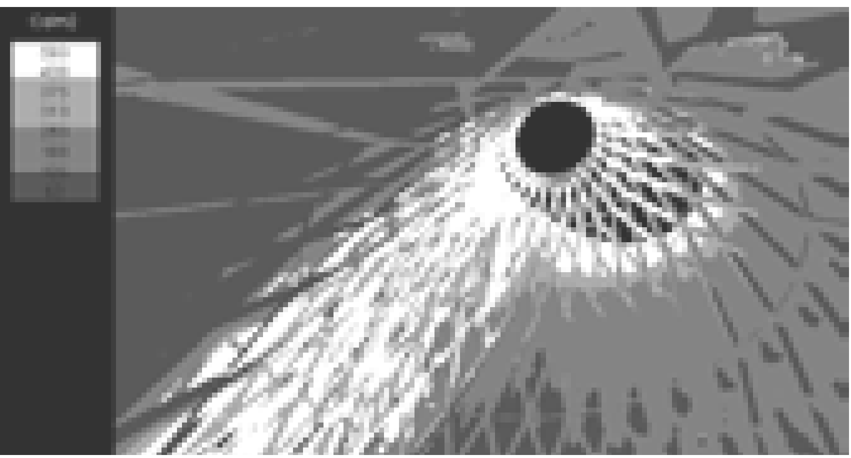


Light Case 3: Lighting from south



Light Case 2: Lighting from north



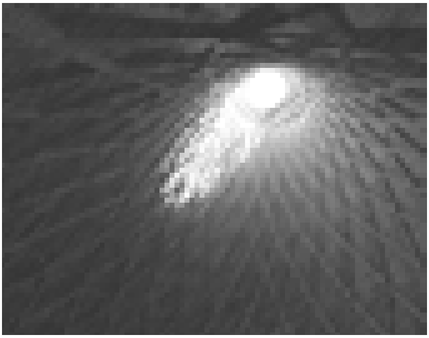


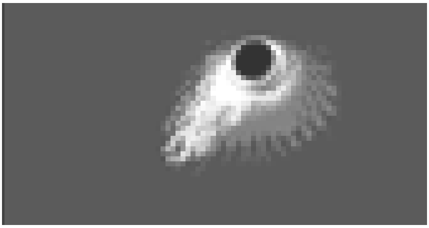
hand the darkness of the shadows and the gloom in the pub, can also be used as a retreat to sit and see without being seen, though always with the prospect of being able to step into the light. In this project we will therefore be working with the quality of light, creating spaces and encouraging exploration through light rather than the quantity of light.

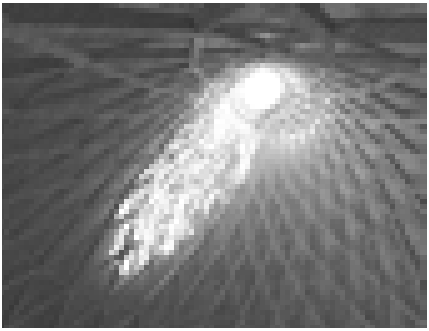
The daylight study has the aim of exploring the different character of direct and indirect light. We therefore created three simple light studies of light only from the south, light only from the north and light from all angles. In compliance with our vision of the pub being a very introverted space, focused on the human interaction rather than the panoramic views of the Gorge. Lighting will come from three different sources throughout the project. Skylights, light reflected off the cliff surface and small selected views of the gorge.

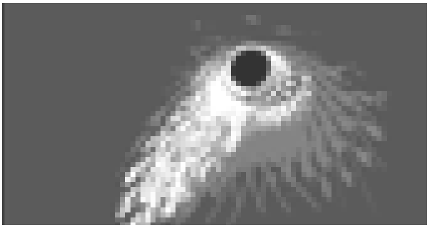
As this light study is focused primarily on the Pod and the light within this, we will in this study be working with skylight. Another reason for this is that light from the south in the pods only will be possible with the high location of the pod top, as most of the site is located in the shadow of the cliff face to the south.

All the studies are represented by a render, illustrating the lighting conditions as well as a false color luminance (cd/m^2) which is the amount of light reflected off a

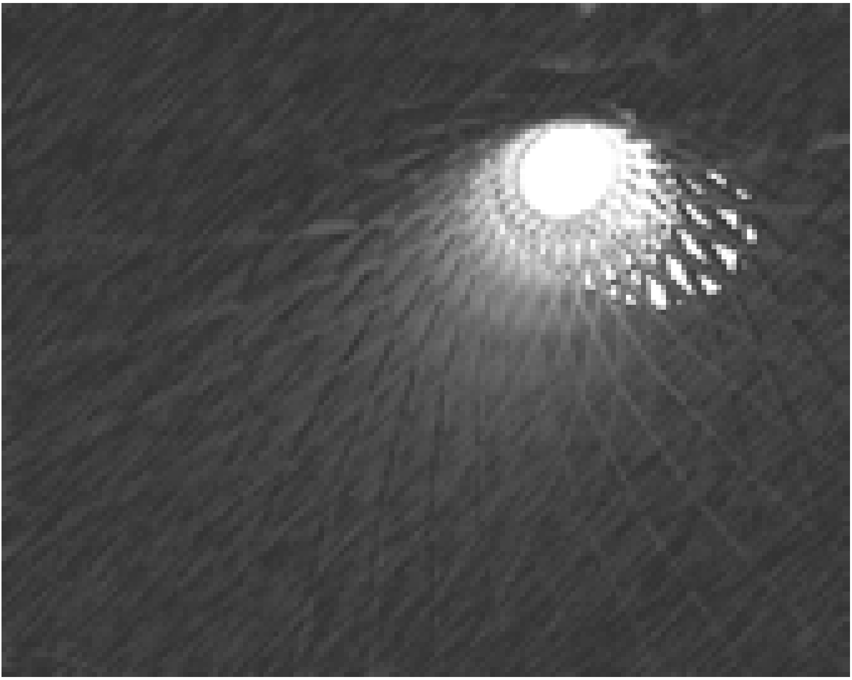


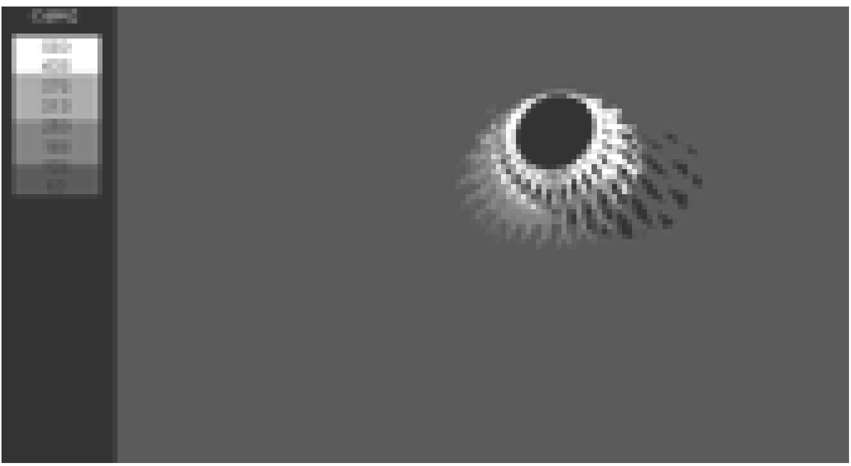






LIGHT STUDIES CASE 2

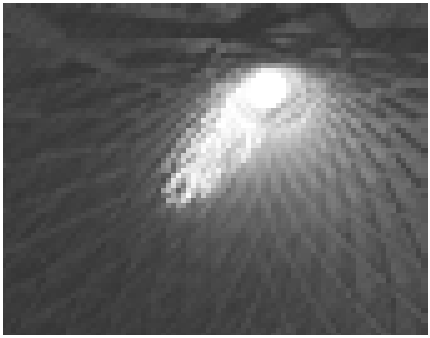


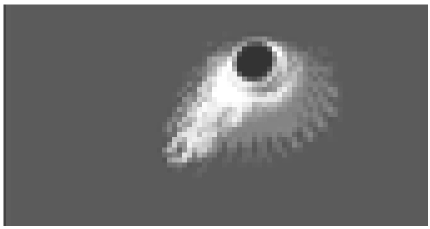


surface.

CASE 1:
LIGHT FROM SOUTH

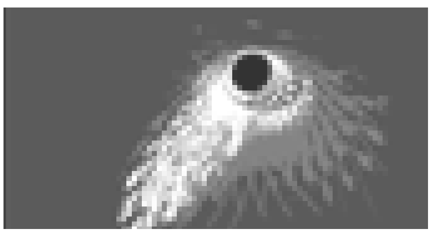
In the first case of light, with light purely from the south, the direct sunlight upon the internal structure, gives depth and dimension to the construction enhancing its aesthetic features. At the same time the direct light creates a sharp contrast to the gloomier parts of the space in the bottom of the construction. The luminance is divided sharply, going almost instantaneously from 500 to a 100 cd/m2. The sharp contrast could in our opinion make the 100 cd/m2 seem more like darkness rather than gloom.



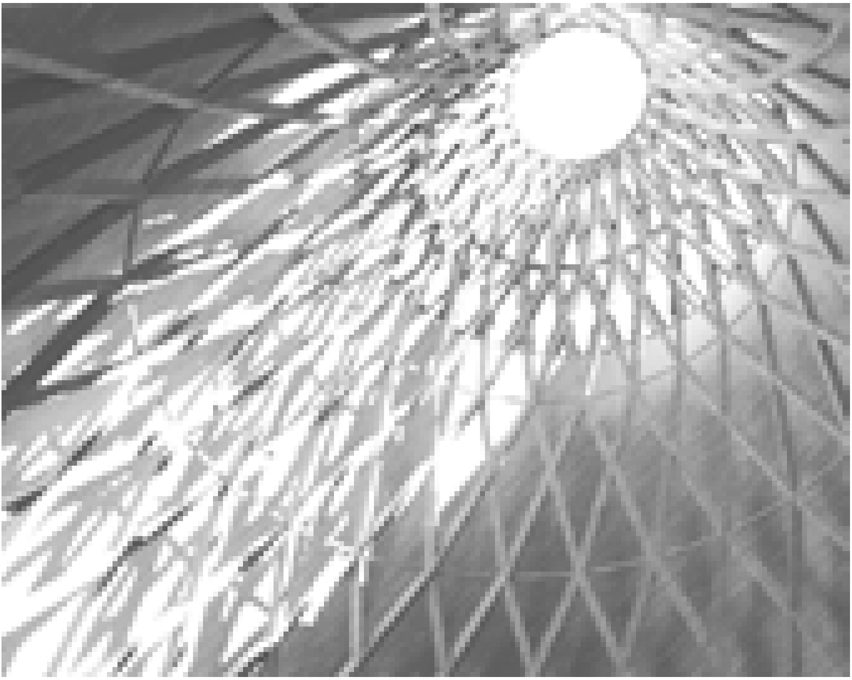


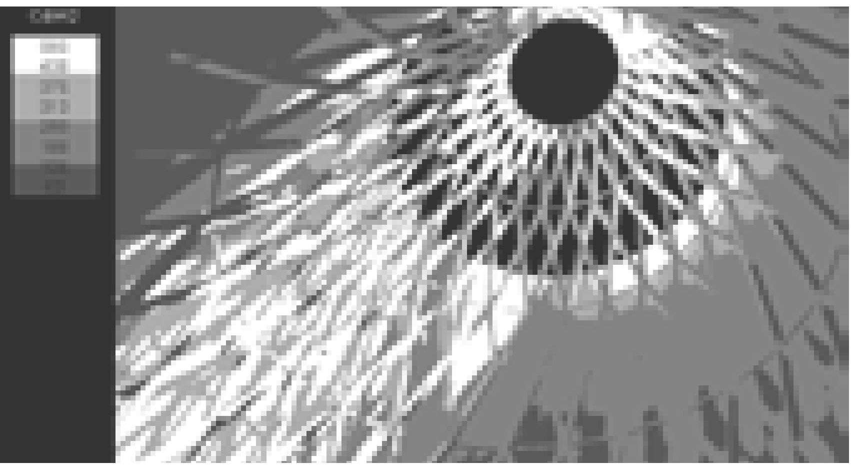
CASE 2:
LIGHT FROM NORTH

In the second case we investigate the daylight qualities of light purely from the north. The interest in this case is the fact that the weather on the location is mostly overcast, so focusing on light from the north would give the most uniform lighting experience throughout the year. Unfortunately this lighting strategy needs a much more integrated approach, working with reflective and light distributive surfaces, which is the exact opposite of our actual structure. We do not wish to hide the loadbearing structure for the benefit of a more uniform light distribution. As we argued earlier a quantity of light is not the main goal of this study, but rather the quality of light. In the



LIGHT STUDIES CASE 3





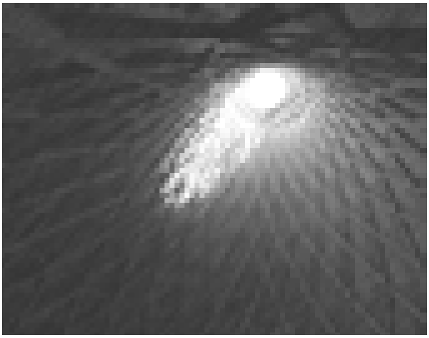
case of light only from the north, in this particular structure, the results are an overall gloomy space, with very little contrast and quality.

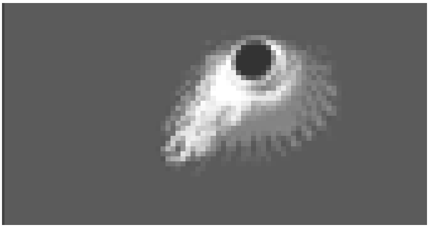
CASE 3:
LIGHT FROM ALL DIRECTIONS

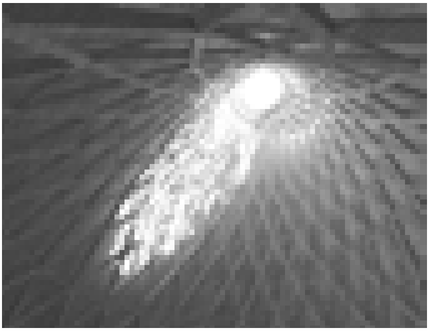
The third and last case is an investigation in light from all directions. The qualities of this lighting approach are that its character is not that of a specific character, but rather a direct reflection of the outdoor environment. The light character within the pod is very dependent on the time of day and time of year, thereby creating a more versatile experience for the return visitor.

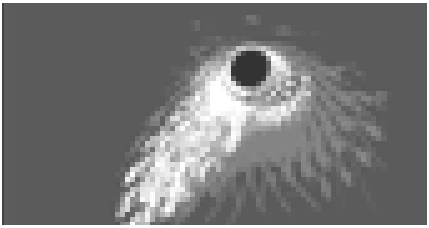
That said this lighting case also permits the most amount of light into the structure on overcast days and the lighting from all direction helps to blur the transition from the brightly lit areas to the gloomier areas of the space.

Skylights from all directions will therefore be our chosen lighting approach for this project and we will go into a little further depth with this lighting strategy on the next couple of pages.

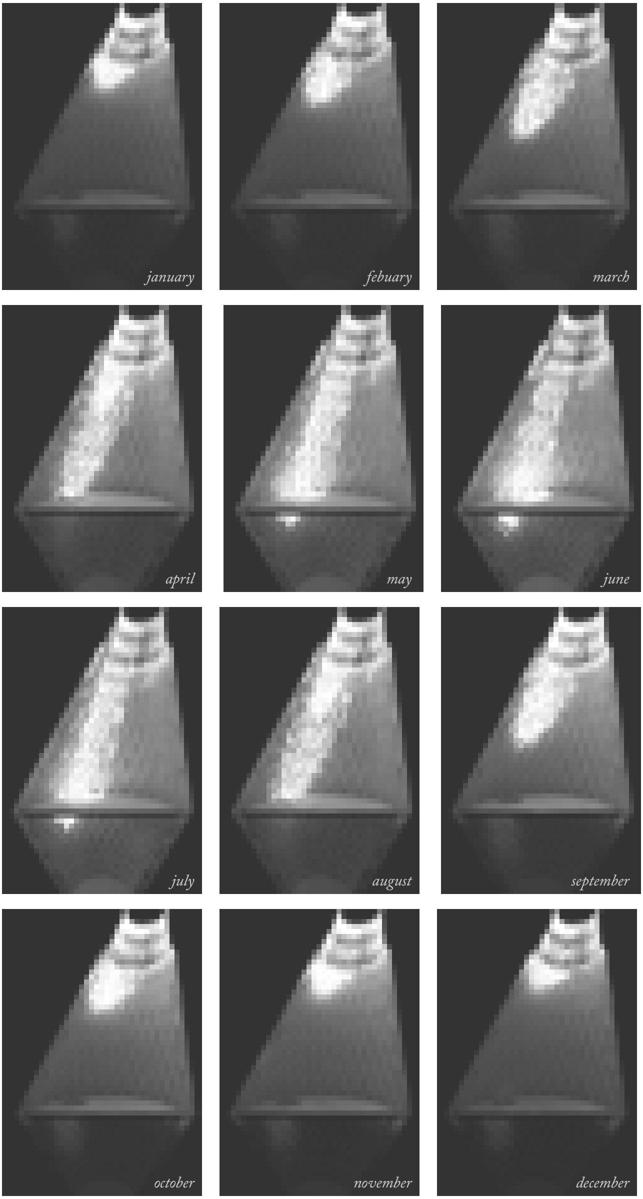


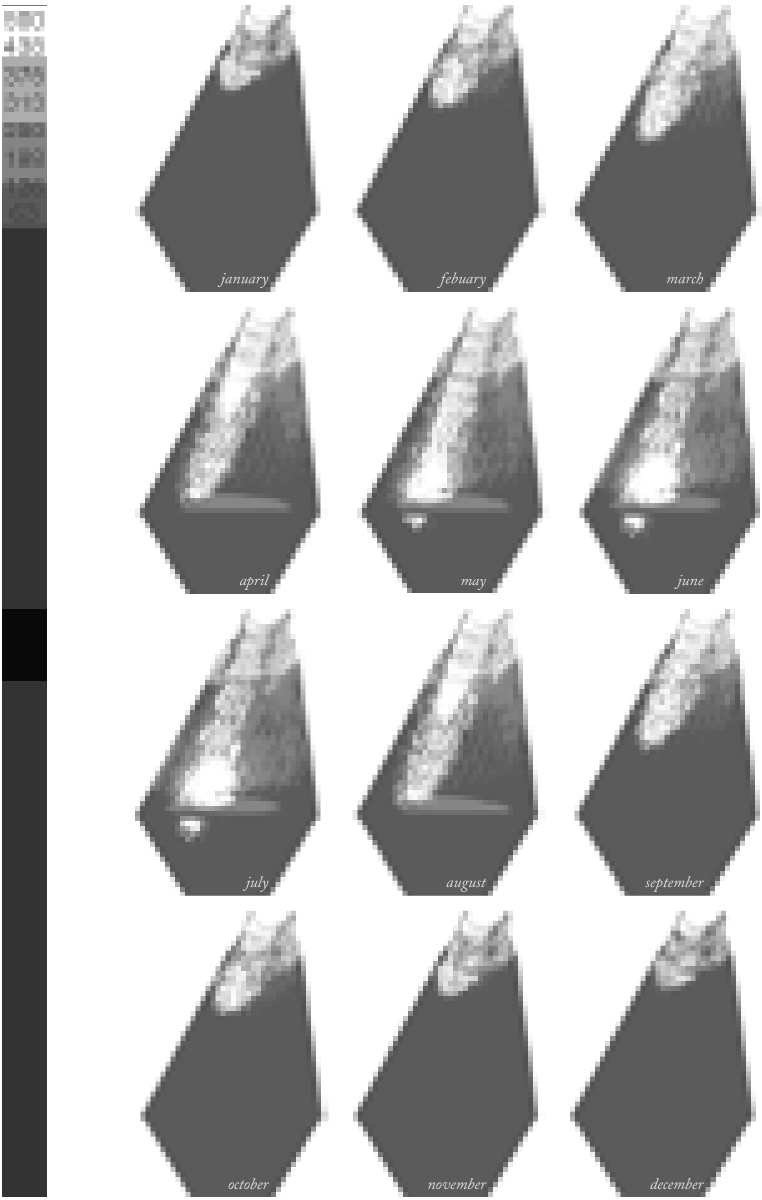






ANNUAL LIGHTING




january
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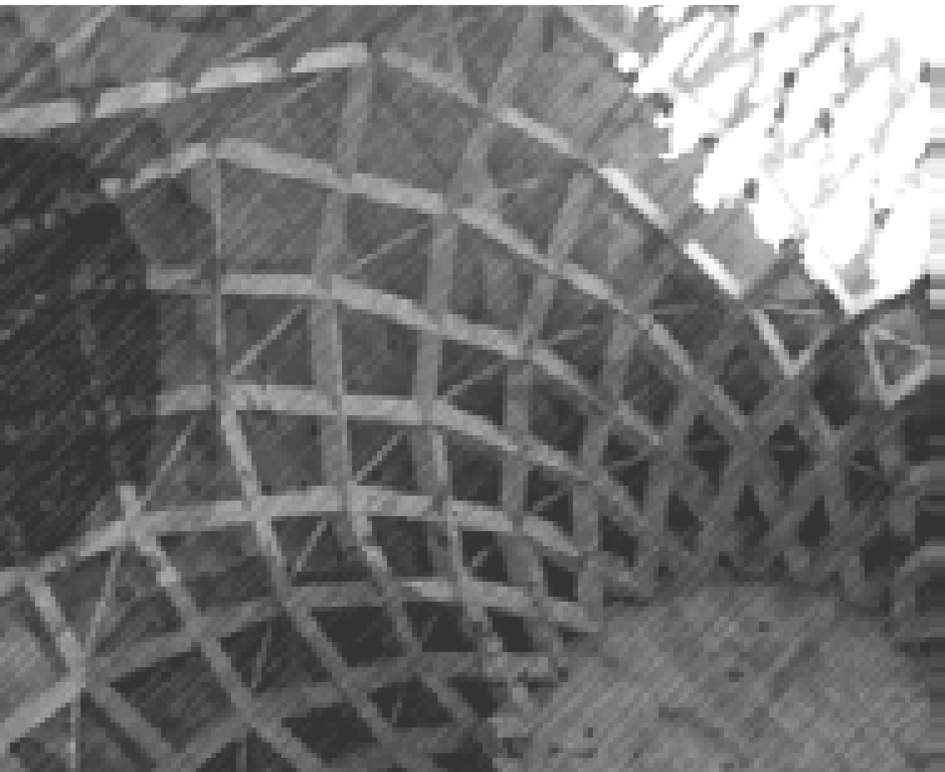
november
december

DAYLIGHT CONCLUSION

In relation to the theory, light and seclusion are one of the highest indicators of mystery, encouraging the user to explore. The contrast of light and darkness within the pod thereby creates a sense of visual prospect in the presence of light and locomotive refuge in the shadows.

The light from the oculus will be washing down upon the wood, providing depth and tactility the construction. The floor deck within the pod is offset slightly from the loadbearing structure to allow the warm light reflected on the wooden surfaces to reach the lower parts of the pod that connects to the main pub. The contrast of the main pub with its concrete structure, lending a cellar like character to the pub, in comparison to the warm light washing down upon the wood structure and the winding stairs going up towards the light again encourages the user to explore through mystery.

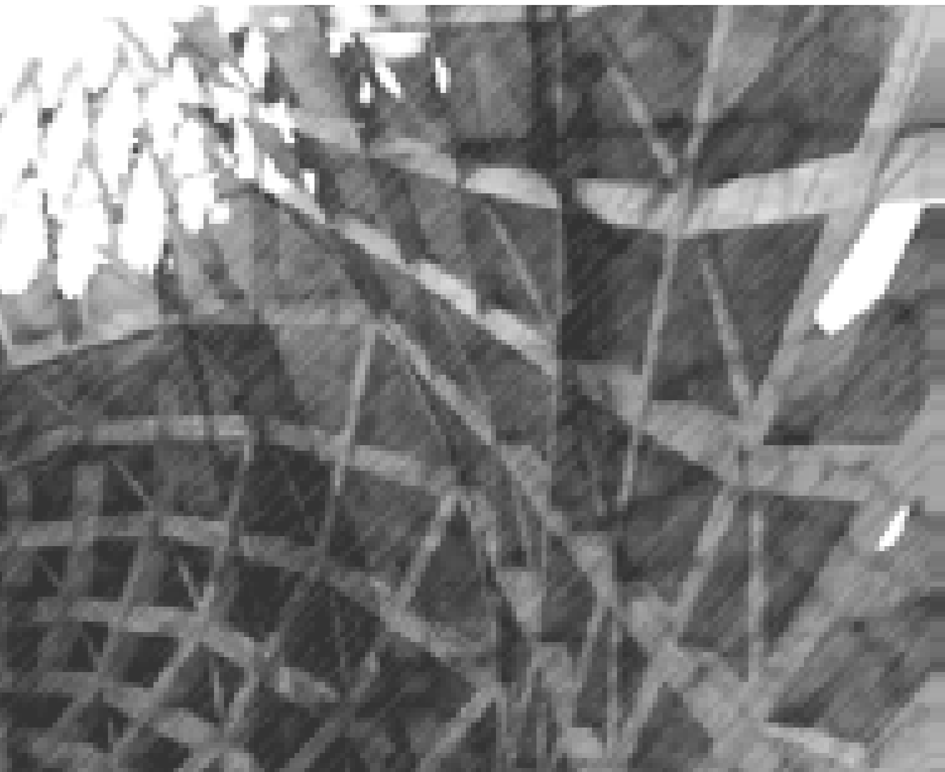
This might raise the question why we use the lighting strategy of light from all angles rather than just light from south, as the light from south would enhance and underline the contrast between light and dark. In answer to this it is important to remember the



significant difference between mystery and surprise. Too stark darkness might suggest surprise rather than mystery as the bright south light in especially the summer period might blind the user and thereby limit the visual range in the shadows, creating an element of surprise and risk, actually discouraging exploration rather than encouraging it.

Rather than having a uniformly lit pub in general we utilise the character of the light to define space, creating a refuge in the shadows of a clearly demarcated territory without using obstacles which could diminish the visual range and thereby the visual sense of escape.

A uniformly lit room would in this design case not work in our favour, as well as a high daylight factor has been proven to decrease the amount of time spent in a pub, this in combination with the knowledge that the ratio between the amount of time spent in a pub and the amount of beverage intake are fairly linear – the longer they stay, the more they drink. (Robert Sommer : 2007)



To keep the building envelope weight to a minimum we have chosen a self-bearing insulation system.

REDAir FLEX is self-bearing and is therefore not dependent of the transferral of forces to the foundation. This is because the weight of both insulation and cladding are consumed by a combination of the insulation strength and the friction created up against the back wall.

This insulation system can carry a cladding weighing 50kg/m2, whereas the wood shingles we are using in this project only weigh 18kg/m2.

The u-value for this construction is calculated by Rockwool energy calculator and determined to be 0,09W/m2K, the insulations batts have a heat transmission capacity of 0,033 W/mK. (Web: Rockwool)

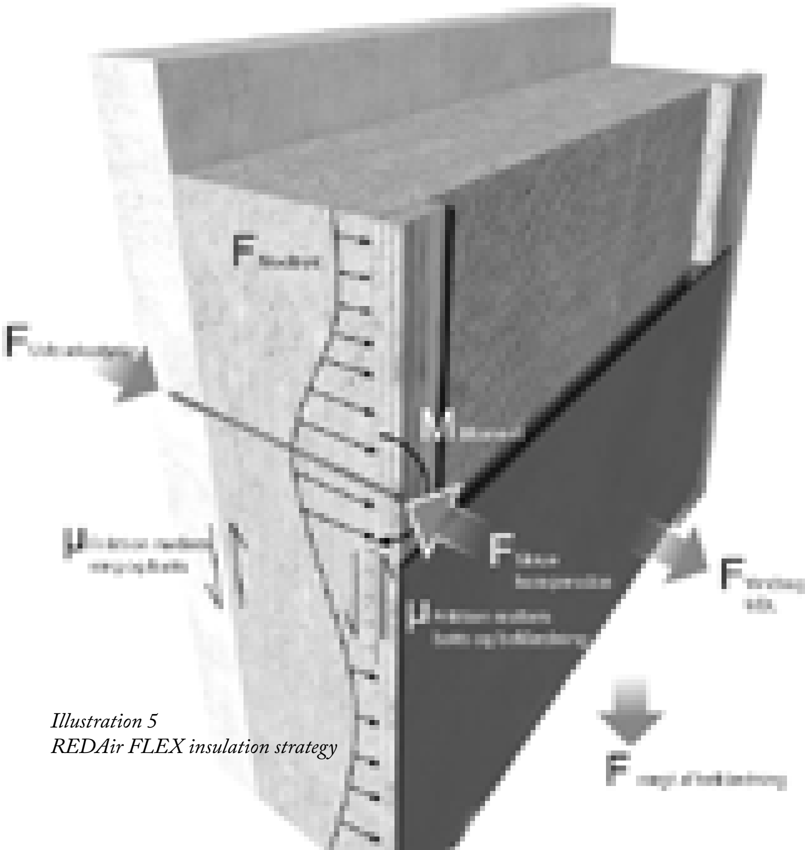


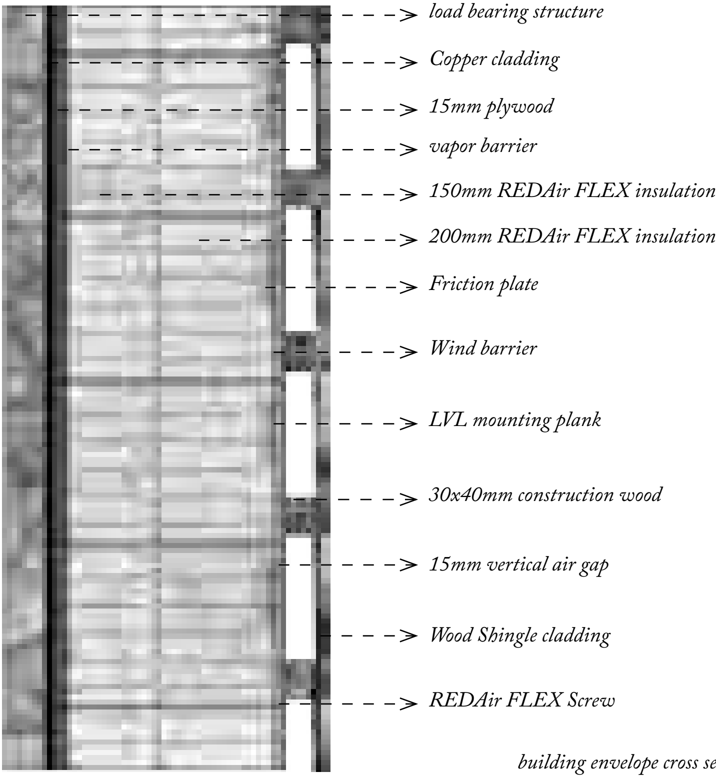
Illustration 5
REDAir FLEX insulation strategy

By using the REDAir FLEX system we eliminate the need for any secondary structure to mount the insulation and cladding upon, we thereby reduce the permanent dead load upon the structure.

The back wall requirements for this façade system are meet with 15mm plywood sheets
.

The maximum amount of insulation thickness for this system is set to 350mm, which will be what we are using in this project.

In between the LVL mounting plate and the insulation batts we place the wind barrier, so to allow for possible water to run off behind the cladding, as well as ventilate the wood in order to keep it dry.



building envelope cross section

MATERIALS

The exterior cladding shingles as well as the load bearing structure are created from English Oak, both for its aesthetic and associative values as well as its strength as a construction wood and suitability for shingling.

The English Oak is the national tree of England, thanks to its extraordinary height, venerable age and legendary strength. It is still the most common tree in the English woodlands, though more common to the south and east of England where our site is located. The shape of its leaves are so familiar to the English culture; it is more or less imprinted in the English national psyche. (Web: wood finishes direct)

In respect to the brewing process oak has traditionally been the preferred wood sort for cooping the barrels for cask beers.

Illustration 6
Oak shingles

Illustration7
Copper cladding

Copper is chosen as interior cladding for multiple reasons, besides its associative qualities to the copper kettle used in the brewing process, the reflective surface will increase the amount of luminance (cd/m2) which is the amount of light reflected off a surface. Furthermore we wished to have a surface that would highlight the complexity of the structure as well as the warm and soft properties of the oak. For this a simple copper cladding with hidden seams would be appropriate, whilst still remaining and even enhancing the warm wash of light in the pods.

Illustration 8
Oak Structure

The jointing of the individual timber members in the structure will be done with a specially designed shoe bracket. Allowing the assembly to be done on the non visible side of the structure. There will be a slither of copper covered metal showing, to underline that the members are in fact individual timber member.

Or as Kengo Kuma might describe it; Human beings are frail creatures, and architecture must offer comfort as well as protection. This is done by breaking down materials into particles or fragments that can then be recombined into units of the right scale and thereby provide comfort and intimacy. Scale and materials should not overpower the beauty of individual elements, so there is a balance between the parts and the totality (Goodwin:2014 page 61)

To create a strong visual connection between the load bearing structure and the building envelope, we lace the envelope in the pattern of the structure rather than a straight cut. In combination with the shingle cladding this, from a distance, creates the illusion that the envelope of the structure is woven upon it.

The copper flashing will, in time, create a patina of discoloration running down the structure, highlighting the sense of the structure being vowen.

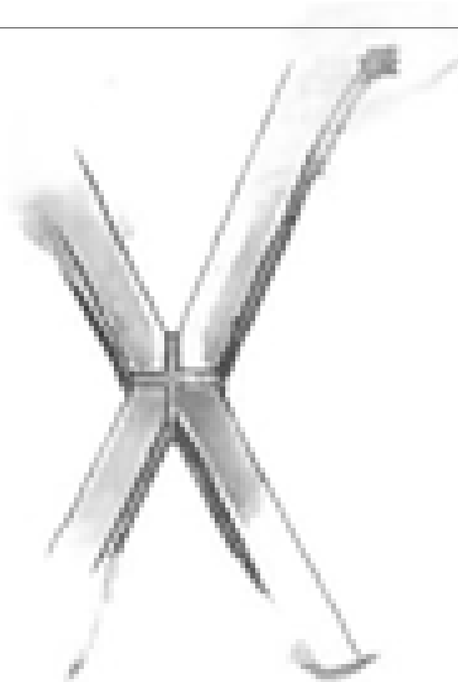


Illustration of the detailing : Structure joints

Illustration of the detailing : flashing below the skylights

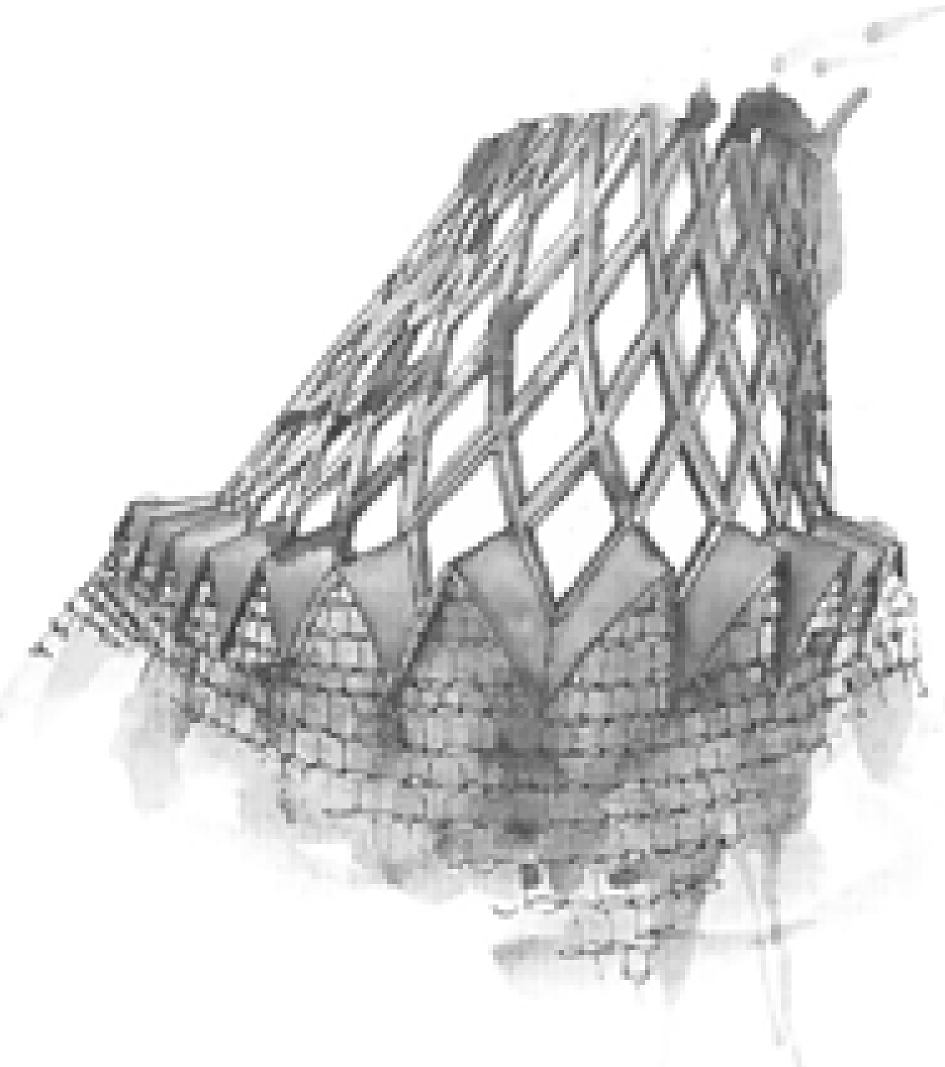


Illustration of the detailing : Building envelope cladding and structure

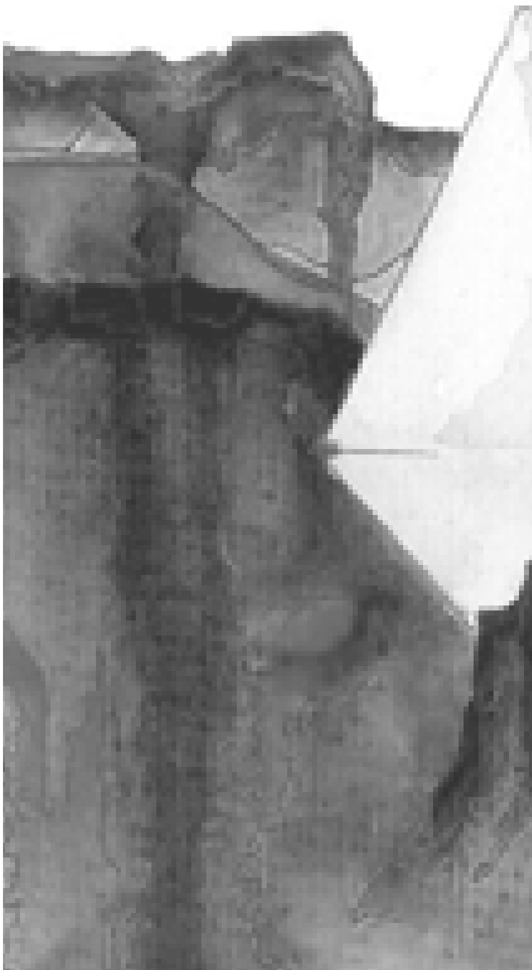
ENERGY STRATEGIES

Looking at the project in terms of energy and energy savings, we identify two main risks.

Overheating and air pollution from occupants within the pub will create a high demand for the air change in the pub, the heating and cooling of this air could become a big energy consumer. However, we do not fear for overheating because of solar gains as the location of the site are placed in the shadows of the gorge as documented in the program. On the other hand this sets requirements for a tight and highly insulated building in order to reduce the transmission losses through the building envelope.

The solutions to these two energy issues arrive from the concept of the design and the resources of the site. Supplying the fresh air intake from the many caves on the site allows us to heat the air purely with a heat recovery system as the constant temperature in the caves around 11-12°C means that the air only needs to be heated slightly before its supplied into the pub.

We limit the heat transmission loss through the envelope via the introverted concept for the pub, with limited views and window openings in the façade. This was pondered in the program for the design, as we knew the site was mostly in the shadows and wouldn't benefit or suffer under solar heat gains.



ILLUSTRATIONS

Illustration 1
http://upload.wikimedia.org/wikipedia/commons/1/13/Oast1.jpg

Illustration 2
http://www.coolplaces.co.uk/system/images/2387/rye-playden-oasts-bars-pubs-2387-large.jpg

Illustration 3

Illustration 4
https://www.pinterest.com/pin/390124386446112873/

Illustration 5
http://www.rockwool.dk/r%C3%A5dgivning/facadeisolering/redair+flex+-+ventilerede+facader/systemet

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Illustration 7

Illustration 8
http://upload.wikimedia.org/wikipedia/commons/b/be/Charpente_eglise_Saint-Girons_Monein.jpg

All illustrations not listed here, are of our own making.

All illustrations listed here have been modified to for the layout

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No1
THEORY

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ABSTRACT

A BRIEF SUMMARY OF THE THESIS RESEARCH

"With this goal in mind this thesis will seek to reveal the most basic of preferences in architecture, the preferences that are embodied within us, biologically, as human beings rather than as individuals."

Several theories have been put forward which relate our aesthetic preferences to our biological and evolutionary programming. These theories suggest that upon entering a space we evaluate it in terms of its potential risks and rewards from a survival perspective. This thesis seeks to investigate these theories of biological aesthetics with respect to architecture. Four theories that can be united under the term Habitat Theory will be critically examined in order to derive a set of principles to inform the design process from an architectural perspective. These principles will then be employed in a critical analysis of the Chapel by Friis and Moltke, on the grounds of Sygehus Syd in Aalborg.

PREFACE

ARCHITECTURE AND BIOLOGY

"We wanted to understand that instant evaluation of a space, the unconscious split second where we decide whether or not we like something, which seems to depend on some kind of primitive level of perception, pre-programmed into our biology."

After a combined total of over ten years of studying architecture we decided that a thesis was the perfect opportunity to gather some of the knowledge we have accumulated over that time. This thesis was therefore undertaken with the aim of developing an area of interest to the both of us into something resembling the beginning of a personal philosophy on architecture.

Our area of interest initially began with the subject of atmosphere in architecture. However, relatively shortly into our study on the subject it became clear that the field was too broad for us to cover with our comparitively small base of experience. Not wanting to engage a subject so broad that we would need to resort to a superficial covering of the material, we decided to narrow our focus into a gap in the literature that we could really sink our teeth into and hopefully bring something new to the table in terms of the subject of atmosphere in architecture. The primary focus has always been to investigate the common denominator of human experience in the built environment. We wanted to understand that instant evaluation of a space, the unconscious split second where we decide whether or not we like something, which seems to depend on some kind of primitive level of perception, pre-programmed into our biology. We felt that understanding this level of architectural experience would greatly inform our own design process as well as the way we talk and think about architectural experiences. Therefore, investigating biological theories of aesthetic preference offered itself as a natural choice.

Selfishly this thesis is aimed at developing our own understanding of architecture, although we hope that anyone reading this, whether they are engaged in the construction industry of just interested in the subject will learn something new or perhaps view architecture from a slightly different perspective once they have finished.

Finally we would like to thank Mads Dines Petersen and Lars Vabbersgaard Andersen for their criticism, support and advice throughout the writing process.

INTRODUCTION

WHAT AND WHY?

"Does our biology cause us to experience architecture innately as human beings rather than individuals with personal and cultural differences?"

"The title <Atmospheres> is generated by a question that has interested me for quite some time. And you are unlikely to be surprised when I tell you what it is: what do we mean when we speak of architectural quality? It is a question I have little difficulty in answering. Quality in architecture does not - not to me anyway - mean inclusion in architectural guides or histories or getting my work into this or that publication. Quality architecture to me is when a building manages to move me. What on earth is it that moves me? How can I get it into my own work? How could I design something like the room in that photograph - one of my favourite icons, a building I have never seen, in fact I think it no longer exists - a building I just love looking at. How do people design things with such a beautiful, natural presence, things that move me every single time." (Zumthor, 2012, p. 10)

Zumthor's design process is orientated around the idea of creating a work of architecture that moves him, it is a personal mission to imbue his buildings with qualities that stir emotions into life, to bring them bubbling to the surface of his consciousness. But if Zumthor's mission is highly personalised and related to his own experiences of architecture, often drawing on memories of his childhood in Switzerland, then why is that his buildings stir these same emotions in thousands of other people?

If so many people from all walks of life, countries, continents and cultural backgrounds can be moved in similar ways by the same space, or surface texture, or a certain quality of light, does that suggest that there is some common denominator in experience that links these people together? Does our biology cause us to experience architecture innately as human beings rather than individuals with personal and cultural differences?

These are the questions that lead us in the direction of investigating architecture from a biological perspective and the development of new questions such as what influence can our biological preferences for space have in the architectural design process?

Figure 1. "How could I design something like the room in that photograph – one of my favourite icons, a building I have never seen, in fact I think it no longer exists – a building I just love looking at." Broad Street Station by John Russell Pope is the object of Zumthor's admiration.

With this in mind this thesis will be focused on investigating basic biological preferences in architecture.

There is surprisingly little research within the field of architecture into our biological preferences for space, fortunately the field of landscape architecture is comparatively rich in resources for our subject. Perhaps the best know theory amongst architects is Prospect-Refuge theory, proposed by Jay Appleton (1975), which is one aspect of what Appleton terms Habitat Theory. The theory is based on Darwinist principles in that is suggests that animals that preferred habitats that were conducive to their survival would live to reproduce, whereas animals that choose habitats that were ill fitting to their survival needs would be exposed to threats that lead to an untimely death, this would eventually lead to an inborn preference for habitats that appear to meet our survival needs.

This idea forms the basis of this thesis and from that point we investigate several other theories that fall under the remit of Habitat Theory, which we are using in this thesis as an umbrella terms for theories of aesthetic preference based on biological principles. The theories investigated here can form the basis of a theoretical body of knowledge relating to biological preferences for architecture and is intended for architects and designers as a fresh perspective on design and the design process.

Instinctual Intelligence

Traditional thinking holds the belief that humans are no longer ruled by instinctual behavior like animals, but that our increased flexible intelligence is due to our ability for reason and higher order thinking. William James (1890) held the opposite belief, human beings are more flexibly intelligent than any other animal because they have more instincts, not fewer. Traditionally humans' instincts to react to external stimuli is seen as having been overpowered by the logic and reason of the brain, the mind and the body have been largely viewed as separate entities. However, seeking to re-evaluate western philosophy using the findings of cognitive science, George Lakoff and Mark Johnson (1999, p. 3), assert that "the mind is inherently embodied" and that the structure of reason itself is derived from the neural and cognitive mechanisms that also allow us to perceive and move around our environment. The conclusions that are being drawn from the fields of cognitive science establish that the nature of our relationship with the natural and built environment is embodied, that we evaluate our environments with our entire being, not solely within an isolated mind.

The impact from these findings on the way we approach architecture is profound. Understanding the nature of our embodied existence and the way in which we interact with our environment on an instinctive level is a vital task concerned with the fundamentals of architecture. Investigating the nature of our instinctual response to an environment's spatial experiences is the task of this thesis.

To maintain a focus with which this investigation can have a physical realisation and direct translation, in order to pin the theoretical findings to real world situations, the field is narrowed to study only the aspects of the embodied mind that deal with evaluating the artificial environment. More specifically the expressive potential of tectonic architecture towards human preferences in the built environment.

Architecture as an Extension

Site and human nature in the context of architecture are eternal and symbiotic in the sense that we are products of our environment, both in terms of evolution and experience. Edward T. Hall (1966) introduced the term "extensions" to describe the way humans have created highly advanced tools for completing tasks, he suggests that the computer extends the brain, the telephone extends the voice and the wheel extends the legs. In this sense architecture, like clothing, is an extension of our skin, it is a tool designed to help protect us against the elements, as such it negotiates between human beings and the environment, in other words architecture is a mediator between life and place. This is an idea that Christian Norberg-Schulz (1997) examines in Nightlands, when he suggests that life and place form a unit together, illustrated by the commonly used phrase, 'life takes place', from this we can assert that if architecture speaks of its place then it also speaks of the life inhabiting that place.

Further to this, Kaplan and Kaplan (1989) identify the important relationship between human beings and the larger whole, concluding that occasional fascinating elements in our environment will only be momentarily interesting if they are not connected to a larger whole. Even a series of novel elements will not engage us if they are unrelated. The existence of a larger pattern of which we form a part is required in order to engage high-level human motivation, this is due to our fascination with discovering patterns in series of seemingly unrelated objects. As human beings we therefore form a part of a larger pattern, our lives are interwoven with a sense of the environment in which we live.

Contextual Patterns

In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming a part of a connected whole will stimulate us to a greater extent. Interestingly, Peter Zumthor, an architect who has received critical acclaim for the way in which his projects approach the subject of atmosphere, has a very similar outlook on the relationship between building and context. According to Christian Borch (2014), Zumthor's conception of atmosphere is not limited to the engagement of the body with the building, atmospheric quality in architecture is dependent on the immersion of a building in its environment.

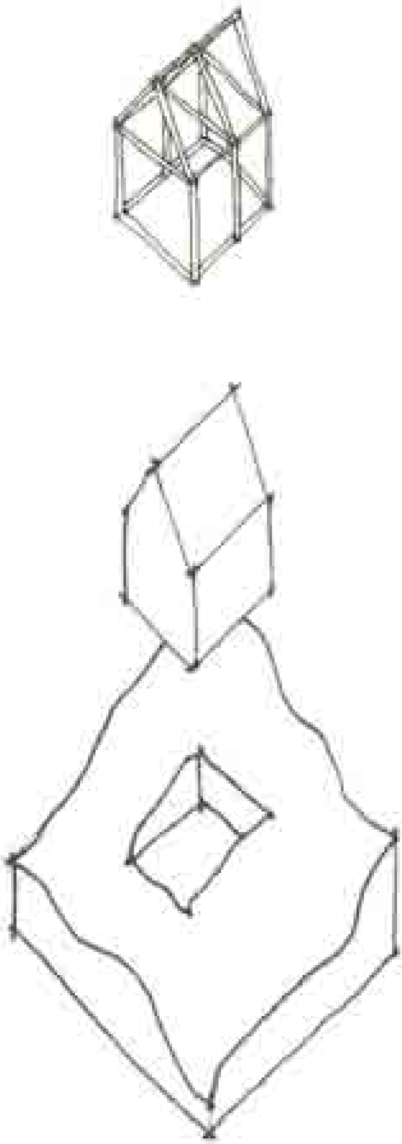

Figure 2 Typos, Topos and Tectonics – Typology, Topography and Tectonics

This brings us back to the symbiotic relationship out of which architecture emerges, Kenneth Frampton claims that the built invariably comes into existence out of: “the constantly evolving interplay of three converging vectors, the topos, the typos and the tectonic.”(1995, p. 2). In other words architecture is born from a sense of place, typology and construction.

How Buildings Learn: What Happens After They're Built by Stewart Brand stimulated a line of thought which provides a starting point for explaining the decision to write about these three fundamentals of architecture, or rather the inability to isolate and separate them. In the book, Brand (1997) creates a set of principles for the creation of long lasting architecture. His approach is to outline the rates of change within a building: The fashionable aspects of architecture, room layouts, furniture, technology, services and cladding, are the aspects that are liable to change most rapidly, as technologies become obsolete or trends come and go. Whereas, at the other end of the spectrum, “Site is eternal” (Brand, 1997, p. 13), and structural elements last between 30 and 300 years. Using empirical evidence Brand suggests that technology and fashion should not form the main basis for architectural design, because in a few years they will be out dated. At the other end of the scale, the aspects that characterise a building over its lifetime; site, structure, materials, are the elements that are worth investment. For Brand that equates to adaptable, flexible constructions, which will extend the lifespan of the building. Brand encourages architects not to be at war with time, to embrace the idea of good architecture being entirely dependent on a building's ability to adapt. Brand's (1997) concept of site is that the geographical setting, boundaries and context within which a building is placed outlasts the ephemeral nature of architecture. Here Brand identifies one of the key areas in which architecture often fails, which is a failure to become symbiotic with its context.

The Eternal Human

The human body is conspicuous in its absence from Brand's work, his focus is highly pragmatic in terms of the physical functions of buildings. The idea that strikes us is that human nature is far older than almost any site. The time it takes natural selection to build new neurological circuits to adapt to even small changes in the environment, is at least tens of thousands of years, so although human nature is not eternal, it outlasts the changing landscape by thousands of years and thus can be considered to be eternal within the context of modern history. According to Cosmides and Tooby (1997), we have spent over 99% of our evolutionary timeline living in hunter-gatherer societies, meaning that settlement and agriculture, leading to permanent, formal architecture constitute only a small portion of the history of Homo sapiens. Put into this context, our ancestors have evolved to read and inhabit the natural environments during the last 10 million years, as Cosmides and Tooby (1997) put it, "Our modern skulls house a stone age mind.". Therefore, any work of architecture created in the following decades, centuries or millennia will be experienced by human beings of very similar evolutionary design to ourselves.

Architecture, Style and Intellectuallism

This begs the same question as Heinrich Hübsch (1828) put forward: In welchem Style sollen wir bauen? (In what style should we build?) Or rather; based on this knowledge does it make any sense to base the aesthetics of the built environment on any particular style at all. This is exactly what Giogi Grassi's critical polemic addresses in his essay "Avant Garde and Continuity" of 1980, in which he wrote:

"As far as the architectural vanguards of the Modern Movement are concerned, they invariably follow in the wake of the figurative arts… cubism, suprematism, neoplasticism, etc., are all forms of investigation born and developed in the realm of the figurative arts,

and only as a second thought carried over into architecture as well. It is actually pathetic to see the architects of that "heroic" period, and the best among them, trying with difficulty to accommodate themselves to these "isms"; experimenting in a perplexed manner, because of their fascination with the new doctrines, measuring them only later to realize their ineffectuality."(Grassi as quoted in Frampton, 1995, p. 2)

Architects that endeavour to design based on abstract intellectualism very often create buildings that become time capsules as soon as they are completed; they become museums dedicated to a fleeting moment in the expanse of history. Architecture that solely engages with the theoretical discourse of the time will fail to interest subsequent generations except in the context of architectural history. This is because knowledge and theory changes at such a rapid pace, compared to human evolution, that it can not form the common denominator of human experience.

Memory and Legend

Gaston Bachelard (1994, p. 33) speaks as a philosopher when he says that great images, and therefore great buildings, '...*have a history and a prehistory; they are always a blend of memory and legend, with the result that we never experience the image directly.*'. Whereas, Edward T. Hall (1966, p.2) conveys the same message from the point of view of an anthropologist when he discusses the idea; that our culturally patterned sensory screens filter and perceive data in dramatically different ways from person to person, meaning that conscious knowledge is derived from instinctive processes. Finally, Leda Cosmides and John Tooby (1997) write of the same point as evolutionary psychologists. They conclude that conscious experience is the result of a few high level conclusions, formed from environmental stimuli processed by thousands of specialised mechanisms that observe, analyse, evaluate the information **and even fill out the blanks** before providing a conclusion to the conscious mind.

In this sense, architecture is a result of a perceived environment in the mind of the designer, therefore it reflects the culture in which it was created and at the same time is the manifestation of primal instincts. In this sense our experience of the world is a blend of our personal and cultural memories as well as our primal programming.

The Narrow Plane of the Present

Supporting our choice of evolutionary aesthetics as the field in which to investigate the aesthetic preference in architecture is an idea by Robert Sommer, author of *Personal Space, the behavioral basis of design.* Sommer addresses the need for a shift in temporal perspective and encourages architects to shift some of their attention away from past architecture as well as the architectural utopias of the future *"and study buildings on the narrow plane of the present"* (Sommer, 2007, p. 8).

Biologists are generally concerned with things as they are, or the reason why they developed as they did, rather than environments and organisms that do not yet exist. They are concerned with adaptation and habitat selection, whereas the architect is concerned with planning a new world (Sommer, 2007, p. 168). The truth in this criticism lies not in the architects vision to plan a new world, but in how he tries to plan this new world. Theoretical discourse unrelated to existing conditions, is the basis for many a architectural utopia. Studying architecture on the narrow plane of the present and concerning oneself with the reason why architecture has developed as it has, does not rule out the possibility for the architect to concern himself with planning a new world, on the contrary, it gives him the tools to pinpoint the change or the invention needed to steer the future. This is exemplified in the book *Psychology and the Built Environment* (Canter & Lee, 1974) by D. A. McIntyre & I. D. Griffiths who state that in order to solve a global problem one does not necessarily have to address the issue on a global scale, small ideas can change the world.

"The Industrial Revolution occurred not because of changes in economic or social technology, but because of relatively simple changes in engineering…" (Canter & Lee, 1974, p. 14)

McIntyre & Griffiths demonstrate this point by referring to the findings of Reyner Banham (1969), showing the direct connection between the first appearance of the revolving door and that of the skyscraper. To relate this back to Robert Sommer; by concerning ourselves with things as they are, or the reason why they developed as they did, rather than what does not yet exist, engineers, architects and scientists are capable of pinpointing the relatively simple inventions that are needed to change the world, rather than planning for the perfect world without the means to realise this utopia.

Therefore by studying the way we behave and the reasons why we behave in that way we can identify aesthetic preferences for architecture from a biological perspective and the idea that all human behaviour is a result of biological instincts that have evolved in order to further the survival and reproductive capabilities of the species.

The Reconciliation of Body and Mind

Evolutionary aesthetics is based on the idea that all human behavior is a result of biological instinct that has evolved in order to further the survival and reproductive capabilities of the species. This theory approach is considered by some, such as Susanne K. Langer, to be a viewpoint that ignores the effect of culture and human reason on behaviour. Langer argues from the opposite pole of Lakoff & Johnson and evolutionary psychology, when she separates humans from animals by the human ability for higher level reason, exemplified in her attempt to decipher Aristotle's definition of man as "the rational animal" and hereby implying that animals are not capable of rationality.
"The power of understanding symbols, i.e. of regarding everything

about a sense-datum as irrelevant except a certain form that it embodies, is the most characteristic mental trait of mankind. It issues in an unconscious, spontaneous process of abstraction, which goes on all the time in the human mind: a process of recognizing the concept in any configuration given to experience, and forming a conception accordingly. That is the real sense of Aristotle's definition of Man as "the rational animal." (Langer, 1942, p. 58)

In direct opposition to Langer's view on man is the book: Philosophy in the Flesh, the Embodied Mind and its Challenge to Western Thought by Lakoff and Johnson (1999) who put forward three conclusions, two of which will have an impact on the direction of this thesis: **The mind is inherently embodied and thought is mostly unconscious**. These two statements point out inconsistencies with fundamental parts of Western philosophy in particular Anglo-American analytic philosophy and postmodernist philosophy. For over two millennia, reason has been the defining characteristic of human beings. On the basis of empirical research, Lakoff and Johnson suggests a radical change in the understanding of reason:

"Reason is not disembodied, as the tradition has largely held, but arises from the nature of our brains, bodies, and bodily experience. This is not just the innocuous and obvious claim that we need a body to reason; rather, it is the striking claim that the very structure of reason itself comes from the details of our embodiment. The same neural and cognitive mechanisms that allow us to perceive and move around also create our conceptual systems and modes of reason. Thus, to understand reason we must understand the details of our visual system, our motor system, and the general mechanisms of neural binding. In summary, reason is not, in any way, a transcendent feature of the universe or of disembodied mind. Instead, it is shaped crucially by the peculiarities of our human bodies, by the remarkable details of the neural structure of our brains, and by the specifics of our everyday functioning in the world.

Reason is evolutionary, in that abstract reason builds on and *makes use of forms of perceptual and motor inference present in "lower" animals. The result is a Darwinism of reason, a rational Darwinism: Reason, even in its most abstract form, makes use of, rather than transcends, our animal nature. The discovery that reason is evolutionary utterly changes our relation to other animals and changes our conception of human beings as uniquely rational. Reason is thus not an essence that separates us from other animals; rather, it places us on a continuum with them."* (Lakoff & Johnson, 1999, p. 4)

Lakoff and Johnson break with the traditionally held belief that human instinct to react to external stimuli has been overpowered by logic and reason, effectively stating that the mind and the body should not be viewed as separate entities.

Narrowing the Field

Considering some valid criticisms of evolutionary aesthetics such as the disregard for culture and individual experience, we believe that the sensible way forward is a layered approach that acknowledges biology, culture and personal attitude as contributing factors in aesthetic experience.

However in order to maintain a focus within our research we will be working with the basis on which aesthetic experience is built, the biological instinct. Or as Juhani Pallasmaa describes it in his text; *Space, Place and Atmosphere: Peripheral Perception in Existential Experience:* The experiential atmosphere, the emotive impression of space, is providing the unifying coherence and character for a room, space, place and landscape.

"It is "the common denominator", "the colouring" or "the feel" of the experiential situation. Atmosphere is a mental thing, an experiential property or characteristic that is suspended between the object and the subject." (Borch, 2014, p. 21)

Unfortunately, the scope of this project is not large enough to include cultural and personal experiences in relation to the subject of atmosphere in architecture and therefore the focus remains firmly on biological aesthetics, what we see as the common denominator in architectural experience.

Informing the Design Process

Defining this common denominator could further develop a perspective from which to view or design architecture, understanding biological preferences for space adds an extra level of understanding to the design process, or provides a fresh lens with which to examine architecture. It should be made clear at this point that this thesis will not propose a recipe for architecture, our conclusion will not be prescriptive or provide a checklist of preferences, it is more a case of learning the rules to be able to bend and break them, putting each architectural decision on a scale. In designing a bridge for example, the designer could choose to make his passengers feel safe, by providing a sturdy construction that stands stiff and strong, with protective handrails and firm footing, in all likeliness this would be preferred among many people. However, the designer might chose to expose his passengers to a different experience, inducing a thrill through the use of a glass floor, or a rickety rope bride. Understanding biological preferences in architecture therefore allows us to make informed decisions in terms of making the users experience something, as Zumthor mentioned at the beginning of this introduction, how can we get the qualities that move use into our buildings.

The Relationship Between Life and Place

Where is this common denominator to be found in the context of architecture, which is relatively new in the context of human history, as mentioned earlier human nature is far older than site and construction, Cosmides and Tooby (1997) state that we have spent over 99% of our evolutionary timeline living in hunter-gatherer societies, concluding that permanent, formal architecture, which is a product of settlement and agriculture, constitute only a small portion of the history of Homo sapiens. Put into this context, our ancestors have evolved to read and inhabit the natural environment during the last 10 million years. Therefore, any work of architecture created in the following decades, centuries or millennia will be experienced by human beings of very similar evolutionary design to ourselves. **It would seem that the common denominator is to be found in the very fabric of our being and evolution.**

Searching for the common denominator in evolutionary psychology could potentially pose a problem for this investigation, as it is important that we do not venture uncritically into a field where we have no formal training and are probably more ignorant than we care to admit. Moreover it is a field that can stand alone without any obvious and strong ties to architecture.

Architecture is relatively new in the context of human history which suggests that we evaluate space based on our ancestral knowledge of environments, furthermore evolutionary psychology implies that our psychology is shaped by the environment, studying evolutionary psychology to understand the environment would therefore seem to be a backwards way of approaching the problem. So even though the common denominator is to be found in the fabric of our flesh and psyche, which we already established to be one and the same thing (Lakoff & Johnson, 1999), evolutionary psychology suggests that the natural environment itself is the facilitator and catalyst for any evolutionary change or preference embodied in human beings. Habitat theory suggests this approach. However habitat theory originally developed for evaluating landscape, how can this help us to evaluate architecture?

"Humanity cannot exist independently and must cherish the relationship binding us to the rest of life. That relationship is expressed

usually by the landscape in which we live." (Colvin, 1970, p. 108)

What the british landscape architect, Brenda Colvin touches on in this quote is the important relationship suspended between life and place. Colvin suggests that life and place define each other and there is a need to cherish the relationship created between them. To add on to this statement, the above writings of this thesis states that **the natural environment is not just the relationship between life and place, but also the facilitator and creator of these.**

Topos, Typos & Tectonics

Architecture is both a part of the landscape in the sense that it is a product of its environment as well as craftsmanship, local materials, and the influence of vernacular architecture devloped to suit a specific locality. Lastly architecture is also a product of aesthetic preference, which according to habitat theory is again shaped by our environment. **Architecture forms a part of the environment in a symbiotic relationship with human beings, it is both a product of its environment, but also a creator of life or a way of life in a specific place.** Determining or evaluating the strong link between architecture and the natural environment is derived from its quality.

The strongest link between architecture and habitat theory is again to be found in the evolution of man himself. Explained by Cosmides and Tooby (1997) the time it takes natural selection to build new neurological circuits to adapt to even small changes in the environment, is at least tens of thousands of years, rendering the impact of formal architecture on how human beings have evolved to evaluate our environment, minimal. The preferences human beings are programmed with in the unconscious mind to evaluate the artificial environment, are subsequently preferences taken from and created by the evaluation of the natural environment.

Habitat Theory and Construction

"Without wishing to deny the volumetric character of architectural form, this study seeks to mediate and enrich the priority given to space by a reconsideration of the constructional and structural modes by which, of necessity, it has to be achieved." (Frampton, 1995, p. 2)

There is no architecture without construction. Standing on the shoulders of Kenneth Frampton and his *Studies in Tectonic Culture*, the aim is to add new knowledge of preference to the structural modes by which, of necessity, architecture has to be achieved. The investment in the tectonic structure of architecture, put forth in the research of this thesis is derived from the empirical evidence, observed by Stewart Brand (1997) concluding that an investment in good structure is the foundation of long lasting architecture. The quality of long lasting architecture as well as the visible pleasure we get from durable constructions is underlined by Frampton, when he makes the statement that architecture finds itself in opposition to the gratuitous figurative arts, because architecture is conceived as having a long durability.

"As a value architecture finds itself in opposition to the reasonless figurative, since to the degree that our works are conceived as having a long duration we must produce things that look as if they were always there" (Frampton, 1995, p. 26)

Even though durability, seems to be on the list of architectural qualities, durability alone does not necessarily constitute for good architecture, exemplified by Gaston Bachelard

'…whenever the human being has found the slightest shelter: we shall see the imagination build 'walls' of impalpable shadows, comfort itself with the illusion of protection- or, just the contrary, tremble behind thick walls, mistrust the staunchest ramparts. In short, in the most interminable of dialectics, the sheltered being gives perceptible limits to his shelter.' (Bachelard, 1994, p. 21)

Habitat theory is the basis for aesthetic preference, upon which cultural and personal attitudes develop. By understanding the principles of instinctive evaluation of space as architects, we can manipulate this experience of space in order to generate desired reaction in an audience. **As such habitat theory can be considered as a fundamental aspect of architectural design.**

Problem Formulation

All of this leads to our problem formulation, where our objective in this thesis is to develop the theories of biological preference from space into usable guidlines for designing architecture. The problem formulation is therefore:

How can Habitat Theory shed new light on the subject of architectural atmosphere?

PHILOSOPHICAL BACKGROUND

AESTHETIC PERSPECTIVES

"It is in this relationship
that we find the philosophical basis
for this thesis,
that aesthetic experience is based on
the interaction of a biological organism
and its habitat,
specifically for us,
between a human being
and architecture."

Before embarking on a presentation of the relevant theories and their individual characteristics it is necessary to provide a brief overview of the philosophical background of evolutionary aesthetics, before informing the reader of the philosophical stance taken by the the authors. Establishing a critical stance will provide a clear perspective from which to view habitat theory within the field of evolutionary aesthetics. Bearing in mind that a full discussion of evolutionary aesthetics would be enough to fill a book much thicker than the pages of this thesis, a comprehensive study is provided by Beardsley (1985). Two general sets of contrasting viewpoints within the field of aesthetics can be observed. Firstly, the opposing views of detached aesthetic experience versus engaged aesthetic experience. Secondly, objectivist and subjectivist viewpoints. An attempt to reconcile these four perspectives is made by Bourassa (1991), who calls for a mediation between the polar extremes in order to create a paradigm for the aesthetics of landscape.

Detached Aesthetics

The roots of detached aesthetic experience have been traced by Stolnitz (1961) to the eighteenth century philosophers Shaftesbury, Hutcheson and Burke. These three philosophers were the first to establish aesthetics as an autonomous field of philosophical study, at the same time they began to define the aesthetic object itself as an autonomous entity in terms of aesthetics rather than other values such as usefulness. The distinction made in the eighteenth century by these philosophers was a novel idea at the time, Stolnitz observes that for much of the history of western philosophy aesthetics and other values have gone hand in hand, for example Plato and Aristotle's views on the subject of beauty were very much integrated with ideas of morality, health and well being, so the idea of separating these would have been incomprehensible before the eighteenth century (Beardsley, 1985). One of the key points made by Burke (1958) that stands in direct opposition to the theories put forward later in this thesis is that the love of beauty does not involve desire or lust. Burke made the distinction between love, which has beauty as its object, and the passions of the 'society of sex' which are mixed with lust. In this distinction Burke effectively separates the appreciation of beauty from the biological desire of sexual reproduction. By separating beauty from desire Burke rejects the idea of a biological basis for aesthetic appreciation. This is a line of thought that is developed further by Immanuel Kant, who systematically separated aesthetic experience from desire.

Kant's *Critique of Aesthetic Judgement* (1911) puts forward the idea that all aesthetic experiences are 'disinterested', in other words we take pleasure in an object that we judge to be beautiful, we do not judge an object to be beautiful because we take pleasure in it. This assertion separates aesthetic appreciation of an object from its usefulness or purpose so that we do not consider what the object is used for when we judge its beauty. Relating to the qualities of aesthetics Kant classified two sets of judgments, firstly the class of 'logical judgements', these are judgements which relate to the properties of objects such as the material an object is made from, or its colour. The second class of 'aesthetic judgements' is further separated into two classifications, the majority of aesthetic judgements are considered to be reports of pleasure, we might remark on how an object makes us feel, an object may be pleasant or delightful. However, the aesthetic judgements that we are primarily interested in are those that judge beauty, Kant calls these judgements of taste and as mentioned previously, these judgements are 'disinterested'. If the pleasure we derive from an object stems from our want for it to exist or possess it, then this is an interested judgment and therefore not valid as a judgement of taste.

Kantian aesthetics are not difficult to reconcile with experiences of discrete works of art; paintings or sculptures for example, because it is very easy to see how we might appreciate a gallery displayed painting without needing to possess or use it. However, when considering architecture it becomes much more difficult to appreciate aesthetics from Kant's disinterested viewpoint, Bourassa summarises the problem when he says of landscape.

"It is a messy mix of art, artifact and nature, and it is inextricably intertwined with our everyday, practical lives. The intractable landscape refuses to conform to the neat philosophical model of aesthetic objects as discrete works of fine art that are somehow set apart from mundane existence." (Bourassa, 1991, p. XIV).

In this context Bourassa addresses the irresolvability of Kant's philosophy with the aesthetics of landscape, where the term landscape includes man made environments such as towns and cities, as much as countryside scenes. Architecture forms an inextricable part of many landscapes and our appreciation of the usefulness of buildings presents a problem when considering Kant. In *The Aesthetics of Architecture* Roger Scruton (1979) also observes that Kant's separation of aesthetic pleasure and usefulness is irreconcilable with the nature of architecture, Scruton illustrates this point by considering a sham facade, *"Our enjoyment of a facade is affected when we learn that, like the facade of the Old Schools in Cambridge, it is a piece of detached stage scenery."* (Scruton, 1979, p. 72). In this sense the usefulness or integrity of architecture also forms a part of the aesthetic experience, suggesting that cognition also plays a part in the appreciation of architecture, understanding a building and the job of work that it performs contributes to the pleasure we take in it, Kant insisted that cognition played no role in judgements of taste and that they were *"merely contemplative"* (Meredith, 1911, p. 53). The inadequacy of detached aesthetics is also illustrated by Beardsley in a seemingly contradictory pair of statements on Kantian aesthetics.

"It is extraordinarily difficult to capture in words the exact ways in which the practical and technological aspect of an object can and cannot enter into the experience of it if that experience is to have this… feature of detached effect." (Beardsley, 1982a, p. 291)

"It is true that in detached affect there is a lack of concern about the

instrumental values - and in the aesthetic experience of architectural works, for example, such an awareness ought to be present." (Beardsley, 1982a, p. 291-2)

Here Beardsley acknowledges the incompatibility of Kantian aesthetics with architecture, where the function of an object is inextricably bound up in our appreciation of it, there may be beauty in the way that rain is carried off a roof, or in the apparent effortlessness of a bridge crossing a great span as illustrated poetically by de Boton.

"Yet the bridge testifies to how closely a certain kind of beauty is bound up with our admiration for strength, for man-made objects which can withstand the life-destroying forces of heat, cold, gravity or wind. We see beauty in thick slate roofs that challenge hailstones to do their worst, in sea defences that shrug off the waves which batter them, and in bolts, rivets, cables, beams and buttresses. We feel moved by edifices - cathedrals, skyscrapers, hangars, tunnels, pylons - which compensate for our inadequacies, our inability to cross mountains or carry cables between cities. We respond with emotion to creations which transport us across distances we could never walk, which shelter us during storms we could not weather, which pick up signals we could never hear with our own ears and which hang daintily off cliffs from which we would fall instantly to our deaths." (de Boton, 2006, p. 204)

In this sense our appreciation of architecture lies partly in the way in which it affords us protection, architecture in a sense is our third skin, where clothing is our second, it is an extension of our body that shelters us from the dangers of the world. The ability to dwell is a byproduct of the feeling of safety architecture affords. Gottfried Semper describes the structure of architecture in his book; *Der Stil* from 1860-62, as a tiny world where the human being can find a moment of peace and harmony as a result of the legibility of the architecture and his control of its cosmos.

"Surrounded by a world full of wonder and forces, whose law man may divine, may want to understand but never decipher, which reaches him only in a few fragmentary harmonies and which suspend his soul in a continuous state of unresolved tension, he himself conjures up the missing perfection in play. He makes himself a tiny world in which the cosmic law is evident within strict limits, yet complete in itself and perfect in this respect; in such play man satisfies his cosmogonic instinct.

His fantasy creates these images, by displaying, expanding, and adapting to his mood the individual scenes of nature before him, so orderly arranged that he believes he can discern in the single event the harmony of the whole and for short moments has the illusion of having escaped reality. Truly this enjoyment of nature is not very different from the enjoyment of art, just as the beauty of nature…. is assigned to the general beauty of art as a lower category." (Frampton, 1995, p.13)

Semper goes on to explain how this artistic enjoyment in nature's beauty is not one of the most naive or earliest manifestations of artistic instinct, on the contrary he implies, it is highly undeveloped in comparison to the delight primitive man has taken in natures creative law. This refers to the important relationship between human beings and the larger whole, identified by Kaplan and Kaplan (1989). As mentioned in the introduction, unrelated elements in our environment will only be momentarily interesting if they are not connected to a larger whole. The existence of a larger pattern of which we form a part is required in order to engage high-level human motivation, this is due to our fascination with discovering patterns in series of seemingly unrelated objects. In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming a part of a connected whole will stimulate us to a greater extent. It is therefore very difficult for us to accept Kantian aesthetics in relation to architecture, we must look elsewhere for an aesthetic perspective that allows us to take into consideration the usefulness of objects in our environment.

Engaged Aesthetics

John Dewey first expressed his ideas on the philosophy of aesthetics, which he would later go on to develop in Art as Experience (2005), in a previous work; The Experience of Nature (1925). Here Dewey already expresses his concern at the separation of aesthetic experience from practical, everyday experience.

"There are substantially but two alternatives. Either art is a continuation, by means of intelligent selection and arrangement, of natural tendencies of natural events; or art is a peculiar addition to nature springing from something dwelling exclusively within the breast of man, whatever name be given the latter. In the former case, delightfully enhanced perception or esthetic appreciation is of the same nature as enjoyment of any object that is consummatory. It is the outcome of a skilled and intelligent art of dealing with natural things for the sake of intensifying, purifying, prolonging and deepening the satisfactions which they spontaneously afford." (Dewey, 1925, p. 389)

Here Dewey is suggesting that art is the culmination or completion of a goal based process, any process that is meaningful in its own right, rather than being instrumental in achieving some other goal, can be considered art, using Dewey's term, art is consummatory. For Dewey there is no distinction between experiencing art and experiencing daily life as both are evaluated through the same integrated processes or sense, emotion, cognition and action.

"The senses are the organs through which the live creature participates directly in the on-goings of the world about him. In this participation the varied wonder and splendor of this world are made

actual for him in the qualities he experiences. This material cannot be opposed to action, for motor apparatus and "will" itself are the means by which this participation is carried on and directed. It cannot be opposed to "intellect," for mind is the means by which participation is rendered fruitful through sense; by which meanings and values are extracted, retained, and put to further service in the intercourse of the live creature with his surroundings" (Dewey, 2005, p.22)

In this sense Dewey is suggesting that we cannot detach our senses, emotions, intellect and actions, placing them in separate boxes of experience, they form part of an integrated and reciprocal system. Dewey's philosophy of aesthetics is holistic in the sense that it attempts to shift the focus of aesthetic experience away from the subject and object as separate entities towards the relationship between them, the whole process which he refers to as an experience. Dewey's definition of art is therefore much more open than the Kantian model, Dewey makes no distinction between fine art and useful art because both can be consummatory experiences for both the artist and the perceiver. In fact he is highly critical of previous aesthetic theories, which separate art from day to day experience, which he saw as glorifying art and placing it on a pedestal detached from everyday life, this is exemplified by galleries, concert halls and museums.

Dewey sets about correcting this duality in *Art as Experience*, which is widely acknowledged to be the most valuable work on aesthetics of the past century (Beardsley, 1985). In the book he develops his ideas from *The Experience of Nature* and defines aesthetic experience as a heightened sense of everyday experience, which is mostly lacking from our daily lives due to the poor quality of our aesthetic environment, Dewey suggests that the real distinction does not lie between fine art and useful art, but simply in good art and bad art. Dewey describes experience simply as an interaction between man and his environment in its entirety, that is to say the relationship existing between the subject and the object, within which neither truly exists as a separate entity. **It is in this relationship that we find the philosophical basis for this thesis, that aesthetic experience is based on the interaction of a biological organism and its habitat, specifically for us, between a human being and architecture.**

Dewey's philosophy of aesthetics has been criticised by some for his emphasis on the biological aspect of aesthetic experience. Most notably by S.K Langer in her book *Feeling and Form* (1953). Langer strongly advocates the uniquely human aspect of art and accuses Dewey of reducing aesthetic experience to base animal desires. However, Dewey was fully aware that aesthetic experience is far more complex than that of an animal experiencing its habitat, as suggested by the following statement from Art as Experience

"Experience is a matter of the interaction of organism with its environment, an environment that is human as well as physical, that includes the materials of traditions and institutions as well as local surroundings. The organism brings with it through its own structure, native and acquired, forces that play a part in the interaction." (Dewey, 2005, p. 246)

What Dewey was really suggesting was that there is a biological basis for aesthetic experience, upon which the culture and personal attitude of an organism is built, adding human layers to the aesthetic experience. It is this biological basis that we will be exploring through this thesis. It is important to state however that like Dewey, we also believe that the cultural and personal upbringing, that which makes us, and the experience of art, uniquely human, has a large role to play within an aesthetic experience. However, during this thesis we will maintain a focus on the biological basis of aesthetic experience.

The Tourist and the Passive Outsider

Kantian aesthetics is problematic in the context of habitat theory. This may be partly due to the development of habitat theory using Deweyan aesthetics by Jay Appleton (1975). The main problem with a Kantian perspective is that it suggests that the observer is disinterested, the subject is effectively outside of the object and the knowledge brought forward by the subject in terms of the environment is not relevant to aesthetic appreciation. 'Disinterest' suggests no desire for the object to exist and no desire to possess it.

This is fundamentally opposed to habitat theory which suggests that a biological basis for aesthetics is dependent on an environment meeting survival needs, if a biological basis for aesthetics exists then the organism must therefore desire that objects within an environment exist and stake territorial claims to these objects. Attempts have been made to explain the two opposing perspectives in relation to landscape, most notably Arnold Berleant who put forward two contrasting perspectives in an essay titled *The Viewer in the Landscape* (1982). In the essay Berleant puts forward the perspective of the 'panoramic landscape' which is detached and therefore requires Kantian 'disinterest' and the 'participatory landscape' which is engaged and therefore Deweyan. Berleant observes that both modes of perspective exist in landscape painting. For example Bourassa suggests that the modern Western approach to landscape painting is primarily rooted in the panoramic landscape, of a tourist or passive outsider observing an environment from a distance, in contrast to this Bourassa points to ancient aboriginal art which illustrates the active insider's mode of experience.

This can also be seen in the work of some contemporary inuit artists, where paintings do not simply show what the observer can see, but also what the observer knows is there. This is demonstrated in paintings of fishermen and the seals swimming

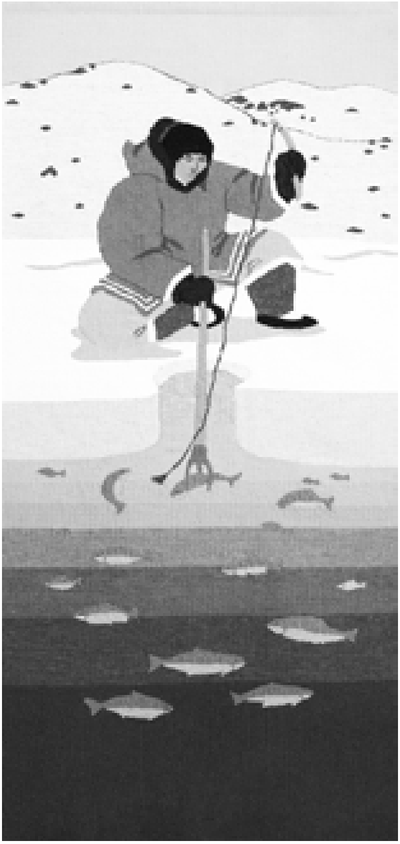

Figure 3 Inuit art is often painted from the perspective of the active insider.

below them, or in paintings depicting x-ray perspectives of igloos and the relationship between interior and exterior. In the case of the 'tourist' painting a landscape with which he is not familiar, there will always be knowledge brought forward by the artist, that is then fused with the object that he is painting, the subject and the object are therefore combined in the artist's expression of what he sees. In this sense the perspective of a 'tourist' is still not truly Kantian as it lacks 'disinterest', a painter might paint a tree which he has not encountered before, yet this tree may bring forth all of his previous experiences of trees, his intimate knowledge of climbing them, sheltering from rain beneath their canopies, seeking shade in the summer or picking fruit from their branches. In fact we would go as far as to say that the perspective of a 'tourist' or the 'panoramic landscape' does not truly exist because the subject will always bring their past experience into the new experience, the world model that an organism has developed since birth will impact upon the way in which the present world is experienced.

Philosophy of Habitat Theory

In which case rather than two opposing perspectives of passive outsider and active insider, we would simply suggest that the knowledge brought forward from previous experience, will be combined with knowledge of the current environment being experienced, whether that knowledge is limited or extensive. Therefore, like Bourassa and Scruton before us, we will also reject Kant's aesthetic philosophy as it fails to provide an adequate explanation for the aesthetics of architecture. We will instead take a Deweyan perspective on the subject of habitat theory, which is appropriate considering this is its point of origin.

THEORY SELECTION

INTRODUCTION

"By focusing on one theory at a time we hope to provide the reader with an overview of the theories before they are discussed critically in relation to one another."

In the following section the habitat theories will be presented in chronological order. The theories have been selected for dicussion because they each propose a theory of preference based on an environment appearing to meet survival needs. Each theory will include a summary, presentation of the major supporting arguments, a discussion of the methods employed by the theorists, a critical analysis, and will conclude with a bullet point synopsis. By focusing on one theory at a time we hope to provide the reader with an overview of the theories before they are discussed critically in relation to one another.

HABITAT THEORY

JAY APPLETON
1975

"...if we share with other animals
the desire to eat, sleep and reproduce,
then it would be illogical to assume
that awareness
of the perceived environment
has disappeared,
it is only 200 hundred generations
since the stone age,
when environmental awareness
was still a vital faculty"

Introduction

Although originally put forward as a theory in its own right by Appleton (1975), Habitat Theory is being used in this thesis as an umbrella term for a theory that suggests that an environment that appears to meet our survival needs will be aesthetically preferred. The theory revolves around Darwinism in that it suggest that animals who preferred habitats that were conducive to their survival would live to reproduce, whereas animals that chose habitats that did not meet their survival needs would reproduce less, eventually leading to an inborn preference for habitats that appeared to meet our survival needs.

Habitat Theory

Appleton believed that adopting a Deweyan philosophy was a prerequisite for making progress in the field of landscape aesthetics although he believed that Dewey's philosophy existed in an abstract realm which focused on explaining the process in general terms, whereas Appleton set about developing an *'object-oriented'* (1975, p. 58) approach, focusing specifically on the composition of elements in a landscape. Appleton initially develops an ethological argument, that is constructed around the idea that certain behavioural patterns are genetically transmitted, in the same way that we share anatomical similarities with our parents. Appleton draws on Dewey at this stage, quoting a key paragraph that supports the argument for Habitat Theory.

"The nature of experience is determined by the essential conditions of life. While man is other than bird and beast, he shares basic vital functions with them and has to make the same basal adjustment if he is to continue the process of living. Having the same vital needs, man derives the means by which he breathes, moves, looks and listens, the very brain with which he coordinates his senses and his movements, from his animal forebears. The organs with which he maintains himself in being are not of himself alone, but by the grace of struggles

and achievements of a long line of animal ancestry." (Dewey, 2005, p. 12)

In this statement Dewey is arguing that because the human body has evolved from a more primitive, animal form, man shares many basic animal instincts as they have been inherited from our ancestors, and is therefore less far removed from more primitive species than we would perhaps like to think. Appleton extends this to include behavioural patterns, which he posits are also inherited to an extent.

Ethological Argument

His support for this argument is drawn largely from experiments with birds, he cites Thorpe (1956), who demonstrated that chaffinch song is partly learned and partly inherited by separating chaffinches at birth and examining the differences between isolated chaffinches and a flock of chaffinches. The simple and restricted song of the isolated chaffinch, in contrast to the more elaborate song that the flock developed suggested that chaffinches inherit the basis for their singing genetically. Dilger (1962) worked with two groups of lovebirds exhibiting slightly different behaviour in terms of nest building. The first group carried materials in their bills, whilst the second group tucked the materials into the feathers. Dilger bred birds from either group with each other which resulted in a new hybrid which displayed a conflict in choosing between one method of carrying materials and the other, suggesting that both these behaviours were inherited from their parents.

From this point Appleton turns to the phenomenon of territoriality, where he draws on Lorenz's (1964) work with water shrews. Water shrews develop 'path-habits', meaning that they can move quickly along familiar routes until they are confronted by an unfamiliar object or situation, no matter how small. If an element of the environment has changed, the shrew must incorporate this into it's path-habit. Appleton uses this example as an analogy to innate and learned behaviour, suggesting that the shrew's path habit could be considered as the innate basis of human behaviour, whilst each new scenario that is incorporated into this habit is part of the learning process. It is important to note that whilst an ethological approach may help to shed light or point the way forward for investigating human behaviour, it is important not to directly apply the observations of animals to humans as there are many other factors involved in determining human behaviour.

Appleton's second point that is fundamental to habitat theory is that some behavioural characteristics serve in creating a relationship between the organism and its environment. Appleton stays with his ethological approach and draws on the work of Tinbergen (1951), MacFadyen (1957) and Batten (1920), to support this point. The key text is provided by Batten who observes that the primarily solitary roe-deer, if left undisturbed, will frequent the same typological 'harbours' in various geographic locations; an open plateau with bracken, and a harbour in swampy ground. At least three harbours are maintained, where dung is dropped more liberally than any other location, whilst the deer use the same paths that connect these harbours. Appleton believes that it is impossible that the roe-deer could follow such consistent patterns of behaviour, within different geographical locations, yet not have shared inborn characteristics. Appleton's deduction seems to be founded on a very limited amount of evidence and he acknowledges that Batten's scientific interpretations of animal behaviour were suspect.

The conclusion of Appleton's ethological support for Habitat Theory comes from the Encyclopedia Brittanica's (1969) definition of behaviour, which categorises primitive behaviour into ingestive, shelter seeking, sexual, and investigatory, more complex behaviours include; agonistic, escape, allelomimetic, epimeletic, et-epimeletic, and eliminative. Appleton observes that all of these forms of behaviour are part of a relationship with the environment and illustrates this with examples on several forms of behaviour and the way in which they relate to the environment. It seems a common sense conclusion that our behaviour is based on a relationship with the environment, behaviour is a way of reacting to a situation. Appleton has tried to argue that part of this behavioural reaction is innate, and part is learned. Appleton suggests that innate behaviour forms the basis for all learned behaviour, although the support for this argument is limited to ethology and we must therefore be careful before accepting its validity. Appleton attempts to shrug off anticipated criticism of the ethological argument by suggesting that it is important not to get lost in the details of animal behaviour, humans will obviously not behave exactly like monkeys, but animal behaviour might point the way for investigating human behaviour.

Atavistic Argument

Appleton (1975) then looks to our ancestral lineage to support his theory. Homo sapiens are one of 193 living species of monkeys and apes, and our behaviour patterns are considered to be developments of more primitive patterns of primate behaviour. Appleton suggests that it is logical therefore that studying the behaviour of more primitive species may shed light on our own behaviour. Here Appleton looks to Berlyne (1971) and Lee (1972, See under Race, 1972) who provide support to this suggestion although both are careful to observe it may be the case that the basis for biological behaviour is so heavily overlaid by conditioning that it might be completely overpowered. However, Stea (1965) and Cullen (1961) provide a counter argument to this point by suggesting that the desire to possess territory, in terms of occupying space, is as powerful in humans as it is in other animals. Appleton builds on this by observing biological desires that we experience on a daily basis, such as the desire to drink, sleep, and reproduce. Even if we are able to control these impulses by conditioned, logical reasoning, it is not learned behaviour that pushes these desires into our consciousness. Appleton makes the point that if we share with other animals the desire to eat, sleep and reproduce, then it would be illogical to assume that awareness of the perceived environment has disappeared, he acknowledges of course that it is less important to use this awareness, and by lack of use the faculty might become less efficient but should remain nonetheless. Appleton supports his point by arguing that it is only 200 hundred generations since the stone age, when environmental awareness was still a vital faculty, this is a relatively short period of time in evolutionary terms, and Appleton suggests that it is not long enough for a faculty to disappear completely. Searles provides support for Appleton with the following paragraph.

"It is my conviction that there is within the human individual a sense of relatedness to his total environment, that this relatedness is one of the transcendentally important facts of human living, and that if he tries to ignore its importance to himself, he does so at peril to his psychological well being." (Searles, 1961-2, p. 31)

Stating that a relationship with the environment is important is one thing, and having now been established by Appleton, he turns his attention to what elements of landscape composition are important to humans.

"If then, we allow that human beings are born with a tendency to be immediately and spontaneously aware of their physical environment; if they experience pleasure and satisfaction from such an environment when it seems to be conducive to the realization of their biological needs and a sense of anxiety and dissatisfaction when it does not, how can we analyse those properties of an environment which are capable of producing this effect?" (Appleton 1975, p. 68)

Appleton asserts that the important phrase in this passage is *"seems to be…"*, suggesting that an environment does not have to meet our biological needs, it only has to appear to meet them.

This is once again supported by observations of birds. Lack (1933) and Hinde (1966) both assert from their work with birds that it is conspicuous, characteristic features of a habitat that will cause a bird to select it as a place to nest. From these two works, and the previous supporting arguments Appleton draws the following conclusion.

"All this leads to the proposition that aesthetic satisfaction, experienced in the contemplation of landscape, stems from the spontaneous perception of landscape features which, in their shapes, colours, spatial arrangements and other visible attributes, act as sign stimuli indicative of environmental conditions favourable to survival, whether they really are favourable or not. This proposition we can call habitat theory." (Appleton 1975, p. 69).

Appleton acknowledges that this observation is already implicit in Dewey's work Art as Experience although in order to further develop the concept Appleton chooses to focus on one aspect of the relationship between an organism and its environment, which is to see without being seen.

Method

Although Habitat Theory covers a broad range of subjects, The Experience of Landscape almost entirely focuses on landscape painting as a way of testing and evaluating the theory put forward. Habitat theory is deemed to be too broad to test in Appleton's work so the scope is narrowed by introducing the concept of prospect-refuge theory which will be discussed further in the next section. Appleton then uses a framework of symbolism to describe elements of the landscape that might symbolise survival related images. Appleton's framework uses verbal constructs such as "arboreal refuge" and "cloud canopy" (1975, p. 87) which are pinned to examples given in landscape paintings. This system is primarily devised by Appleton in order to better explain prospect and refuge theory

Critical Analysis

In The Experience of Landscape, Appleton is working primarily in an art criticism tradition where his theories are being tested by analysing landscape paintings using his framework of symbolism. Using the framework makes sense because it is used as a specific way of examining paintings. However, it is difficult to quantify to what degree an "Arboreal Refuge" actually offers refuge, Appleton's landscape evaluation is highly qualitative and lacks quantitative data (Stamps, 2005). Appleton was of course aware of this at the time of writing because his book was intended as a reaction against the "quantitative revolution" in the field of geography (Appleton, 1988, p. 28). Where Appleton failed to provide quantifiable data, scientists have stepped in to test the validity of Appleton's theories, some of whom will be mentioned subsequently in the succeeding theories that found their germ in Appleton's work. However, in a recent literature review of The Experience of Landscape by Stamps (2014) it was found that only 5% of the sources citing The Experience of Landscape were focused empirical studies which met the current standards for behavioural science, whereas over 50% of the sources were humanistic, experiential or proposed alternate theories without empirical evidence and over 30% of the sources cited Appleton as background to other applications. Stamps concludes that;

"The clear implication is that most of the literature citing The Experience of Landscape book is either discursive, rather than scientific, or assumes the theory to be sufficiently valid to justify application to other topics, rather than actually testing that validity. Actual empirical validation of the concepts of prospect and refuge theory seems to be an issue very much ripe for future research." (Stamps, 2014, p. 3)

It is important therefore to balance Appleton's theories with the work of other authors in order to develop a broader base of knowledge from which to develop principles to aid the design of architecture.

Synopsis

- **Habitat Theory suggests a biological basis for environmental preference.**

- **Environments that appear to be conducive to our survival will be preferred.**

- **Appleton supports his theory through an ethological and atavistic approach.**

- **Appleton uses a framework of symbolism to evaluate landscape paintings, which could be described as art criticism with a biological perspective.**

- **Appleton has been criticised for his emphasis on the qualitative, however the quantitative data gap has been filled since the work was published.**

PROSPECT-REFUGE THEORY

JAY APPLETON
1975

"...prospect-refuge theory
was an attempt to provide
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for evaluating
visual qualities of landscape composition in
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to human preference."

Introduction

Appleton narrows the scope of Habitat theory by focusing on the concept of being able to see without being seen, which is suggested as having a positive impact on being able to survive in an environment. Appleton puts forward the two concepts of prospect and refuge in relation to environmental hazards, and calls it prospect-refuge theory.

Prospect-Refuge Theory

Prospect-refuge theory is a development of Appleton's proposal of habitat theory, in order to narrow the scope of the investigation and provide a more focused evaluation of landscape preference Appleton chooses to examine the experience of being able to see without being seen. This concept is developed from a quote from Konrad Lorenz, which serves as an introduction to Appleton's chapter on Behaviour and the Environment.

"It is early one Sunday Morning at the beginning of March when Easter is already in the air, and we are taking a walk in the forest whose wooded slopes of tall beeches can be equalled in beauty by few and surpassed by none. We approach a forest glade. The tall smooth trunks of the beeches soon give place to the Hornbeam which are dotted from top to bottom with pale green foliage. We now tread slowly and more carefully. Before we break through the last bushes and out of cover on to the free expanse of the meadow, we do what all wild animals and all good naturalists, wild boars, leopards, hunters and zoologists would do under similar circumstances: we reconnoitre, seeking, before we leave our cover, to gain from it the advantage which it can offer alike to hunter and hunted – namely to see without being seen." (Lorenz, 1952, p. 181)

Appleton observes that an environment that allows an animal to see without being seen is advantageous in four modes of behaviour, namely; hunting, escaping, shelter-seeking and

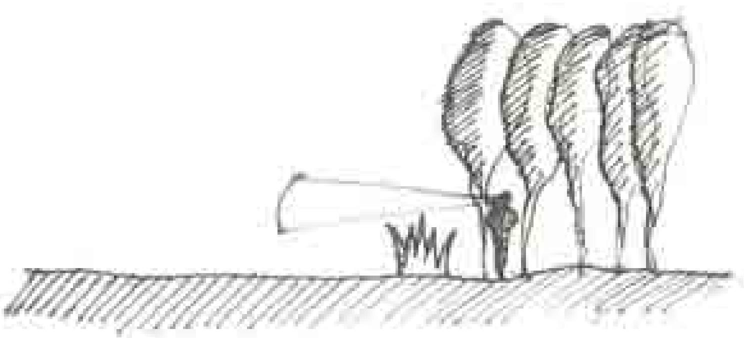


Figure 4 seing without being seen

exploring. By way of personifying the mind of an animal Appleton rationalises the thought process of animals engaged in hunting and escaping, if a predator is to catch its prey, then it must do so before the prey can reach a place of safety, in order to maximise the chances of catching the prey, the predator desires to move as close as possible to the prey without being detected. Therefore, both the predator and the prey desire to be able to see the other before being seen, they desire to be able to see without being seen.

Shelter-seeking is a slightly different form of behaviour, a reaction in this case to an inanimate environmental threat such as wind, rain, excessive heat or cold. There is of course a large degree of overlap in the types of shelter that an animal escaping from animate or inanimate threats might seek. Appleton points to a rabbit hole, however trees might be seen to provide shelter from the elements or a place of height to escape to, a cave may provide darkness to hide in or a more stable temperature compared to an exposed plain.Elements of the environment can function in multiple ways depending on the scenario the organism is experiencing.

Exploration and Home Advantage

Finding shelter or escaping to a place of safety or preventing prey from escaping can all be achieved more effectively if one has a more intimate knowledge of the environment than the opposition. Manning (1972) illustrates this point.

"A detailed knowledge of the geography of their home area will often mean the difference between life and death to a small mammal or bird as a predator swoops down." (Manning, 1972, p. 190)

So being able to explore the environment is important in that it allows the organism to gather knowledge about the world around it. Exploration is a key facet of prospect-refuge theory and several subsequent habitat theories. Appleton observes however that whilst exploring an animal must constantly be prepared for the presence of a hazard, therefore they must be able to escape to a place of safety. A creature engaged in exploring behaviour will therefore be in a constant state of tension as they search for a habitat that will meet their survival needs, only once such a place has been found can the creature relax.

Recognising once more the dubious validity of relating the behaviour of animals to that of humans, Appleton instead turns to anthropological literature to look at the way man uses the environment as a strategic tool for hunting. Drawing on paragraphs from Spencer and Gillen (1899), Downs (1966), and Krause (1956), Appleton suggests that the prowess of human beings in terms of hunting ability is due largely to their exploitation of the natural environment to get close to the prey, in general, primitive hunting societies do not possess special talents for accuracy over long distances, their survival depends on being able to get so close to the prey that it is impossible to miss.

Savannah Theory

Following the publication of The Experience of Landscape there was some research done to establish what habitats primitive man inhabited and to what extent these ancestral landscapes have a bearing on modern aesthetic preferences. Butzer (1977) and Isaac (1980) have provided an examination on the characteristics of landscapes inhabited by prehistoric man, whilst Orians (1980, 1986), Woodcock (1982), and Wilson (1984) have investigated the implications that our ancestral habitats might have on modern aesthetic preferences. Under the general heading of Savannah Theory, these authors posit that for most of our existence as a species, we have inhabited savannah or savannah like landscapes, which can be described as largely open grassland with groups of trees and a proximity to water. The work of Orians is based on the idea that because the time that man has inhabited urban environments is comparatively small, there will be some innate preferences remaining for savannah landscapes. Orians put forward a three point argument for his theory of innate preference, firstly based on the explorers of the North American West, secondly the factors determining land prices in free market economies, and lastly the characteristics of designed landscapes. These arguments are critically evaluated by Bourassa (1991), and found to be explainable by cultural bias rather than innate preferences. However, some evidence for innate preferences is provided by Balling and Falk (1982), who conducted an empirical study investigating the preferences for five different landscape types. A choice was given of tropical rainforest, desert, savannah, temperate deciduous forest and coniferous forest, out of these options savannah, temperate deciduous forest and coniferous forest emerged as the most preferred landscapes to live and visit, although the preferences for visiting were significantly higher than those of living. These findings are consistent with earlier work by Rabinowitz and Coughlin (1970) and Ulrich (1977), who conducted similar experiments concluding that the subjects showed a preference for park like landscapes. Woodcock's (1982) study examined preferences for savannah, hardwood forest and rainforest. The slides shown to the subjects were evaluated using two algorithms which determined their place between open country and forest, and relatively dense and relatively open forest. The results once again supported the previous research with savannah, followed by open forest as the most preferred environments and dense forest being the least preferred.

Critical Analysis

Appleton wrote The Experience of Landscape as a reaction to what he termed the *"quantitative revolution"* (Appleton, 1988, p. 28) in geography, his own field of specialisation, and the reduction of visual analysis of the landscape. Appleton's proposal of habitat and prospect-refuge theory was an attempt to provide a methodological framework for evaluating visual qualities of landscape composition in terms of their relationship to human preference. One of the key issues in dealing with Appleton's prospect-refuge theory is understanding that the concept is a simplification for explanatory purposes. Appleton necessarily focuses on the key concepts of prospect-refuge at the expense of many other factors, stating in a later review of his own work,

"*Put in another way, theory isolates the common characteristics of a set of circumstances and ignores the others, and this inevitably distorts the total image of each individual circumstance*." (Appleton, 1988, p. 28).

However, one critic points out the oddness of Appleton's emphasis on prospect-refuge at the expense of other features of the landscape that are conducive to survival such as access to freshwater (Crawford, 1976). This point might be explained with the argument that eating, drinking and reproducing can all be postponed, whereas avoiding a dangerous enemy must be dealt with immediately, therefore making it a priority in terms of attention (Hediger, 1950/1964). Nevertheless, whilst this may have been Appleton's intention it does reduce his work to a rather narrow focus, which requires further development before it can be applied to architecture.

Bourassa (1991) criticised Appleton's framework for symbolism as merely a list of landscape features, many of which are ambiguous in terms of offering prospect, refuge and hazard, a view which is supported by Bunkśe (1977) and Bergman (1978). Bunkśe made the point that

"*Darkness may not always signify a refuge, but may instead be forbidding; it is, in fact, one of the few universal environmental elements that induces fear in infants*" (Bunkśe, 1977, p. 151).
It is important therefore to treat each case as individual, features that sometimes might suggest refuge, may at other times suggest hazard, analysis on a case by case basis is therefore necessary.

As mentioned earlier, Appleton was fully aware of the risks of simplification at the expense of individual cases, it is therefore important to understand the role of other factors when seeking to apply prospect-refuge theory to architecture.

Whilst Appleton's work does contain some examples of architecture it is primarily focused on a visual evaluation of the landscape, therefore the architecture that is included is viewed as objects within a landscape. There have been some attempts to apply Appleton's theory to interior architecture, most notably Grant Hildebrand analysed the works of Frank Lloyd Wright using Appleton's methodological framework. From the following passage from his analysis we can see the problem that Hildebrand encountered through a misunderstanding of prospect-refuge theory and a too literal application of the concept to architecture.

"Refuge is small and dark; prospect is expansive and bright. It follows that they cannot exist in the same space. They can occur contiguously, however, and must, because we need them both, and we need them together. From the refuge we must be able to survey the prospect; from the prospect we must be able to retreat to the refuge" (Hildebrand, 1999, p. 22)

Hildebrand's description of what constitutes a prospect and a refuge shows that he understands them as objects, or in this specific case, spaces. His argument that they cannot exist in the same space is contrary to Appleton's concept and to common sense. Appleton makes this clear in the following passage which could have been written in response to Hildebrand, but was in fact made quite clear in Appleton's original text,

"That there is an element of contrast between them is obvious. 'To See' is clearly not the same as 'not to be seen'. But it would be quite fallacious to regard them as 'opposites' as we might regard good and evil, bigness and smallness, light and darkness, and so on, as opposites" (Appleton, 1975, p. 73)

Hildebrand's direct application of prospect-refuge theory to architecture was explored by Stamps (2006) who followed Hildebrand's description of what constitutes prospect and refuge in an interior in an attempt to validate Hildebrand's architectural criticism. Stamps found that the strongest correlator with comfort was the width of the room where r=.35, whereas transferring from low to high as well as from dark to light were found to have very subtle correlations at r= .08 and 0.2 respectively. It was also found that people preferred looking from larger, bright, tall rooms to smaller spaces, which was contrary to the hypothesis and Hildebrand's suggestion that moving from a dark space into a light one will produce pleasure. It is important to note however that Stamps was investigating Hildebrand's interpretation of prospect-refuge theory, rather than Appleton's original concept. However, as mentioned previously, it is important to look to other authors to develop a more well rounded approach to the subject of biological preferences in architecture, before putting forward principles to aid design.

Synopsis

- **Appleton narrows the scope of Habitat Theory by focusing on the concept of being able to see without being seen, which is suggested as being beneficial to survival, he terms this Prospect-Refuge Theory.**

- **Appleton developed a framework of symbolism which lists and categorises landscape features as a way of analysing a landscape in terms of prospect and refuge.**

- **Support for the theory has been provided by numerous authors since its publication, however many of the arguments in support of the theory**

can be explained through other means, and only 5% of a sample of 214 references we focused empirical studies that met current standards for behavioural science.

- **It is important not to view prospect-refuge theory independently, but rather in the wider context of habitat theories developed since its publication.**

STRUCTURALIST THEORY

NICHOLAS HUMPHREY 1980

"...encouraging architects to go out
into the natural landscape
and discover
the relationships between things
that man finds beautiful
before incorporating
the 'felicitous rhymes of natural beauty'
in temporal and spatial relationships
with the built environment."

Introduction

Humphrey's structuralist theory posits the idea that aesthetic appreciation itself serves a biological function, suggesting that we find an environment beautiful because it is conducive to expanding our world model by providing new information which is neither too easy or too difficult to grasp. Humphrey therefore suggests that aesthetic appreciation is a taxonomic process where we classify objects in order to predict future situations and change our behavior accordingly. The things we find most beautiful are those that lend themselves to this process, variations on a familiar theme, likeness tempered with a difference, which Humphrey describes as rhyme by way of analogy with poetry and zoology.

Structuralist Theory

Humphrey is not ambivalent about the phenomenon of aesthetics, for him it is a biological issue, he therefore puts forward a simple question in biological terms, *"What is the function of man's appreciation of beauty?"* (Humphrey, 1980, p. 59). For Humphrey the basis, and possibly the entirety of aesthetic experience can be pinned on our biological instinct for survival. Humphrey's starting point builds on the idea that if in a state of nature an animal kills to live, in a state of affluence an animal lives to kill, by extension Humphrey argues that if an affluent human lives to cultivate the arts, in a state of nature humans cultivated the arts to live. Humphrey holds a Kantian philosophical stance, stating that Kant was near the truth, quoting the philosopher,

"When the question is whether a thing is beautiful, we do not want to know whether anything depends or can depend, for us or for anybody else, on the existence of the object." (Humphrey, 1980, p. 59)

In this sense Humphrey regards one of the criteria of aesthetic experience as an irrelevance to obvious needs, this is strongly reinforced using a partial quote from Théophile Gautier, *"Il n'y a de vraiment beau que ce qui ne peut servir à rien"* (Gautier as quoted by Humphrey, 1980, p. 59) meaning that, *"there is nothing truly beautiful that can be of any use"*, Humphrey is careful to leave out the final part of the quote, *"tout ce qui est utile est laid"* (Gautier, 1835, p. 28), or, *"everything that is useful is ugly"*, which might suggest that he believes Gautier goes too far and that utility can have its own aesthetic. Humphrey provides a slightly different perspective to Appleton when he suggests in the following quote that it is the aesthetic experience itself that has a biological function, not the object observed or what it might represent

"Yet in the quest for a functional explanation it would be self-defeating to deny aesthetic preferences any useful role. If the response to beauty in one form or another occurs regularly and consistently within the human species it is fair to assume that it confers some biological advantage." (Humphrey, 1980, p. 59)

So what Humphrey is saying is that for an object to be beautiful it must be useless, but the appreciation of beauty itself may have a function. This both classifies it as a Habitat Theory whilst becoming a distinguishing feature, a taxonomic classification that Humphrey would have enjoyed, as we will see shortly. Considering that Humphrey is writing in a publication titled *Architecture for People* the implication that useful objects cannot be beautiful is controversial, as we saw earlier, Alain de Boton argues that there is a beauty in the way objects can perform tasks that we are unable to achieve ourselves, architecture certainly falls into this category and there is no shortage of people who would claim to have experienced beautiful architecture. Habitat Theory is based on the idea that an environment will be aesthetically pleasing when it appears to be conducive to our survival, whether or not this is the case. Humphrey's theory makes the distinction that the aesthetic appreciation itself serves a biological function and that the appreciation of beauty is a form of taxonomy which has enhanced our ability to survive. In this sense Humphrey echoes Brian Goodey's brief statement on the subject of aesthetics, taken from an introduction to the literature of environmental perception, Goodey states,

"Suffice to say, our ability to organize our perceptions probably gives us a satisfaction which is at the root of our aesthetic judgements." (Goodey, 1971, p. 3)

Beauty and Rhyme

However, one of the central problems in the suggestion that aesthetic experience serves a biological purpose is accounting for the differences in tastes within the human species, Humphrey seeks to address this issue with a structuralist approach, pointing out that the fields of linguistics and anthropology owe their breakthroughs to similar methods. In linguistics it was the realisation that it was not the sounds themselves that were connected with meaning, as many cultures use the same sound with completely different meanings, but rather the combination of sounds that contains the important information. By the same token he suggests that what we find beautiful are the relationships between objects, which will naturally be different depending where and whom you ask, due to associated cultural and personal meanings, therefore accounting for the problem of taste.

Having established the suggestion that the relationships between objects hold the most critical information, Humphrey sets himself the task of investigating what relationships are important and why. He draws his primary inspiration from an anecdote by the poet Gerard Manley Hopkins, Hopkins writes of a conversation between a student and a professor who are discussing the leaves of a chestnut tree, leading them to a conclusion on the beauty of the leaves and the drawing of an analogy with poetry, as quoted by Humphrey;

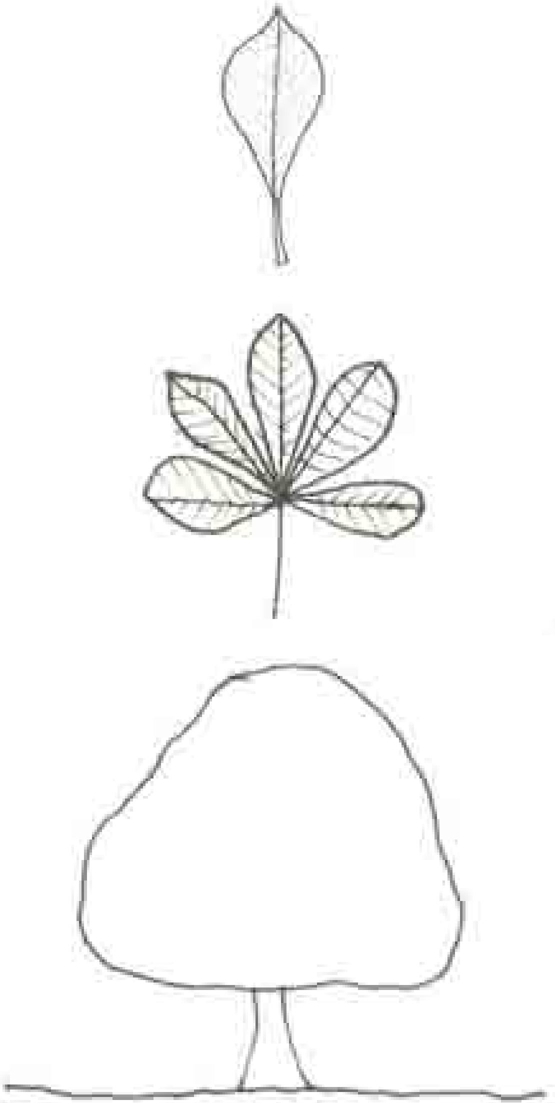


Figure 5 The chestnut tree illustrating rythm – likeness tempered with difference

"'Then the beauty of the oak and the chestnut-fan and the sky is a mixture of likeness and difference or agreement and disagreement or consistency and variety or symmetry and change.'
'It seems so, yes.'
'And if we did not feel the likeness we should not feel them so beautiful, or if we did not feel the difference we should not feel them so beautiful. The beauty we find is from the comparison we make of the things with themselves, seeing their likeness and difference, is it not?'"

'Rhythm therefore is likeness tempered with difference… And the beauty of rhythm is traced to the same causes as that of the chestnut-fan, is it not so?'…'What is rhyme? Is it not an agreement of sound with a slight disagreement?'…'In fact it seems to me that rhyme is the epitome of our principle. All beauty may by a metaphor be called rhyme, may it not?'" (Humphrey, 1980, p. 63)

This dialogue forms the basis of Humphrey's argument, he suggests that rhythm and rhyme are important relationships in the appreciation of beauty. With a twist on his original question Humphrey asks, *"What is the biological advantage of seeking out rhyming elements in the environment?"* The answer proposed is that humans have an aesthetic preference for environments that facilitate the classifying of objects, beautiful environments are therefore ones that facilitate the gathering and classifying of information. Humphrey seeks to justify this view in three steps, firstly by explaining why classification is important to biological survival, secondly by explaining why rhyme should present information in a way that is conducive to classification and lastly, by providing evidence that humans instinctively classify their environments and are particularly attracted to the presence of rhyme.

Classification of a World Model

Humphrey asserts that classification is the process of developing a world model, which is a way of predicting future events using past experience. Such a model enables an animal to associate characteristics with objects in the environment, allowing the animal to predict the course of events and behave accordingly. This world model functions as a kind of shortcut for reducing thought load and response times, allowing the animal to distinguish threatening objects and make faster decisions. Humphrey's argument is that any animal that was unable to classify effectively was unlikely to survive for long and so animals that could classify would survive and reproduce. No empirical evidence is provided for this argument other than the implied argument of natural selection.

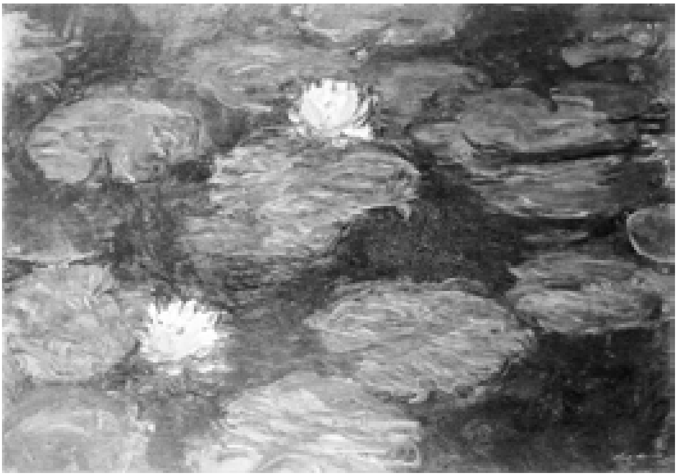
Rhyme and Classification

For the second justification of the argument Humphrey draws parallels between the taxonomic process of a zoologist and an animal's development of a world model. Humphrey argues that a zoologist needs to prove that his classification process serves to group certain animals together whilst distinguishing one group from another, a zoologist is therefore searching for a likeness tempered with a difference, in other words rhyme. The zoologist is not interested in classifying the same animal twice, nor is he interested in classifying an animal that causes confusion to his taxonomic system, he is looking for a variation on a theme. Humphrey believes that the zoological example applies to every animal when classifying the world around it, if rhyme is conducive to classifying for the zoologist, then it is helpful for the animal to do so also, which is why Humphrey suggests we have evolved to respond to the relation of beauty as epitomised by rhyme.

Humphrey primarily relies on his own work with monkeys to back up the suggestions he puts forward. He chooses a particular example that suggests that when monkeys work to look at pictures it is because the new picture provides them with the challenge of incorporating new information into their world model. The monkeys that Humphrey worked with would spend far less time on paintings of familiar objects, and even less time on paintings that were a complete ‘jumble’. However, the pictures that held the animals’ attention the longest were those containing objects for which they had no category readily available, suggesting that the monkeys preferred variations on familiar stimuli. In addition to his own work, which is only mentioned briefly, Humphrey draws upon empirical evidence from three other experiments: Firstly, McClelland et al (1953), who found that humans responded with pleasure to minor variations on familiar stimuli, secondly, Kagan (1970) demonstrated that chicks who were exposed to an artificial stimuli early in life came to prefer stimuli that were slightly different to the one they were originally exposed to, and lastly Bateson (1973), who observed that babies who had been exposed to a particular abstract pattern showed a preference for new patterns which are variations of the original. Humphrey also points to many less scientific examples of pleasure derived from classification, such as a child’s learning process through the naming of objects in picture books, or classification activities such as stamp collecting. Humphrey finds an ally in Pavlov (1928) who echoes Humphrey’s starting point of man living to cultivate the arts when he talks of the reflex of collecting.

“If we consider collecting in all its variations, it is impossible not to be struck with the fact that on account of this passion there are accumulated often completely trivial and worthless things, which represent absolutely no value from any point of view other than the gratification of the propensity to collect. Notwithstanding the worthlessness of the goal, every one is aware of the energy, the occasional unlimited self-sacrifice, with which the collector achieves his purpose. He may become a laughing-stock, a butt of ridicule, a criminal, he may suppress his fundamental needs, all for the sake of his collection.” (Humphrey quoting Pavlov, 1980, p. 67)

Humphrey touches upon the beauty of mathematical classification and the relationships between numbers, of musical



Figur 6 Illustration of Monets Water Lillies, adding an new dimension to reality

composition and the way that individual notes can be woven together to form a tapestry of sound, and of visual composition in painting where the relative positioning of a collection of symbols forms meaningful relationships within an image. These are only brief stops, with a few well chosen examples that support Humphrey's argument, one could add further to these with a glance to Bachelard (1970) who claims that anyone who has experienced Monet's water lilies will never see water lilies in the same way again, they will be more beautiful and float on the water with more tranquility for the experience of Monet's painting. This anecdote supports Humphrey's argument in the sense that experiencing the beauty of Monet's work adds a new dimension to reality, the incorporation of Monet's expression of water lilies develops the observer's own world model.

Finally, Humphrey turns towards architecture and the built environment, where he suggests that the key in creating a beautiful landscape is that the classificatory puzzle neither be too difficult or too easy to solve. One aspect of the environment that Humphrey suggests particularly captures our imagination is the capacity for "*systematic change*" (Humphrey, 1980, p. 71), Humphrey uses the example of a child recognising its mother, despite the fact that its mother is different from one moment to the next, perspective, changes of expression, clothing and context all contribute to a continual recreation of its mother in the child's eyes. The same is true for all environments, there are several factors that change constantly such as the annual cycle of the seasons, or the weather, the sharp contrast between day and night, in cities there are even more levels of continual change such as the working week, weekends, special events, rush hours. Each of these changing cycles contributes to a new experience of the city which can be classified into our world model. Humphrey concludes by **encouraging architects to go out into the natural landscape and discover the relationships between things that man finds beautiful before incorporating the 'felicitous rhymes of natural beauty' in temporal and spatial**

relationships with the built environment.

Method

Humphrey developed his theory primarily through his observations in poetry, the arts as well as with empirical evidence through his own work and references to empirical research conducted by others. However, Humphrey's proposal of structuralist theory is limited to a single article collected in a series of essays entitled *Natural Aesthetics*. Unfortunately, despite his extensive work on related topics Humphrey did not further develop his structuralist theory relating to aesthetics and a database search performed on Thomson Reuters returned only six results citing Humphrey's theory, and all but one only gave Humphrey a customary nod whilst using his theory to support research on related subjects. Humphrey's theory is therefore isolated compared to other habitat theories, however when it is examined in the context of similar theories there are many recurring ideas to be found in each work which will be discussed in the criticism section.

Critical Analysis

The primary criticism of Humphrey's structuralist theory is simply that it has not been developed or tested further by other researchers, therefore there is a lack of empirical research to validate Humphrey's ideas on the subject although his arguments are founded on existing empirical data. It is important therefore to consider Humphrey's theory as part of the larger whole of in terms of the other theories being discussed. Many of the ideas that Humphrey puts forward can be found in the work of other habitat theorists. Despite his apparent Kantian allegiance, Humphrey shares many common ideas with John Dewey, such as the concept of rhyme. Dewey posits that form is deeply rooted in the natural world and that the relationship between the live creature and its environment is the source of all artistic forms. Art is an expression rather than a statement, as such art is an expression of the world mediated through the human body, in Humphrey's theory art can therefore be said to be an expression of the unique categorisation of the world by an individual. However, the relationship between the live creature and the environment existed long before, art, music, poetry and architecture, Dewey uses the term relations as an active interaction between the live creature and the environment, and the elements of interaction Dewey calls rhythm. Some of the larger rhythms within nature are day and night, the seasons, life and death, these rhythms are far older than homo-sapiens and so are deeply embedded within our classifications of the world.

The rhythms mentioned are primarily temporal although they each affect our spatial perceptions of a place. Both authors focus on these large natural rhythms in terms of their influence on aesthetic form, especially Humphrey's **call for architects to learn from the temporospatial relationships of nature and the city.** The character of the place changes completely during the day compared to the night, in the sun compared to the rain, or on a workday as opposed to the weekend, these are rhythms which give the same location a new perspective, they are variations on a theme. In addition to the temporospatial rhythms of nature and the built environment there are of course other categories of rhythmic elements, however these are not mentioned by Humphrey, therefore there is plenty of room for developing his theory to include further categories such as the symbolic relationships between objects. In the following passage Dewey describes the experience of a well furnished room primarily in terms of its temporospatial qualities,

"Now there is nothing different in principle here from what is done in the furnishing of a room, when the householder see to it that tables, chairs, rugs, lamps, color of walls, and spacing of the pictures on them are so selected and arranged that they do not clash but form an ensemble. Otherwise there is confusion - confusion, that is, in

perception. Vision cannot then complete itself. It is broken up into a succession of disconnected acts, now seeing this, now that, and no mere succession is a series. When masses are balanced, colors harmonized, and lines and planes meet and intersect fittingly, perception will be serial in order to grasp the whole and each sequential act builds up and reinforces what went before. Even at first glance there is the sense of qualitative unity. There is form." (Dewey, 2005, p. 142)

Dewey does not focus on other qualities a furnished room might have, perhaps there is a unity between function and comfort, a balance in the sensuous qualities of the materials chosen, or a harmony in the composition of symbols within the room; an armchair which suggests comfort before we sit down, a bookshelf that speaks of an accumulation of knowledge, a fireplace that provides the potential for warmth. These are examples of other rhythms that could be considered in the aesthetic appreciation of a space, although admittedly this is an example filled with cultural and personal layers of perception.

Synopsis

- **Humphrey suggests that the process of aesthetic appreciation itself has a biological function.**

- **Therefore aesthetic appreciation is derived from the ability of a person to categorise their environment effectively.**

- **Elements of the environment that rhyme with our current model of the world and are therefore easily categorisable will therefore be preferred.**

- **Humphrey suggests architects should look at the temporospatial rhythms that we find beautiful in nature in order to understand how to create similar relations in a built context.**

INFORMATION PROCESSING THEORY

RACHEL & STEPHEN KAPLAN
1989

***"This vital cornerstone
of human function
is not a passive,
neutral system,
human beings actively seek out
new information
about the world around them"***

Introduction

The Kaplans' 1989 work *"The Experience of Nature"*, which summarises about twenty years of research by themselves, their students and their colleagues (Bourassa, 1991) is based on an argument developed in previous studies by Stephen Kaplan (1972, 1973, 1976). Kaplan argues that human beings could not have survived as big game hunters on the african savanna by physical prowess alone, and that the development of an ability to outsmart prey was a fundamental factor in the survival of the species. Being able to utilise their intelligence to a far greater degree than other animals was therefore vital. The general argument is that human beings have had to evolve to process large amounts of information about their environment in order to survive. Therefore the Kaplans posit that environments that facilitate a human's ability to understand and gather further information will be preferred because these environments are essential to survival and it is adaptive to prefer environments that are conducive to survival.

From this the Kaplans derive that the functioning of human beings is based on information. Storage and processing of information allows us to assess current situations and predict future ones, this would clearly have had a benefit in big game hunting on a savanna. Much of the information we need can be gathered from the environment, and much of it we bring forward from previous experiences, both sets of information affect how we think, feel and act in a situation. The new information that we gather from our current environment is processed and stored in order to be used in future situations. The more information that is gathered, the better we will be at predicting future situations, which has an obvious survival benefit in terms of adapting our behaviour towards a favourable outcome. This vital cornerstone of human function is not a passive, neutral system, human beings actively seek out new information about the world around them and it can affect them in many different ways. Approaching events and situations can drastically affect and alter our moods, for example, not even a grey, miserable afternoon can dampen the elation we feel on a friday with the whole weekend ahead of us, but a beautiful sunday afternoon can be overshadowed by the imminent arrival of monday morning. Future situations can be positive or negative, and this affects how we think of them and how we will behave when they arrive.

Information Processing Theory

In order to test this concept the Kaplans have employed what they refer to as a *"Category-Identifying Methodology"* (Kaplan & Kaplan, 1989, pg 20) which is included as an appendix to The Experience of Nature. As the name suggests this methodology seeks to identify categories in terms of preference. The process involves showing a group of participants a number of stimuli which they rate according to preference, these stimuli can then be grouped by common features that may identify why they were preferred or disliked. In order for this process to work the Kaplans had to have enough individuals taking part in the research to justify the conclusions, the overall goal is to identify what the 'average' person perceives and prefers, so a large number of participants is essential. This approach also requires that the participant is provided with enough examples of the environmental category that is being evaluated. The problem in both cases is presenting a large enough group of participants, with a large enough number of stimuli to provide a representative sample. allowing the Kaplans to draw firm conclusions. Another issue lies in the categorisation of stimuli, which is determined by the researchers' interpretation. A researcher analyses a stimuli and interprets what it has in common with a group of stimuli, dense vegetation may be a common feature identified, however what dense vegetation consists of is interpreted rather than computed. In order to avoid a bias on a particular feature of an environment the Kaplans examine several prominent features of the stimuli. Two sets of categories emerged from the Kaplans' research that broadly deal with the subject matter of the stimuli being provided, that is content-based categories which deal with specific objects, and spatial configuration categories which focus on how those elements are arranged in a stimuli. The Kaplans further develop these sets of categories in terms of how available information is within the stimuli. Content-based categories have information that is readily available in terms of the two-dimensional plane of the image being shown, that is the shapes, patterns, colours etc. of the image. The spatial configuration categories are formed from stimuli where information is inferred when the observer imagines themselves within the setting. The Kaplans suggest that observers evaluate the possibilities for action based on the spatial relationships they perceive, citing Gibson's (1979) concept of 'affordance', as in what the environment offers the perceiver. The Kaplans suggest that even though the subjects cannot carry out actions within the images they are perceiving because they are two-dimensional objects, they still evaluate the stimuli in terms of potential for action. This is not a conscious appraisal but one that occurs instantaneously as preference can be determined from the briefest of glances before a conscious evaluation takes place.

Exploration

From their examination of previous research the Kaplans produced a preference matrix that evolved from the scenes which were the most and least preferred. The matrix is divided into two domains, which are both further divided into two parts, these domains are chosen because they are critical to the way humans relate to information. The first domain includes the desires that humans beings feel for understanding and exploration. The Kaplans posit that we have a need to understand information and that we may even become angry and hostile when we are not able to. The Kaplans also assert that exploration is a pervasive human need in terms of broadening our horizons and gathering further information about our environment. If both of these assertions are true then environments that facilitate

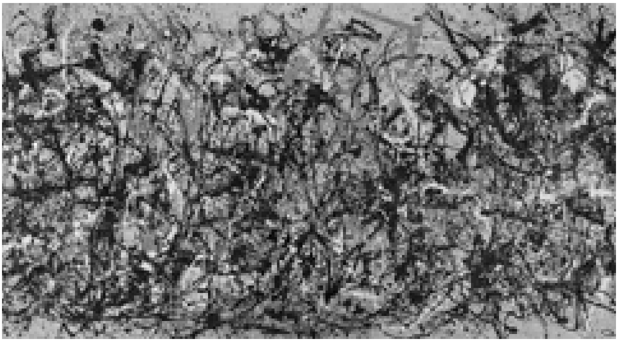


Figure 7 Jackson Pollock illustration complexity with a number of different elements in an image

Figure 8 Mark Rothko illustration coherence and its contrast to the complexity of Jackson Pollock

understanding and exploration will be preferred to those that do not allow these functions. The second domain is concerned with how much information is inferred in the scene and is further divided into two categories, immediate and inferred, which have been derived from content based and spatial configuration categories. In summary the preference matrix is concerned with understanding and gathering information, and how easy it is to achieve these functions through the availability of information. By combining the four factors the Kaplans generate a further four informational patterns which are complexity, coherence, legibility and mystery.

Complexity

The Kaplans define complexity as the number of different visual elements in an image, further described as its intricateness or richness. Complexity is a measure of how much there is to look at in an image, how much informational content there is in terms of the picture plane, rather than depth cues. In short, complexity is a measure of how much there is to think about on the surface of an image.

Coherence

In the Kaplans' definition, coherence is the orderliness of a scene in terms of patterns of brightness, size and texture amongst other variables. These variables can help to delineate areas of the picture plane to order the image into parts of a system. Coherence relies on the two dimensional picture plane and is immediate rather than inferred. Coherence is important because the orderliness of a scene is central to how easy it is to understand. Coherence and complexity are related in the sense that we may consider a disorderly scene to be overly complex, however the Kaplans stress that it is possible for a scene to be both coherent and complex at the same time.

Legibility

Legibility in terms of the environment was introduced by Kevin Lynch in The Image of the City. Lynch's concept of legibility includes all of what the Kaplan's describe as understanding and points to coherence and structure. However the Kaplan's have adapted the term to refer to **the ability to orientate oneself within a scene, how easy it is to build a mental map of points which one can move between and find a way back to**. A high degree of legibility may be achieved in settings with distinctive features and regions that aid the construction of a cognitive map for memorising a setting.

Mystery

Mystery is defined by the Kaplans simply as the promise of learning more. Scenes with a high mystery value may include features that draw the viewer in, suggesting that more information can be gathered by exploring the scene. It is important to note that there is a large difference between mystery and surprise, the Kaplans illustrate this in the following passage,

"A path leading to a visible closed door suggests surprise but not Mystery. For the latter, the change in vantage point needs to provide information that is continuous with what is already available, rather than a surprise. Given the continuity, one can usually think of several alternative hypotheses as to what one might discover – in other words, there is both inference and a sense of exploration." (Kaplan & Kaplan, 1989, pg 56)

Mystery represents a pleasant challenge to the imagination which encourages the observer to explore a setting further to investigate the information which is at first hidden, for that to be possible the observer must be able to move freely within an environment. The Kaplans point to the work of Gimblett, Itami and Fitzgibbon (1985) who identified three factors that were effective in enhancing mystery, these were screening, enclosure, physical accessibility, forest illumination and a relative lack of distance of view.

The Symbiotic Relationship Between the Four Factors

Through the Kaplans' observations of previous research they determined that although complexity is the factor that has been examined the most thoroughly in previous research it is not a particularly powerful indicator for explaining preference in the natural environment. What the Kaplans found was that the most preferred scenes contained a high degree of mystery, where there is partially hidden information and an element that tempts the viewer to investigate. The patterns suggested by the Kaplans' observations are that for a scene to be preferred it must at least have a degree of coherence and complexity, a lack of coherence prevents us from understanding and a lack of complexity will not lead us to explore the image in its immediate dimension. So these two qualities must at least be present for a stimuli to be preferred. However, increasing the amounts of coherency and complexity will not necessarily lead to the stimuli being more preferred, the results plateau. For the factors that rely on inferred information, the ability to imagine oneself in the three-dimensional environment the Kaplans research shows that the higher degree of legibility and mystery the better. The Kaplans posit that more legibility leads to a greater degree of confidence in one's ability to orientate oneself and that the setting will continue to be understandable, whereas mystery encourages the viewer to further explore the scene.

In summary the results of the studies examined by the Kaplans suggest that in terms of understanding a scene, coherency, the orderliness of immediately available information is important as it allows the participant to gain a quick grasp of the setting. In terms of exploration the promise of more information, mystery, is shown to be the strongest predictor of preference. However, the Kaplans note that it is important not to isolate and optimise one factor at the expense of others when designing a highly preferred setting as the interaction between these factors plays an important role.

Critical Analysis

There is clearly a degree of overlap between the Kaplan's theory and the theories of Appleton and Humphrey. Appleton's concept of prospect is directly related to gathering more information about the environment and Appleton also investigated exploratory behaviour in animals. Humphrey's structuralist theory follows a similar idea to the Kaplans, in that he posits that environments that are conducive to classifying information will be aesthetically preferred, however where Humphrey focused on the relationships between objects, the Kaplans add a content based dimension to their theory, suggesting that the objects themselves are also important. The taxonomic similarities to Humphrey's theory are shown in the following passage from The Experience of Nature,

"It is perhaps not surprising that content is a major aspect of environmental perception. Grouping what the environment contains into coherent content categories is, after all, basic to cognitive economy. By establishing such groupings it is possible to react to a wide range of different situations in a similar way. Because one is constantly confronting situations that are at least slightly different from any that were previously experienced, the use of categories is not merely convenient but essential if one is to apply one's past learning to new situations." (Kaplan & Kaplan, 1989, p. 28)

The theme of exploration and information gathering is strong in all three theories and the stimulation of a subject to explore, therefore adding further information to that which is already stored, seems to be a strong recurring theme related to preference.

The Kaplan's work has been criticised by Stamps (2005a) who found that the reliance on verbal constructs was incompatible with his own mathematical methods of testing theories.

"For the Kaplans, use of verbal constructs was intentional. Most of the rather large body of research on their theory report environments in terms of verbal categories. However, a review of that literature – covering 61 articles, 12 452 participants, and 3125 environments (Stamps, 2004) – indicated that 91% of the verbal categories were found only once, implying that the protocol of using verbal categories to describe environments does not generate reproducible findings." (Stamps, 2005a, p. 737)

Stamps (2005a) goes on to suggest that an alternative to relying on verbal constructs is to replace "Aristotle with Plato" (2005a, p. 737) and rely instead on mathematical constructs that create reproducible results. However, we would suggest that there is a place for both modes of investigation and a happy medium between the two. We feel that the core concepts of the theories already discussed are intuitively understood by most people and that although validation using mathematical methods will certainly develop the previous theories. Validation provides a stable platform for the theories on which an architect might elaborate, however an architect cannot design with mathematics alone, there must be room to manoeuvre artistically and this can come from the architects intuitive understanding of the concepts discussed so far.

Synopsis

- **The Kaplans posit that in order for early humans to be successful as hunters they had to outsmart their prey rather than relying on physical prowess alone.**

- **Therefore in order to survive humans beings had to develop to gather and process large amounts**

of information about the environment.

- **Environments that stimulate and facilitate the gathering of information will be preferred as they will be conducive to survival.**

- **The Kaplans found four qualities of the environment that were interdependently related to preference: Coherence, Legibility, Complexity, and Mystery**

PERMEABILITY THEORY

ARTHUR E. STAMPS III
2003

"Spatial enclosure
is such
an important
environmental property
that a region of the brain
functions specifically in detecting
enclosure"

Introduction

Permeability theory has been developed by Arthur E. Stamps III and is currently a work in progress in terms of research. Unlike the other theories previously discussed, there is no comprehensive volume which draws together all of the research and context through which the theory has developed, almost all of Stamps' work is in the form of published journal articles, the context, theory, results and relevance of which we will attempt to briefly summarise here. Permeability theory puts forward the idea that being able to escape from a predator is the most important biological function of an animal. Being able to escape depends on two factors, perceiving a threat and being able to move away from it, these are termed visual and locomotive permeability by Stamps. The object that blocks or allows movement and vision is termed enclosure and is defined as a three-dimensional space.

"I have called this idea – that enclosure can be conceived as properties of a three-dimensional region of space which affects safety by the degree to which it permits or limits locomotion or perception through itself – permeability theory." (Stamps, 2005, p. 5)

Permeability Theory

In terms of illustrating why permeability is an important area that is worth further investigation Stamps (2003) initially turns to Heini Hediger. Hediger (1950/1964) posits that the ability to escape an enemy is the most important biological function that an animal can have. Other fundamental biological functions that are essential to our survival as a species, such as eating, sleeping or reproducing can be postponed, however escaping a dangerous threat requires immediate attention and as such the animal will constantly devote a portion of attention to detecting hazards in the environment. Escaping from a threat requires the ability to detect potential enemies and to reach a place of safety or else face a potentially lethal fight. In Stamps' (2005a) second article focusing on permeability he supports the importance of the subject further by introducing the work of Epstein and Kanwisher (1998) who identified that there is a region in the brain that responds specifically to spatial enclosure, known as the parahippocampal place area or PPA. Stamps suggests that the implications of this research is twofold, firstly it suggests that **spatial enclosure is such an important environmental property that a region of the brain functions specifically in detecting enclosure,** and secondly that gaps in enclosure are more important than complete enclosure. Epstein and Kanwisher's work is further supported by more recent empirical research conducted by Doeller & Burgess (2008), and Doeller, King, & Burgess, (2008). Stamps uses Hediger (1950/1964, 1955/1968) to support his suggestion that a theoretical reason why the PPA responds to spatial enclosure is that survival is the most important purpose an organism can have. In terms of evolutionary theory an animal should adapt to distinguish between safe and dangerous situations. The ability of an animal to perceive or move through an environment has a direct relevance to its survival which may be a reason why the PPA responds specifically to spatial enclosure. Hediger's theory itself is a more specific interpretation of Darwinism with respect to environmental features, permeability theory therefore has it's theoretical basis in Darwin's theory of evolution, in the sense that anything that has a value to survival will become more prevalent in a population (Stamps, 2010). In Stamps' most recent articles the argument for the importance of permeability has been refined and condensed, the argument is summarised by Stamps as follows

"1. The most important function an environment can provide for its inhabitants is safety,

2. Among other things, safety depends on how far and how easily one can sense or move through an environment, *3. Ability to move through something is called permeability, from which comes the name of this theory, and,*

4. Therefore, data regarding how environments can mitigate either sensing through or moving through those environments is needed." (Stamps, 2012, p. 427-428)

The first source that Stamps uses to build the basis for his theory is J.J Gibson's ecological psychology (Stamps, 2003). Gibson suggests that features of the environment can either assist, hinder or block the actions of an animal. The degree to which the action of the animal is influenced by the environment is dependent on three factors; the properties of the environment, the physical properties of the animal and the action it is attempting to perform (Gibson, 1979/1986). Stamps quotes Gibson on the nature of enclosure, stating that enclosure is "*...a layout of surfaces that surround*" (Gibson, 1986, p. 34) and that "*persisting surfaces of the world are what provide the framework of reality*" (Gibson, 1986, p. 100), these quotes suggest that the world is composed of boundary surfaces of varying degrees of thickness and passability. Gibson's concept regarding the relationship of an organism with its physical surroundings is the basis for Stamps research, which is then developed further into a more compact but abstract concept.

The terms Gibson uses to describe the physical environment, such as *"surfaces"*, *"layout"*, *"medium"*, *"substantiality"*, *"impenetrability"* and *"opaqueness"* are condensed into Stamps' definition which is focused on permeability. Permeability is defined by Stamps as being the *"...ability of one thing to move through something else."* (Stamps, 2003, p. 1305). The *"something else"* in Stamps definition differs from Gibson's view of the world being comprised of surfaces in that Stamps defines it as a three-dimensional space. The permeability of that space is determined by the physical features of the space and the nature of the *"thing"* moving through it, importantly Stamps defines this as the locomotion or perception of an animal through the

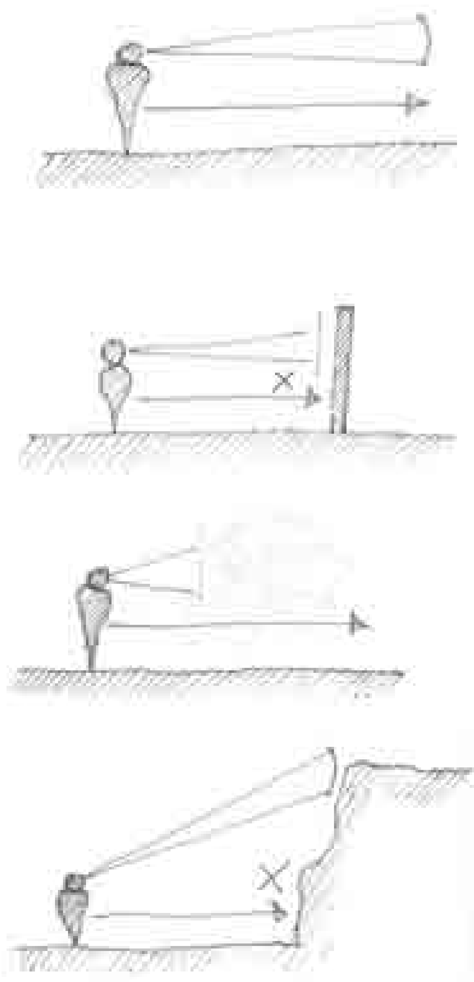


Figure 9 Illustrating visual permeability

space. The following passage illustrates the nature of the new definition with respect to the *"thing"* and the *"something else"*.

"In the new lexicon, a three-dimensional region of air (not a solid surface!) can permit, retard, or block vision by humans, depending on the density of fog. (The example of fog comes naturally to someone living in San Francisco.) Air, however, will not block locomotion by humans. Thus, a dark and foggy night in San Francisco will create regions that are totally permeable to human locomotion but completely impermeable to human vision. Hills, however, are another matter. Depending on one's stamina, any decent San Francisco hill can completely block locomotion, even though one can see the crest quite clearly. Numerous other examples can be imagined (clean air is totally permeable to human locomotion and nearly so to human . . vision; the region of air over a body of water is impermeable to human locomotion but nearly totally permeable to human vision; the deep ocean is impermeable to human vision but is permeable with respect to human locomotion; the proverbial brick wall is completely impermeable with respect to human locomotion and vision. Extensions to other senses and organisms are obvious (a traditional Japanese paper wall is permeable to sound but not locomotion; a picket fence blocks locomotion by dogs but not by mosquitos, etc.)." (Stamps, 2003, p. 1306)

The Experience of Landscape is cited by Stamps as providing some theoretical underpinning to his theory, primarily in Appleton's concept of hazard as a prerequisite for the aesthetic qualities of prospect and refuge. The work of Appleton and the Kaplans has been investigated by Stamps, alongside his own research and an investigation into conspecifics. In 2012 Stamps' database for empirical evidence on permeability theory included 348 studies from other researchers, 57 original experiments, 1396 participants, 17750 stimuli and 92 properties of the physical environment that have been demonstrated to influence responses of safety, enclosure, spaciousness and pleasure. As a brief summary of research in the field Stamps lists four series of data relating to permeability theory (2012).

Conspecifics

Key sources: Hall (1966), Goffman (1971)
Data: 8 Studies to show how threat is conveyed by nonverbal cues over varying distances.

Prospect and Refuge: Appleton's Theory

Key Sources: Appleton (1975)
Data: 8 Studies on environmental properties such as distance in view; presence of a permeable boundary in front of the observer; direction of light; special transitions such as low or high, light or dark, or large or small; and venue (natural or built).

Information Theory

Key Sources: Berlyne (1960), Kaplan and Kaplan (1989)
Data: Responses studied include complexity, mystery, uncertainty, preference, and exploration; environmental factors studied include number of vertices in silhouettes, amount of detail, light, occlusion, and a mathematical model of uncertainty called "entropy." The latest article in that series is by Stamps (2010b)

Enclosure, Spaciousness and Permeability

Key Sources: Stamps own work
Data: 27 Experiments on responses such as safety, enclosure, and spaciousness and environmental properties such as boundary properties (permeability with respect to locomotion or vision, height, depth, and location with respect to observer [above or below, front or back, and sides]), properties within boundaries

(area, concavity, and elongation), and other variables such as light, color, and material (natural or built). The latest summary of this series is given in Stamps (2011)

Critical Analysis

Stamps' theory is partly developed on the former habitat theories that we have already covered, so naturally there is considerable overlap in terms of shared concepts. By researching previous theories such as prospect-refuge theory and information processing theory whilst being critical of the work Stamps strengthens his own position whilst simultaneously asking questions about the validity of previous theories relative to his own. By no means does that mean dismissing those theories, rather Stamps is critical in his evaluation of the strengths and weaknesses of previous research in relation to his own. The cost of Stamps very thorough and precise empirical evidence is naturally the lost effect of the innumerous other variables that would occur in a real world setting. On the other hand, the effect of these variables would be impossible to determine, if Stamp did not firstly isolate the specific phenomenon he wished to research, and then secondly implemented a controlled combination of other variables. The extensive gathering of empirical evidence by Stamps sheds light on all aspects of habitat theory in its current state and its previous theories. However, Stamps emphasis on mathematical constructs to investigate his theory in reaction to the previously verbal emphasis is open to the same criticism that he offers the Kaplans which is that whilst mathematical constructs may provide validation for the theory, there must also be a balance with verbal concepts in order to convey the ideas of permeability to architects.

Synopsis

- **A region of the brain, the PPA, has been discovered to respond specifically to spatial enclosure,** which strongly suggests that enclosure is an important subject for investigation.

- Stamps develops his theory of permeability from Gibson, shifting the focus from surfaces enclosing a region to a three-dimensional space.
- Stamps theory is also built on the other habitat theories

- Permeability is defined as an organisms ability to perceive or move through a region of three-dimensional space.

THEORY & METHOD CRITICISM

THE RELATIONSHIP BETWEEN HABITAT THEORY AND ARCHITECTURE

"This is to remind us
that sometimes
it is the empirical evidence
that is of the greatest importance
and at other times
it is the question itself."

Evaluating the theories presented in this thesis, based on the original thesis question: *How can habitat theory shed new light on the subject of architectural atmosphere?* We realise the explanatory power of habitat theory on the phenomenon of tectonics is entirely dependent on the translational ability of habitat theory from the natural environment to the artificial environment of architecture. The important key in this translation from natural to artificial environments, comes from an evolutionary understanding of the programming of our neurological circuits:

"The reason we have one set of circuits rather than another is that the circuits that we have were better at solving problems that our ancestors faced during our species' evolutionary history than alternative circuits were. The brain is a naturally constructed computational system whose function is to solve adaptive information-processing problems (such as face recognition, threat interpretation, language acquisition, or navigation). Over evolutionary time, its circuits were cumulatively added because they "reasoned" or "processed information" in a way that enhanced the adaptive regulation of behavior and physiology." (Tooby & Cosmides, 1997)

The Translation from the Natural to the Artificial Environment

Tooby and Cosmides (1997) illustrate this description of natural selection by the eat-dung-and-die-principle. They argue that natural selection doesn't work *"for the good of the species"* (Tooby & Cosmides, 1997, para. 25) but that it is simply a process in which a phenotypic design feature causes its own spread through a population, even if this leads to the extinction of the species. The eat-dung-and-die-principle is based on the neural circuits that all animals need, to govern that what is appropriate to eat. This is the function of the human brain - to generate *"appropriate"* (Tooby & Cosmides, 1997, para. 18) behavior to the environmental circumstances.

It is not safe for humans to eat dung, but that does not mean that an ancestral human has not existed who had neural circuits that made dung smell delicious and compelled him to dig into a big, smelly pile of dung whenever he could. This would be completely natural and appropriate behavior for a dung fly. Unfortunately this behavior for a human would probably lead to disease and as a result of sickness he would be too tired to search for food, mate and he might die before being able to reproduce. Humans with different neural circuits, dung avoiding circuits, would not get sick so often, resulting in a longer life, and having more time to mate and find food, therefore continuing the survival of the species leading to offspring who would also be programmed not to avoid dung.

"Since the neural circuitry of children tends to resemble that of their parents, there will be fewer dung-eaters in the next generation, and more dung-avoiders. As this process continues, generation after generation, the dung-eaters will eventually disappear from the population." (Tooby and Cosmides, 1997, para. 25)

The point of this graphic illustration is that the neural circuits of human beings have been naturally selected by appropriate behavior in the given environment. Our biological needs in combination with the environment that we have evolved in - the natural habitat - has shaped and selected the programming of our brain.

It is this very same programming that evaluates the artificial environment of architecture. Returning to the original thesis question now: *How can habitat theory shed new light on the subject of architectural atmosphere?*

In this sense, as long as habitat theory is based on the biological preference for the natural environment, it is this study into the biology behind the aesthetic preference for environments natural or artificial, that is of interest in this thesis. Habitat theory works to decipher what our preference is within the natural environment and more importantly why we have developed these preferences. It is in this context the importance of the research done by Lakoff and Johnson (1999) which concludes that thought is mostly unconscious and the mind is embodies. In other words, we sense a space and are affected by it unconsciously, before we arrive at an intellectual appreciation or understanding of it.

Evolutionary Programming and the Artificial Envrionment

To establish the relevance of habitat theory in relation to the thesis question and how these theories can be translated into architectural theory, it is important to understand that it is not possible to deem the natural and the artificial environment equal or remotely the same. It is in the way our evolutionary programming is designed to cope with our environment that allows for this translation. This supports the agreement between Appleton and Bourassa that Dewey's philosophy towards aesthetics, which suggests that we cannot detach our senses, emotions, intellect and actions, placing them in separate boxes of experience, form part of an integrated and reciprocal system. Human beings are not programmed with two different settings for either, the natural environment or the artificial environment of architecture. We simply process our environment whatever that may be, largely unconsciously, through our evolutionary programming. Our evolutionary programming, the common denominator of human beings, this is the reason why we can transfer the theories and discoveries made on the frontier of habitat theory to inform the process of architectural design. It is in this relationship that we find the philosophical basis for this thesis, that aesthetic experience is based on the interaction of a biological organism and its habitat, specifically for this thesis, between a human being and architecture.

Lack of Biological underpinning

On the other hand it is critically important to identify when these theories are construed regardless of our biology, as is the case with the Kantian approach, as Kant insisted that cognition played no role in judgements of taste and that they were "merely contemplative" (Meredith, 1911, p. 53). This is why lack of biological underpinning has been the main focus of our method criticism in the theories chapter.

Besides from our obvious need to scrutinize these theories for faults in their application to architectural theory, we also turn to other theorists reasonable objections of the methods their colleagues in the field have used to establish their theories with.

Researcher Criticism

Arthur E. Stamps has explored many theories including Appleton's (1975/1990) theory of prospect and refuge, Gibson's theory of ecological psychology (1979), and the coherence, legibility, complexity, and mystery theory of Kaplan and Kaplan (1989). He argues that in his endeavour to test these theories against permeability theory it is an underlying issue that these theories relied mainly on verbal constructs to describe environments.

"For the Kaplans, use of verbal constructs was intentional. Most of the rather large body of research on their theory report environments in terms of verbal categories. However, a review of that literature – covering 61 articles, 12 452 participants, and 3125 environments (Stamps, 2004) – indicated that 91% of the verbal categories were found only once, implying that the protocol of using verbal categories to describe environments does not generate reproducible findings." (Stamps 2005, p. 736-737)

Grant Hildebrand (1999) suggested that Appleton's Prospect-

Refuge Theory can be applied to interiors. In the context of interiors refuge and prospect are opposites, compared to Appleton's definition that prospect is a matter of how far you can see and refuge is how protected one is from possible enemies:

"Refuge is small and dark; prospect is expansive and bright. It follows that they cannot exist in the same space. They can occur contiguously, however, and must, because we need them both, and we need them together. From the refuge we must be able to survey the prospect; from the prospect we must be able to retreat to the refuge" (Hildebrand, 1999, p. 22)

Hildebrand interprets that Interior refuge is created by: darkness, solid walls, closure on three sides, a small horizontal dimension, a narrow horizontal aspect ratio and low ceilings. Interior Prospect is created by; Bright light, Large horizontal dimensions, transparent surfaces and large vertical dimensions. Moving from darker to lighter one will be able to see without being seen, one can therefore explore in safety and hence produce pleasure. The conclusions is that when combined with visual occlusion, back-lit, partially hidden environments should be enticing. Hildebrand (1999, p. 15-32) also proposed that use of natural materials, views of nature, views of water, and wide rather than narrow spaces would increase comfort.

Hildebrand takes the concepts of prospect and refuge too literally, they need not be spaces or physical objects as such, obviously a small dark space cannot be a large bright space at the same time, however a small dark space may provide refuge whilst also providing a view, a prospect can simply be an expansive view, and this can be provided by an architectural nook. Wide open spaces do not always have prospect and small, dark ones do not always offer refuge. Hildebrand has, in our opinion, misunderstood Appleton's theory.

The overall general result of Stamps experiment; Interior Prospect and Refuge (Stamps, 2006) on the statements made by Hildebrandt, the conclusion was, that far more empirical work is needed to establish a solid foundation for this particular hypothesis described in detail in Hildebrand's work; *Origins of Architectural Pleasure* (Hildebrand, 1999), based on the concept of Prospect and Refuge from habitat theory. The lack of empirical evidence not construed from verbal construction, seems to be a general problem of many of the habitat theories put forward in this thesis. Nonetheless there seem to be a clear history of progress since the birth of habitat theory, the progress has to some extent been overlapping and contradictory, but most importantly it has been incrementally progressive. There is a clear pattern of knowledge built on already acquired knowledge or by questioning the knowledge put forth before the present. The primary part of this knowledge is based on simple observations, how well the particular theorist has established a foundation of empirical evidence for the theory behind their observations are varying, but to remember the words of Humphrey:

"Yet in the quest for a functional explanation it would be self-defeating to deny aesthetic preferences any useful role. If the response to beauty in one form or another occurs regularly and consistently within the human species it is fair to assume that it confers some biological advantage." (Humphrey, 1980, p. 59)

Eduardo Souto de Moura describes this process in terms of architecture as a need for continuity:

"Architecture requires continuing: we have to continue what others have done before us but using different methods of construction and materials. This means that the language too has to change." (Goodwin, 2014, p.163)

We believe that the key to a greater understanding of the phenomenon studied in this thesis; is to stand on the shoulders of previously produced knowledge and theories. Not to discard any theory because of its lack of empirical evidence, but to critically evaluate the truth in the observations behind the theories. This is the foundation that shapes our thesis question and directs our research to much greater extent than the previous theories answers our thesis question.

The Role of the Social Environment

Before we endeavour to uncover any biological principle of preference in tectonics we want to address the criticism put forward by Yiu, L. Zheng, R. & Sun, Y. in their article from 2013: *Permeability Theory in a social environment:* Comment on Stamps (2013) That Stamps research only is appropriate for a physical environment, but might not work in a social environment. This because boundary depth can be described as personal space, it is therefore not enough to consider architecture as a merely physical environment. To validate Stamps theory and its internal inconsistencies the theory of permeability needs to incorporate the social environment as a factor.

In the article from 1993 by L. J. Loewen, G. D. Steel and P. Suedfeld; *Perceived safety from crime in the Urban-Environment.* Their empirical evidence confirms this criticism, by identifying humans as both a factor for feeling safe as well as endangered. The ability to contact other people for help, makes us feel safe, on the contrary, the danger humans feel are instigated by other humans. Humans are afraid of humans.
Permeability Theory is based on the biological need to escape immediate hazard, in an architectural setting this hazard will primarily consist of other people, without people in the equation the need to escape the structure will feel less pressing.

If social environments influences perceived enclosure and the feeling of safety, this suggests that there are differences between physical and social environments. The theory of permeability is not capable of explaining the empirical evidence of social proximity.

Personal Space

To accommodate this factor the theory of preference should be combined with further theories on personal space. Personal space is a psychological construct related to physical and psychological distance, it is a movable boundary, functioning as a buffer zone that provides protection against perceived threats. Spatial distance is the most immediate way to maintain personal space.

The investigation into social behaviour has limited itself to territory and dominance as this touches on an ongoing theme in this thesis, which forms the basis for the strong relevance of habitat theory on architecture. this is the solid counter argument for the commonly held belief that humans are no longer governed by instinctual behaviour like animals, but that our increased flexible intelligence is due to our ability for reason and higher order thinking, we have already introduced the counter arguments of William James (1980) stating that human beings are more flexible intelligent than any other animal, because they have more instincts, not fewer. This statement gets backed up by George Lakoff and Mark Johnson (1999) when they state that the mind is inherently embodied.

The same discussion has been brought up in relations to habitat theory, Where Stea (1965) and Cullen (1961) provide a counter argument to Berlyne (1971) and Lee (1972) who observe that it may be the case that the basis for our biological behaviour is so heavily overlaid by learned behaviour that it might be completely overpowered. The counter argument suggests that the desire to possess territory, in terms of occupying space, is as strong in humans as it is in other animals.

Studies on animal behaviour as well as human behaviour reveals that both territoriality and dominance behaviour are tools to maintain social order. If one tool is insufficient the other takes over (Altman & Haythorne, 1967). (Following Hediger we use the term territory and territoriality to represent an area which is first rendered distinctive by its owner in a particular way and, secondly, is defended by its owner (Hediger, 1964). exemplified in the quote from the book by Robert Sommer: Personal Space, the behavioral basis of design:

"The complementary relationship between territoriality and dominance behaviour is expressed in Victor Hugo's declaration, "Every man a property owner, no one a master" the implication is that when everyone possesses an individual territory, the reason for one man to dominate another disappears."
(Sommer, 2007, p. 19)

The thought is to take this declaration and apply it in a smaller scale such as a single room and make it dependent on the particular nature of the social environment intended for that room. Another implication of this quote is the obvious deduction that without humans present in the environment the main hazard is absent leaving the need to flee the environment less pressing.

This is the fact that stamps address in his research article: Mitigation of threat by posture, distance, and proximity from 2013. the article extends the relevant body of knowledge by investigating a new factor in addition to the previous shown factors that distance mitigates the extent to which nonverbal cues such as direction of eye gaze, facial expression, sex and posture communicate threat. This new factor is; Proximity of threat. The new findings show that proximity has an effect on perceived threat, when this threat was communicated by nonverbal cues such as posture and sex.

This task in human behaviour, to discover and react appropriately to the threat is described and categorised into two modes of activity by Erving Goffman in his book; Relations in Public:

Microstudies of the Public order:

"Individuals, whether in human or animal form, exhibit two basic modes of activity. They go about their business grazing, gazing, mothering, digesting, building, resting, playing, placidly attending to easily managed matters at hand. Or, fully mobilized, a fury of intent, alarmed, they get ready to attack or to stalk or to flee.... The individual mediates between these two tendencies with a very pretty capacity for dissociated vigilance. Smells, sounds, sights, touches, pressures—in various combinations, depending on the species—provide a running reading of the situation, a constant monitoring of what surrounds. But by a wonder of adaptation these readings can be done out of the furthest corner of whatever is serving for an eye, leaving the individual himself free to focus his main attention on the non-emergencies around him. Matters that the actor has become accustomed to will receive a flick or a shadow of concern, one that decays as soon as he obtains a microsecond of confirmation that everything is in order; should something really provide to be 'up', prior activity can be dropped and full orientation mobilized, followed up by coping behavior. Note, the central thesis here is Darwinism. If individuals were not highly responsive to hints of danger or opportunity, they would not be responsive enough; if they carried this response far on every occasion of its occurrence, they would spend all their time in a dither and have no time for all the other things required for survival." (Goffman, 1972, p. 238–239).

The above statements and findings describes the importance of considering the social situation in the design process, as these has a huge impact on the perceived safety and thereby the need to find refuge - the ability to flee rather than fully mobilizing as a fury of intent, alarmed and ready to attack. Without the refuge, in an unstable social situation, the risk of confrontations will be heightened.

The Impact of the Social Environment on Design

A large amount of the empirical investigations conducted by

Stamps evolves around perceived spaciousness, as he has found a clear link between perceived spaciousness and permeability. One of the more obvious findings from these investigations is that a larger floor area increases the perceived spaciousness, but when this is related to a specific social environment, Robert Sommer describes how different characteristics of spatial areas are more suited to one tactic than another.

For example a large homogeneous space, lacking clear indications of demarcation barriers, makes it problematic to mark out and defend individual territories. As well as in a large sociopetal room, orienting its users towards a center, makes it difficult for people to retreat. In general, irregular shaped spaces are difficult to defend and are more likely to need defending as its irregularity is likely to be accompanied by vague indications of boundaries leading to more frequent disputes over the ownership of that particular area.

Area shape thereby has a weighty effect on defensive behaviour. Small but well articulated areas are more easily defendable and recognisable as occupied territory, in comparison to large unobstructed areas (Sommer, 2007, p. 62-72).

This is consistent with research conducted to establish which habitats primitive man inhabited and to what extent these ancestral landscapes have a bearing on modern aesthetic preferences. As mentioned in the theory chapter; Butzer (1977) and Isaac (1980) have provided an examination on the characteristics of landscapes inhabited by prehistoric man, whilst Orians (1980, 1986), Woodcock (1982), and Wilson (1984) have investigated the implications that our ancestral habitats might have on modern aesthetic preferences. Under the general heading of Savannah Theory, these authors posit that for most of our existence as a species, we have inhabited savannah or savannah like landscapes, which can be described as largely open grassland with groups of trees and a proximity to water.

Translated into Permeability and social proximity; Spacious areas with direct relations to well articulated smaller areas. This conclusion has many similarities to that of prospect and refuge theory. As we have made clear in our approach to the existing material, this is by no means a counter theory to Permeability, but rather an additional layer.

PRINCIPLES OF PREFERENCE

THE INSTINCTIVE HUMAN PREFERENCE

"Habitat theory, provides the designing architect with a whole new set of tools to understand which characteristic traitss of an environment enables the inhabitant to dwell and thereby allow life to take place."

In answer to the thesis question: *How can findings from the field of Habitat theory define an instinctive human preference for the artificial environment of architecture,* we present four principles of preference derived from the knowledge gained in the field of Habitat Theory.

The principles revolve around Darwinism in that it suggest that animals who preferred habitats that were conducive to their survival would live to reproduce, whereas animals that chose habitats that did not meet their survival needs would reproduce less, eventually leading to an inborn preference for habitats that appeared to meet survival needs. The answer to the thesis question has lead to the four principles of preference which will be presented with their theoretical underpinning as well as their translation into the artificial environment of architecture in the next chapter

"It can now be observed that seeing and hiding have a unique complementary role to play in all these 'primitive' activities. But the spontaneous appraisal of the landscape can only be successful in safeguarding the observer if it is followed by the inducing of anxiety or restlessness which will prevent the creature from relaxing its attention to potential danger until it has found an environment which furnishes the conditions for protecting itself from such danger and, whatever these conditions may ultimately be, they are first apprehended in terms of the ability to see without being seen. Where these conditions are present their perception is attended with pleasure; anxiety is set aside and relaxation is possible. Where they are absent anxiety continues and there is no relaxation" (Appleton, 1975, p. 71)

The above quote, highlights the need for an understanding In the architectural design process, this understanding being; a biological basis for aesthetics is dependent on an environment meeting or seemingly meeting our survival needs, is crucial for designing architecture which allows the inhabitant to dwell. Gaston Bachelard (1994) considers the word dwelling; *"to dwell* *as in to reside, to dwell on a thought or a subject, in dwelling we create dwelling places"* (Bachelard, 1994, p. 4) by extension we could argue that it is not the dwelling that creates the space, but that it is the specific character of that space that allows for dwelling. Christian Norberg Schulz (1980) identifies and investigates this phenomenon as the relationship between architecture and its site. He argues that a concrete term for environment is place. He describes how place is evidently an integral part of existence as it is in fact meaningless to imagine any occurrence taking place without reference to a locality;

"The existential purpose of building (architecture) is therefore to make a site become a place, that is, to uncover the meanings potentially present in the given environment." (Norberg-Schulz 1980, p. 18)

Habitat theory, provides the designing architect with a whole new set of tools to understand which characteristic traitss of an environment enables the inhabitant to dwell and thereby allow life to take place.

The principles put forth by this thesis are meant to aid the design by informing the process, or enabling the designer to make more informed decisions. The principles are construed from a biological preference of environments that meet our survival needs, knowing the origin and aim of the principles of preference, it should be made clear that these are not rules of successful architecture, they are only biological preferences.

Knowing the preferences and the rules allows the designer to make an informed decision about consciously breaking the rules of preferences in order to evoke other feelings in the human being such as; danger, alertness, disorientation, contrapment or exposure. The principles laid out, exemplified and theorised in the next parts of this

thesis consciously informs what the good architect often knows intuitively and thereby aids him in his decisions and reasoning in construing architecture, which in itself is a human preference.

UNITY & UNIQUENESS

THE UNIQUENESS OF THE ARCHITECTURE SHOULD ARISE FROM ITS SPECIFIC LOCALITY TO CREATE UNITY.

"Man
symbolises his understanding
of nature
by translating this understanding
into another medium,
such as architecture"

Summary

To intrigue and create an initial fascination for the architecture, a certain degree of unity with the specific location of a construction is needed. This unity arises from the uniqueness of the location. By communicating and being sensitive to the uniqueness of a location, architecture becomes a manifestation of place.

Theoretical Underpinning

The principle of unity and uniqueness is primarily derived from Information Processing Theory, which suggests that humans have had to develop their informational processing ability of the environment in order to compete with other species. Environments that facilitate and stimulate the acquisition of knowledge will be prefered as they are conducive to the preservation of the species.

Secondly this principle is backed up by Humphrey's structuralist theory which posits the idea that aesthetic appreciation itself serves a biological function, suggesting that an environment is found to be beautiful because it is conducive to expanding our world model, by providing new information which is neither too easy or too difficult to grasp. A world model is a way of predicting future events using past experience, such a model enables us to associate characteristics with the relationships between objects, allowing us to predict the course of events. Structuralist theory suggests that aesthetic appreciation is a taxonomic process where we classify objects in order to predict future situations and change our behavior accordingly. This world model functions as a shortcut for reducing thought load and therefore response time, allowing us to distinguish threatening objects and make faster decisions, not getting ourselves killed. The environments and objects in the world that we find most beautiful are those that lend themselves to this process, variations on a familiar theme, defined by Humphrey as rhyme.

Aesthetic appreciation itself, therefore serves a biological function and the aesthetic preference for an environment lies in its facilitation of classifying of objects within an existing world model. Beautiful environments are therefore ones that facilitate the gathering and classifying of information.

That humans take pleasure in the process of adding information to their world model is supported by Kaplan and Kaplan in their information processing theory. In their research they found that in order for scenes to be preferred they must have at least a modicum of complexity and coherency. The complexity being immediately apparent and encouraging further exploration and study, and the coherence enabling the understanding of this further study.

Kaplan and Kaplan (1989) hereby identify the important relationship between human beings and the larger whole, concluding that occasional fascinating elements, elements not yet classified, encourage us to conduct further investigation, on grounds of their complexity. The variations on a theme, the complexity or the rhyme, in our environment will only be momentarily interesting if they are not coherent and connected to a larger whole. Even a series of novel elements will not engage us if they are unrelated. The existence of a larger pattern of which we form a part is required in order to engage high-level human motivation, this is due to our fascination with discovering patterns in series of seemingly unrelated objects or classifying according to structuralist theory (Humphrey, 1980) (Kaplan & Kaplan, 1989).

In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment,

forming a part of a connected whole will stimulate us to a greater extent.

The Translation into Tectonics

"The basic act of architecture is therefore to understand the "vocation" of the place. In this way we protect the earth and become ourselves a part of a comprehensive totality. What is here advocated is not some kind of "environmental determinism". We only recognize the fact that man is an integral part of the environment, and that it can only lead to human alienation and environmental disruption, if he forgets that." (Norberg-Schulz. 1980, p. 23)

In his book: Genius Loci: *Towards a phenomenology of architecture* (1980), Christian Norberg-Schulz underlines the importance of architecture to immerse itself into its specific site in order to transform the site into a place, he argues that the existential purpose of architecture is to make site become a place by uncovering the meanings potentially present in the given environment (Norberg-Schulz, 1980, p. 18). Norberg-Schulz describes this symbiotic relationship between man-made things and the natural environment by arguing that man wants to visualize his understanding of the natural environments structural composition by building what he has seen. complementing the given site and situation by adding what it is lacking in order to "complete" the place. Man symbolises his understanding of nature by translating this understanding into another medium, such as architecture, whose properties make the character of the place manifest. (Norberg-Schulz, 1980, p. 17) In other words,

"Natural objects possess what we might call an organic unity with their environment of creation: such objects are a part of and have developed out of the elements of their environments by means of forces at work within those environments. Thus the environments of creation are aesthetically relevant to natural objects." (Carlson,

Figure 10 Kunsthaus Graz working against the principle of Unity and Uniqueness by rejecting its context

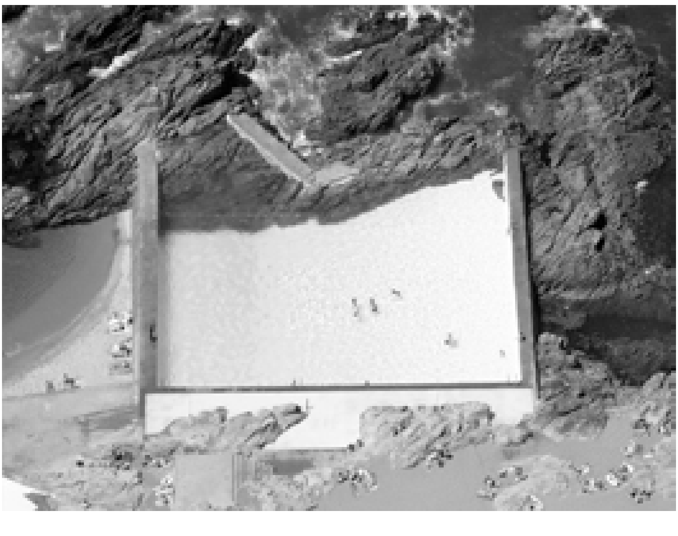


Figure 11 Leca Pool becomes a manifestation of place, by submerging itself into its context

1979, p. 44)

In terms of man made things and their relation to the environment this is described in genius loci:

"In other words, man receives the environment and makes it focus in buildings and things. The thing thereby explain the environment and make its character manifest." (Norberg-Schulz, 1980, p. 16)

The importance of these observations by Christian Norberg-Schulz and Carlson lies in the implication that man gathers the experienced meanings of objects to create for himself a microcosmos which concretised his world model. As epitomised through the theory, these observations are perfect examples of man's need to decipher patterns to then manifest these patterns in terms or tools that he finds familiar to his world model.

"In general we may conclude that place is the point of departure as well as the goal of our structural investigation; at the outset place is presented as a given; spontaneously experienced totality, at the end it appears as a structured world, illuminated by the analysis of the aspects of space and character" (Norberg-Schulz, 1980, p. 18)

The reason for why a structure of architecture fascinates us initially, comes from a variation on a theme. The theme being architecture, with its well known elements, as for example Semper's four elements of architecture, Where Semper (1989) attempts to explains the origins of architecture through the lens of anthropology. He boils the elements of architecture down to; the hearth, the roof represented by carpentry, a weaved enclosure and the mound created by earthwork. This theory can symbolise a theme and it is the variations on the theme, the different ways that these four well known elements are connected created and put into existence, that initially fascinates us to conduct a further research into why and how this variation has arisen. If the fascination into this new level of complexity turns out to be unsubstantiated by its context and therefore fails to create a holistic coherency, which adds to or enriches the world model of the subject, the engagement with the object will be lost. The fascination springs from our evolutionary design, to classify all things in our world model in order to enable quick decision making regarding our survival.

Synopsis

- **The Unity between architecture and place enables understanding of both.**

- **The communication of the Uniqueness of a location through the architectural construction, serves as a manifest of the natural landscape.**

- **The communication of the Uniqueness of a location through the architectural construction leads the viewer to explore the architecture in its immediate dimension.**

- **Without Unity and Uniqueness the architecture will fail to awaken the interest of the viewer.**

- **The viewer is thereby much more unlikely to engage in the architecture if it is unified with the context.**

PERCEPTIBLE KNOWLEDGE

THE CONVEYING OF MATERIAL PROPERTIES AND FORCES AT WORK WITH RESPECT TO CONSTRUCTION

"The harmony that he feels
comes from his intimate understanding
of how this artificial environment works,
knowing that the roof
will not fall on his head
and being able to read
the structural integrity of this,
his cosmos."

Summary

By communicating the conveying of forces as well as the material properties of the construction elements in a visible and perceptible method, the architects knowledge is brought forth to both ensure the safety and understanding of the structure.

Theoretical Underpinning

This principle is derived and based primarily on the theories put forward by information processing theory. A short summary of this theory would suggest that humans have had to develop their informational processing ability of the environment in order to compete with other species for food. Acquiring and processing information about the environment is essential for the preservation of the species. Therefore environments that facilitate and stimulate the acquisition of knowledge will be preferred. The quality of an environment being clear enough to read, furthers the survival of the inhabitant in the simple sense, that it contributes to further understanding. This clarity can provide confirmation of the safety of the environment, resources or potential danger.

In the context of habitat theory, the theory simply explains a phenomenon created by the environment and the environmental effect on human evolution. Implementing the knowledge of legibility accumulated from the natural environment into the design process will help to underline the potential safety, resources or danger that the architecture may wish to convey. The key is to understand that we as architects are not the source of these emotions, these emotional reactions to architecture are embodied within us through the evolutionary relationship with the natural environment, represented by our current biology. An understanding of this relationship, as studied in this thesis through habitat theory, sheds light on the basis of

Figure 12 MVRDV going against the principle of legibility by hiding the steel vierendel structure in wood cladding

Figure 13 Peter Zumthor creates a highly legible structure by revealing the load bearing structure and its functions in materiality and application entirely.

our instinctual reactions to the environment, aiding the design process in the attempt to stimulate certain biological reactions from the inhabitant. The physical manifestation of this design tool, in the context of architecture, has to be the construction of which architecture by necessity derives.

The Translation into Architecture

"Surrounded by a world full of wonder and forces, whose law man may divine, may want to understand but never decipher, which reaches him only in a few fragmentary harmonies and which suspend his soul in a continuous state of unresolved tension, he himself conjures up the missing perfection in play. He makes himself a tiny world in which the cosmic law is evident within strict limits, yet complete in itself and perfect in this respect; in such play man satisfies his cosmogonic instinct." (Gottfried Semper as quoted in Frampton, 1995, p. 13)

As an introduction to the theories chapter Gottfried Semper was quoted on the above. He talks of the cosmogonic instinct of man. Man needs to create and be in control of his universe or his cosmos, he satisfies this instinct when he constructs his dwelling. In this artificial environment, man achieves harmony from the unresolved tension he feels from the forces in this world that he longs to understand, but is unable to decipher. **The harmony that he feels comes from his intimate understanding of how this artificial environment works, knowing that the roof will not fall on his head and being able to read the structural integrity of this, his cosmos.**

"For our house is our corner of the world. As has often been said, it is our first universe, a real cosmos in every sense of the word."(Bachelard, 1994, p. 4)

On this note Marco Frascari's (1981) approach to tectonics, described in his *The Tell-the-Tale Detail,* Ph.D Dissertation becomes very relevant as he is focused on the *"techne of logos and logos of techne"* (Frascari, 1981). Here we refer to the greek meaning of the word techne, which as Heidegger points out meant a revealing of truth, belonging to poesis, that is making.

"It is the outcome of a skilled and intelligent art of dealing with natural things for the sake of intensifying, purifying, prolonging and deepening the satisfactions which they spontaneously afford." (Dewey, 1925, p. 389)

Techne is the craftsmanship the revealing of the true properties of the processed material. techne of logos and logos of techne is the knowledge of craftsmanship and the craftsmanship to bring forth that knowledge in the element crafted. This ties back to both Semper and his theory on man's need to understand his world in order to dwell in harmony, as well as it is explained by the concept of legibility.

The legibility of a structure, not just the craftsman's ability to build a sustainable structure, but also to convey this ability and the specific means by which he obtained structural stability, can provide a reassurance that allows us to put our minds at ease and focus on satisfying other biological needs.

Relating this to the term poetics of construction coined by Kenneth Frampton, who devoted his book; *Studies in Tectonic Culture* to the expressive potential of the tectonics and doing this without restricting this expressive potential to "speak the truth". In speaking the truth, we mean, that the tectonics do not necessarily convey how it handles the forces at work internally and/or externally. Instead he separates the term into tectonics and atectonics, both bearing equal ability to effect the unconscious and conscious mind of the inhabitant, even though our biology shows a clear preference for tectonics in the sense that Frascari communicates.

Synopsis

- **The perceptibility of knowledge in the construction is an extension or the realisation of the Biological principle of preference; Unity & Uniqueness.**

- **The perceptibility of knowledge in the construction provides the viewer with the confidence to investigate the structure further.**

- **By investigating the structure further the Perceptible Knowledge in the structure connects the structure to a larger whole.**

- **The existence of a larger pattern of which we and the architecture forms a part, enables the viewer to engage high-level human motivation.**

- **Understanding and using the biological principle of preference, Perceptible knowledge, the designer permits the quality of architecture immersing itself in its environment.**

TERRITORY, VISUAL RANGE & ESCAPE

THE ABILITY TO DEFEND OR ESCAPE A TERRITORY

"The properties of such a refuge is a small well articulated area easily recognised as occupied territory whilst remaining a degree of visual and locomotive permeability, so that the refuge does not become a trap."

Summary

A conflict arising in a social environment represents a hazard to our safety that automatically transfers the human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations by clear demarcations of territory.

Theoretical Underpinning

Permeability theory puts forward the idea that being able to escape from danger is the most important biological function of any animal. Being able to escape depends on two factors, perceiving a threat and being able to move away from it. These two factors are termed visual and locomotive permeability by Stamps in his permeability theory from 2003. His theory is translated into spatial design through very thorough empirical observations and is derived from a notion put forward by Heini Hediger in his book, first published in 1955; The psychology and behaviour of Animals in Zoos and Circuses:

"The most important biological activity of all animals, for that matter of all living organisms, and to which all their biological functions and behavior are directed, is without any doubt the preservation of the species… The satisfaction of hunger and sexual appetite can be postponed: not so escape from a dangerous enemy. As far as the higher animals are concerned, escape must thus at any rate be considered as the most important behavior biologically. The primary duty of the individual, to ensure its own existence, and thus the preservation of the species, lies in being prepared to escape." (Hediger, 1968, p. 39).

Therefore, properties of physical environments that mitigate either perceiving through or moving through those environments are strongly related to responses of perceived safety and environmental preference.

As Appleton also touches on in relations to perceived safety, when he proposes that aesthetic satisfaction in the natural environment, stems from a spontaneous perception of features of the natural environment, the visual attributes of which act as sign stimuli indicative of the safety of the environment and its ability to sustain life - *"Whether they really are favourable or not. This proposition we can call habitat theory."* (Appleton, 1975, p. 69)

This phenomenon, of an environment seeming to be favourable to survival, is visible, in an architectural context, in the words of Gaston Bachelard from his book; The poetics of space.

"…whenever the human being has found the slightest shelter: we shall see the imagination build 'walls' of impalpable shadows, comfort itself with the illusion of protection- or, just the contrary, tremble behind thick walls, mistrust the staunchest ramparts. In short, in the most interminable of dialectics, the sheltered being gives perceptible limits to his shelter." (Bachelard, 1994, p. 5)

These perceptible limits given by the sheltered being is in this sense, given by the biology of the sheltered being. Our sense of safety is thereby determined by, mostly unconscious, programmed perception, not necessarily by the actual safety or danger of the environment.

This is highly relevant to architecture, as nature has shaped this programming in our biology, the perceived safety and danger in the natural environment most often will correlate with the actual safety or danger in the environment. As architecture is man made, a deep understanding and knowledge of habitat theory, and the influence of the natural environment on our biology, would be required to ensure that this correlation between perceived and actual safety is in fact present in the artificial environment that architecture creates.

The principle of *Territory, Visual range and Escape* will more specifically be working with all the elements from habitat theory that has an impact on the PPA (the Parahippocampal Place Area), the region in the brain that responds specifically to spatial enclosure. All theories regarding spatial enclosure have a natural and easy translation into architecture.

The principle of *Territory, Visual range and Escape* does not derive from one or two elements of habitat theory, but rather four highly overlapping theories; Prospect & Refuge (Appleton, 1975), Savannah theory (Butzer, 1977), Legibility and mystery (Kaplan & Kaplan, 1989) and Permeability theory (Stamps ,2003) and furthermore we found it necessary to introduce social behaviour (Sommer, 2007) in the theory and method criticism.

The Translation into Architecture

To relate the principle of *Territory, Visual range and Escape* to a theory directly related to architecture we can look to the solid-void theory (Frederick, 2007). The solid-void theory states that the volumetric spaces shaped or implied by the placement of solid objects are at least as important as, the objects themselves.

Relating this to the theory and method criticism where we establish that large rooms, orienting its users towards a center, makes it difficult for people to retreat and that irregular shaped spaces are more likely to need defending as its irregularity is likely to be accompanied by vague indications of boundaries leading to more frequent disputes over the ownership of that particular area. Area shape thereby has a weighty effect on defensive behaviour. Small but well articulated areas are more easily defendable and recognisable as occupied territory, in comparison to large unobstructed areas (Sommer, 2007, p. 62-72). As we also establish in the section of theory and method criticism, these findings are in compliance with savannah theory. The key findings from the chapter on theory and method criticism, summing up Prospect & Refuge, Savannah Theory, Legibility and Permeability Theory, and its realisation into architecture is that a clear preference exists for spacious areas with a high degree of visual and locomotive permeability. These characteristics allow for greater legibility of the space and thereby greater confidence to dwell and move about in the spatial enclosure. The complications with such a composition is pointed out by Savannah Theory and Prospect & Refuge Theory, as a need for refuge would become immediate when a perceived threat enters the environment. The legibility and the spaciousness allow for a quick reaction and overview of the environment, but in the case of a threat appearing a place of safety is needed for retreat to avoid conflict and possible death. The properties of such a refuge is a small well articulated area easily recognised as occupied territory whilst remaining a degree of visual and locomotive permeability, so that the refuge does not become a trap.

This is where the concept from solid-void theory becomes interesting as it puts forward the statement that the volumetric spaces shaped or implied by the placement of solid objects are at least as important as, the objects themselves. The interesting aspect being the implied space, as this would enable us to create a clearly defined territory without eliminating the visual and locomotive permeability in relation to the larger space.

Positive space, which is a space with a defined shape and a sense of boundary or threshold, is almost always preferred for lingering, dwelling and social interaction and can be defined in an infinite number of ways; by points, lines, planes, solid volumes, trees, building edges, columns, walls and innumerable other elements. (Frederick, 2007) With the knowledge obtained from Habitat theory, the intuitive and well known theories from architecture, becomes informed and can be implemented with the argumentation of concrete empirical evidence as well as being employed to a defined and conscious purpose rather than relying on the architects intuition alone.

Synopsis

- **A high degree of visual range offers appropriate warning time for the subject to engage in other functions.**

- **A high degree of walkability enables the subject to avoid confrontations when possible threats are detected.**

- **When a threat is detected it is preferred to retreat to a place of safety.**

- **The safety of a refuge is dependent upon the perceptible limits the subject gives it.**

- **These limits are partially dependent upon a clear demarcation of territory.**

- **For the refuge not to become a potential deathtrap, visual range and possible escape needs provided.**

- **There is a clear preference for large spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhibiting the same visual and movable properties, these properties extending to the larger space.**

EXPLORATION

THE PROMISE THAT FURTHER INFORMATION COULD PROFITABLY BE ACQUIRED.

"Mystery
can be
the guiding factor
that makes
the user
want to go
where they are
meant to go."

Summary

To further engage the viewer in exploration of the architecture, the presence of mystery is required, mystery is simply the promise that more information could profitably be acquired.

Theoretical Underpinning

The biological principle of preference for exploration is derived from the Kaplans information processing theory. The basis of this theory was developed by Stephen Kaplan (1972,1973, 1976) who argues that human beings could not have survived as big game hunters on the african savannah by physical prowess alone, and that the development of an ability to outsmart prey was a fundamental factor in the survival of the species. It is the ability to utilise our intelligence to a far greater degree than other animals that has been vital for our survival. Our survival has therefore depended on the evolution of human beings towards processing large amounts of information about the environment in order to survive. This is the main body of argumentation that leads the Kaplans to posit that environments that facilitate a human's ability to understand and gather further information will be preferred it is simply adaptive to prefer environments that are conducive to survival. Gathering additional information and recognising patterns, improves the subjects ability to predict future situations with similar patterns to those already experienced. Using information from the past to predict the future has obvious survival benefits in terms of adapting our behaviour towards a favourable outcome.

This keystone in human functioning has been recognised by the Kaplans not to be a passive system, on the contrary human beings actively seek out additional information The Kaplans also assert that exploration and the act of gathering further information about our environment is an omnipresent human necessity in terms of broadening our perspective. If both of these assertions are true then environments that facilitate understanding and exploration will be preferred to those that do not allow these functions.

The Translation into Architecture

"As we move through buildings, towns, and cities, we mentally connect visual cues from our surroundings to our needs and expectations. The satisfaction and richness of our experiences are largely the result of the ways in which these connections are made.
Denial and reward can encourage the formulation of a rich experience. In designing paths of travel, try presenting users a view of their target—a staircase, building entrance, monument, or other element—then momentarily screen it from view as they continue their approach. Reveal the target a second time from a different angle or with an interesting new detail. Divert users onto an unexpected path to create additional intrigue or even momentary lostness; then reward them with other interesting experiences or other views of their target. This additional "work" will make the journey more interesting, the arrival more rewarding." (Frederick, 2007, note 11)

The above quote on denial and reward, is an example of how to create mystery and engage further exploration in an architectural setting. Empirical evidence provided by two articles written by Arthur E. Stamps, from 2007: *Mystery of Environmental mystery and Entropy and Environmental Mystery* also conclude that mystery is strongly influenced by the amount of light, and that mystery is moderately influenced by occlusion. Stamps also concludes that he was unable, through two attempts, to establish any solid connection between uncertainty regarding what might come next and a preference for mystery. This correlates with the Kaplans' observations on the difference between mystery and surprise:

"A path leading to a visible closed door suggests surprise but not Mystery. For the latter, the change in vantage point needs to provide information that is continuous with what is already available, rather than a surprise. Given the continuity, one can usually think of several alternative hypotheses as to what one might discover - in other words, there is both inference and a sense of exploration." (Kaplan & Kaplan, 1989, p. 56)

The insinuation of the architecture, which can be produced by perceptible knowledge in the structure, Territory, Visual Range and Escape in the spatial enclosure and the overall faithfulness of the architecture to the Unity and Uniqueness of its site, will provide a reassurance of continuity in the architecture which will not surprise the subject, but simply afford them further knowledge and information about their environment.

The principle of exploration can be employed to guide the user in and around the environment. Using the principle of exploration, the architect can direct the flow, pace and direction of the user, without giving the user the feeling of being herded like cattle. Mystery can be the guiding factor that makes the user want to go where they are meant to go.

Synopsis

- **To further engage the viewer in exploration of the architecture, the presence of mystery is required.**

- **Mystery is the promise that more information could profitably be acquired.**

- **Mystery is not surprise, surprise is not preferred in an architectural setting according to our biology.**

- **Surprise is avoided by fulfilling the previous** principles of preference, as these gives the architecture continuity.

- Continuity provides confidence in the subject that the discoveries made by the exploration is implied in the architectural setting already.

- The sense of mystery can be achieved for example with the technique of 'denial and reward', or light and occlusion.

- Unity and Uniqueness and Perceptible knowledge, provide a certain identity to the architecture derived from its context, the faithfulness to these principles allows the subject to hypothesise on what one might discover, eliminating the sensation of surprise.

- The principle of Territory, visual range and escape provided in the spatial enclosure also ensures a favourable outcome of an exploration of the architecture as the principle facilitates safety.

THE FOUR PRINCIPLES

THE IMPORTANCE OF THE PRESENCE AND INTERACTION OF ALL FOUR PRINCIPLES IN A HIGHLY PREFERRED SETTING.

"The most preferred scenes contain a high degree of mystery, where there is partially hidden information and an element that tempts the viewer to investigate."

The Success of Unity and Uniqueness is Decided Instantaneously

The patterns suggested by the Kaplans' observations are that for a scene to be preferred it must at least have a degree of *Unity & Uniqueness* a lack of *Unity* prevents us from understanding and a lack of *Uniqueness* will not lead us to explore the image in its immediate dimension.

However the studies conducted by the Kaplans show that increasing the amount of *Unity and Uniqueness*, will not necessarily lead to the stimuli being more preferred. This makes sense in the context of this preference; this is not a preference which the subject arrive at after intellectual contemplation, this is a preference that is decided instantaneously. Increasing the *Unity and Uniqueness* is not going to change that first hand fascination that lead us to explore the image in its immediate dimension, the results reach a plateau.

A Pleasant Challenge for the Imagination

The Kaplans research shows that the same is not the case for the factors that rely on inferred information, here the results do not plateau. Inferred information in regards to the principles of preferences, includes: '*Exploration*', and '*Perceptible Knowledge*'. Increasing the impact of these two principles will increase the preference for the artificial environment.

'*Exploration*' and '*Perceptible Knowledge*' represents a pleasant challenge to the imagination which encourages the viewer to investigate a setting further to gather the information which may perhaps is at be first hidden. For that to be possible the observer must be able to move freely within an environment.

What the Kaplans found through their empirical evidence was that the most preferred scenes contained a high degree of mystery, where there is partially hidden information and an element that tempts the viewer to investigate.

A Highly Preferred Artificial Environment

However the Kaplans note the importance of not isolating and optimising one factor at the expense of others. When designing a highly preferred setting, the interaction between these factors plays an important role, as we will try to explain in the following

The research by the Kaplans forms the basis for the necessity of the presence of all four principles of preference in an artificial environment of architecture: To engage higher order thinking or just to awaken interest for a building it must have at least a degree of *Unity and Uniqueness,* without it, the subject will feel no need to investigate the architecture in its immediate dimension. After catching the interest of the viewer the designer might require the subject to engage further with the architecture. To provide the viewer with enough confidence to do so the architecture should have a high degree of *'Territory, Visual Range and Escape'* and *'Perceptible Knowledge'*. These will assure the viewer about his ability to orientate himself and suggest that the setting will continue to be understandable, whereas *'Exploration'* is the preference that encourages the viewer to further explore the scene, with its promise of more information.

USING THE PRINCIPLES OF PREFERENCE

IMPLEMENTATION IN THE DESIGN PROCESS

"Employing the principles of preference
can assist
in the creation of
a highly preferred
artificial environments,
evoking emotions appropriate
to the given context."

To exemplify the principles of preference's impact on architecture we will conduct a case study, pinpointing the qualities in the architecture that has an effect on our instinctive like or dislike of the artificial environment. But the principles of preference is not meant as a analytic tool as much as it is a design tool.

Unity & Uniqueness

The underlying Habitat theory behind the principle of Unity and Uniqueness suggests that humans have had to develop their informational process ability of the environment in order to compete with other species. Environments that facilitate and stimulate the acquisition of knowledge will therefor be preferred as they are conducive to the preservation of the species.

To gain the initial interest of the viewer the architecture must contain a new variety of complexity, which will be the uniqueness of the architecture, but to maintain the viewers interest, this uniqueness must be derived from the architectures context, which will be the unity.

In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming part of a connected whole will stimulate us to a greater extend.

The unity between architecture and place offers the architecture its unique character and enables understanding of both the place and the architecture and the architecture thereby becomes the manifestation of place.

Using this knowledge consciously in the design process, the first step to creating architecture is to investigate its context and let the context do the legwork of deciding what foundation would be most suited to the terrain, which building materials would be best suited according to weather, supply and construction limits due to the location, which slope should the roof take to accommodate precipitation, Where should the openings in the building envelope be located according to views, terrain access, heat transmission, energy consumption and ventilation, and so on. The unique character of the design of the architecture should be derived from the context to create the unity with the place. In this way architecture can enrich the beauty of the place by enriching the understanding of the place for the viewer, reading the architecture will be reading the site.

Perceptible Knowledge

From the point of view of habitat theory, the quality of an environment being clear enough to read, furthers the survival of the inhabitant in the simple sense that it contributes to further understanding. This clarity can provide confirmation of the safety, resources or potential danger of the environment. The perceptible knowledge of a structure is not just the craftsman's ability to built a sustainable structure, but also his ability to convey this skill. Crafting a structure that allows the viewer to read the knowledge of the specific means by which the crafter obtained structural stability. This quality characteristic in the detailing of structure as well as the architecture as a whole can provide a reassurance that allows us to put our minds at ease and focus on satisfying other biological needs, or indeed do the exact opposite. What and how much is the structure supposed to communicate, this will need to be answered in the design process, before the detailing of the architecture can commence.

This ease and reassurance is obtained through the design process of detailing the structure both in compliancy with the architecture as a whole, the certain properties of the specific material and the way in which the detail conveys the forces of the structure.

Before choosing the construction material it is necessary to know what type of force there will be inflicted upon the material and equally important the architect will need to know what- and how much knowledge the viewer should gain from the construction. What is the feeling that is wished provoked by the architecture upon the viewer.

Territory,
Visual Range & Escape

A conflict arising in a social environment represents a hazard to our safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations by clear demarcation of territory. This could be achieved with large open spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and movable properties, these properties extending to the larger space.

From all this information it is down to the skill of the architect, to connect the dots of all the gathered knowledge from the context and synthesising it into one unifying shape.

Exploration

A conflict arising in a social environment represents a hazard to our safety that automatically transfers a human being into a fight or flight state of mind. Without a flight possibility the subject is left in constant stress as a potential confrontation could turn out to be lethal. This can be prevented with appropriate visual range and escape opportunities. Furthermore it is possible to minimize confrontations by clear demarcation of territory. This could be achieved with large open spaces with a high visual range and a high degree of walkability with connections to smaller well defined areas inhabiting the same visual and movable properties, these properties extending to the larger space.

An analysis of the social space is necessary to determine in which direction it is wished to guide the social interaction. Is the social meeting between strangers or people very familiar to each other, is the activity of an extrovert or an introvert character or is it a place of transit or pause. Knowing the preference for space aids the understanding of how to achieve the appropriate mindset for the activity taking place within the architecture.

From all this information it is down to the skill of the architect, to connect the dots of all the gathered knowledge from the context and synthesising it into one unifying shape.

Employing the principles of preference throughout the design process, can assist in the creation of a highly preferred artificial environments, evoking emotions appropriate to the given context.

Synopsis

- **Using the principle of Unity & Uniqueness in the design process is done by gathering all information about the site that could have an effect on the construction, such as: Geology for secure foundations, weather data for material choice, construction type, shape, location and size of openings in the envelope. Knowing the properties of local raw materials. As well as the more sensitive data, the tactility, palette and sense of the place. Letting the initial part if the design process be guided by the site, is how the architecture becomes a manifestation of place.**

- **Using the principle of Perceptible Knowledge in the design process calls for the architect to**

make a informed decision about what and how much information he wants the structure to communicate.

- **Using the principle of Territory, Visual range and Escape in the design process, regards the analysis of the character of the social interaction taking place within the environment as well as an analysis of the participants. This to gain knowledge of the appropriate state of mind that the architecture should facilitate.**

- **Using the principle of Exploration in the design process can aid the guidance of the user, letting the mystery intrigue the human beings need for exploration and thereby guide the user in and around the facilities.**

THE CASE STUDY METHODOLOGY

QUANTIFYING THE PRINCIPLES OF PREFERENCE

"Truth
changes accordingly
to the dynamic
between
the subject and the object"

Introduction to New Empirical Evidence

In determining how best to quantify these new principles and their application in architecture, a case study will be introduced, to help interpret the survey data of former empirical evidence introduced in the context of Habitat Theory.

A case study is simply a method, by which, information of a complex phenomenon can be learned. This learning is based on a comprehensive understanding of that phenomenon, which in this case is the four principles of preference derived from the thesis question: *How can findings from the field of Habitat theory define an instinctive human preference for the artificial environment of architecture*?

A comprehensive understanding of this phenomenon is obtained through extensive description and analysis of that phenomenon taken as a whole in its context. In this particular case, this would be a piece of architecture in its built context.

Qualitative Case Study Methodology

The method used is based on the qualitative case study methodology (Baxter, 2008). The methodology is based on a constructivist paradigm, which asserts that the truth is relative and that the truth always depends on one's perspective, saying that the methodology...

"...recognizes the importance of the subjective human creation of meaning, but does not reject outright some notion of objectivity. Pluralism not relativism is stressed with focus on the circular dynamic tension of subject and object" (Miller & Crabtree, 1999, p. 10)

There is no right or wrong in architecture, and good architecture cannot be put down to a checklist of preferences, it is the way in which the architect utilises knowledge which creates good architecture. The above thereby underlines why the case study is a well chosen approach in this particular thesis research, as truth changes accordingly to the dynamic between the subject and the object.

Thereby continuing the thread of Deweyan philosophy, rejecting any notion of universal truths. It would therefore be a waste of time to try and find an average design that is most pleasing to the largest amount of people, through a large survey of people subjected to different artificial environments. Rather, it is more appropriate to use the empirical evidence for preference to inform the design process. It is a case of, knowing the rules, in order to break them. Knowing the biological preferences for our environment can help the designer to make informed decisions and argue these decisions, whether these goes for or against the preferences.

It is this paradigm that backs up the reasoning for choosing a case study as the media for illustrating, analysing and describing the four principles of preferences for the aesthetic qualities of tectonics and the artificial environment. Pure objectivity, questionnaires and observation is a field of its own, that has the potential to become comprehensive and time consuming, as it would take a lot of research on the methods of how to conduct the gathering of empirical evidence from these sources. Even then, this still does not guarantee full objectivity, the sources of which could have caused the loss of objectivity from either us or the test subject, would need to be covered, regarded as bias and speculated upon their impact on the empirical evidence.

In conclusion a case study is not an approach designed to reveal a universal truth, it provides a truth related to an individual study, in this specific case; on how human preference could be used to evaluate and inform architectural structures, without providing a universal truth to good design.

Why is a case study a good approach to this investigation?

The qualitative case study methodology (Baxter, 2008) allows us to investigate a complex phenomenon within its context. This facilitates an exploration ensuring that the phenomenon is not explored through a single lens, but rather a variety of lenses, allowing for all the multiple facets of the phenomenon to be revealed and understood. The need for this approach is underlined by Carlson (2005),

"natural objects possess what we might call an organic unity with their environment of creation: such objects are a part of and have developed out of the elements of their environments by means of forces at work within those environments. Thus the environments of creation are aesthetically relevant to natural objects." (Carlson, 2005, p. 44)

This is an idea that Christian Norberg-Schulz (1997) examines in *Nightlands*, when he suggests that life and place form a unit together, as demonstrated by the commonly used phrase, 'life takes place', from this we can assert that if architecture speaks of its place then it also speaks of the life inhabiting that place. Kaplan and Kaplan (1989) identify the important relationship between human beings and the larger whole, concluding that occasional fascinating elements in our environment will only be momentarily interesting if they are not connected to a larger whole. Even a series of novel elements will not engage us if they are unrelated. The existence of a larger pattern of which we form a part is required in order to engage high-level human motivation, this is due to our fascination with discovering patterns in series of seemingly unrelated objects. In terms of architecture this suggests that buildings that disregard the context in which they are situated will only hold our attention momentarily, whereas buildings that are rooted in their environment, forming a part of a connected whole will stimulate us to a greater extent. It is therefore impossible to look at architecture as isolated structure without its specific context. The case study allows for a much more holistic investigation, analysis of the theory and application of the principles.

This is the purpose of the case study; particularization, not generalization. By taking a specific case and getting to know this specific case well, conveying this knowledge through description. The choice of the case study approach is a sign of a phenomenon uniqueness dependent on its particular context, which architecture, according to the biological principles as well as previous architectural history such as Genius Loci (Norberg-Schulz, 1980), should be.

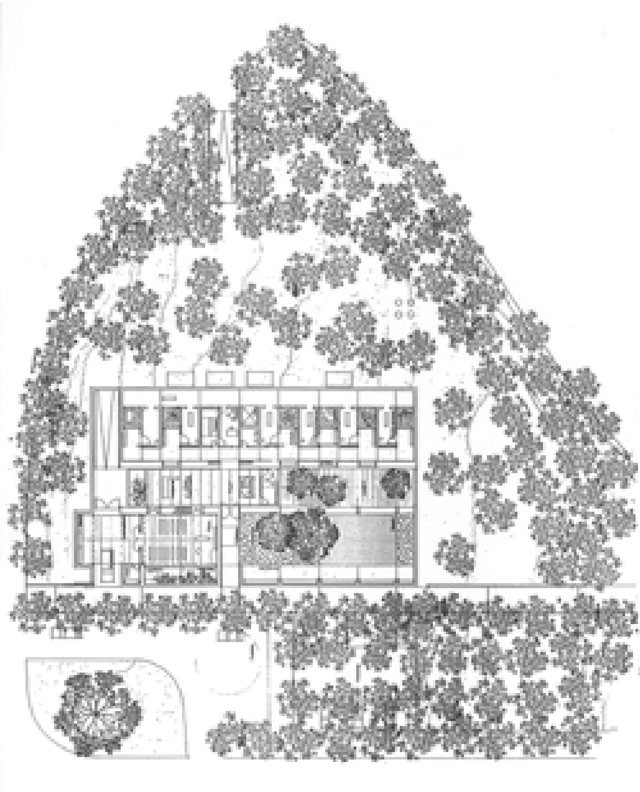
The Nature of this Case Study

The Case study of this thesis research will begin descriptively, meaning that it will simply describe the phenomenon, in this case a piece of architecture, and the context in which it occurs. This is to add realism and in-depth examples of how the biological principles of preference can be employed to evaluate architectural structures. The case study will then, during the investigation change nature, from descriptive to illustrative, meaning that we will give illustrative examples on how a different architectural structure would affect the viewer's impression of the architecture according to the application of the biological principles of preference.

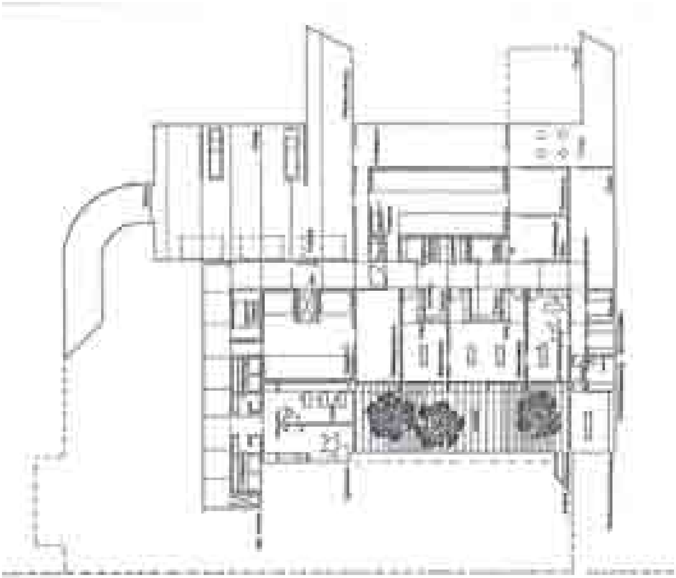
THE CHAPEL

FRIIS & MOLTKE
AALBORG, DENMARK
CLIENT: AALBORG KOMMUNE
COMPLETED IN 2000

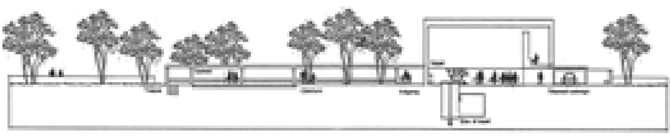
The chapel is situated in a green triangulated area, which borders residential areas on two of its sides and the hospital grounds on one. From the outside the architecture presents itself as a one-story building where only the chapel hall remarks itself in scale and thereby providing a clear perceptible knowledge of hierarchy.



Figur 14 Siteplan not to scale



Figur 15 Basement Floor plan not to scale



Figur 16 Section not to scale

Description of the case study, by method of the four biological principles of preference

Viewing the architecture as a passer by from the exterior, the outer perimeter of the building sits low in the context, on a gentle slope away from the hospital towards a residential area. The Chapel is geometrically strict in its orthogonal form, defined by the white concrete slabs by which suggest a compound. A structure approximately three times as high as the walls sits above the compound indicating a position of importance. The perimeter walls of the structure extend below the earth and are uniform as they meet the ground, with no variation to highlight that such a meeting is taking place, this conveys that the structure does not simply place itself upon the topography, but anchors itself by reaching deep within it. The rooting of the protecting walls of the outer perimeter combined with their low position in the landscape, their clean cut uniform surface, and the material properties of the hard and durable concrete, leaves the impression that the architecture is braced against the earth itself, as if the visible building is only the tip of the iceberg.

The above observations would indicate a great deal of mystery, implying that much more information could be acquired within this building, but arriving at the site and viewing the architecture this is not the impression left on the viewer, and neither is the architecture meant to invite exploration. The truth is that you would hardly give the building a second glance, unless you had business within it. It registers as little as a utility station for water or electricity, we know the building is there for a good reason, but how and why, seems to be none of our concern, and the architecture conveys this message, with its lack of openings; windows and doors. There is no spatial continuity when viewed from the exterior, in the Kaplans' terms the lack of openings represents surprise, not mystery (1989). The two access ways to the chapel are both sealed with iron gates, and the one view allowed into the reception courtyard is likewise gated.

The building is almost fortress like in its shutting out of the outside world, with a keep rising above the castle walls and bars on the gates, the only thing missing is a moat. We examined through sketching what happens when a single side of the compound is opened up as a colonnade, therefore creating a greater sense of spatial continuity. With the internal courtyard exposed the hostility of the structure diminishes and the courtyard becomes less defined physically, becoming part of the context as the spaces flow into one another. The courtyard is now more open and inviting to the outside and curious passers by even come in to have a look, however it is also more exposed to the outside world which is not necessarily a good thing for a funeral chapel to be, where the privacy of the grieving family should be of the utmost importance.

Louis Kahn is said to be the first to use the elephant and mosquito metaphor when referring to design, the elephant represents what we would call atectonic design, where the elements of the construction are unified in a single form rather than being expressed individually (Fehlbaum, 2009). In a mosquito building the individual elements are expressed as part of the composition which would be tectonic. That being said not all elephant buildings are atectonic and not all mosquito buildings are tectonic. The Chapel is arguably a bit of both. It is an elephant building in the sense that all of the rooms and spaces are enclosed within an orthogonal concrete compound, like a fortress as we previously discussed, the individual elements of the construction are not expressed as such but neither do they need to be because of the nature of concrete construction. The building is tectonic in the sense that we can read the structure quite clearly, it is easy to understand how and where the roof is supported because in most cases the entire wall is supporting it. Using a concrete structure allows the building to be plastic, in the sense that openings can be cut where they are needed, rather than having to obey a structural grid. By adding a colonnade one could say that the building will become more mosquito and less elephant by expressing individual elements of structure

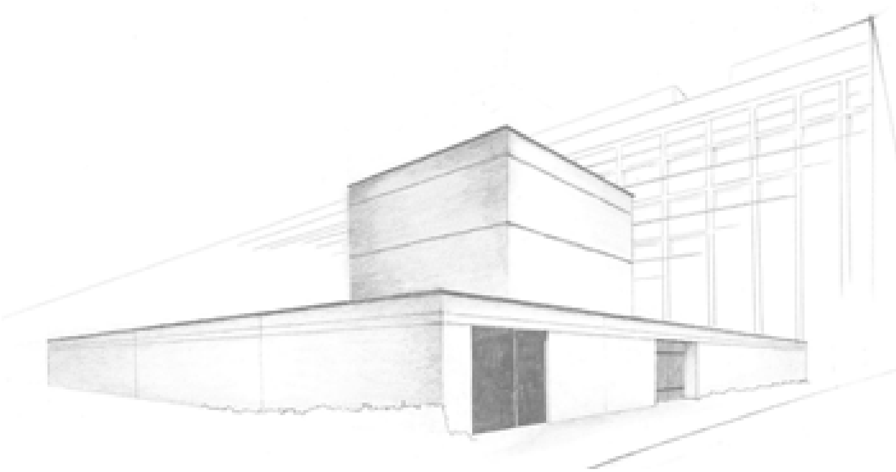


Figure 17 chapel exterior sketch

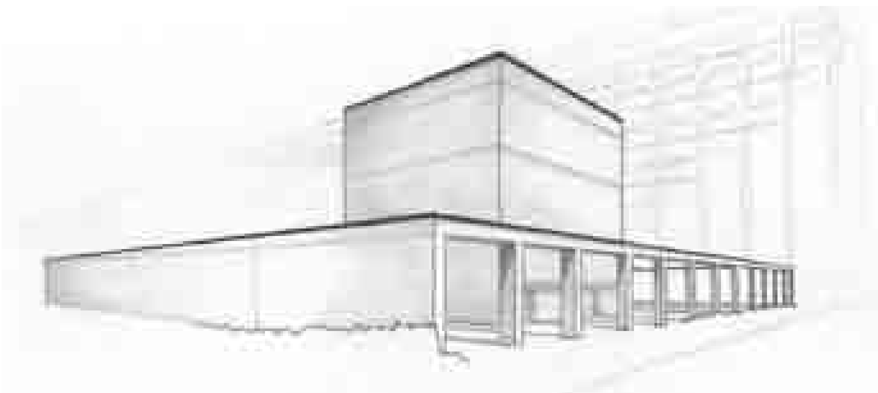


Figure 18 inviting the public in by opening the structure rather than a uniform surface.

In its existing state, an occupant of the courtyard who might be enjoying a private moment, may be surprised if someone were to enter the courtyard, there might even be some embarrassment as both parties feel that they are intruding on the other. The lack of spatial continuity and views out of or into the courtyard create surprise when a visitor enters the space. The high level of spatial definition and the absence of alternative escape routes may cause the occupant to feel like they are occupying a territory to be defended, but also feel trapped when the space is compromised by another visitor. We all know the feeling that accompanies a private moment disturbed by the arrival of others. If the space is opened to the exterior then the views into and out of the courtyard will provide people approaching with a signal that the space is already occupied, or the occupants with a warning that someone is coming. By opening the walls into a colonnade the definition of the space decreases, whereas before it might have felt like a private space, with a colonnade the space will feel more public. The colonnade will still provide some level of definition as a signal of entering a separate area but it will no longer be a physical barrier to vision and locomotion. Arguably this would be inappropriate, as mentioned before, the privacy of a grieving family is important in a funeral chapel and the level of introspection the courtyard currently affords is ideal for maintaining the privacy of the funeral process.

Exploration is a key theme in each of the theories that we have discussed previously and we can see in the case study how the concepts put forward by the Kaplans for example are expressed in architecture. As it currently stands the exterior of the compound lends itself more to surprise than mystery, and mystery is one environmental factor that can stimulate exploration (Kaplan & Kaplan, 1989). The compound is currently surrounded by a uniform concrete wall with strategically placed openings. Although the main gateway into the courtyard space is open, and the bars on the gate allow a view through, there is still a

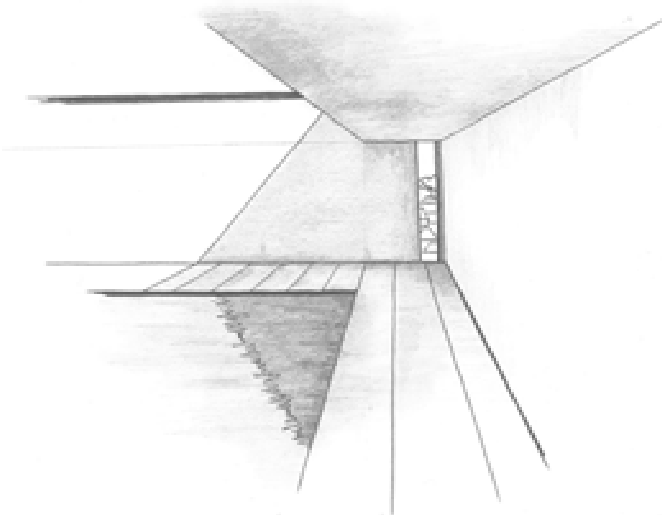


Figure 19 court yard sketch

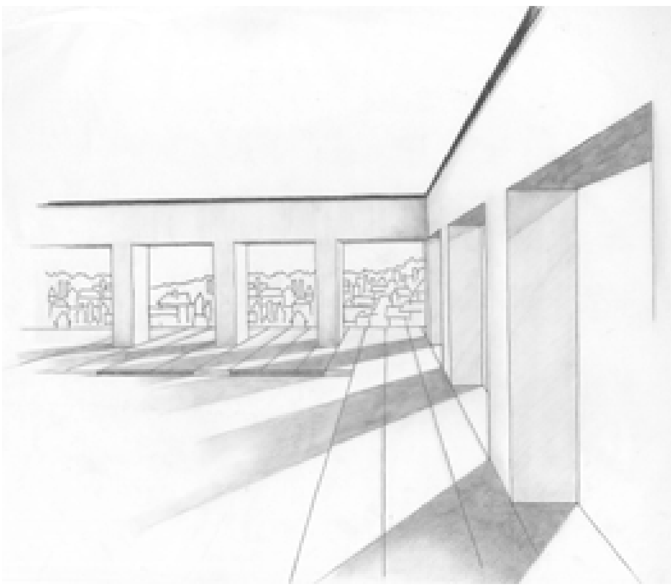


Figure 20 removing all mystery from the interior court yard by opening it up in a collonade strong sense of both mystery and surprise about the building when viewed from the outside. By opening the facade into a colonnade the surprise factor is almost completely diminished, but so too is the mystery, when everything is revealed there is no reason to explore further. Perhaps a colonnade with more solid than void, wider column and smaller openings might provide spatial continuity whilst maintaining some mystery and privacy for the courtyard, therefore stimulating exploration.

The anonymity of the exterior facade deliberately declines to invite the viewer to explore the interior more closely, it is not mystery, but surprise and thereby hazard that this building entails. The Chapel is introspective, oriented inwards, towards itself and does thereby not communicate directly to the bypasser. This introvert stance is what fails to interest the viewer into exploring the building in its immediate dimension and the viewer will therefore pass it by without much thought. This does not mean that the chapel in particular lacks unity and uniqueness, on the contrary, the Chapel by Friis & Moltke possess a great deal of unity and uniqueness, it simply means that the architecture has derived its unity and uniqueness from another source than its specific locality, namely itself.

A comprehensive knowledge of the culture and tradition of those using a Chapel is a prerequisite for its design. In this thesis we have limited ourselves to investigate the biological preferences, but we will argue that even though the architecture deliberately fails to engage the viewer with its hostility, and even though the building deliberately fails to submerge itself into its specific context, the chapel successfully submerges itself into the cultural and geographical context of the nordic countries, with its traditions and culture. We leave this statement unsupported as it goes beyond our investigation.

Entering the building through its main gate, the only gate permitted entrance for visitors, you enter the micro cosmos of the compound, enclosed on all sides by white concrete. The main entrance leads the visitor into a courtyard and as all views into the building are removed so are all views out, except one small slit opening. This small but very significant opening, contrasts and enhances the appreciation of the serene environment, there has been a shift in perception. Before entering the chapel, the building seemed like a small, insignificant and even unwilling contributor to the fabric of the cityscape. After entering, the small slit of cityscape puts in relief the cityscapes own insignificance in the context of the chapel interior. The small opening provides another dimension of depth in the environment, letting the eye reach far to focus on something much further away than the wall, not necessarily to see, what can be seen through the opening, but to gaze into and beyond the wall. The opening provides a visual range, but no escape. It frames a view, which is restricted by the dimensions of the opening on demand by the architect. The view cuts out the busy street, the hospital and its grounds and the immediate context around the building, allowing the viewer only a glimpse of the scenery in the far background, the residential area stretching up upon the hill till they fade out and let the natural greenery of the landscape take over with its trees reaching to meet the sky. The denial of the whole city, rewards the viewer by letting them see what would have been lost in the complexity of the context.

Rather than creating a connection to the outside world, the slit window seems to emphasise the distance between the courtyard and the context. The slit window provides what Christopher Alexander terms a 'Zen View',

"This is the essence of the problem with any view. It is a beautiful thing. One wants to enjoy it and drink it in everyday. But the more open it is, the more obvious, the more it shouts, the sooner it will fade. Gradually it becomes part of the building, like the wallpaper; and the intensity of its beauty will no longer be accessible to people that live there." (Alexander et al, 1977, p. 641)

By reducing the size of the view the architects emphasise the difference between the interior of the courtyard and outside world. The walls of the courtyard strictly define the space and therefore demarcate the boundaries of what is inside and outside. By contrast changing these clear boundaries to a colonnade as we saw in fig ? from the outside allows the spaces to flow into each other. Despite it being outside the boundary of the courtyard the view is now a part of the interior, it exists as a constant feature of the courtyard, the context and the building become more unified and their distinctiveness from one another is diminished.

The removal of the overhang and the the opening of the walls into a colonnade expand the visual range and locomotive possibilities within the space, however the space is also far less sheltered. Whereas the existing space is a place where one could sit and dwell the new space is a space to move through, a transition space, providing no corners or places to hide, no refuge, but plenty of options to escape.

In the existing building the slit window creates a sense of mystery as a view is provided but not fully revealed, it invites the observer to examine more closely. However, because the view is narrow there is no potential to explore beyond looking through the opening. Widening the view so that a person could move through allows further exploration of the space. The second sketch has opened the courtyard into a colonnade and removed the overhang. Removing the shelter provided by being in an enclosed space prevents the observer from relaxing, which cultivates a constant state of tension which will lead to further exploration of the space.

As a continuing theme throughout the building, all doors are made from copper and have a weight to them that gives way surprisingly easily when they are pushed open. In time the doors will tell their own story of how they have been used and how often, developing a patina across their surface. The copper on the exterior side of the door, has already gained a cooler dark

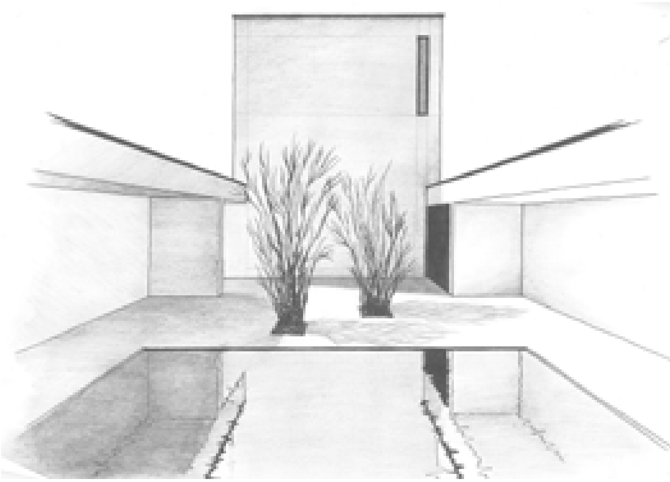


Figure 21 court yard sketch

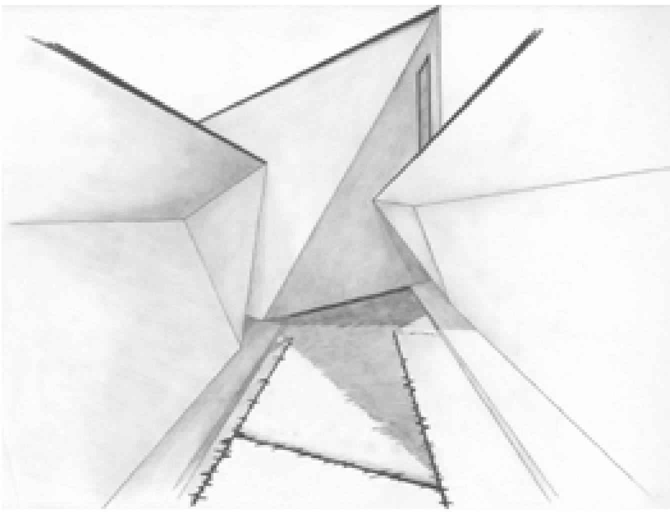


Figure 22 recreating the courtyard assymetrically with sharp unpredictable angles green color than the internal doors that are sheltered from the elements in the stable internal environment. The dark green of the door stands in contrast to the primarily cold pallette of the courtyard, white concrete and stone slabs, cold to the touch and often reflecting the cool and bright colour of the northern sky. This reflection of the sky is enhanced by a large, shallow pool taking up most of the surface of the courtyard. The stillness of the water surface, creates reflections of its surroundings as well as underlining the serenity of the courtyard within its protected walls, creating a sheltered environment from the wind and noise outside the chapel. The double axis symmetry with small variations, eases and calms the eye, creating a pleasant composition to dwell upon. The simple, almost spartan, unity of this composition, ensures the viewer that no surprise, hazard or unexpected element in the environment will appear, and this insurance allows the viewer to relax and dwell within this place, even before entering the interior of the building itself.

Entering the courtyard is like stepping into another world. The Chapel is located in a fairly busy area of the city but occupies a site that mediates between the grounds of a major hospital and a quiet residential neighbourhood. The entrance faces the quieter side, although upon entering the courtyard the silence is brought into sharper focus by the stillness of the space. The noise of the city feels distant when heard from inside the compound walls. This sense of stillness is brought about by several factors, not least of which is the shallow pool of water occupying the majority of the courtyard. The calm, flat surface of the pool provides a sense of tranquility that only the presence of water can create. In the pool, the reflections of the orthogonal form of the chapel can be seen clearly, creating an axis of symmetry in the horizontal plane of the water's surface. Symmetry has traditionally stood for order, reliability and predictability, which is certainly the case in this courtyard, where the double axis symmetry of the horizontal and vertical planes combine to create a sense of peace that greets the visitor before they enter the chapel. In contrast to the existing courtyard we can examine an asymmetrical version of the space, with sharp, unpredictable angles which change our perception of the perspective and add dynamism to the space where before there was stillness. In the existing courtyard the sense of stillness in the space emphasised its status as a separate world in contrast to bustle of the city, in the second version the courtyard retains the separateness but in a dynamic, visually exciting way, contrasting with the straight lines which the city is mostly composed from.

It is easy to understand visually how the structure of the existing courtyard is performing, it is a simple system of horizontal elements being supported by vertical elements. In the second sketch the system has been complicated, the irregular angles of the construction meet the ground oddly and seem to be out of balance with their weight, anchored into the ground through brute force rather than in an elegant system. There are forces at work which we cannot understand through vision alone, we would have to understand how the structure is fixed in the ground. The wall on the right hand side seems to be falling inwards creating a sense uncertainty about the stability of the structure, whereas the left hand side is leaning away, creating a visual imbalance in that direction.

There are two major differences between the two images. Firstly, in the existing courtyard there is a clear path around the water, and whilst the connection to the path cannot be seen from the view provided we feel as though we can move to the paths and therefore out of the courtyard through one of the openings at the far end. In the second courtyard the paths have been narrowed and the water is now blocking the connection between the two. The visual range of the image has also been reduced meaning that if a threat did come round the corner we would have a shorter length of time to perceive it and take a course of action. Our visual and locomotive abilities have been reduced by constraining the space we have in which to operate. Comparing the two scenes, we would arguably feel more awkward in the second scene if a second person were to enter the courtyard as there is less territory to share between two people.

In this image there is a discrepancy between what the drawing shows and what the real life observer experiences. In reality, one enters the space through the gap in the wall on the left hand side, meaning that this area has already been explored and the door opposite is the only way into or out of the courtyard which will lead us to the immediate deduction that it is the entrance to the building. However, looking at the drawing one would like to know what is around that corner on the left, far more than what might be behind the door on the right. This suggests a sense of mystery encouraging exploration which might be derived from the light that is shining into the courtyard from that side, where as the door is covered in darkness. The open entrance also has a sense of spatial continuity that the door lacks. In the second image the door is hidden and there are therefore two options for further exploration and a larger degree of mystery in the scene, this is combined with a smaller visual range and pathways that do not allow the occupant to relax until they have found a safe place in which to do so. The inclusion of a bench in the first image even suggests a place to relax, whereas in the second image there is not enough space for one to sit down without blocking the path.

Entering the foyer, through the heavy copper door, the viewer is presented with two options of exploration: Firstly a view straight ahead to four alternate directions, submerged in a repetition of dimmed, occluded warm light. Throughout the building the floor is expressed as a uniform surface of large tiles without any obstacles, such as thresholds and changes in material. The Plaster on the walls is almost silky to the touch and appears slightly porous to the eye, the softness and porosity of the walls combined with the slightly rounded edges, defined by an exposed metal frame, creates an impression of warmth, friendliness and continuation. The continuation is underlined by a slim black skirting tracing and embracing the length of the walls, guiding the eye around the corners of the space,

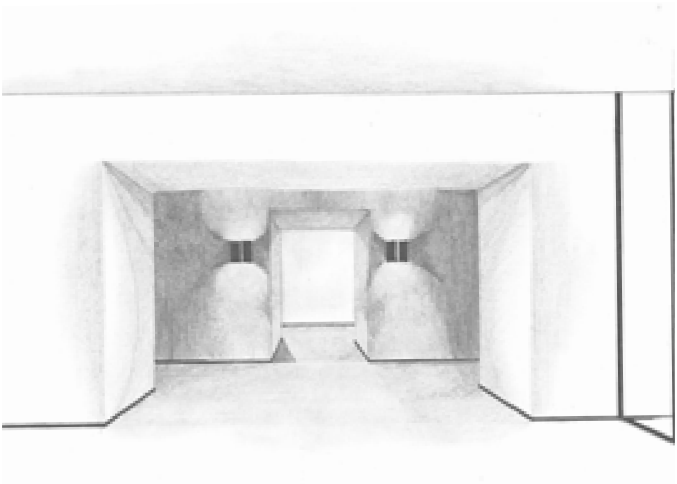


Figure 23 interior sketch, low visual permeability, combined with the insinuation of high locomotive permeability

Figure 24 creating visual permeability, but limiting the locomotive permeability bu installing a door

This insinuation of continuity combined with the occlusion leads the viewer onto exploration, as the high degree of unity and uniqueness creates a promise from the environment to the viewer of faithfulness to this coherence, letting the viewer hypothesise about what lies ahead, removing the sense of hazard there would be present in a possible surprise.

The contrast between the two images on the left hand page. clearly lies in the permeability of the walls. In the first sketch, the existing walls are solid, opaque and massive. They do not offer glimpses of what might be around the corner but through a tapestry of both light and dark, solid and void, they intrigue us and draw us in. We may be encouraged to pass through the darkened corridor and not to linger too long before moving into the well illuminated room beyond, or perhaps the darkness of the corridor may cause us to pause and turn to either side to examine where the passageway leads, if anywhere at all. In either case it is the contrasts combined with spatial continuity that leads us further into the image. By contrast the second sketch is far more open due to the visual permeability of the walls, yet the locomotive permeability of the scene has decreased due to the addition of a glass door directly in front. The impact of the door depends on whether or not the room ahead is occupied, which it is now possible to observe from the outside. If it is indeed occupied then we may be less inclined to venture inside, if it is not occupied then perhaps we would be happy to cross the threshold that has been put in place and explore further. Whilst locomotive permeability might encourage us to explore in the first example, visual permeability is more of a permission to explore without consequences or the fear of invading someone else's territory in the second.

The overhanging ceiling in the existing building could be argued as a further incentive to explore, the way in which the ceiling is supported is at first unclear, and a wash of diffuse light falls down the wall and emphasises the separation between the wall and ceiling elements. This may cause us to

Figure 25 Interior sketch

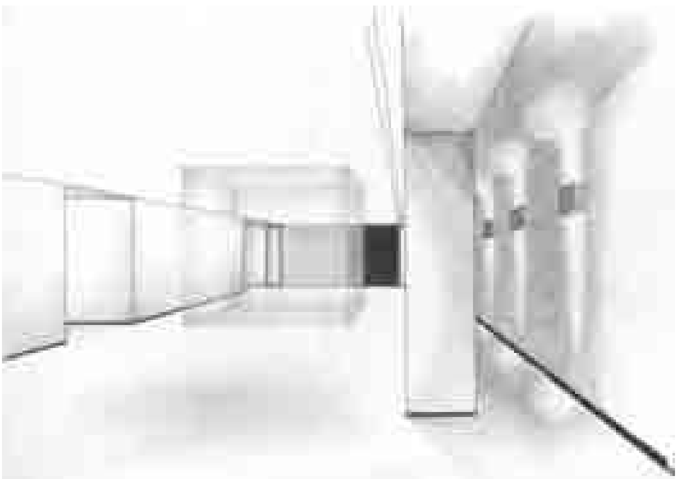


Figure 26 Removing the mystery of the room whilst creating a high visual range

move into a position where we can perceive how the structure is operating in order to understand the system. For the more claustrophobically sensitive among us it might encourage us to move out from under the overhanging ceiling which is suspended so mysteriously. Such a feeling causes us to move forward to a place where we can understand the forces at work. The construction of the walls themselves has been altered in the second image to a timber construction with many small, individual elements that compose the wall, contrasted with the homogeneity of the existing building.

The second option of exploration is to turn left after entering the building. In contrast to the occlusion the medium used to catalyse the exploration is light. A glass light shaft catches the eye and guides the line of sight towards the heart of the chapel. The hierarchy of these two options of exploration has been made clear by the empirical evidence conducted by Stamps (2006) based on the theory of Prospect and Refuge as he states that there is a clear link between light, occlusion and mystery, but a high preference for light. Light is thereby the strongest pull for exploration of the environment, guiding the the viewer to the Chapel Hall.

Both of these sketches depict attractive spaces, but in different ways, the first image is complex, intriguing and mysterious, however in the centre of the view there are physical objects that block our locomotion and vision. These elements encourage our desire to explore as we wish to discover what might be behind them. In the second image these obstacles are removed and the room is empty except for a glass light well at its centre. The second image is less complex and less mysterious, but it also has a larger visual range and affords the ability to see someone coming who would otherwise have been hidden by the columns. The light well takes centre stage in the second image and with the removal of the columns it can illuminate the room more effectively. There is still a degree of mystery in the second sketch which comes from the spatial continuity between the main room

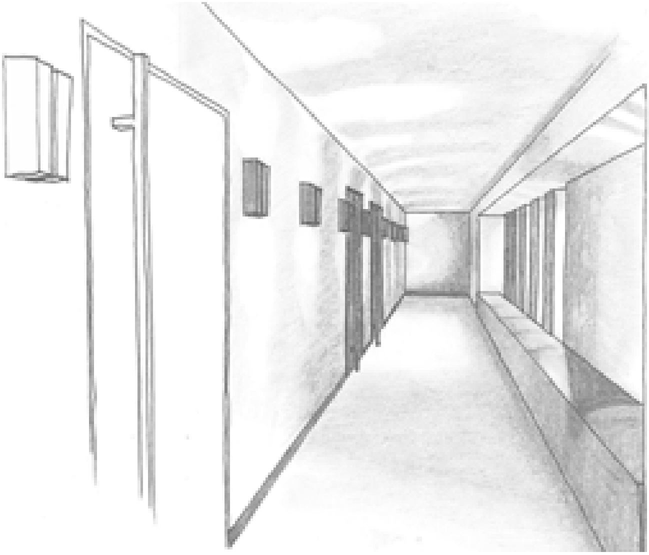


Figure 27 interior sketch illustrating a minimum of mystery.

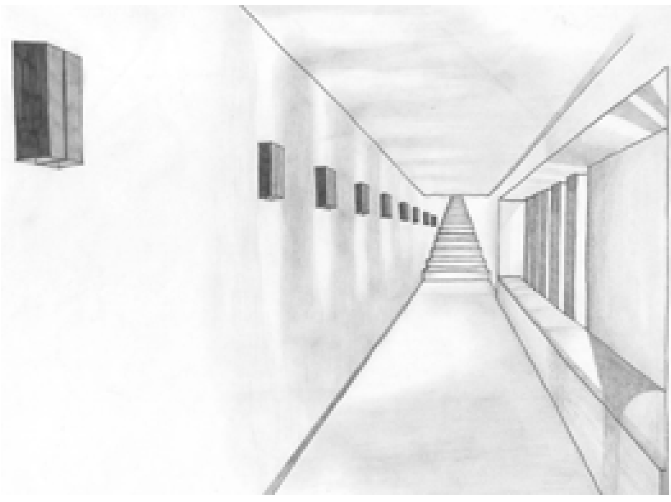


Figure 28 interior sketch by installing a stairway leading up and into the light, mystery is created, encouraging exploration and the passageways on either side. The light that washes down the walls highlights these areas, drawing the eyes' attention towards them. One detail is consistent in both images is the location of the vanishing point which is hidden by the wall in the foreground. Locating the vanishing point here encourages us to lean out to either side of the wall to see what it is currently blocking us from seeing to the end of the wall.

In terms of maintaining a degree of separation from the outside world the Chapel is consistent in its approach to light and views. Along this corridor a series of narrow openings lets light into the passageway but prevents views out until the observer is perpendicular to the opening, even then the view is to the internal courtyard space. The interior is simple in its layout, a long corridor with heavy copper doors on one side

In the first image there are three visible options for movement provided by the three doors on the left hand side. However, because each of these doors is closed and therefore spatially discontinuous, we cannot be sure of what might be on the other side. The corridor is a dead end, which means that every door that we pass as we move down increases the potential for someone to emerge into the corridor from one of the doors, blocking the route by which we arrived in the space. We can also consider an alternative reason why we are not compelled to move to the end of the corridor, perhaps it is because we can already see the entirety of the space, the only region we feel drawn towards are the openings on the right because of their spatial continuity and the light coming in through them which suggests a view and therefore the possibility for us to gather further information about the environment.

The first image is not conducive to exploration. Three closed doors signify surprise rather than mystery and the corridor leads to a dead end, all of the information that the scene has to offer can be read from the position that we are already in, with the exception perhaps of seeing what is outside the openings.

However, in the second image, although the doors have been removed, there is more potential to explore. The staircase at the end of the hallway encourages us to stand at the bottom step and look up, the fact that we cannot see the top of the stairs emphasises the mystery, and the spatial continuity of the open staircase enhances this, we may even decide to find out what is at the top of the stairs if the view from the bottom is intriguing. In the first image there are multiple pathways for exploration, however they are spatially discontinuous and therefore less inviting. In the second image there is only a single pathway to be explored which provides a very linear and predictable way forward.

It has been repeated several times in this thesis that habitat theory does not provide a recipe for architecture as it should be, but instead offers different perspective from which to analyse it. This case study demonstrates this by highlighting how biological preferences for architecture can be used to achieve specific goals. Creating a courtyard with a sense of privacy and serenity for example.

CONCLUSION AND DISCUSSION

HOW CAN HABITAT THEORY SHED NEW LIGHT ON THE SUBJECT OF ARCHITECTURAL ATMOSPHERE?

"Understanding this can allow designers to generate a specific atmosphere within a space through the sensitive manipulation of the principles that have been laid out."

Conclusion

This thesis was undertaken to investigate how biological theories of aesthetics can influence the design of architecture, posing the question; how can habitat theory shed new light on the subject of architectural atmosphere? The distillation of the theories into the four principles of preference and their implementation in the case study analysis has shown that habitat theories, in the context of architecture, are not recipes for the perfect building. Instead they provide us with an understanding of how the environment might influence emotions and behaviour. Understanding this can allow designers to generate a specific atmosphere within a space through the sensitive manipulation of the principles that have been laid out. Having a knowledge of these basic instinctual preferences is important for designers as they form a common denominator of human experience and the base for cultural and personal forms of experience. Many readers may feel that the conclusions of the theories that have been presented and the four principles that have been derived from these theories are intuitive, especially for designers, who arguably have a more sensitive disposition than most to the way that we experience the world. Therefore this thesis can be used as argumentation to validate intuitive design decisions that otherwise might lack support. The principles should therefore be viewed as a lens through which to view architecture, providing an additional layer of design to be applied during the design process.

Discussion

The validity of a set of principles of biological aesthetics that are at least partly derived from theories on landscape design is a point that is certainly up for debate. The view taken in this thesis is that if humans have evolved over thousands of years to experience the natural environment in a certain way, then the artificial environment would therefore be experienced in a similar way. If this is indeed the case then there should be little difficulty in adapting a theory of landscape aesthetics to architecture. In addition to this architecture may be seen as a continuous part of the landscape rather than a separate element and therefore the two can be treated as one. The two theories that are primarily concerned with landscape aesthetics are also balanced somewhat by Humphrey's more general theory of aesthetics and Stamps' theory which is focused on the artificial environment, providing a fairly well rounded selection of theories on the subject of biological aesthetics.

Although we have included a comprehensive selection of habitat theories in this thesis, personal and cultural experience has been ignored. This was a conscious decision aimed at maintaining a focus within the thesis that allowed a level of depth that would not have been achievable with a larger subject. However, in the design of architecture it would be unwise to focus solely on biological aesthetics at the expense of cultural and personal modes of experience. Biological, Cultural and Personal modes of experience are reciprocal. However, as mentioned in an earlier section, cultural conditioning has such a powerful influence on the way we experience the world that there are some who believe that it overrides instinctive preferences. The research presented here would argue otherwise, strongly suggesting that understanding our instinctive preferences is useful in the design process. However, it is important to acknowledge that architects should be conscious of all three modes in order to create a layered and enriching experience for users.

Even with the extensive work of Stephan and Rachel Kaplan, Arthur Stamps, and many other researchers, there is still a feeling that the surface has barely been scratched. If Nicholas Humphrey's structuralist approach to addressing aesthetics is taken then the architect must have two things in mind in order to design: Firstly that it is the relationships between things that is important in creating beauty and secondly, that in order to generate beautiful experiences the architect must understand what relationships produce aesthetic pleasure. If a group of scientists decided to create a formula for the perfect building, the variables currently available to them, such as the permeability of enclosure or legibility of the scene, are too few. Until more research is done there will be no conclusive answers as to what relationships create pleasure but perhaps it is more exciting for an architect to discover that for themselves. It is difficult to say which is more arrogant, that scientific research can provide a formula for creating a beautiful experience, or that it can't.

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Illustration list

Figur 1
Broad Street Station by John Russel Pope
http://www.corbisimages.com/images/Corbis-GE001416.jpg?size=67&uid=394738af-89b3-4404-a586-5f0e5204735c

Figur 2
Typos, Topos and Tectonics
Own illustration

Figur 3
Inuit x-ray art
http://www.uqqurmiut.com/Tap_Images/Tap%20476%20Kakivak%20fishing.JPG

Figur 4
Seing without being seen
Own illustration

Figur 5
Chestnut tree and leaves
Own illustration

Figur 6
Monet's waterlillies
http://uploads2.wikiart.org/images/claude-monet/water-lilies-1899-1.jpg

Figur 7
Jackson Pollock
http://www.galleryintell.com/wp-content/uploads/2013/03/autumn_rhythm-pollock1.jpg

Figur 8
Mark Rothko
http://www.markrothko.org/images/paintings/orange-and-yellow.jpg

Figur 9
Visual Permeability
Own illustration

Figur 10
Kunsthaus graz
http://upload.wikimedia.org/wikipedia/commons/a/ae/Graz_Kunsthaus_vom_Schlossberg.jpg

Figur 11
Leca Pools
http://www.architectural-review.com/Pictures/web/u/k/i/revisit636port_636.jpg

Figur 12
MVRDV WOZOCO
http://4.bp.blogspot.com/-vRBJY1Bc_cY/T8biyePYiFI/AAAAAAAAEPg/SsCHYCZixX4/s1600/b5.jpg

Figur 13
Steilneset Memorial
http://static1.1.sqspcdn.com/static/f/601055/23414960/1377825235140/skysthelimit8.png?token=HhBfTbroPdL9m%2FHaXMVY6iy5Fdk%3D

Figur 14
Siteplan Chapel
Image curtesy of Friis & Moltke

Figur 15
Basemen plan Chapel
Image curtesy of Friis & Moltke

Figur 16
Section Chapel
Image curtesy of Friis & Moltke

Figur 17-28
Chapel Sketch
Own illustration