A LIBRARY IN HYDE PARK
COVERED BY EMOTIONS

SEMIHA TOPTAS, 2018 MASTER THESIS
AALBORG UNIVERSITY, DENMARK

''While the brain controls our behavior and genes control the blueprint for the design and structure of the brain,
the environment can modulate the function of genes and, ultimately, the structure of our brain, and therefore they change our behavior. In planning the environments in which we live, architectural design changes our brain and behavior.''

(Fred Gage, neuroscientist, 2013, p.5)

COLOPHON

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COVERED BY EMOTIONS

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The aim of this introduction chapter is to provide a brief description of the project, in order to outline the main goals and purpose of this thesis. In addition, in this chapter, I will provide a detailed description of the chosen methodology that is used throughout this project.

ABSTRACT

The presented project is the master thesis of Semiha Toptas from the Department of Architecture & Design at Aalborg University, Denmark, 2018. The thesis is a final architectural project that proposes a design of a New Public Library in London, UK, by using research-informed -and integrated design methods with sustainable design aspects. Furthermore, a study of the body, mind and the emotions of the human being will be carried out, to design architecture that is in close relation to the physical and mental needs of the visitors and to understand the impact of the architectural and environmental context on the human beings.

COMPETITION BRIEF

The thesis takes inspiration from a former international architectural design competition of designing a public library in Hyde Park hosted an architectural competition website Arcasm in 2017 (Archasm.in, 2017).
The project will not stick to all of the given information regarding room programme or other statements, however, the competition brief will be used to find a site to built a library.
Some of the statement and concerns that the project will take into account will be as follows:

1: Create a public library in Hyde Park that will promote reading culture by, for instance, re-inventing new room designs that can incorporate new digital technology for learning purposes.
2: Create a new library typology that will stand out in the context and will change the rigid outlook of libraries by concidering the aesthetic quality, materiality and form that will all add a sense of identity and beauty to the space and will still respect the context
3: Designing innovative and interesting reading spaces, furniture design and interior arrangements.
4:The library should become an experience for the visitors that will stimulate the mind and make them want to stay in the library for a long time.
(Archasm.in, 2017)

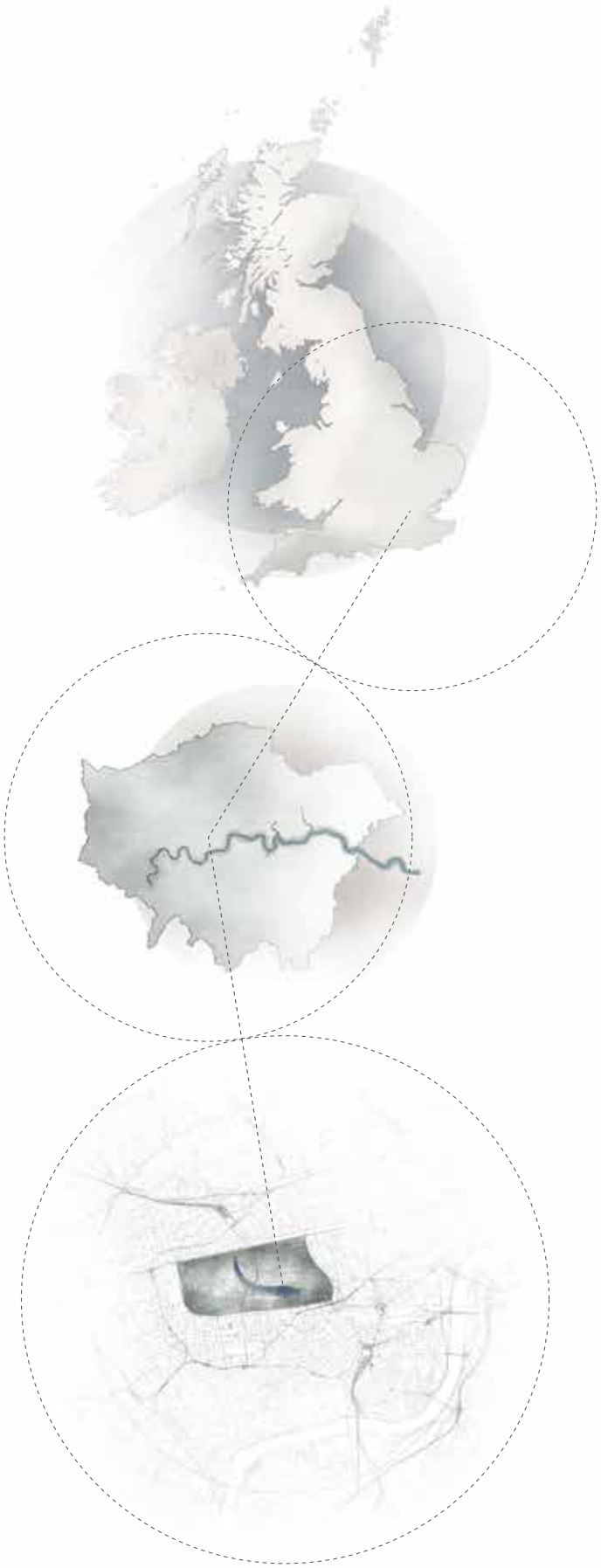
MOTIVATION

My motivation for designing a Public Library in Hyde Park is the opportunity to investigate and explore the contemporary perception of a 21st-century library. Achieving an interplay between the contextual conditions and the architecture as a way of reinventing the library concept for the new ages, will be the main focus of this project, as well the studies of cognitive science, in order to understand how people experience architecture and sustainable aspects

The vision of the thesis is to examine how architectural and the environmental context can affect the human beings and the positive effects architecture have on the mind, body and the reading culture. Furthermore, the vision is to study the importance of reading, and explore how to attract young people, by providing new technologies that increase the learning performance and creates interactive environments that are inviting for visitors

INTRODUCTION

The project proposes a design of a Public Library in Hyde Park, situated in Central London, UK. Hyde Park is the biggest of the Royal Parks in the city and covers 142 hectares. The park borders Bayswater Road to the North, Park Lane to the east and Knightsbridge to the South. It lies near Kensington gardens, divided only by the Serpentine lake. (visitlondon.com, n.d.)
The total area of the site is approximately 13.000 sqm.



Ill.0 Diagram of Site location

METHODOLOGY
INTEGRATED DESIGN PROCESS & RESEARCH-INFORMED DESIGN

Integrated Design Process

"*The Integrated Design Process*" described by Mary Ann Knudstrup has been the overall structure of this architectural task. The main idea of this method is to integrate the aesthetic, functional and technical aspects of an academic project with a systematic approach that will ensure a more holistic sustainable architecture. (Knudstrup and Ring Hansen, 2005).

From the beginning of a process, different knowledge from different specialization will be a part that will ensure the method to be highly efficient and interdisciplinary. The method will act as a platform in which it will be easy to control every single parameter of one project. By being able to move back and ford between each one of these parameters and knowledge, it ensures the ability to solve the complicated problems of any sustainable building designs. (Knudstrup and Ring Hansen, 2005)

The Integrated Design Process essentially consists of five phases that will actively overlap one another until the end of a project. The interdisciplinary working processes among the phases will ensure a closer relationship between the architectural and engineering fields with different insights.

"*Problem Formulation or Project Idea*", will be the first step of any environmental or sustainable building design, where the main intentions and ideas of the project will be described and clarified.

The Analysis Phase is the second phase, which concerns the analysis of all kind of information needed for the project and the site before starting the sketching phase. Here it is highly important to gather every information and documentation of the project that will also serve as a tool to decide a specific direction and concept of the design.

The Sketching phase is the third phase, where every idea of the design proposal will be drawn and tested based on the knowledge gained from analysis phase.

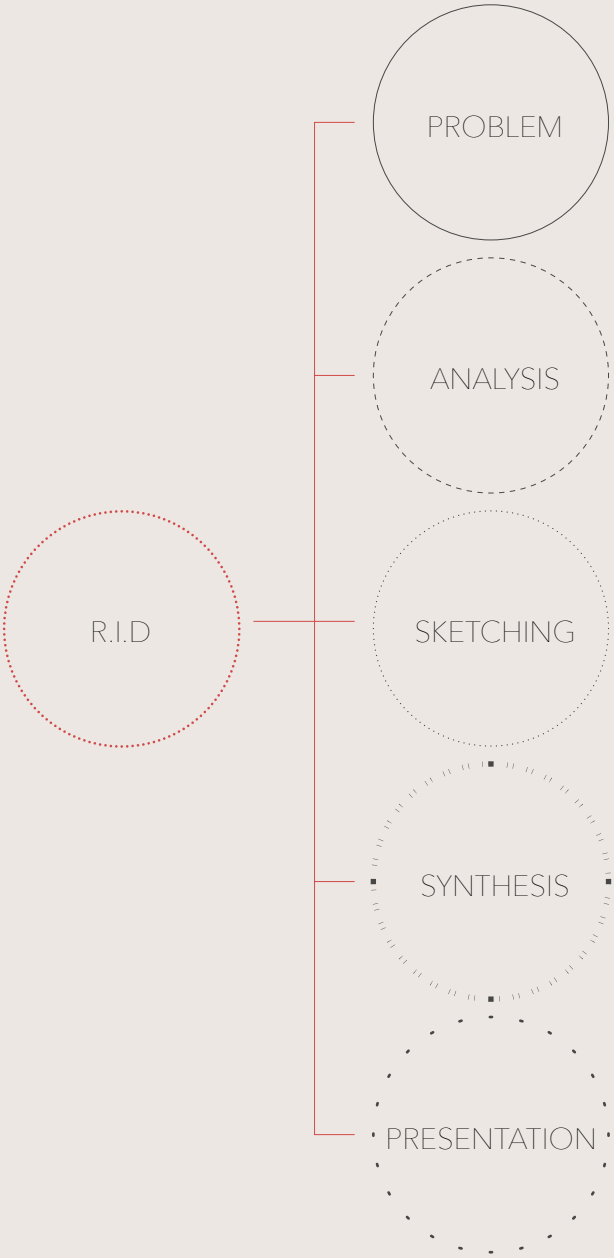
The Synthesis Phase is the fourth phase where the design finally takes its form and both the aesthetical, functional and technical demands in the design are met.

The Presentation Phase is the final phase that concerns the final presentation of the project. Here, the main idea of the project will be shown with clear diagrams, drawing, and visualizations that ensure the main concept to be explained. (Knudstrup and Ring Hansen, 2005)

Research-Informed Design

In addition, the research-informed design method will be used in order to use knowledge from different fields that will all help to understand the impact of architecture on the human body and mind because it affects our physical and mental health. The research-informed design uses the already published research of any chosen theme in order to inform and guide the design of a project. (Sichler, 2016)

The approach of using these two terms will be by merging them together with the integrated design process. It will mainly be applied to the analysis and sketching phases, that will ensure to gain a broad amount of research before while designing.



Ill.1 Diagram of Methodology

2 PRELIMINARY

This chapter concerns the preliminary studies of the site and the context. By understanding the existing place and the landscape, it aims to form an architecture that deeply connects with the surroundings and enhances the existing natural and pleasant area. Therefore, in this chapter, I will describe the existing characteristics of the site and I will use the results of the site analysis to understand the area and the atmosphere. The method will be a combination of mapping studies, observing the site during a site visit, understanding the area by zooming in and out and by different literature studies.

ABOUT HYDE PARK
DISCRIPTION & HISTORY OF SITE

The main intention behind the park's creation was to satisfy the royal passion for hunting around 900 years ago (The Royal Parks1, n.d.). Back then the area was full of deer, boars and wild bulls, all perfect for hunting. King Henry VIII invented a hunting tradition to entertain ambassadors and dignitaries, a tradition that quickly became a huge entertainment culture in the rest of the city as well. (The Royal Parks1, n.d.)

When Charles the I became king in 1625, he decided to open the park to the public in 1627, and it became a fashionable place to visit.
As time has passed, the purpose of the park has changed many times and become a place where people have pursued many pleasures. Hyde Park has been restored and changed whenever a new king came to the throne, yet the major change of the landscape happened in the 18th century when the royal gardener, Queen Caroline, took over. She formed a new park, Kensington Park, with 300 acres from the grounds of Hyde Park. The only thing separating the two in the beginning was a ditch. Later, Queen Caroline established the Serpentine lake, by damming the Westbourne Stream.

Around 100 years later when George IV became king in the 1820s, the park underwent another major change. Here, a monumental entrance at Hyde Park Corner was designed, the park's walls were replaced with railings and plenty of new lodges and gates was created.

In 1851 the last major upheaval came when the Crystal Palace was built by Joseph Paxton alongside for the Great Exhibition. As the intention of it was temporary it later ended up being moved to Sydenham in South London. the park was re-established to its former self, and has remained largely the same ever since. (The Royal Parks1, n.d.)

Ill.2 Picture of Hyde Park taken by Phil Evans

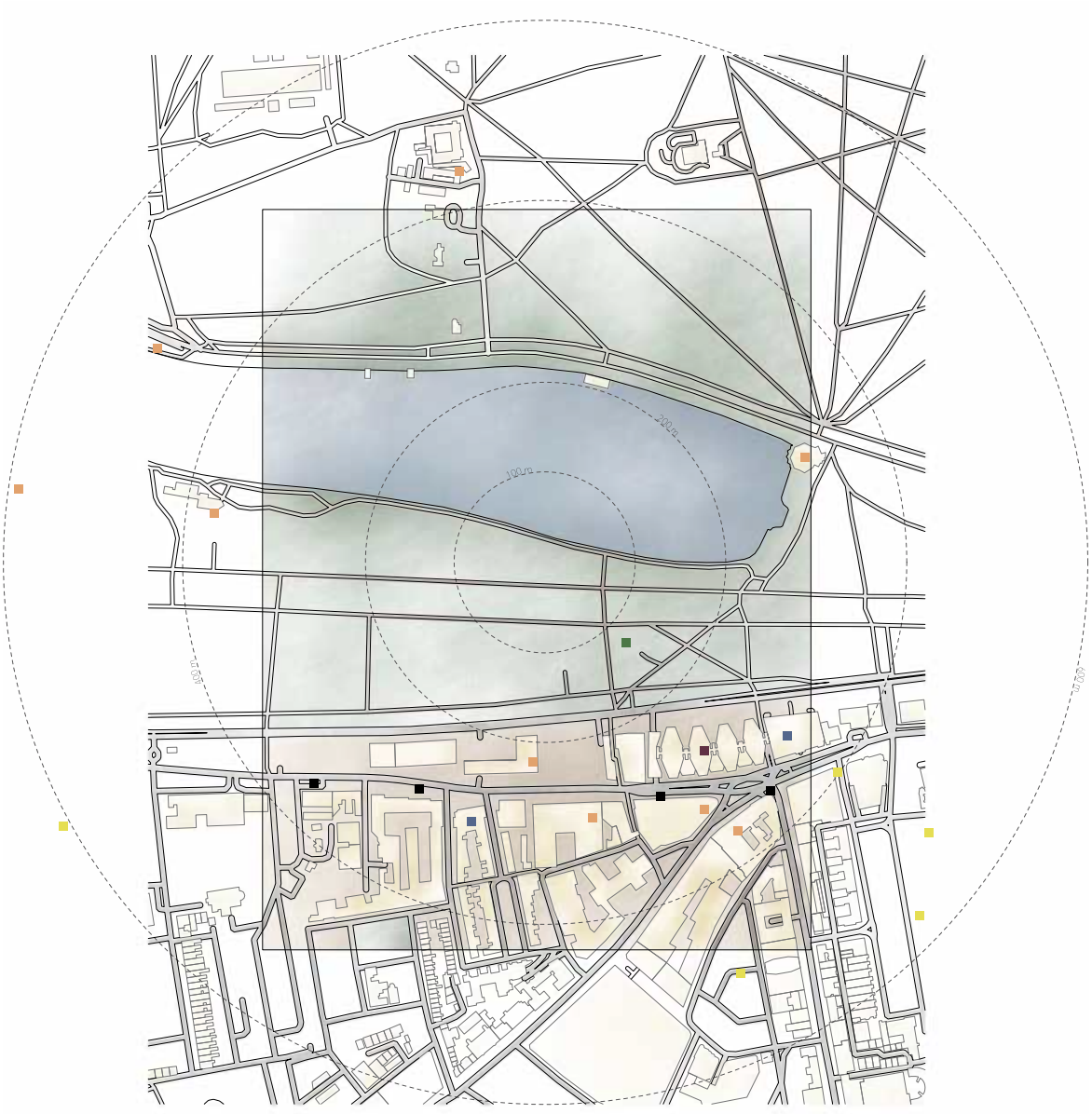
ABOUT THE AREA
INFRASTRUCTURE & FUNCTIONS

London is known for being a city with a great infrastructure with tubes that have immense connections inside the city and outwards. Already 300 meters from the site there is the tube station Knightsbridge and plenty of other bus stops nearby that makes the site easy accesible.

The park is accesible from every borderline with pedestrian and cycle paths. Inside the park numorous pederstrian path are to be find that prevent the walks on the green areas and links every part and corner of the park to one another.

Coming with car to the site area, the best parking possibilities are the small parking lots around the park or towards the urban site. Since the aim of the park is to have a carless area, the parking possibilities are not the finest.

The site is located in the green area bordering on to the beautiful Serpentine lake that truly will have a postive affect for the design, especially when coming from the Eastern urban part of the city. It is hard to avoid the potential of the site with its clean air with breezes from the lake and the trees.



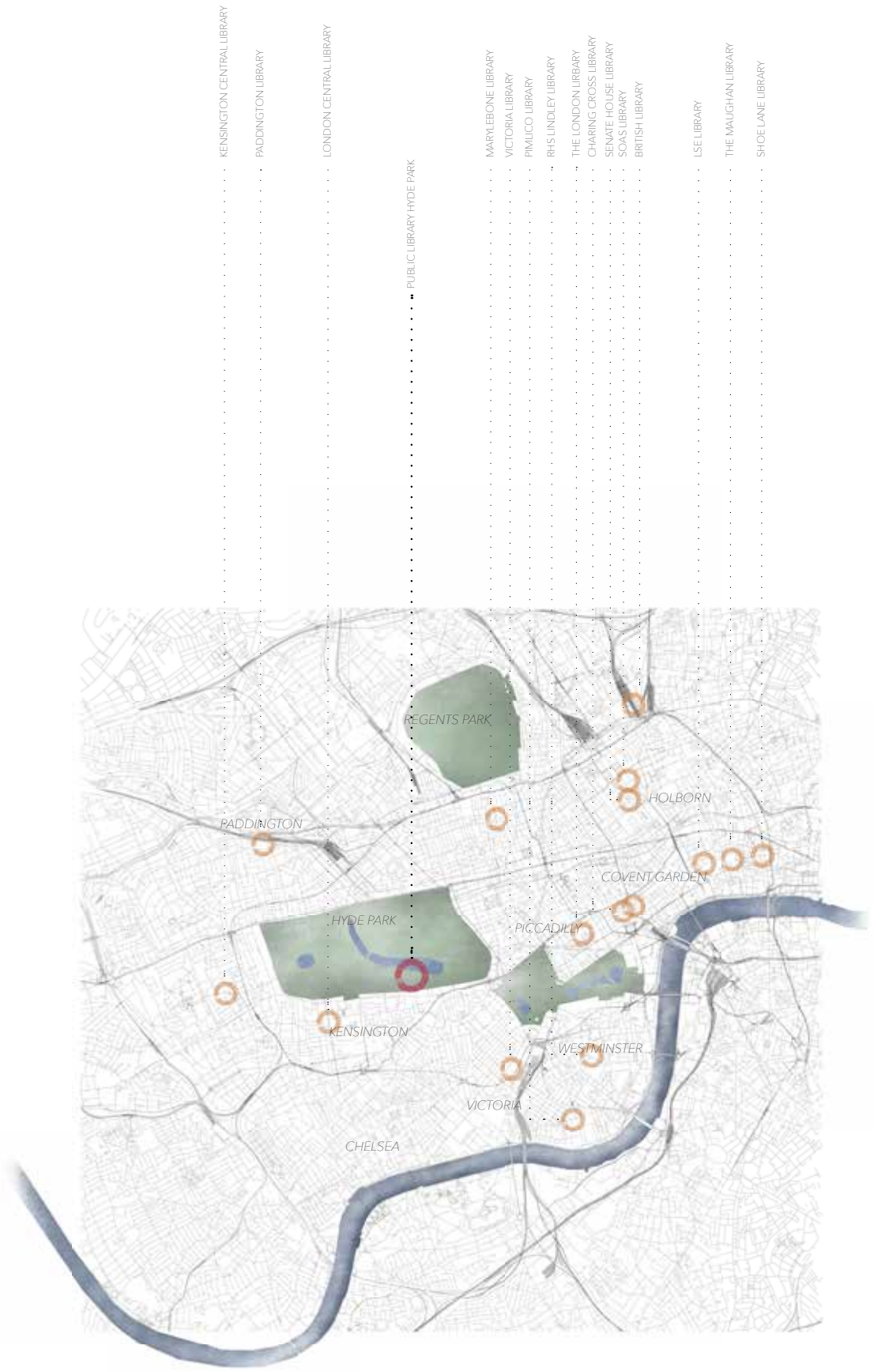
TUBE
OFFICE
RESIDENTIAL & RETAIL
HOTEL
PLAY GROUND
CAR PARKING
BUSY ROADS
PEDESTRIAN ROADS

Ill.3 Diagram of Area of Site

ABOUT OTHER LIBRARIES
AMOUNT & POSITIONS

London is one of the one places that houses a huge amount of libraries of all kind. In the central part of London, one will find 15 libraries all from old antique buildings with old English atmospheres to newer and bigger modern libraries. The common part of these libraries is for instance the archive selection and the reading areas with immense amount of old and new book collection. One thing that not every libraries contains, is the service for the new and current technologies, such as Virtual Reality services.

The distances between the libraries are quite close to one another which makes it esasy to find the perfect library that fits one's need and taste. As to be seen on the diagram, one thing that the public library in Hyde Park has that the others do not, is the connection to the landscape. Some of them are relatively close to a park, but unfortunately non of them are inside or surrounded by any green of blue nature. This is what are the advantages of the site.



III.4 *Diagram of libraries in Central London*

ABOUT POSITION & LANDSCAPE
SECTION & VEGETATION

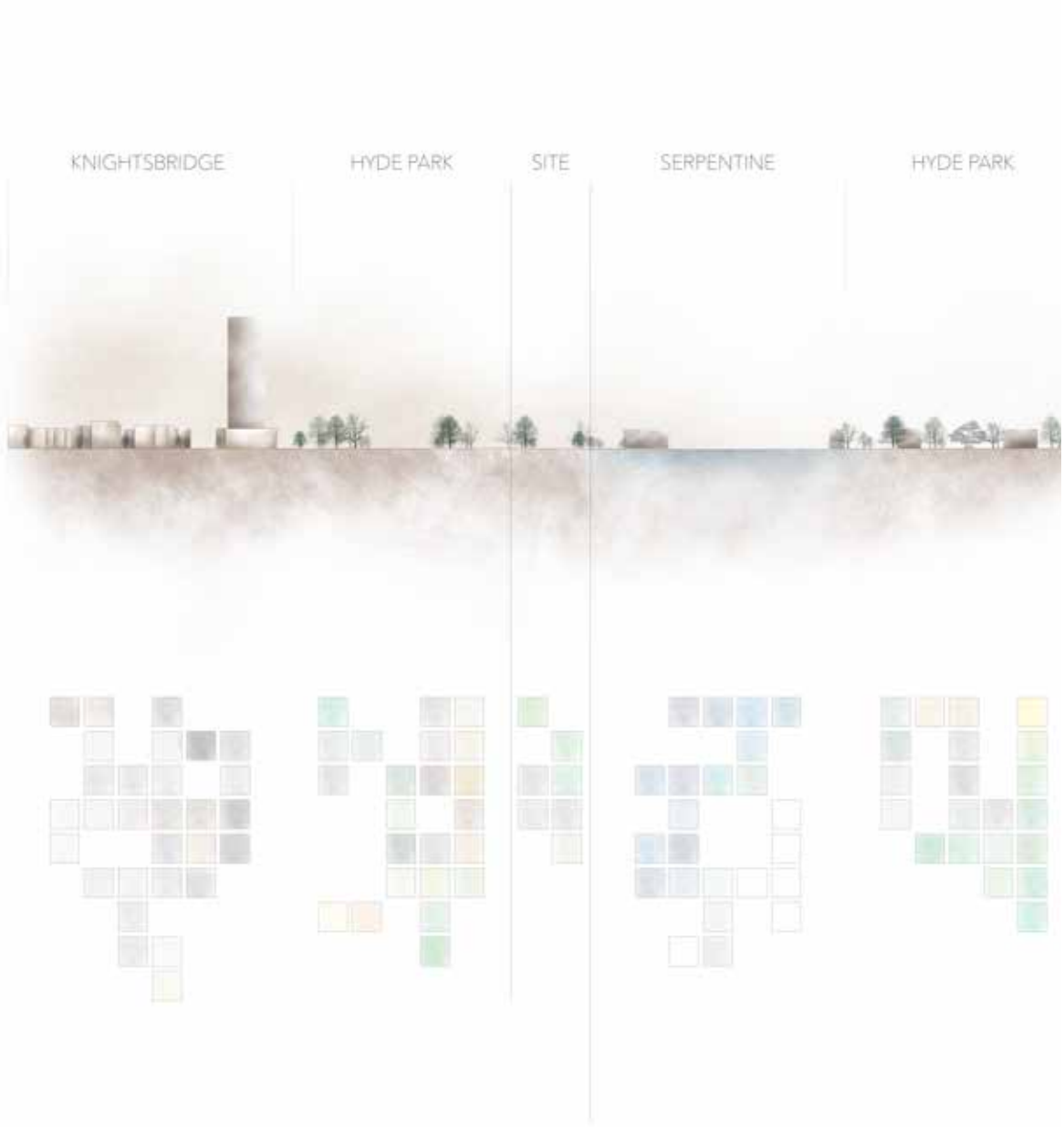
Being a city where the architecture is all from old to new, traditional to contemporary and art deco to gothic, it is highly noticeable how the architecture, urban qualities and planning have its major influence globally. (visitlondon.com2, n.d.)

Among various architecture styles, the building heights are close to one another with few high rise buildings, which applies for this area.
Although the green trees are to find both in the urban site as well as the green part, there is a strong distinguish among the colours in the landscape; A very grey, light brown, yellowish shades compare to green, orange, blue, pink that fully changes the atmosphere and purpose of use.

The site, situated inside Hyde Park, abuts the man-made lake Serpentine with a total cross-distance of 190 meters. Having a site located next to such a beautiful and clean lake does nothing but a great advantage for the architecture.

One of the most important natural elements in the Royal Parks are the beautiful old trees that link the past, present and future. Not only are they known of improving the health by absorbing pollutants, providing shade, slowing the rate of global warming and lower the urban air temperatures but also helping to reduce the wind speed, absorbing stormwater, providing a habitat for birds and other living creatures.
The most common and interesting trees in Hyde Park and the sites are Common Lime Tilia x europaea, Red oak Quercus rubra, Silver birch Betula pendula, Silver maple Acer saccharinum and Weeping beech Fagus sylvatica 'Pendula'.
(The Royal Parks2, n.d.)

Together with the seagull, butterflies, the lake and people, Hyde Park - The site can easily be described as a peaceful and natural destination.



Weeping beech Fagus sylvatica 'Pendula'

Silver birch Betula pendula

Red oak Quercus rubra

Common lime Tilia x europaea

III.5 Diagram of Landscape

ABOUT GENIUS LOCI
A PHENOMENOLOGICAL STUDY OF THE SITE

This study is based upon a visit to the site in early February and will focus on the phenomenological experience and the atmosphere of the area. The pictures are taken during the visit.

Walking through the beautiful major park in a peaceful morning with the smells of the pleasant aromas of the green and blue together with the flying seagulls, one gets the impression of how nature creates empathy with the body and enhances the sensation of being alive. Given the thought that the visiting day has been during a cold morning, the blue and green colours of the landscape are still able to activate deep emotions that makes one want to stay and just observe, listen, smell, feel and taste.

The smooth transition between the enormous green grass, yellowish pedestrian gravel that links one closer to the blue and green and the charming blue lake that has nothing but an unobstructed fresh breeze.

Walking through the green areas or next to the lake, small romantic objects such as the English streetlights and benches increase the nostalgic emotions.

The huge emotionally advantages of the area bring the only thought; what a peaceful place to read!...






Ill.6 Pictures of Site; Self-Taken

ABOUT CLIMATIC CONDITIONS

TEMPERATURE

The climate of London is temperate and warmest month during the year in August, however, June and July also have a pleasant temperature around 20 degrees. Whereas, the coolest temperature during the year is January with the average annual minimum temperature of 5 degrees. (weather-and-climate.com, n.d.)

PRECIPITATION

December and January are the wettest months during the year with average precipitation of 80 mm, whilst July is the driest month with approximately 45 mm precipitation.

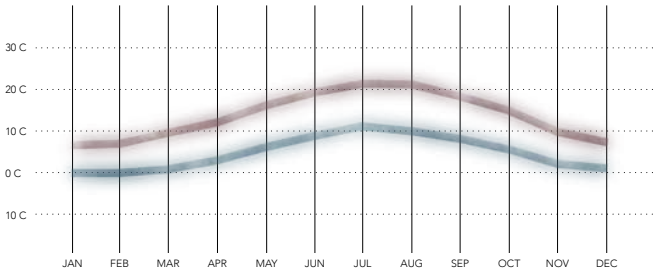
SUN/SUNLIGHT/DUSK

The diagram ill.9 describes the darkness, dawn, sunshine and dusk times for London. It is highly noticeable the huge amount of sunshine hours during the year. The darkest months are, respectively, January and December where the sun rises at 8:00 and sets at16:00. The brightest months are June and July where the sun rises at 4:45 and sets at 21:30.

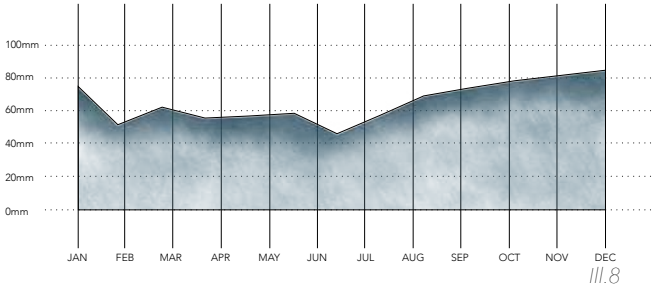
The diagram ill.10 below shows that the sun from North-East at 04:43 and sets at 21:21.

WIND

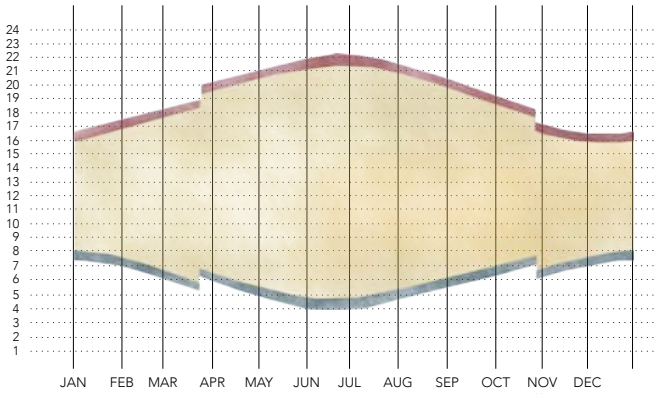
The highest percentage and speed of the wind comes from the southwest direction. Along west and south, it is preferable to have shielding, because of the strong power of the wind. This can be from the design or from vegetation. However, the result is taking from the Gatwick airport and therefore might not be precise, but still gives a good indication.
(weather-and-climate.com, n.d.)



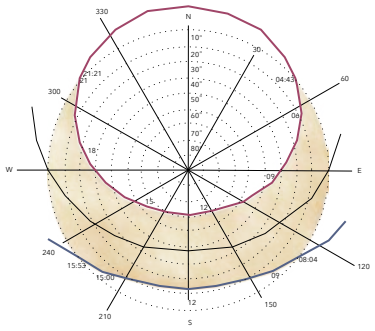
Ill.7 *Diagram of Temperature*



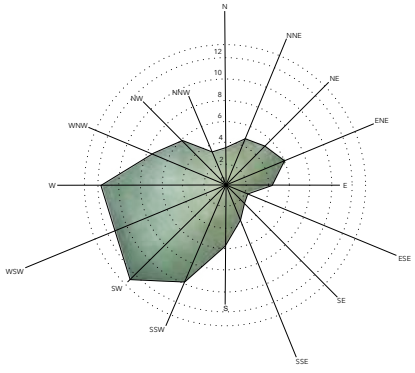
Ill.8 *Diagram of Precipitation*



Ill.9 *Diagram of Sun/Sunlight/Dusk*



Ill.10 *Diagram of Sun Path*



Ill. 1: Diagram of Wind Rose

SUBCONCLUSION

The investigations of the area showed a lack of parking lots for cars and the possibilities for making parking is restricted. However, reaching the site, and the park in general, by bicycle or by walking is quite easy, which means it is possible for the site to be easily connected to the surrounding areas. Concerning the typography and the physical environment of the site, the various trees will be removed or preserved depending on the final design and the flat landscape provides little constriction to the final design.

London is known for being a place with a great amount of precipitation, and considering the microclimate of the site, this means creating shelter for the rain along with integrated gutters leading to the lake. The temperature is pleasant throughout the year, the warmest month being August, and therefore outdoor spaces for reading and other amenities can be a part of the design. The highest wind velocity comes from the southwest direction. To make sure that the wind velocity is pleasant on the site, studies of wind will be done. The sites vegetation will also be beneficial in decreasing the wind velocity.

To conclude the preliminary studies new intentions and observation are to be considered throughout the design.

3 FRAMEWORK

This chapter concerns the framework of the chosen theme of the thesis. Here, a study of the thesis theme: applying insights from cognitive science to architectural design will be described, together with studies of how architecture affects the human beings and their bodies that affects the behaviour, emotions and minds. Subsequently, I will present a study of why reading is important for people and especially the youngsters along with the ways of designing public libraries for the 21st century. Finally, the chosen users group and the programme will be outlined together with a conclusion, to sum up, the investigations.

COGNITIVE SCIENCE & THE IMPACT OF ARCHITECTURE ON BODIES&MIND

THESIS THEME: APPLYING INSIGTS FROM COGNITIVE SCIENCE TO ARCHITECTURAL DESIGN

In the past few decades, cognitive science and R.I.D has gained interest among several theoreticians and architects. This field has been considering the fields: cognitive psychology, neuroscience, embodied cognition, architectural or environmental psychology and social sustainability. These fields put together to explain how human beings experience architecture and how architecture affects the physical and mental well-being.

"The design of our built environment affects our health and well-being, and can have long-term implications for quality of life." (Steemers, n.d.) Says Koen Steermers along with other architects and neuroscientists. The context, architecture, and environment will all have an impact on one's behaviour, mind, and experience. The health is not only to be defined as an ill-health situation but more precisely as physical, mental and as social well-being altogether. Essentially, well-being means: feeling good and functioning well. (Steemers, n.d.)

Embodied Cognition

Cognitive psychology and neuroscience are researchers in progress and provides information on how the built environment changes one's experience, memories, and identity. This theory is more precisely defined as Embodied Cognition, which describes how the experience of the architecture surrounding us as a part of determining our embodiment and the way we think and behave (Thompson, 2012). For example, several studies have shown that architectural details, such as the lighting and view in hospital rooms, may influence the recovering time of patients in hospitals (Adler-Gillies, 2017), and how the design of schools can affect the learning performance of the students. (Adler-Gillies, 2017)

Despite the general aim of architecture, providing social ideals, artistic expressions, the environments necessary to satisfy human needs and physical health, etc., architects all tend to forget or exclude the most important factor; the research of the human response to the environment. (Eberhard, 2009)

Environmental Psychology

The interaction between humans and their environment is studied as Architectural- or Environmental Psychology. This multidisciplinary field links psychology, engineering, and architecture together to create better design solutions that enhance the occupation. Hence, understanding of the human psyche is very important in architecture to improve the quality of life. (Janetius, S.T., 2016)

Social Sustainability

As the environment has a great impact on one's embodiment while designing living spaces for the body requires a change in thinking and behaviour of the designers. Even though there is not one singular design solution nor design process that may be used in architecture, we must still always be able to think beyond the field and become able to solve problems we are yet not able to measure. This concerns the social sustainability that is another practice that promotes architectural and environmental well-being. The architect and LEED consultant Darryl Condon describes Social Sustainability as; *"a process for creating sustainable, successful places that promote well-being, by understanding what*

people need from the places they live and work. Social sustainability combines the design of the physical realm with the design of the social world – infrastructure to support social and cultural life, social amenities, systems for citizen engagement and space for people and places to evolve." (Condon, 2015)

Thesis Theme

Considering the library as a place to learn and develop yourself, contemplating these terminologies while designing the building will be way to achieve an architecture that is in close relation with the visitors and provides spaces and atmospheres that enhances the reading/ learning environment in the best positive way as possible and yet also can be a way to invite more patrons to the library.

"Good designs are where it is not dictated to the individual how they should perceive, operate or feel in the building, but have the flexibility to explore and experience it for themselves," says Dr Marialena Nikolopoulou (Gander, 2016). The theme of this thesis project is to apply the new knowledges from the fields of embodied cognitive science (e.g. environmental psychology and neuroscience) in order to design architecture/library as socially sustainable. By applying research-informed design strategies for developing the design of the library, a library for the 21st century will be designed with the aim to have an impact on the mental and physical well-being of the human beings. The research will be taken from the mentioned fields, where different studies on how the architecture mainly affects the brain and body and also how architecture affects the mind, mood and health, etc. will be examined.

EMOTIONS IN ARCHITECTURE
THE PERCEPTION OF ARCHITECTURE

When designing a library for the current century, the architecture of the library needs to separate itself from the common and basic methods of the past, and instead possess a certain atmosphere that triggers one's emotions, in a way that cultivates the visitors' desire to stay, explore, and experience the building. The intention of the design must be inviting, lasting and with an educative value. This all links the architecture with one's emotions and by investigating about the emotions and feelings a person will get once being in a certain space and how they will experience it, the architecture will achieve a level of embodiment and will affect the reading culture.

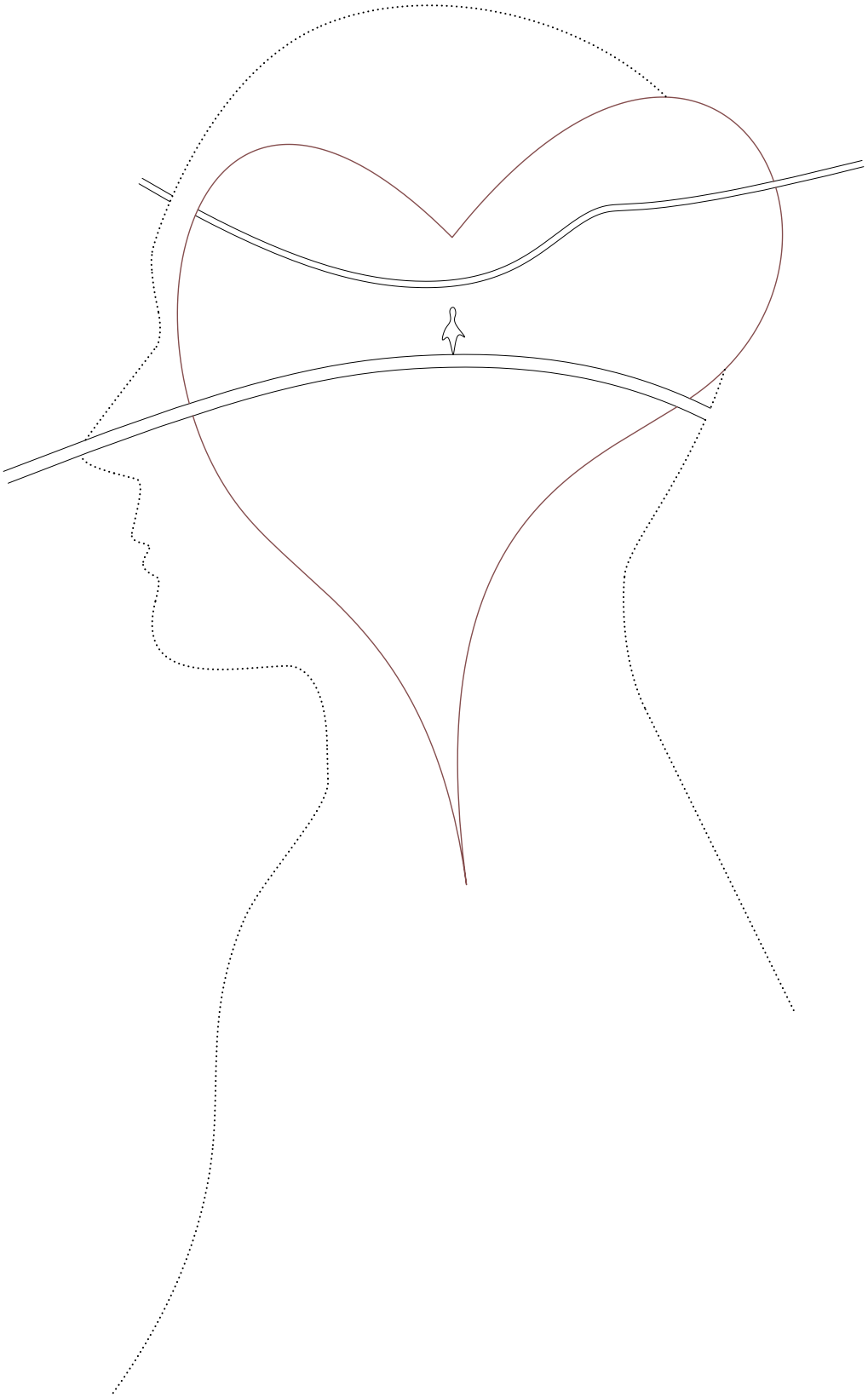
"Emotion is a primal activity at the very core of human nature. It is the lens through which we engage or perceive the world, and for this reason, many neuroscientists like to distinguish between emotion and feeling. Emotional processing takes place during the perceptual act, while feelings are our conscious awareness of these emotional events." Says Harry Francis Mallgrave. (Pallasmaa, Mallgrave and Arbib, 2013)

The emotions that arise through architecture is unavoidable, and it is often belittled how important those emotions are to the well-being and development of the users of the buildings. Although there are many kinds of emotions, the most important thing is that it is a multisensory experience of someone moving through an environmental field. How do we actually experience our buildings and the environment? It is highly noticeable how different architectural details can influence the physical and mental well-being, e.g. room heights, spatiality, and neutral light to name a few. (Pallasmaa, Mallgrave and Arbib, 2013)

Emotions determine our reactions to a specific event or sensory fields and encompass our perceptions, while "feelings" are something that arrives later at these emotional occasions. The combination of genetic inclinations and environmental encounters establishes these emotional reactions, which means exploring the world, sensing and understanding various circumstances of life, one's emotional range will prosper and grow.

Why emotions are important for the architecture is underlined by the fact that our initial emotional engagement with the environment is unconscious. It is indeed very important to be aware that the visitors will not necessarily experience the surroundings in the same way as the architect does and presumes to. As Juhani Pallasmaa states: *"The general ambience of a perceptual field is what people first encounter, in large part through our peripheral vision"*. (Pallasmaa, Mallgrave and Arbib, 2013)

When being surrounded by various building types, different emotions will occur and thereby different feelings and thoughts will be present. Architecture is a very important part of life since it, for instance, provides physical comfort, and different designs can produce emotions like pride, sadness, or gratitude. Architecture has a major influence on one's mood and emotions, especially by how well it exudes a "sense of place" and thereby develop a certain personality or atmosphere connecting the building with its occupants. This way the architecture achieves a higher level of poetic functionality and the aim and purpose of the design will be clearer and imprint the occupants with a lasting impression. All of this can be defined as; *"design through senses",* which can be achieved by using the architectural qualities such as the materiality, light, and sound, which links the architecture to the senses and pulls at the emotions. (Lehman, n.d.)



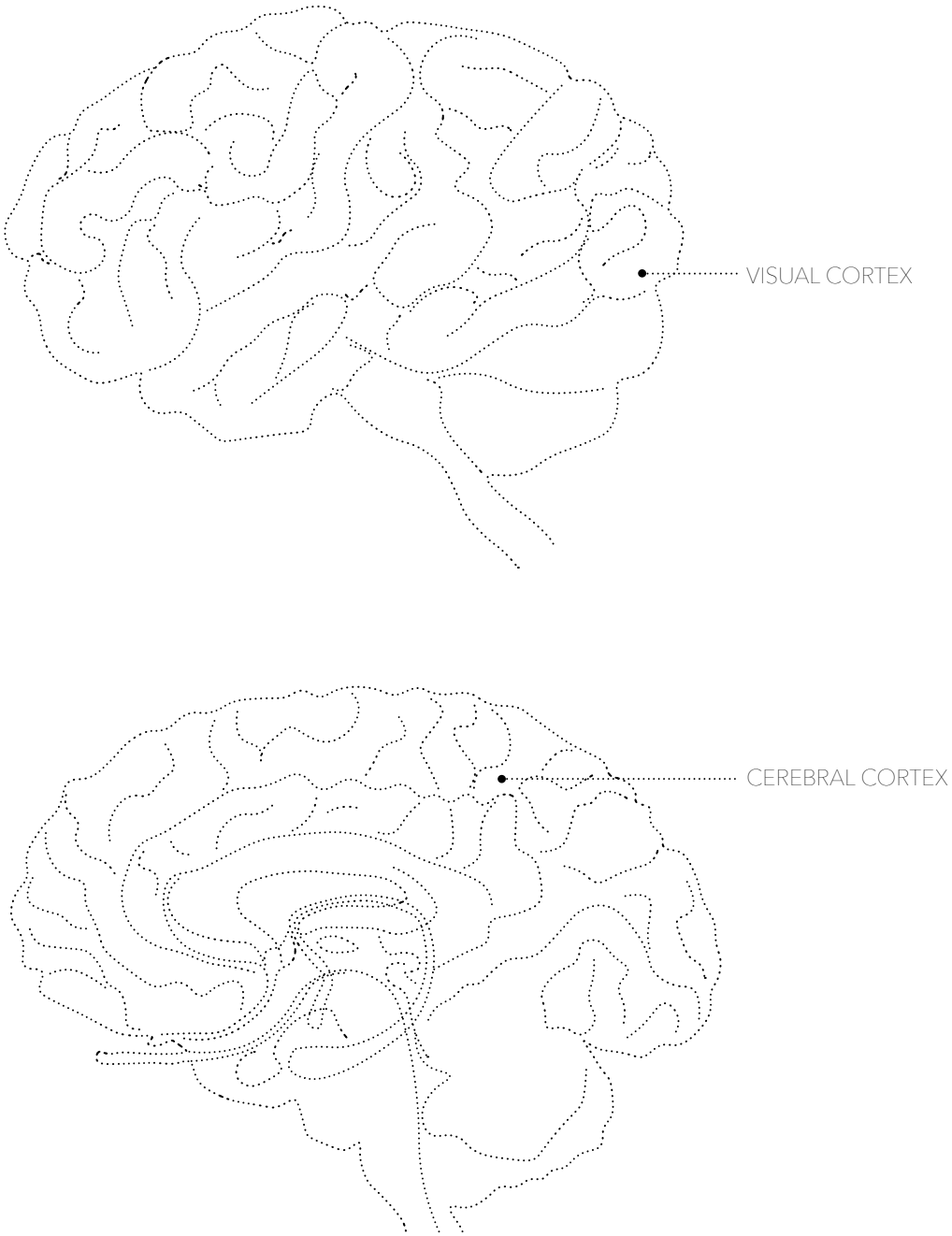
Ill.11 Diagram of Emotion

THE BODY & ARCHITECTURE
THE PERCEPTION OF ARCHITECTURE

All our mental activities with different cognitive functions are part of the mind and thereby the body. The emotions, thoughts, perceptions, desires, memories, and imaginings are created through electrochemical interactions, which take place inside the body and brain. The body's relations to space can be defined as "body schema". (Robinson and Pallasmaa, 2015)

"Like our body, a building is a series of interrelated systems, each possessing its own identity and offering a particular array of affordances. The mind is nested in the body and the body is nested within the contexts of room, building, city, earth, universe. We could say that our body has, nested within it, at least four bodies: our ***physical body****, and the more ephemeral, but equally real,* ***emotional body, mental body****, and* ***social body****"*, says Sara Robinson (Pallasmaa, Mallgrave and Arbib, 2013) and the actions of the four bodies are expressed through the perception. The five modes of perception include the basic oriented, auditory, haptic, tasting-smelling and visual system, is a part of each of the four bodies, as defined by J.J. Gibson and will be the way to understand how the bodies interact with architecture. The study of the human response to architecture is exceptionally important since everyone is constantly surrounded by buildings (Pallasmaa, Mallgrave and Arbib, 2013). Juhani Pallasmaa agrees: *"I believe that neurological research will confirm that our experiences of architecture are grounded in the deep and unconscious layers of the human mental life."* (Pallasmaa, Mallgrave and Arbib, 2013)

In order to fully understand in what way one will experience architecture, the environment and basically, life, we must deeply concentrate on the term consciousness. Without consciousness, no experience will exist and without the physical events in the brain, no consciousness will exist. Whenever the brain is damaged, the ability to form any experience will be lost. The Cerebral Cortex is known for being the part of the brain that is responsible for the content of the one's conscious experience. The activities in the visual cortex are the ones that have a specific location, although these conscious experiences can be extensively distributed. These activities in the visual cortex are known to be triggered by the perception of images through retina composed of the other regions of the brain that all together will form the content of an experience. (Eberhard, 2009)



Ill.12 Diagram of Human Brain

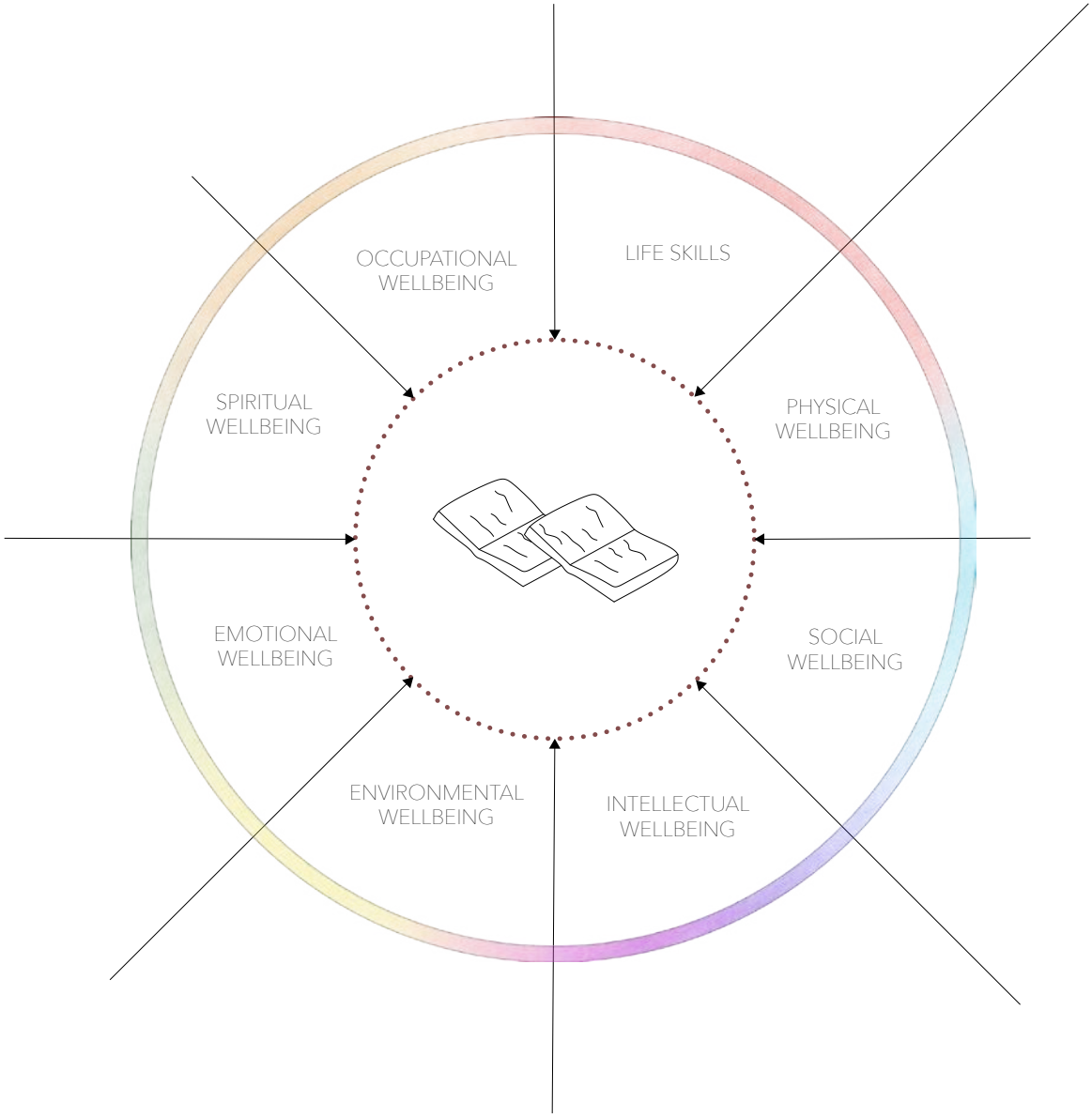
WHY READING IS IMPORTANT

Ever since the modern technologies were developed and more and more, as we moved towards a new Century, the reading culture of the society has been reduced. Nowadays, the internet, new products, and platforms are steadily taking all the attention, and reducing the interest in literature. Especially movies, video games and the internet is very popular among the youngsters. (Ingraham, 2016)
According to evidence of literacy skills and pleasure-reading in the UK, young people between 16-24 years old has lower levels of literacy than young people in other countries and occupy the 21st place out of 24 countries in the OECD. The evidence also shows that 1 out of 5 children cannot read properly by the age of 11. It is very critical that the society is not aware of the benefits of reading for young people in particular. Reading will empower them and increase their feeling of positive self-improvement (Readingagency.org.uk, n.d.). Studies show that reading must be done for pleasure to be beneficial and not be forced upon them. Reading has a great impact on the well-being of people since it reduces the symptoms of depression and the risk of developing dementia in later life. Not only does it enhance their knowledge of the world and other cultures, it also improves empathy and the sense of connectedness to the wider community. (Venning, n.d.)

How reading benefit cognitive stimulation relies on the fact that reading keeps the brain active. The brain consists of muscles that constantly need exercise to stay strong and healthy. (Winter-Hébert, n.d.)

Furthermore, reading expands the communication and writing skills by improving the vocabulary. It is highly important to be articulate and well-spoken for any kind of profession and additionally, it enhances the self-confidence. Reading novels with a diverse assortment of characters works as an exercise for the brain to strengthen the short-term memory.
Lastly, reading improves the concentration and tranquillity, since one is forced to concentrate on a singular task and forget about everything else around them. In this way, one achieves peace and is provided with a sense of calm. (Winter-Hébert, n.d.)

Since reading is this important, how can we then reinvent and boost the reading culture again?
Several studies show, that people nowadays want to be in a good mood to read. This requires a certain place with a certain atmosphere that will heighten one's mood and desire. As previously mentioned, the architecture influences the emotions and how people experience the designed space. In other words, a person must want to be a place to read and it is all about the location and space that contribute to the perfect reading environment, which is not the same for everybody. (Masad, 2016)



Ill.13 Diagram of Reading & Well-being

HOW PUBLIC LIBRARIES ARE DESIGNED

"A PUBLIC PLACE WHERE THE PAST, PRESENT AND FUTURE FRUITFULLY MEET"

(Worpole, 2013)

Libraries today are places for meeting people, reading, discussing and exploring ideas. It is also a book archive and exists in all modern towns. The public libraries of the 21st century need to be places where not only for reading or studying, but also to hang out or simply to seek refuge from the rain. To stay current in the modern world, libraries need to be about the society. They provide space for various user groups, cafés for coffee breaks, and easy access with the intention of widening the public use. Even though the book culture is on the decline, libraries have reinvented themselves, and will therefore still be in need in the future, since it brings people together and provides the boundaries for a meeting of minds. (Worpole, 2013).

The Setting of Libraries

A Library is a complex building type, that needs to house many kinds of traditions, trajectories, and amenities, such as secular and sacred books, archive, books, new media and digital technologies that are all free of charge. The intention of the public library is to be accessible for the public use and thereby be open to everybody. Meaning that the design of such libraries must be open and welcoming, with a clear entrance that will guide one through the building. The architectural critic and academic, Brian Lawson continues: *"…Even though we may never have been in this particular library before, we recognize the setting as a library. Along with that setting comes a sense of social norms that are not so much attached to a particular group as to the setting itself. In plain simple terms, we know how to behave in a library. Without such properties of space and settings, life would be unbearably stressful."* (Worpole, 2013).

Common Atmospheres and Spaces

As Lawson mentions, the one common atmosphere that each library provide is the quietness for studying or reading, which is something every visitor is aware of and respects. One of the most common facilities of a library is the children's section, which is of great importance for the children and their families since it creates a second safe space to be outside their homes. With children, friendly furniture and surfaces, such as small stools and colourful carpets, spaces have a secure and calming atmosphere especially for foreigners and refugees seeking a safe place outside their homes. (Worpole, 2013).

Key Elements

Researchers have stated that the following criteria are key to ensuring the library will function well over the years:

- Maximising neutral light
- Providing a welcoming and warm ambience
- Creating vistas and visual interests – and intimacy
- Designing a place that is a pleasure to be in for long periods of time
- Providing clarity and coherence in the layout
- Delivering the most sustainable building within the budget
- Using zoning to accommodate a range of behaviours – from silent to social spaces
- Designing settings that encourage positive behaviour

Therefore, the atmosphere inside the building should provide a warm, welcoming, diverse, cultured, dignified, and secure atmosphere, with certain architectural aesthetics that excite and creates a place where one will want to be for a long time. (Worpole, 2013).

Ill.14 Collage of Public Libraries

THE CURRENT ROLE OF LIBRARIES

AN INNOVATIVE PLACE

The library consultant of the British Library, Mark Fortune, underlines the fact that the current role of the libraries in England is nothing but trying to survive. Every year plenty of libraries are closing and the demand for library services is decreasing each year. According to his investigations and perceptions, England is one of the countries that is rapidly affected by the arrival of new technologies, which greatly influence the decline of the book culture. He addresses England as the country with the initial thought: Everything must be digital! This includes technologies that will make libraries more efficient for the users and librarians. However, he stresses the importance of ensuring that these new technologies do not replace every librarian, but works as a complementary addition to the workload. (Fortune, n.d.)

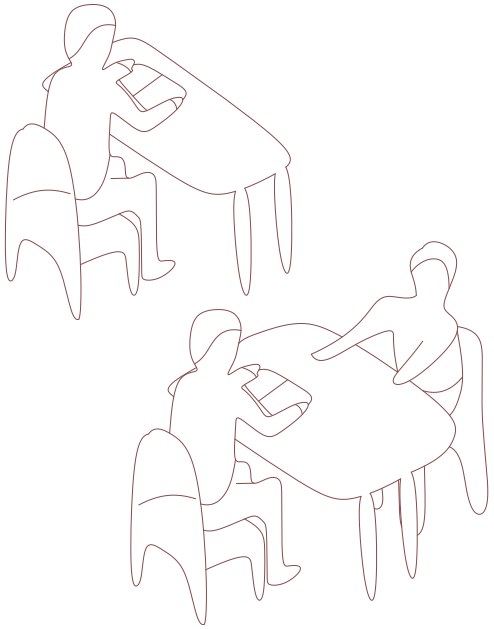
Another library consultant, Claus Bjarrum, who is an architect based in Copenhagen, Denmark, explains the current role of the libraries and how to design in a way that suits the 21st century. He clarifies how new libraries must consider the new technological circumstances, since, as mentioned, the use of libraries changes with time and the new technologies. For instance, nowadays, library resources can be attained through the internet without visiting the libraries at all. Unfortunately, this is another reason why the amount of library visitors is on a decline, and architects will have to rethink the purpose of new libraries. (Libraries as Places, 2011)

A way to achieve a modern library with the right information for the current patrons will be to implement new innovative technologies such as mobile applications (activity list of various libraries, augmented reality apps, etc.), self-service printing and copying, 3D-printers, digital interfaces for printed books and virtual reality. (Paraschiv, 2017). However, although these are the technical implementations that will serve the patrons of the 21st century, they do not define the aesthetical and spatial values of which an architect can contemplate. According to Bjarrum and plenty of other consultants (described earlier), the architecture of libraries should be inviting and appealing (Libraries as Places, 2011), a condition that can be reached through the right choice of materials or the use of natural light, for instance.

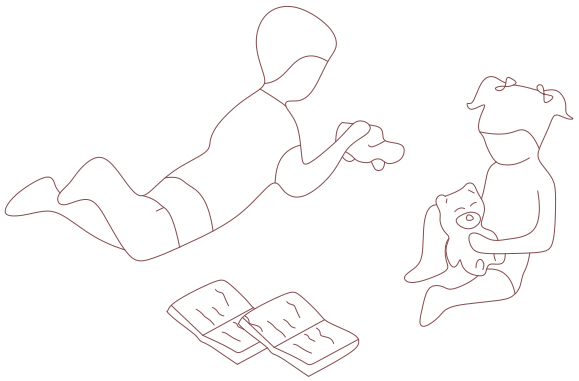
USER GROUP
LIBRARIES OF 21ST CENTURY

As the 21st century is known as a digital era with technologies for both education and joy, a new library design must be relevant for the current society. It is fundamental to re-evaluate and rethink the design strategy for library-architecture, merging traditional media with new age media. (Cranfield, A, Bon, I, & Latimer, K (eds) 2011). Several studies and investigations have shown how much the book culture is about to end in the 21st Century and how little people are aware of that fact and the consequences occurring from this decline. According to evidence about literacy skills in the UK, it is clear how much the reading for pleasure can enhance the literacy skills among the youngsters but still the most of the young people nowadays still do not like to read for fun. Concerning the improvement of facilities for children especially, understanding of new learning methods and trends is a requirement.

When designing this library, the main user group will be young people, where the main intention will be to invite and satisfy the youngsters, in order to restore the declining book culture. However, it is clear the new technologies of this century have affected the society, the learning methods, and performances, but it is still very important to make people interested in reading books and making them aware of how influencing this will be in their lives. It will be highly important to let the architecture do the talking and it will be the main factor in enticing the young people into the library, as well as in making them want to stay and read.



READING SPOT
CAFE
STUDYING
SOCIALIZING
TECHNOLOGIES
LOCATION
INVITING
INDOOR QUALITY
FUNCTIONS



COZY
SMALL SCALE
FAMILY
FRIENDLY
PLAYFUL
INTERESTING

Ill.15 Diagram of User Group

ROOM PROGRAMME
DESCRIPTION

"Good designs are where it is not dictated to the individual how they should perceive, operate or feel in the building, but have the flexibility to explore and experience it for themselves," says Dr Marialena Nikolopoulou. (Gander, 2016)

The intention of the designed spaces should be according to various mood/atmospheric senses, yet also functional needs that will enhance the reading culture and benefit the education.

Library
Since people are quite different from one another, it is indeed hard to define only one single reading room that will invite readers. Therefore, the reading area will consist of different spaces with different atmospheric senses, where people will get the chance to visit the right space that triggers one's attention.

Children's Library
As earlier described, it is very important to make the children nowadays want to read more books, but in this century the education is not only supported by books but also e-books, book clubs, virtual reality and spacious considerations that all benefit the education.

SOCIAL & LEISURE
In order to bring people to the building, to host several events and make room for chatting with a friend and enjoying a cup of coffee, different lounge, cafe and retails shops for the visitors will be provided.

SUSTAINABILITY
Depending on the purpose of each room and space, different consideration of natural light, natural ventilation, landscape connection and view towards the green and blue areas will be provided. The material and light will have a great focus on the architecture in order to contribute to a better sustainable living.

NATURAL LIGHT & VENTILATION
As nature can trigger one's emotions and provide a peace that will be perfect for a place to read or study, especially, the reading and studying areas will be provided with natural light and views towards the green and blue exterior. These rooms will be supported by natural ventilation in order to give a high value of peaceful and comfortable reading experience.

	NO	TOTAL AREA	NATURAL LIGHT	NATURE VIEW	PUBLIC	PRIVATE	TEMPERATURE	NATURAL VENTILATION
LIBRARY		m^2						
READING AREA - LOUD		495	◎	◎	◎		21	◎
READING AREA - SILENT		323	◎	◎	◎		21	◎
READING ROOMS	3	145	◎	◎	◎		21	◎
EMOTIONAL/OBSERVING AREA		135	◎	◎	◎		21	◎
MEDIA SPACE		30			◎		21	
COMPUTER / VR CENTER		165			◎		21	
TOILETS		47			◎			
CHILDREN´S LIBRARY								
FAMILY ROOM		42	◎	◎	◎		21	◎
READING/LEARNING	2	70	◎	◎	◎		21	◎
BOOK CLUB		42	◎		◎		21	
NURSERY		12			◎		21	
COMPUTER / VR CENTER		108			◎		21	
COMMON PLAY/LEARNING AREA		120	◎	◎	◎		21	◎
TOILETS		47			◎			
SOCIAL & LEISURE								
MULTIPURPOSE & RELAXING AREA		225	◎	◎	◎		21	◎
REPROGRAFICS AREA		35			◎		21	
CAFE/LOUNGE		200		◎	◎		21	
INFORMATION		30			◎	◎	21	
RECEPTION		25			◎	◎	21	
FOYEE/ENTRANCE		300	◎	◎	◎		21	
MISCELLANEOUS								
ADMINISTRATION		190	◎	◎	◎	◎	21	◎
STORAGE	3	60				◎		
TECHNICAL ROOMS	2	90				◎		
MEETING ROOM		18		◎		◎	21	◎
TOILETS		8				◎		
TOTAL								
TOTAL ROOMS/AREAS		2962						
COMMON AREA & CIRCULATION		3438						
OUTDOOR ISLAND AREA		960						
TOTAL BUILDING AREA		6400						

Ill.16 Diagram of Room Programme

SUBCONCLUSION

Through these studies and investigations of the relation between the body and architecture, it is very clear how the architecture and environment have a great influence on one's emotions, feelings, behaviour, and experience. It is through our body, brain and thereby our mind that we experience architecture, by other words: consciousness, which is indeed a highly important factor to have in mind before designing any sort of space. Since these psychological fields have been studies by several architects and scientist throughout the centuries, it will be difficult to measure one specific direction for any architectural design strategies. However, by having studied these fields and having them in mind while designing, it will serve as a design tool, that is interpreted and precepted individually.

Concerning the reading culture, it is clear how reading impacts the young people in particular. By reading more for pleasure, one feels empowered and will achieve a wider range of knowledge and skills. To increase the reading among the young people and invite more patrons into the library building, is important to make a library with recognizable and comfortable settings, but also to implement new design strategies that will connect the experience with emotions, the architecture with the body and the nature with the education.

4 CASE STUDIES

SISSI'S WONDERLAND
ROLEX LEARNING CENTER
COLOUR PSYCHOLOGY
DESIGN & MOOD

This chapter concerns the chosen case studies in which each has relevant architectural, technical, and conceptual details that will have an impact on the design of spaces and functions. Furthermore, I will describe case studies of researchers and evidence of how to create a design that benefits the well-being and emotions of the human beings in an architectural environment.

SISSI'S WONDERLAND
CHILDREN'S LIBRARY

Description

Sissi's Wonderland is the name of the new children's library in Shanghai. The architect behind it is the Muxin Studio that refers to the building as a "giant toy". This 108 sqm library consists of one floor with five sitting areas connected with one circular corridor. The spaces are made of light curved wood-lined nooks where the corridor is painted white. The entire building is curved with arch-shaped doors and windows and contains green plants. The furniture is integrated into the shape of the spaces. (Gibson, 2017)

Potentials

The main aim of this library building is to enhance the behaviour and education of children. By having different spaces with various functions and materials, the children will have the chance to understand and explore the different purpose of spaces and the boundaries between private and public of each space that will have an effect of their behaviours. The architecture itself is very cosy and very connected with the children, for example, the light materials, soft carpet, arch openings as in Disney movies and the small and curvy bookshelves in the proper scale, all of which enhances the children's comfort and the perceptibility of space as a child. The architects describe the architecture as being: *"(It's) an attempt to turn the space itself into a giant toy, in which children can freely explore, discover and create their own lively experience."* (Muxinstudio.com, n.d.). Where the main concept of the space also relates to children blowing bubbles. The scale of each bubble depends on its function that can be both private or public. Basically, the bubbles overlap one another and in-between they create both public, private, interior and exterior spaces that are interconnected in a smooth and creative way.

By having this enjoyable children scale, light building with green plants, the architecture will have an important impact on the children's perception, abilities to communicate, reveal the creative nature in them and making them want to stay in the building an enjoy the purpose of the space.

(Muxinstudio.com, n.d.)

Ill.17 Pictures of Sissi's Wonderland by Muxin Studio

ROLEX LEARNING CENTER
A LIBRARY BY *SANAA*

Description

The Rolex Learning Center is a new addition to the Ecole Polytechnique Fédérale de Lausanne, in Switzerland. The building encompasses a library, a research lab, study rooms, lecture halls and social meeting places, to mention a few, with a total of 37.000sqm, on a site of 88.000 sqm. The Innovative Architects behind this: *"radical and highly experimental building, designed for new ways of study and interaction in the 21st century"* (Sommariva, 2010), is the architectural firm SANAA from Japan.

Potentials

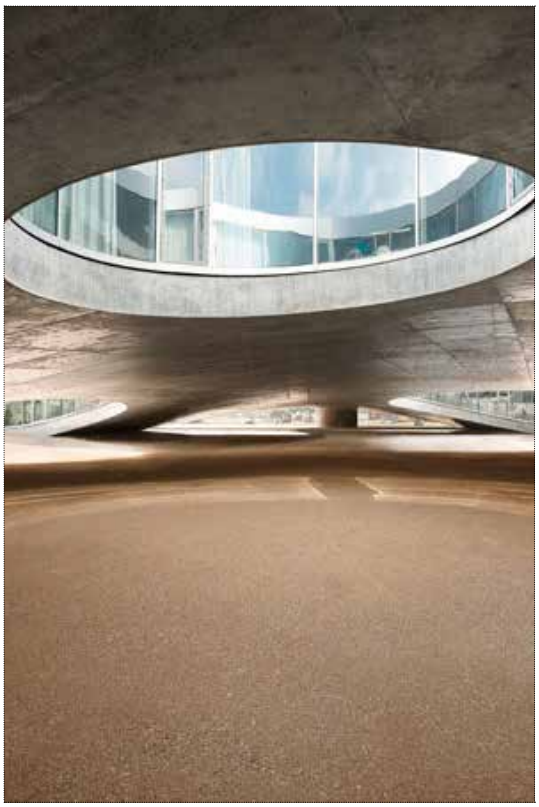
The organic shape of the building emphasises its connection with nature. To strengthen this, the building has fourteen oval shaped courtyards, bringing light into the building, and making small organic pockets of nature throughout the building. (McGuirk, 2010)

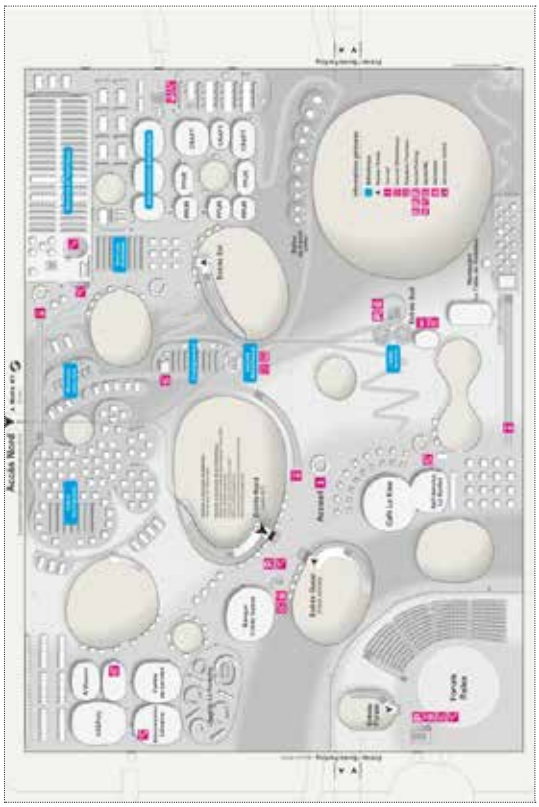
The aspect that makes this architecture so radical and experimental is the fact that the building contains no inner walls. Instead, the rooms are defined by the space in between, an attribute that is enhanced by the white surfaces and undulating floor and ceiling.

The base is made up of two superimposed arched shells, where the openings have been made for the courtyards. The largest of the shells span 80m. The roof is then made with steel beams and wood joists that are interlocked, forming the organic shape. (Bouygues Construction, n.d.)

One of the lead architects on the project, Kazuyo Sejima, describes the concept as a horizontal continuum, inspired in some ways by the classical Japanese architecture, where space is defined by tatami mats, and not by walls. (McGuirk, 2010).

Patrick Aebischer, president of the EPFL and a neurobiologist says: *"The most important thing is that the building forces you to think differently,"*. He believes that the flowing spaces will allow for interaction between different fields of study on a new level, increasing the exchange of ideas. (McGuirk, 2010)





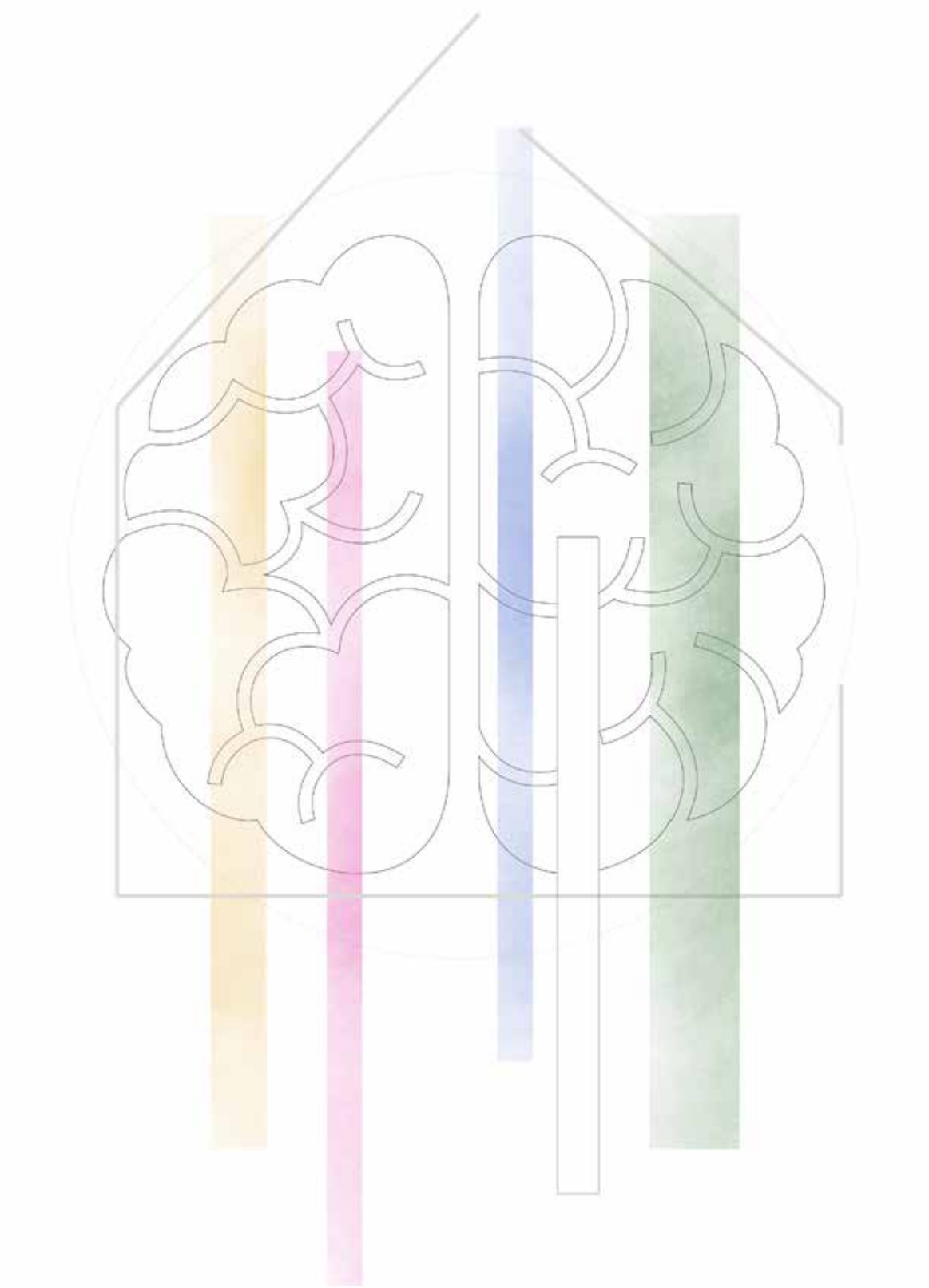
Ill.18 Pictures of SANAA, Rolex Learning Center, Taken by Sergio Pirrone

COLOUR PSYCHOLOGY
HOW COLOUR EFFECTS THE MIND

Decades of observations and studies have proven that the sensory perception of colour is one of the essential elements in the architectural environment that affects the human. Being a sensory perception, colour will have symbolic, associative, synthetic and emotional effects on the visitors, which is also a part of a neuropsychological research that focuses on how the brain reacts among different colours. (Color in Architecture, 2012) However, it is very important there is a balance, since under stimulation (sensory deprivation) or overstimulation (sensory overload) will cause dysfunction. Under stimulation happens once a room contains weak intensities of colours or monotone colours that trigger restlessness, excessive emotions, difficulties in concentration, perception disorders, etc. Overstimulation is the opposite and happens when using too intensive colours, complex colour harmonies, strong contrasts, etc. This will affect the pulse rate, blood pressure, have compounded medical consequences, etc.
(Archinect, 2012)

It is therefore highly important to achieve a space with visual efficiency and comfort for the eyes that will have a positive effect on the mental and physical health. Each colour has its own expressions and effect on the mood and brain and will be an essential element to use, especially when designing study rooms. The helpful colour choices can be as following:

Yellow: Sense of inner power, positivity and happiness.
Magenta: Relaxation, concentration, decreases headaches
Blue: Large positive effects on mental and physical well-being, intelligence, tranquillity
White: Innocence, purity, perfection, mind and clarity.
Green: Harmony, nature, balance, lower anxiety.
(Mutz, n.d.)



Ill.19 Diagram of Colour Psychology

DESIGN & MOOD
MATERIALITY, FURNITURE, VIEW & LIGHT

Based on researchers from different scientists and architects, different architectural elements will have an impact on the mood, creativity, focus of students, etc. To name some of the most important details, the ceiling height, view towards nature, sunlight, furniture, and materials. (Kelly, 2010)

Ceiling height

"Relatively high ceilings may prime thoughts related to freedom, whereas lower ceilings may prompt those that pertain to confinement. We suggest that, in turn, these alternative concepts may affect the particular manner in which consumers process information…" Says professor Joan Meyers-Levy about human reaction to ceiling heights. (Meyers-Levy and Zhu, 2007)

View & Sunlight

Studies and researches made by different environmental psychologist show that a view towards nature can enhance the mood and focus. If the green or blue nature is not available for the building, green plants inside rooms or green terraces can be a substitute. The sufficient amount of natural light will have a positive impact on people and especially students in class or study rooms. (Kelly, 2010)

Furniture & Material

When designing rooms for health care and school/library, a good choice will be to use soft furniture. Smooth and curvy furniture will be a better choice than sharp edges since the sharp edges relate to "danger". (Kelly, 2010)

The building material, wood, is not only a good choice for sustainability purposes, but in fact also for the benefit of health. According to several researchers, a wooden interior setting is getting more and more prevalent with the aim of well-being. Wood provides a healthier indoor environment and quality. By applying non-threatening elements from nature, it will have a great impact on the psychological well-being of the inhabitants and will provoke positive feelings of the aesthetical natural design. Wooden interiors will also decrease stress since being around with nature as wood and green plants, brings more happiness and positivity (Nyrud and Bringslimark, 2009).

Ill.20 Diagram of Design & Mood

SUBCONCLUSION

Throughout these case studies and researches of design details and their influence on the body, it is very clear how simple detail elements can have a huge impact on the mood, brain, emotions, mind and the feeling of staying inside the architecture for a longer period. It is not only about making an outstanding architecture in order to invite people or stimulate the mind but just by playing with the colour, human scale, cozy interior materials and connecting with nature will all be enough to achieve a design that triggers one's attention and emotions.
For what concerns the constructional details, the Rolex Center by SANAA architects, gives adequate ideas of detailing, especially the construction of the curvy roof and the challenges behind it. Furthermore, the building gives an understanding of the material and how an organic design principle can be developed.

5 DESIGN PROCESS

WAVES & BODIES
SITE CHOOSING
FUNCTIONS ON SITE
ROOM DESIGN
FORM & APPROACH
SHAPE & FORM
CONSTRUCTION ON LAKE
MATERIAL & SUSTAINABILITY
TECHNICAL CONCERNS
FROM 2D TO 3D SHAPING
INTERIOR & COGNITIVE THERAPY
BUILDING MEETS PARK
DAYLIGT
WIND
RAIN

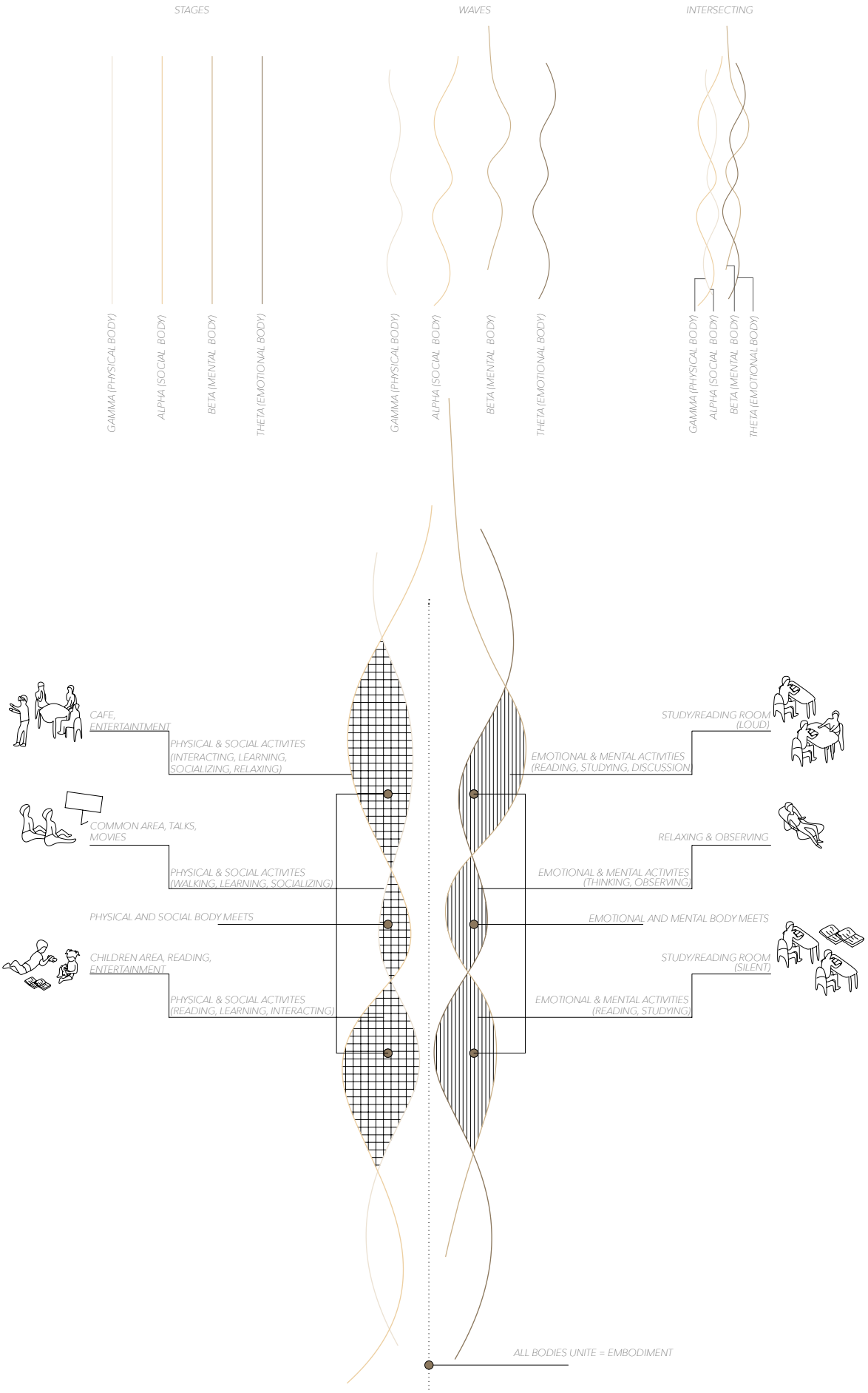
This chapter concerns the design process of the project where I will show several iterations, thoughts, ideas and intentions with 2D and 3D illustrations. The chapter is divided into themes in order to demonstrate the ideas from the beginning and the reasons why they ended up as they are.

WAVES & BODIES
THE WAY TO THE CONCEPT

"Like our body, a building is a series of interrelated systems, each possessing its own identity and offering a particular array of affordances. The mind is nested in the body and the body is nested within the contexts of room, building, city, earth, universe. We could say that our body has, nested within it, at least four bodies: our physical body, and the more ephemeral, but equally real, emotional body, mental body, and social body", says Sara Robinson (Pallasmaa, Mallgrave and Arbib, 2013). As Robinson is mentioning, the body is nested within those four bodies that are nested within architecture. The mind is nested in the body which directs one throughout the life through the perception.
Each one of these bodies can be interlinked with brain waves that represent different actions. Together with our subconscious mind, the brain waves play an important role in creating and understanding one's reality. There are five different brain waves that each represents an action and a state of consciousness; Beta, Alpha, Theta, Delta, and Gamma. (Mindvalley Blog, 2018)

Beta waves are actively engaged in the mental activity, such as learning, studying, making speeches, etc. (Scientific American, n.d.). Beta waves can be interlinked with the mental body that both concerns mental activities and are strongly engaged with the mind.
Alpha waves appear more in the relaxing state, for instance just after studying or doing any kind of tasks. Here the waves can be interlinked with the social body, after all, they both concerns the relaxing and socializing states.
Both Theta and Delta waves involve the resting state. However, Theta appears just before Delta once the person is in a less deep sleep or daydreaming. Both waves will be interlinked with the emotional body, after all, this state is all about relaxing and finding your inner soul and emotional moments. (Scientific American, n.d.).
The last brainwave, Gamma, appears when dealing with higher information processing (Mindvalley Blog, 2018) and can be therefore highly important for the senses and perception, and concerns the learning of new technologies and knowledge. This brainwave will be interlinked with the physical body that both apply to physical activities.

After defining each brain waves that relate to each one of the body, a design of an architecture as a journey for the mind will be achievable. Here, each couple (brain waves and bodies) will define a specific function for specific areas that will guide the plan layout. As the waves can be both of edgy or curvy kind, taking inspiration from the landscape and especially the lake, a curvy translation of waves will be more suitable. The diagrams show each one of the steps of the concept and describe how the intersections of the couples relate to architecture and space planning.



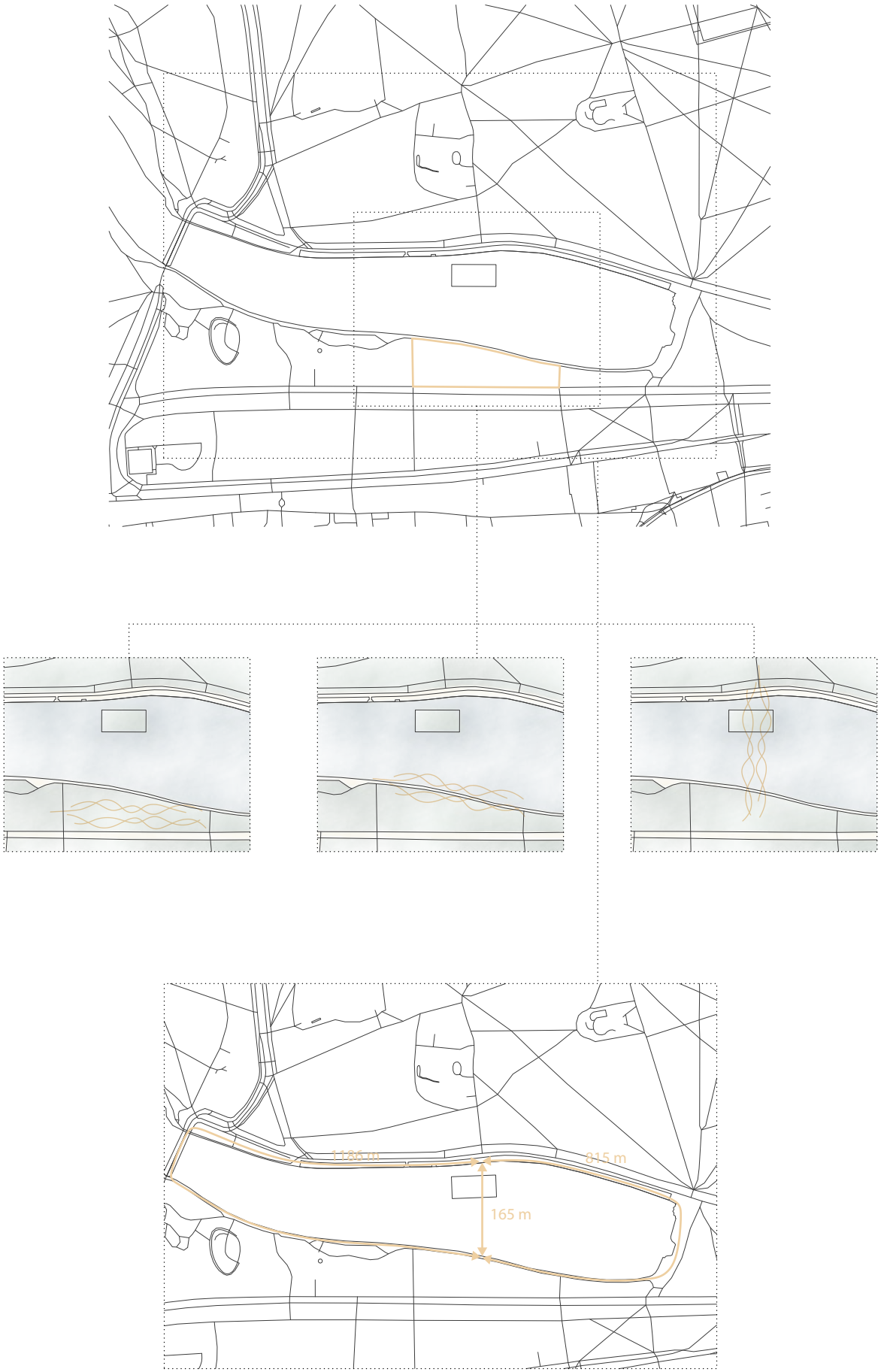
Ill.21 Diagram of Waves & Bodies

SITE CHOOSING
POTENTIALS & MOBILITY

The original location of the site given by the competition brief is illustrated with red in the diagram next page with 16.600 square meters.
The position is beautiful with a huge amount of trees, bushes and just next to the Serpentine lake. The atmosphere is pleasant and calm. The site has full potential of letting the architecture become a part of the park and be very close to the lake as well.

By moving the building half on the water and half on the park, an interesting architecture will arise. Here the architecture will be even closer to the lake that will have a benefit for the atmospheres of the reading/studying rooms. The building will now be connected to the green and the blue that goes along with the pathway that now will be shaped by the building outline.

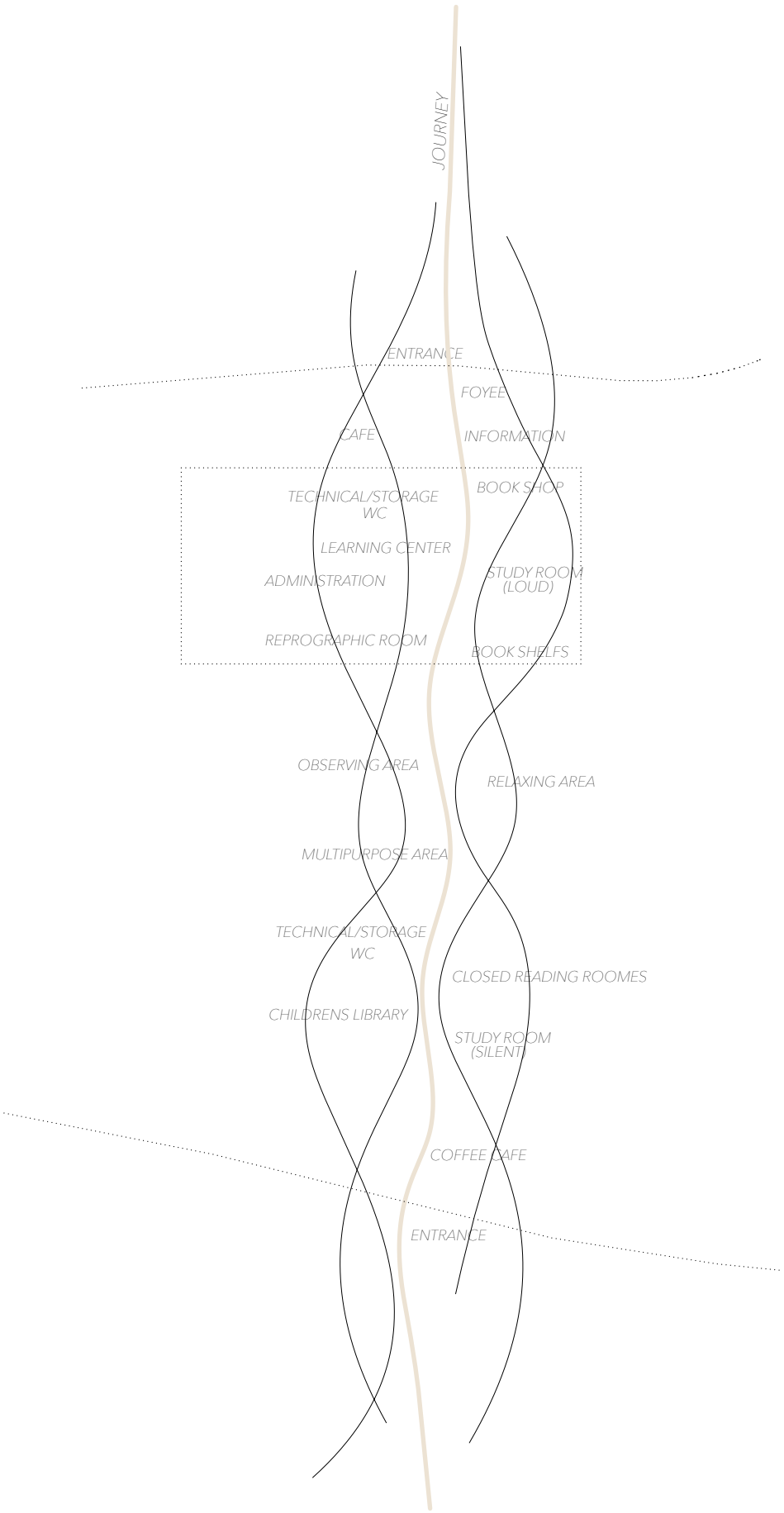
However, by rotating the building with 90 degrees and moving on the existing island on the lake, the architecture will not only be in close relation with the landscape but also function as a bridge landmark that will have a great benefit for the mobility for the park as well (see diagram). The island will be the new park/courtyard for the architecture yet also a benefit for the construction details. This movement will enhance the concept of having a journey through the building where one will find the right pit stop for his need.



Ill.22 Diagram of Site Choosing

FUNCTIONS ON SITE
THE JOURNEY

As the architecture do have an influence and impact on the well-being of an inhabitant, it is highly important to study how to achieve an architecture that provokes the feelings but also affects the behaviour and the body. By letting the architecture become a journey for each person and by placing the functions that are needed in the right areas according to the mind and one's feeling, the architecture will be a step closer to the concept and aim. This means that the functions will be placed according to the intersections of the four bodies and will be defined according to the general library setting, but also according to the relation of the intersection of the bodies.
The diagram shows how these distributions of functions take place and become a stop/rest point during the journey.



Ill.23 Diagram of Functions

ROOM DESIGN
MAIN FUNCTIONS

The diagram shows the designs of the most important rooms in the building with their sizes and needs taking inspirations from evidence and researchers on how to design the rooms perfectly that fit with their needs and settings.

Study Area (Silent)
The silent study room/area consist of tables with different amount of seating. Located towards North - East part of building for a better natural light for study purposes. Higher ceiling in order to achieve a certain atmosphere that triggers the study mood, creativity and openness and with a great view towards the lake.

Study Area (Loud)
Compare to the silent study room, the loud study room is slightly bigger and with a higher ceiling that for instance changes the atmosphere from the silent room. There will be lockers available with a view towards the greenery on the island and the lake.

Different Reading Rooms
Different kinds of reading rooms, that each has it own interior design that triggers different emotions. The rooms are different in height, however, each one of them is placed towards a great view.

Relaxing and Observing Areas
The emotional, observing, thinking, relaxing is to be found next to a clear view towards the lake in the middle part of the building.

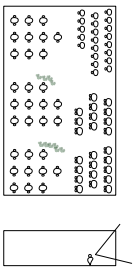
Children's Library
Children library consist of joyful forms taking inspiration from water bobbles from the lake. To achieve an intimite and charming atmosphere, calm and warm materials will be choosen.

New Technologies
New technology rooms and areas will be provided in order to enhance the learning methods and also attract young visitors in particular.

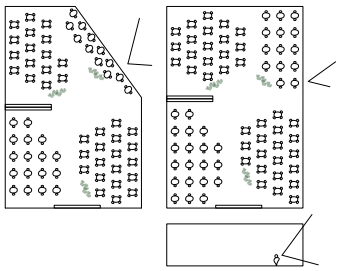
Lounge, Foyer
Lounge and foyer will be placed near the entrance towards the north part that in order to be closer to car accessibility for food delivery etc. The room height will be lower that provides an intimate atmosphere.

Administration
The administration section will be placed towards the north with meeting rooms that have the same form language in order to have a sense of continuity of the plan layout.

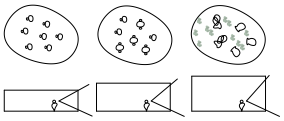
STUDY AREA (SILENT)



STUDY AREA (LOUD)

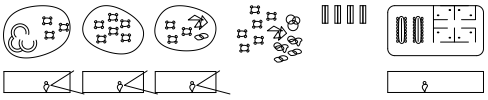


DIFFERENT READING ROOMS

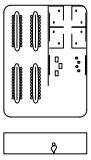


RELAXING, OBSERVING AREAS

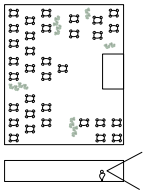
CHILDRENS LIBRARY



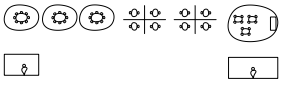
NE W TECNOLOGIES



LOUNGE, FOYEE



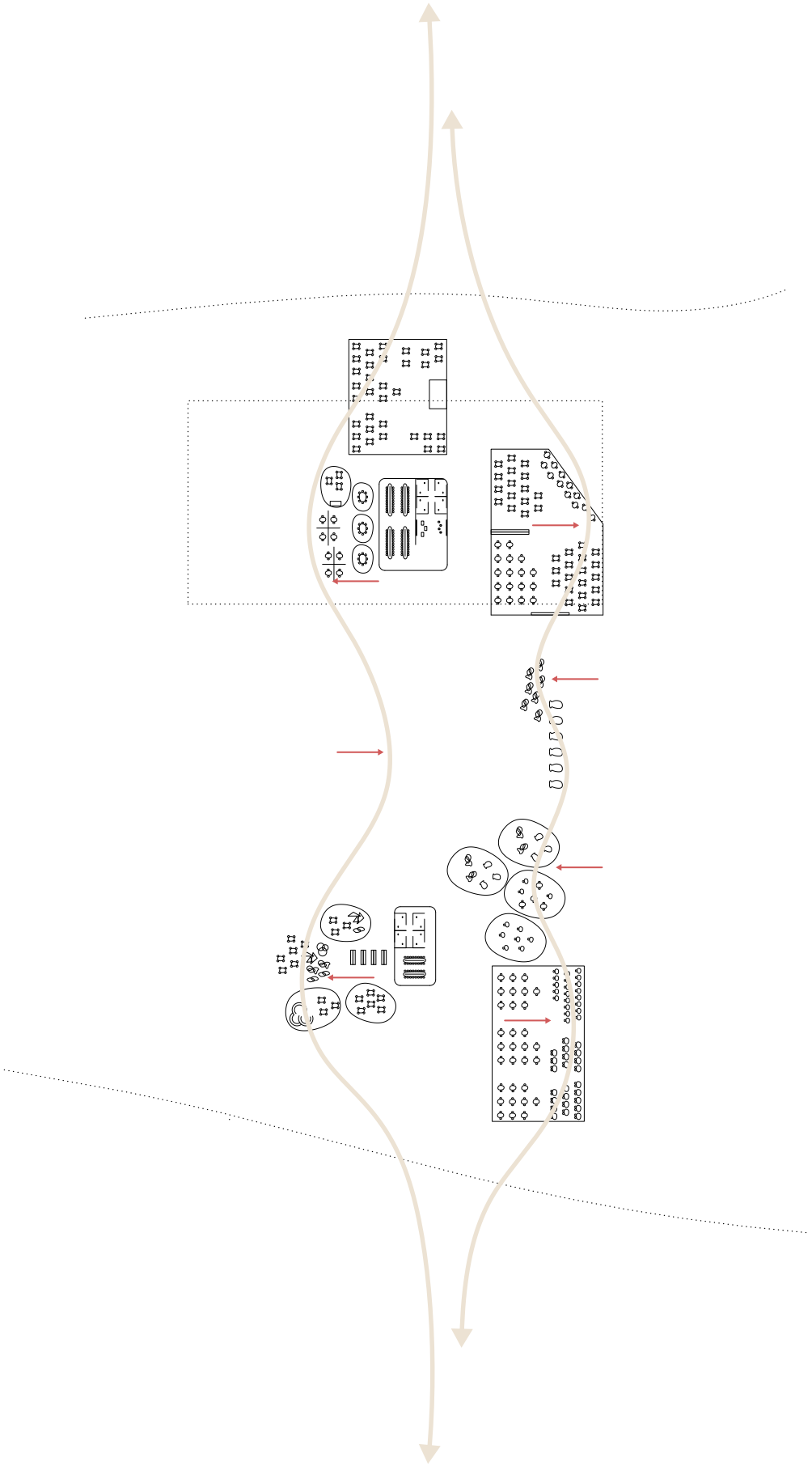
ADMINISTRATION



Ill.24 Diagrams of Room Design

FORM & APPROACH
FROM INSIDE TO OUTSIDE

After defining the room sizes and placement on site, the form of the building will be easier to define after these parameters. The diagram ill.25 shows how the outline of the building takes shape after the needs. Whenever more space needed, the line will be pushed outwards and likewise, whenever less area needed the line will be pushed inwards. This concept allows a flexible design solution that will have a benefit when defining the final shape that also needs to meet the technical requirements and reduces the unnecessary square meters.



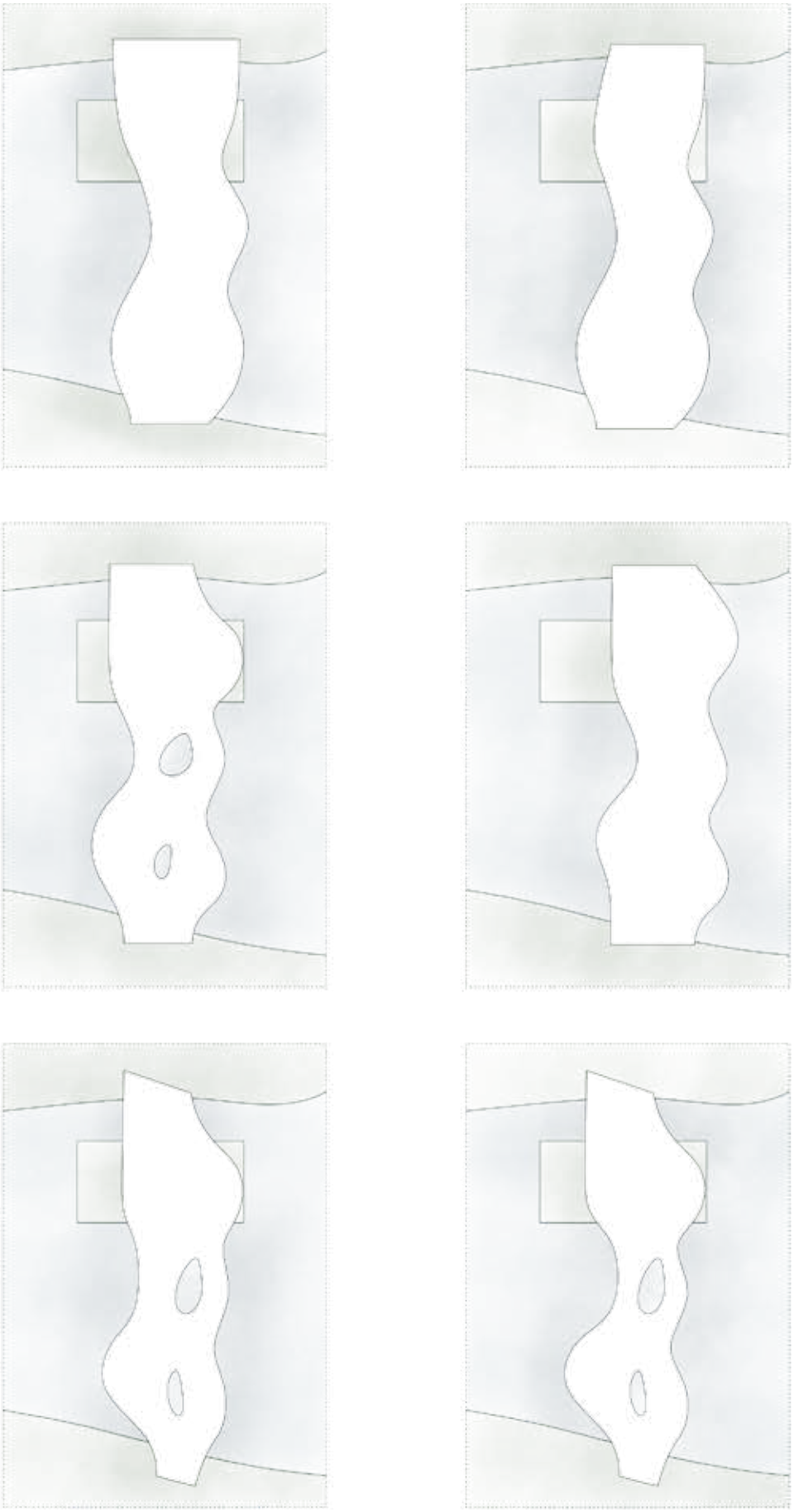
Ill.25 Diagram of Form & Approach

FORM & SHAPE
CURVES

The diagram ill.26 illustrates different options on how to define the outline. It is not only important to meet the best fit for the interior layout and technical concerns, but also to achieve an appealing and aesthetical architecture that crosses the lake.

The meet between the northern and southern edges is an essential design detail since it is the main part that invites the visitors. For instance, by pulling the one edge towards the north, the edge becomes more inviting for the North part of the park.
As using the advantages of building on a lake, openings on the floor will be a beautiful detail that also triggers the emotions and excitements when being inside.

Forasmuch of designing a building with only the amount of square metres that is needed, it will be convenient to build slightly bigger in order to prevent having a too slim and curvy shape.

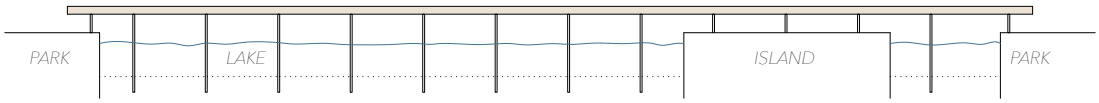


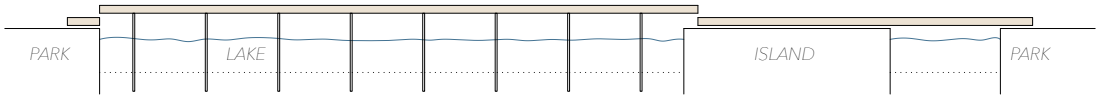
Ill.26 Diagram of Shape & Form

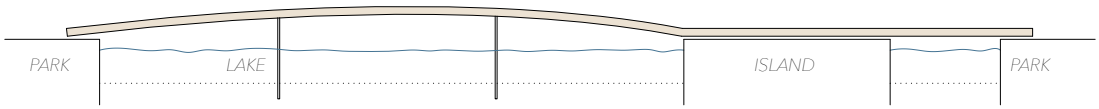
CONSTRUCT ON LAKE
DIFFERENT APPROACHES

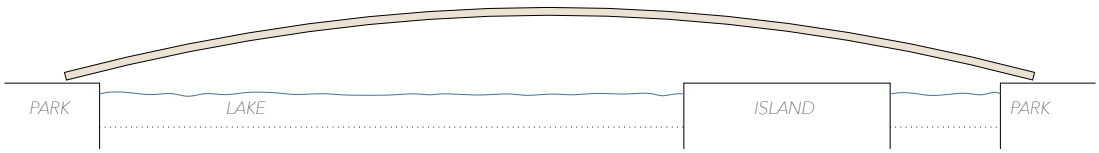
The span from one part to the other part of the lake perpendicular is approximately 165 m which will be the minimum span of the building as well. The distance between the island and park is 20 m from the northern part. Hyde Park is known for having pedal boats during the warmest periods, which means the building must be offset by approximately 3 m for people to pass underneath it. By having these parameters in mind, the diagram shows several approaches on how to build the building across the lake.

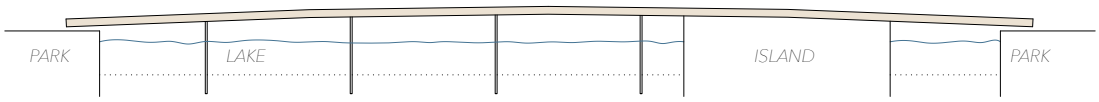
The first sketch shows an idea of having a straight building that makes the interior layout very easy. However, this idea requires plenty of columns going all the way down to the bottom of the lake and needs stairs at the entrances as well. The second idea shows a way to avoid stairs at the entrance but makes the building none regular.
The third idea is a combination between the first and the second one. Due to the arch, fewer columns will be needed.
The fourth idea shows how to have a traditional arch bridge that will maybe have no columns. Unfortunately, the plan layout will be very restricted in this case and the most of the rooms will need to be placed on a platform.
The last option shows a slightly gently arch that lays on the island and ends on the ground level on the park. This means that there will be ramps at the entrance part and at the same time avoids having platforms for all room, but only the rooms next to the entrances. Columns are still needed, but not as much as the previous options.











III.27 Diagram of Construction

MATERIALITY & SUSTAINABILITY

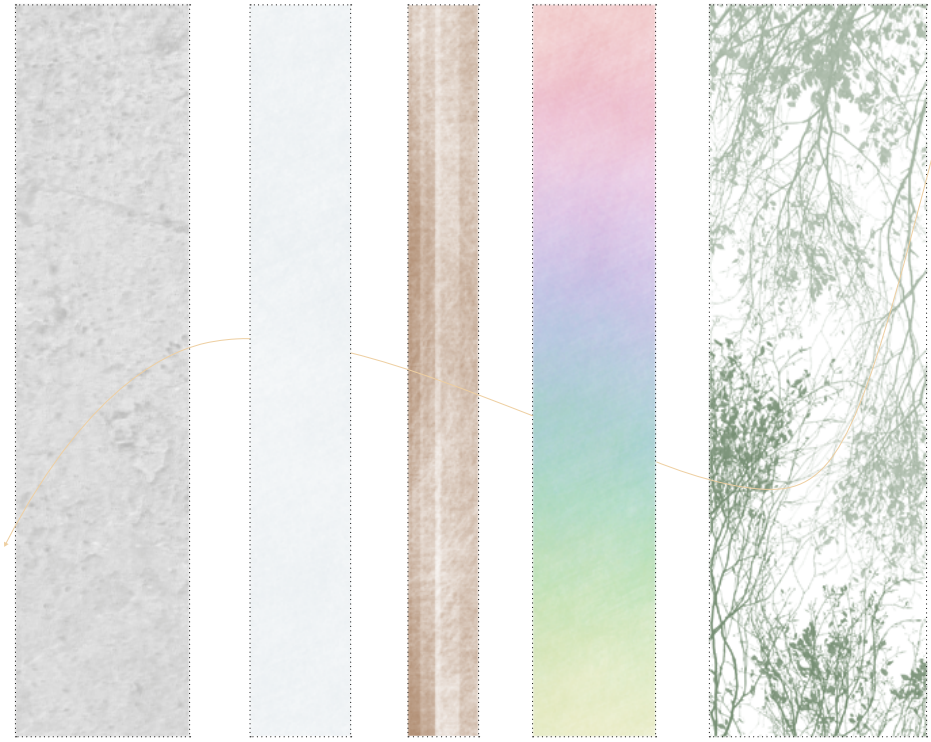
As previously mentioned, the materiality of a building is of great significance. The main use of materiality in this project is concrete, glass, wood, colours and nature.

Concrete's strength and raw materiality make it a natural contrast to a smooth, painted surface. Its natural light grey colour is calm and will work as an emphasiser of other colours and materials. The strength of concrete makes it a very durable material, with a long life and low maintenance. When looking only at the energy cost of producing concrete, the material fails as a sustainable material. However, concrete is made by reusing rubble, and its long life means that it will not have to be replaced repeatedly, as other materials might. Concrete is also easily accessible in England, which means less transportation time.

The materiality of glass and nature are deeply intertwined in this project. Glass is essential to connect the building with the surrounding site. Using nature as interior elements, and a frameless glass facade blurs the separation between inside and outside, making it seem like outside is always only a step away. As mentioned in the preliminary studies, an environment influenced by- or with a view to nature, is beneficial in all kinds of situations.

Glass can be a very sustainable material, when used thoughtfully, to improve the building's solar gains and reducing the amount of excessive heat (Achintha, 2016). It is also highly beneficial for the indoor climate and environment, providing visitors ways to orient themselves and natural light. In this project glass is used excessively, to strengthen the aesthetic vision of the project, which negates its sustainability to some extent. This is a common balance of an architectural project. Sometimes the benefits of sustainable design solutions outweigh aesthetic features, and sometimes an artistic solution that strengthens the design will outweigh other criteria.

Wood and colours are, as with nature, used as interior elements. The warm, earth tone nuances, and texture of wood and the positive influences of certain colours, is used to define areas and to create various environments within the building, each area emphasising specific feelings.
The use of wood as interior design is highly sustainable due to its positive impact on the environment and its long life, when not exposed to weather. The various colours are applied as paint and it is therefore important that the type of paint is chosen based on the sustainability of its production and its contents.

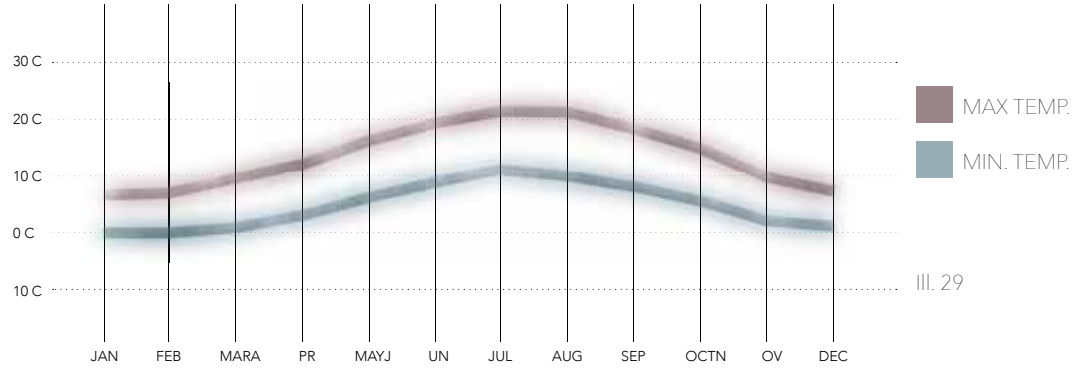


Ill.28 Diagram of Materiality

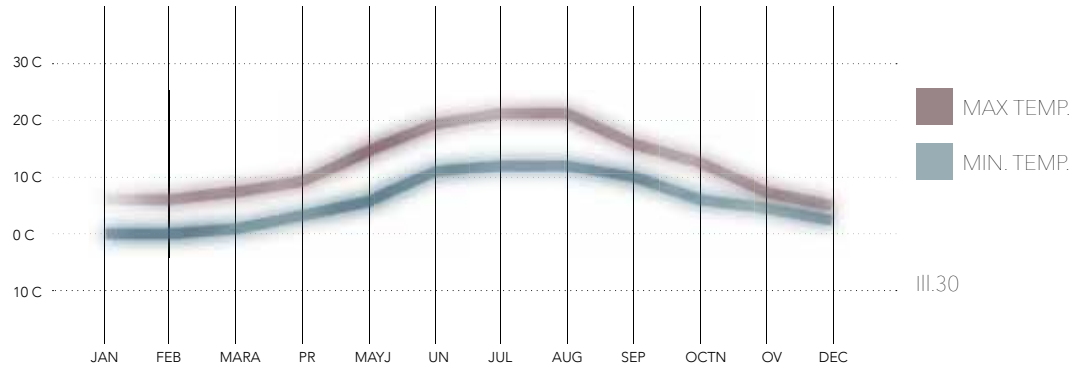
TECHNICAL CONCERNS
ENERGY, INDOOR & DESIGN QUALITY

Concerning the improvement of the indoor quality and building performance that provides a more sustainable building design, the design process will go alongside with technical simulations of bigger design solutions. Once doing the simulations from BSim and Be18 the building will go after the Building Regulations 2015, which is the current one instead of 2020, considering fewer restrictions of design elements, such as thinner building envelope and larger area for the solar cells that need to be a part of the architecture to achieve an integrated design. Not only will it affect the design details, but also have fewer restrictions on the energy use in the building. The chosen hours of the operative temperature will be 100 hours 26 degrees and 25 hours above 27 degrees, which is to be found in the Danish Standards 474 (DS, S-474), however, the final requirement of the indoor climate will be given by the building owners.

The indoor climate and energy consumption simulations have been based on the Danish weather file. Both in England and in Denmark the climate is temperate, which means that the temperature does not differ enormously from one another. The diagram shows how temperatures of the coldest and the hottest months are approximately the same which makes it convenient to use the Danish weather file for simulations. Furthermore, Denmark already is the country that has one of the highest building standards, which only makes it better for using the Danish regulation when designing in England.



Ill. 29



Ill.30

Ill.29 Diagram of Temperature of Denmark
Ill.30 Diagram of Temperature of UK

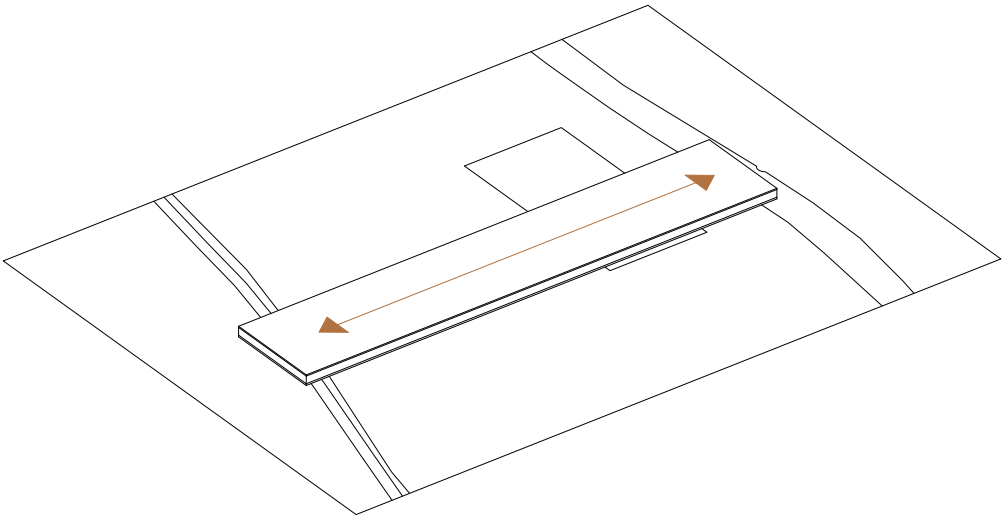
ENERGY QUALITY

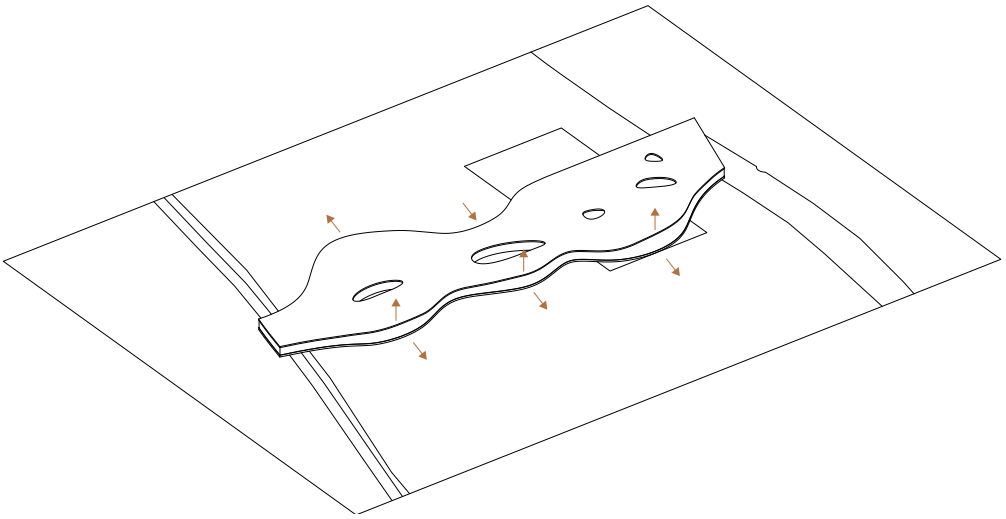
Before defining the final shape of the building, the energy quality and performance has been examined in order to understand how the design can have an effect on the energy consumption and thereby how to improve the design to have an acceptable energy use. These studies have been done by using the energy simulation tool Be18.

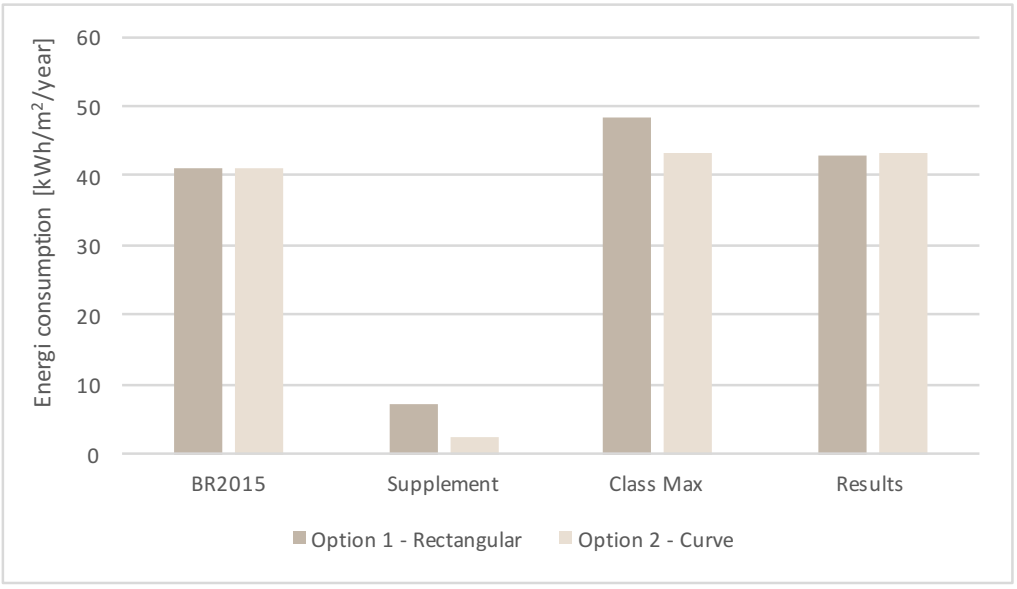
The first iteration is when the design is a simple rectangular shape that crosses the lake and becomes a bridge. Here the aim was to understand how much energy this simple shape uses when having only glass facades and concrete building envelope. However, the plan design and the architectural expression are not at their finest. The result is an energy consumption of 48,4 kWh/m2 with a supplement when considering the building to be in use more than 45 hours per week. To reach the energy requirements of Br15, the design needs to have 150 sqm of solar cells to produce the remaining energy that is needed. The energy consumption will finally be 43,0 kWh/m2 and there will be no need for cooling in the unit.

The second iteration is the design of a design option with curves that will be more close to the final design. Due to a larger heated area and larger area of windows, some part of the building will need to use cooling in order to ensure a well indoor climate. By designing with curves that go in an out, the total glass area will be larger than the first option. The total building area is bigger than the first option since this design is more close to the final idea and concept. The energy consumption for this option is 45,3 kWh/m2 and will need 270 sqm of solar cells due to the extra energy use for cooling.

Even though the glass in the facades is with a relatively low g-value, some part of the building will use cooling to achieve a better indoor quality and to meet the final requirements when designing the final design. Trough these to option examination it has been more clear how much the glass area and the heated area will have an impact on the final energy consumption and surely has to be in consideration when defining the final shape.







Ill.31 Diagrams of Form & Energy Consumption

INDOOR QUALITY

6 m High Ceiling

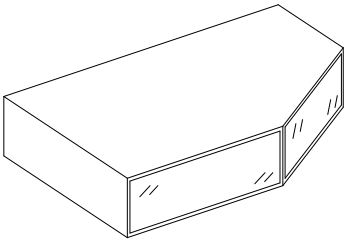
When using the building performance simulation tools, BSim, the ceiling height of the loud study room of 6 m, reaches the requirement of the indoor climate for building regulations 2015 with 45 hours above 26 and 7 hours above 28. Having a lower ceiling height will reduce the amount of glass area and solar radiation that will reduce the heating consumption, hence, less energy for ventilation will be needed. The natural air change will increase due to the lower volume compared to a higher ceiling. Here, the user will have a bigger influence on the building, since they will have to open the windows manually more often. A way to avoid this issue is by reducing the natural air change since the hours above 26 is well below 100.

7 m High Ceiling

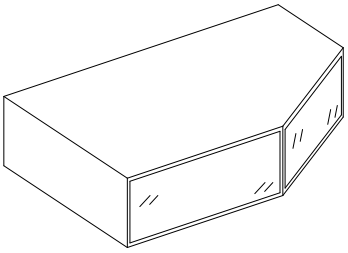
Having a ceiling height of 7 m will increase the volume and will require more glass area if the same architectural expression is needed. Increasing the glass area will increase the solar radiation and the heating consumption and at the end will, for instance, use more energy for the ventilation unit. However, the room still meets the hour's need, as 93 hours above 26 and 24 hours above 27.

8 m High Ceiling

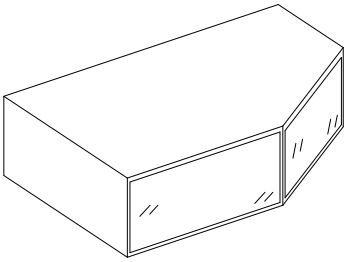
A ceiling height of 8 m makes the scenario even worse. Due to the huge amount of solar radiation coming from the increased glass area, the heating and energy use will be immense. The operative temperature is slightly higher than the other two cases. Unfortunately, the room does not meet the hours as expected, since it is now 131 hours above 26 and 53 hours above 27.
(Please check appendix for more information)



V: 2490 m^3 and
Floor area: 540 m^2
H: 6m
Glass area:
CO_2: Below 750 ppm



V: 2990 m^3 and
Floor area: 540 m^2
H: 7m
Glass area:
CO_2: Below 750 ppm



V: 3490 m^3 and
Floor area: 540 m^2
H: 8m
Glass area:
CO_2: Below 750 ppm

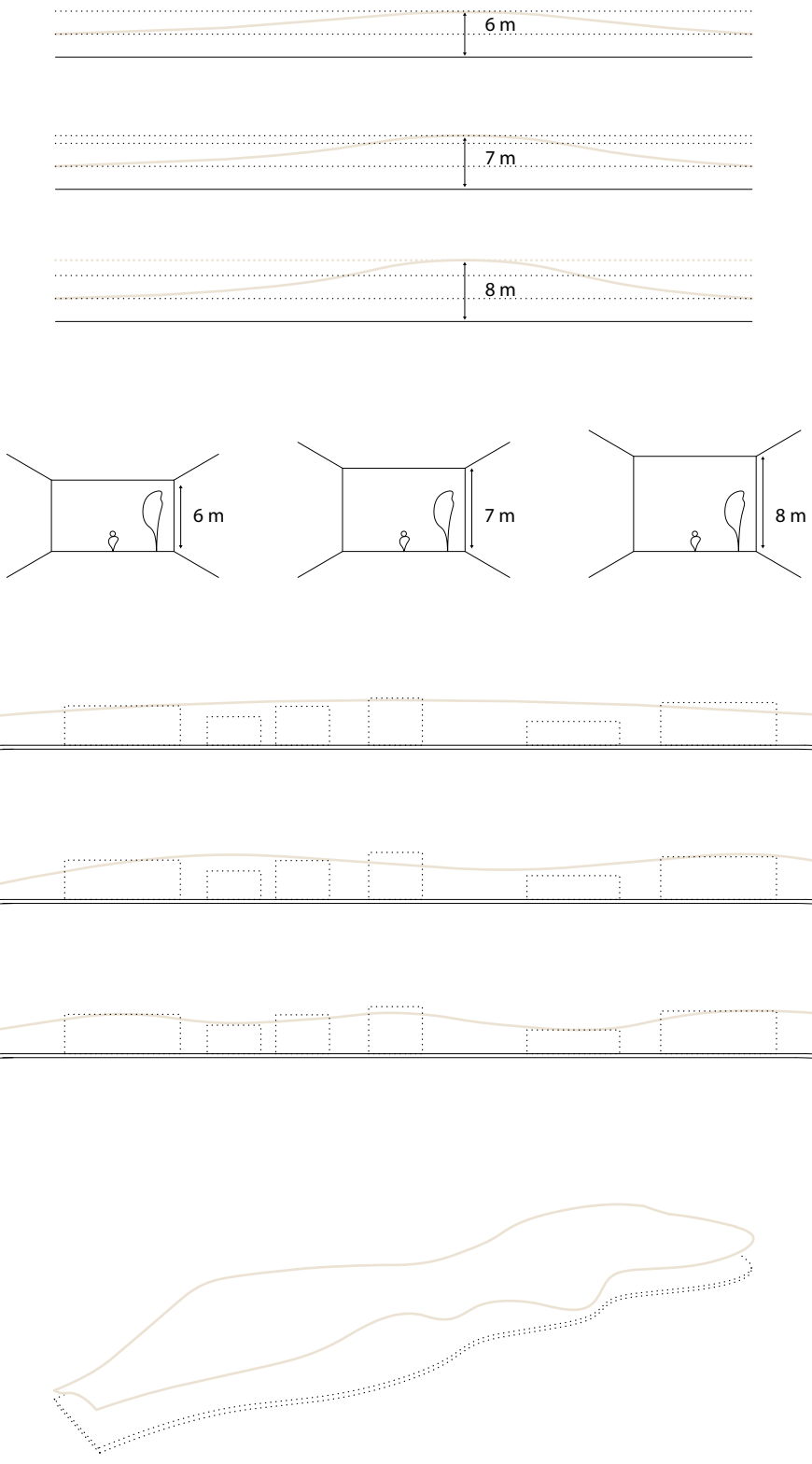
Ill.32 Diagram of Room Heights

FROM 2D TO 3D SHAPING
CEILING HEIGHT & PHYCOLOGY

Ceiling height does not only affect the indoor climate, ventilation nor energy consumption, yet also the brain and the behaviour of a human being. According to several researchers and investigations on the impact of a higher ceiling for the inhabitants that is based on evidence, it results that a higher ceiling than a normal room height as around 3 m is preferable among the consumers. A higher ceiling will affect the psychological well-being of a consumer and will increase the feeling of freedom and creativity, whereas a lower ceiling provides a confinement thinking. (JAFFE, n.d.)

Once designing the study and reading and the emotional section, the intentions have been to design a room with ceiling height around 6-8 m, where the opening height will be around 5 m. This will provide a feeling of freedom and creativity, however, in order not to exaggerate, a ceiling height of 6 m will be more appropriate.

Taking inspiration from the chosen case study of children's library, a lower ceiling height will be more suitable hence it provides a more intimacy and a cozy atmosphere. However, 6 m ceiling height will not be suitable for the this section, the children´s library openning will be around 2.7-3 m in order to provide a more cozy atmosphere.



Ill.33 Diagram of 2D to 3D Shaping

INTERIOR & COGNITIVE THERAPY
DESIGN OF ROOMS

As earlier described it is highly important to achieve rooms that will have a positive effect on the mood, emotions and mental health. According to the previous study, colours as yellow, magenta, blue, white and green will have a positive effect, especially study and learning purposes. These colours will help to trigger the emotions and provide a warm, peaceful, relaxation, clarity, etc. among people. However, it is surely difficult to study this balance with colours and the effect of the body since the colours will depend on the situation, brightness, location, space design, etc., that will all create different atmospheres and moods. Each person has their own ideas, taste and thoughts about colours, therefore, it will be more convenient to provide different atmospheres with different interior designs and colours that make it possible for the single patron to choose the perfect fit for his need and desires.

When choosing colours it will not only be about wall painting but also smaller and bigger elements in the rooms. Surely, the colour magenta is not the most peaceful colour to have as a wall painting, but the effects of magenta can still be provided by using small elements as table or plants in magenta colours.

Blue can be used as painting, however, a view of the sky or lake/sea will be more than enough and will even have a stronger effect.

Green is mostly connected to nature, which means having the nature inside the room or the having a view towards nature will be much beneficial for the mind, emotions and relaxation. The green can be used together with a wooden interior setting that together will provide a better indoor environment and quality and enhance the well-being and positive feelings of the visitors.

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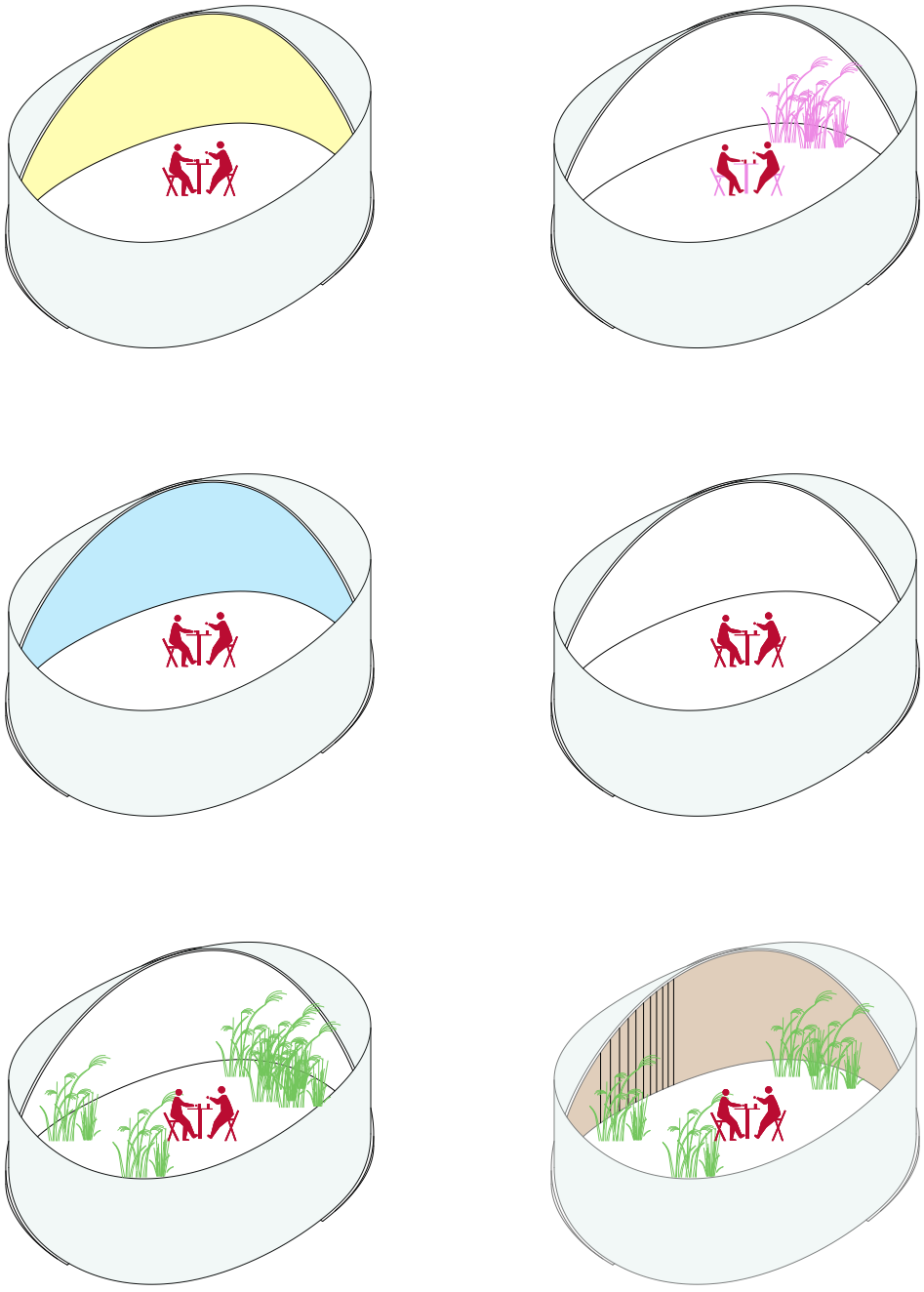


Ill.34 Diagram of Interior & Cognitive Therapy

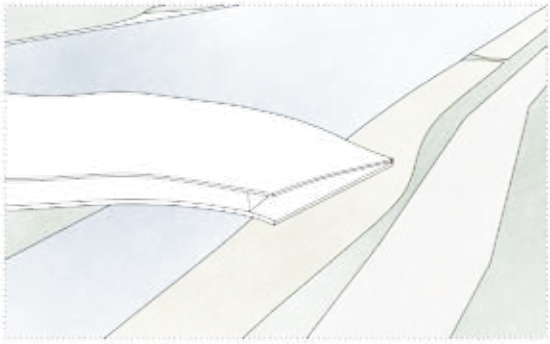
BUILDING MEETS PARK
DESIGN OF ENTRANCES

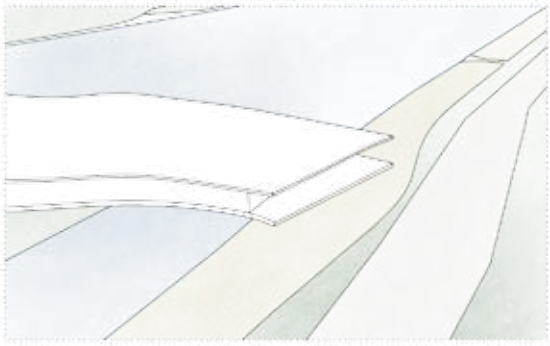
These iterations show how the design of the entrances should take shape as well as the meeting with the park.

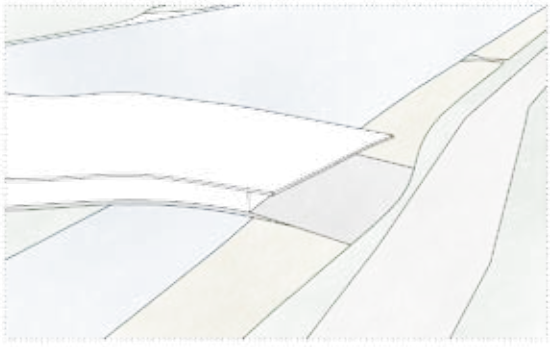
By pulling the one end of the roof down to the ground, it will create an interesting move for the roof and yet also provide an enclosed outdoor area. However, coming from the West, the building will be less inviting and will be an unusual design move when considering rest of the roof.

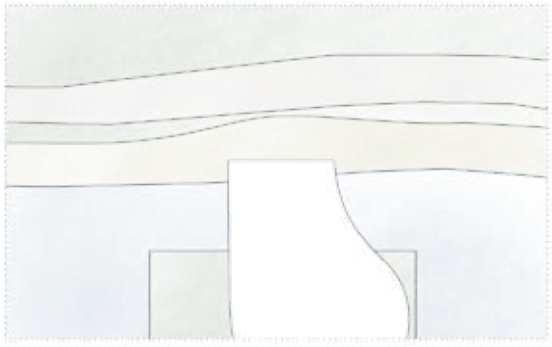
In order to make the building more exciting and also more inviting, the one edge can be pushed out. This move will provide a small gathering space under the roof with a shelter and will enhance the attention when coming from the northern part of the building.

The main material of the floor and ramp is concrete, which means that the concrete element meets a pavement. Here, the intention is to design a ramp that rises from the ground and becomes a building, which means that the material difference should be fluent. By letting the concrete continuing slowly into the pavement until the road a more fluid material change will be possible.









III.35 Diagram of Building Meets Park

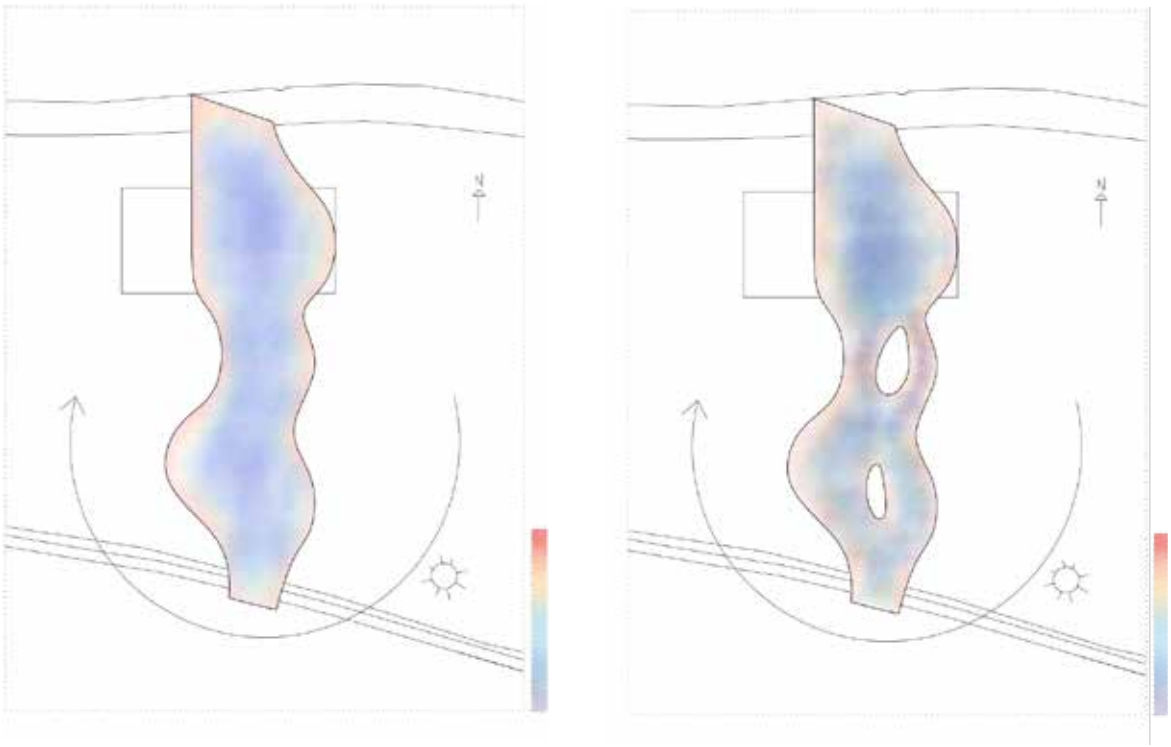
DAYLIGHT

The daylight is limited towards the middle part of the building and the factor is too high next to the windows that for instance requires curtains or other architectural detail solutions.

The two voids definitely help increase the daylight factor in the middle part of the building, however, alone with these voids, a required daylight factor cannot be achieved.

By adding skylights in the most needed parts of the building, the daylight quality will be better. The positions of the openings depending on the need in the plan layout.

There are several options for skylight design. In order to have continuity with bobble designs, the openings can be of the same form and with frost glass, that reduces the amount of strong daylight coming down. Another option is to offset the openings upwards that provide diffused light that can be a benefit for specific rooms.

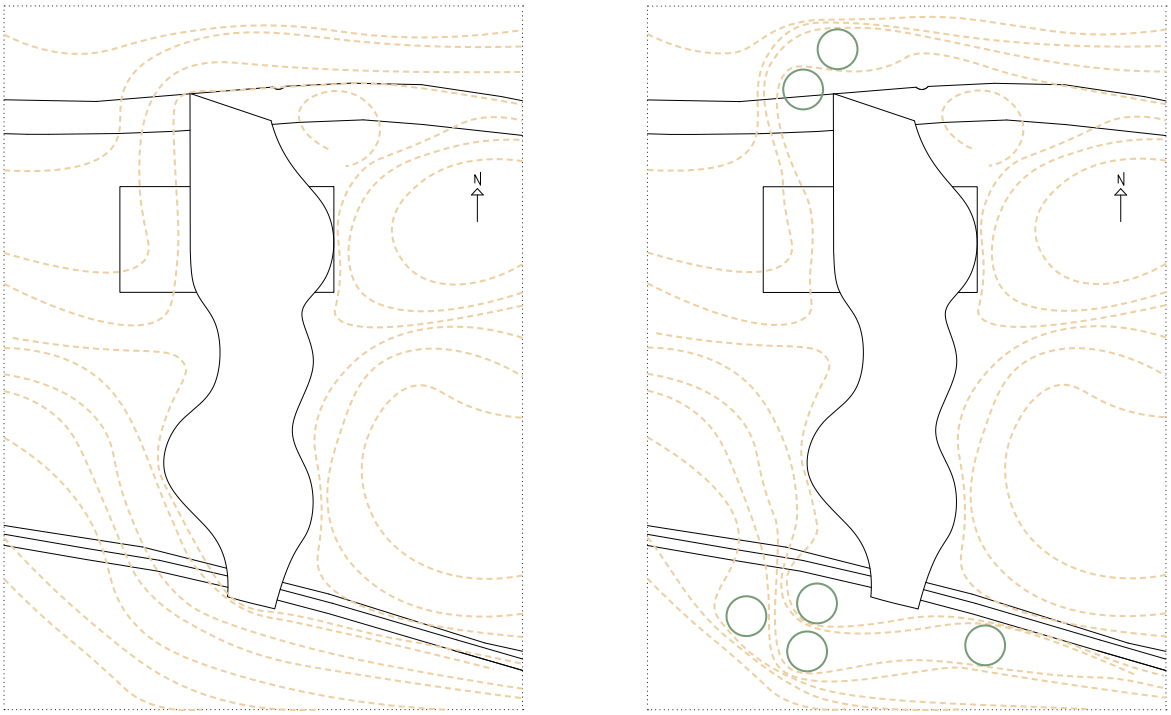


Ill.36 Diagram of Daylight Simulations

WIND

The strongest wind is coming from the western direction with a wind speed between 10-33 m/s. As it shows in the diagram, around the edges of the building the wind will be strong that prevents the possibility to stand next to the entrance. The concept of making a bridge in such cases will be limited due to the high wind speed just around the entrances.

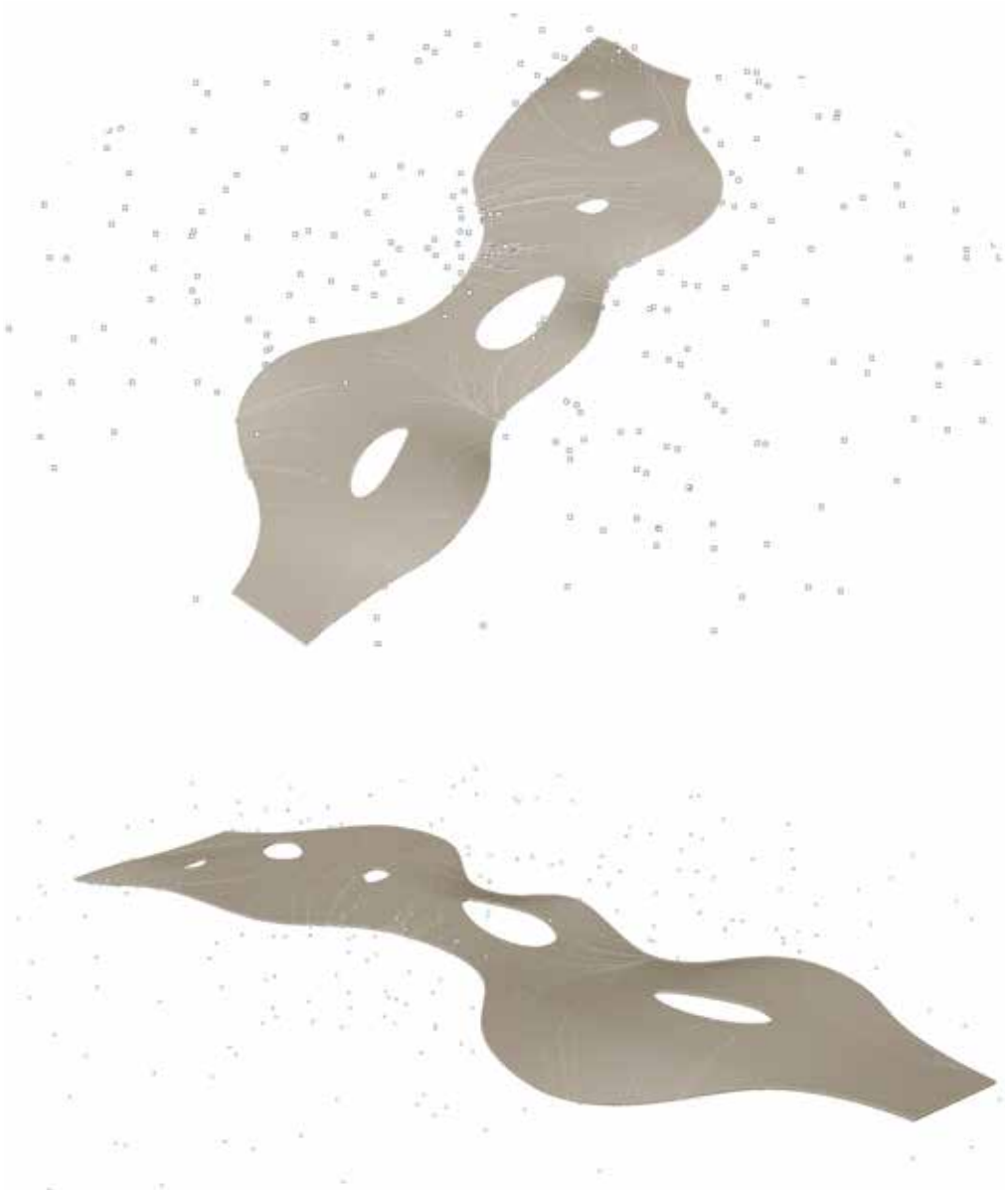
By having trees and vegetation just around the most affected part of the building, the wind speed will be decreased as to be seen in the diagram. Fortunately, the location consists of huge amount of trees and bushes which means only a few trees will have to be planted next to the entrances.



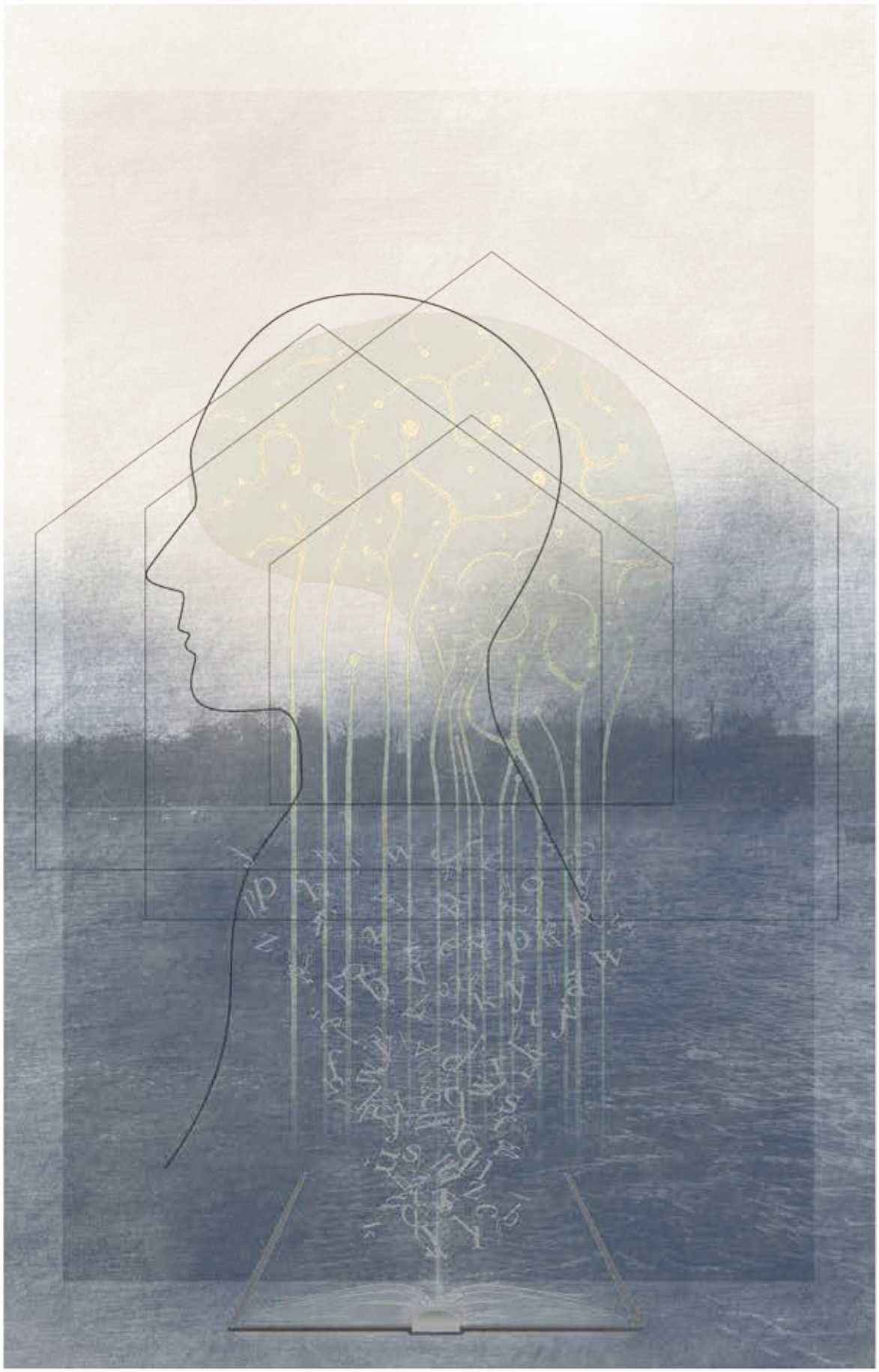
Ill.37 Diagram of Wind Simulations

RAIN

One important thing that has to be in consideration when designing a curvy shaped roof is how the rain falls on the roof. It is highly important not to create small or bigger rain puddles on the roof or areas where the rain will fall relatively much on the facades. This has been investigated through a rain simulation tool and the illustrations show the rain paths on the most critical areas. Throughout the design process of the roof, this study will be inattention.



Ill.38 Diagram of Rain Simulations



Ill.39 Collage of Concept

CONCEPT

The concept of the library design is to make an architecture that invites the lost visitors, which are mainly the young people, into an exciting journey of joy and education by shaping the architecture and the interior in a way that stimulates the mind, emotions, and also provide functions that are needed for the settings. It will be a journey in which your brain will decide how to behave in the context and will have the freedom to decide where to find yourself in. By investigating different design solutions for each space and using the intersections of the four bodies for planning the zones, the architecture and the interior setting will reach to a higher poetic. Your mind will find the right way through your emotions, soul and needs to find the right spot for your needs. Going through the building from one end to another will be a journey in which you will experience and find different attractions, observations and rooms that each connects and trigger your feelings, emotions, desires and focus. Simply, let your mind do the right direction for you on your own journey...

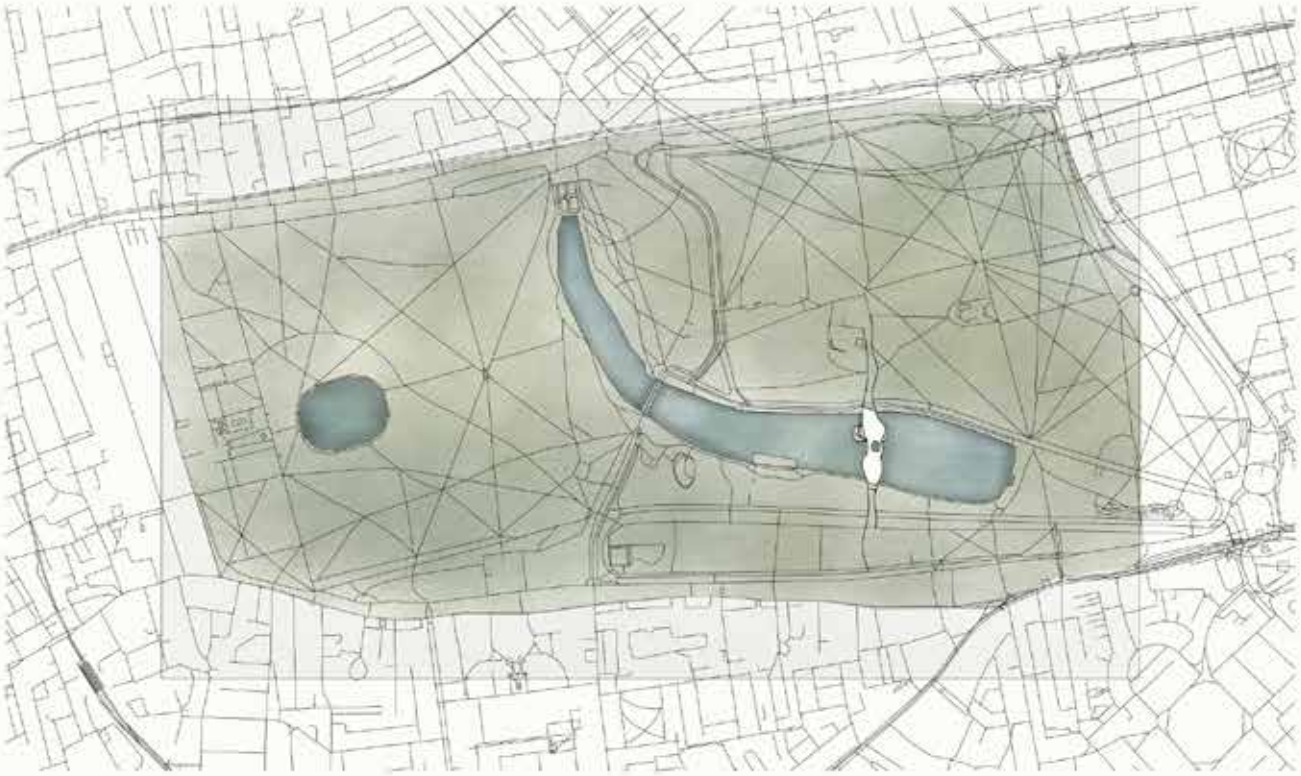
6 PRESENTATION

A LIBRARY IN HYDE PARK
AERIAL VIEW
ENTRANCE
EMOTIONAL AREA VIEW
READING ROOM VIEW
MASTERPLAN
PLAN & ZONING
PLAN EXPLAINATION
SECTION DRAWINGS
ELEVATION DRAWINGS
DESIGN DIAGRAMS
BUILDING PERFORMANCE

This chapter concerns the presentation of the final design proposal of the library. In this chapter, I will show final drawings, 3D visualizations and diagrams of the design that will explain the concept and intentions in the best way as possible.

A LIBRARY IN HYDE PARK
COVERED BY EMOTIONS

The final design of the public library in Hyde Park is a curvy shaped building that crosses the Serpentine lake and becomes a bridge. The design is a one-story building with ramps at the edges with a main entrance at the northern part and a secondary entrance at the southern part. The building lays on the already existing island on the lake that also provides an outdoor space both for study and relaxation purposes. Considering the organic and smooth shape of the lake and its waves, this curvy shaped library building integrates very well with the surroundings and nature. Having the curves of the building extending and disappearing throughout the green nature makes the connection with nature one step stronger. In order to prevent too much unused square metres and enhance the natural daylight, the building contains a water drop shaped void in the middle part and becomes a gentle and romantic move. The interior room designs take, as the void, a shape of a water drop that provides a smooth interior, which relates to the surrounding nature and yet also triggers one´s emotion positively. Considering the design as becoming a bridge that needs to span for 165 m, the design will consist of a large circulation area, however, the waves/curves have been modified in order to decrease the unnecessary areas as possible.



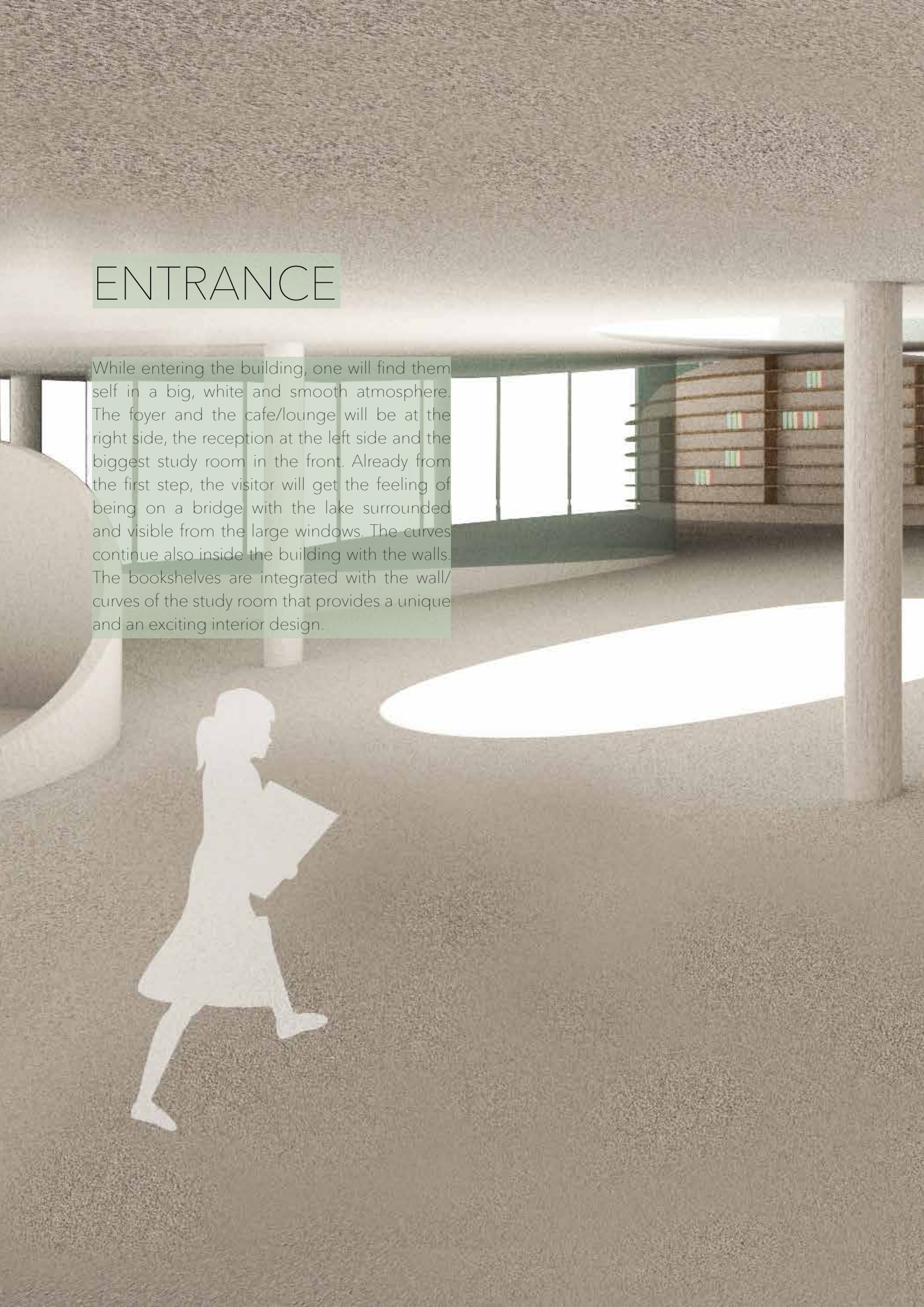
Ill.40 Diagram of Overview

A LIBRARY IN HYDE PARK

AERIAL VIEW

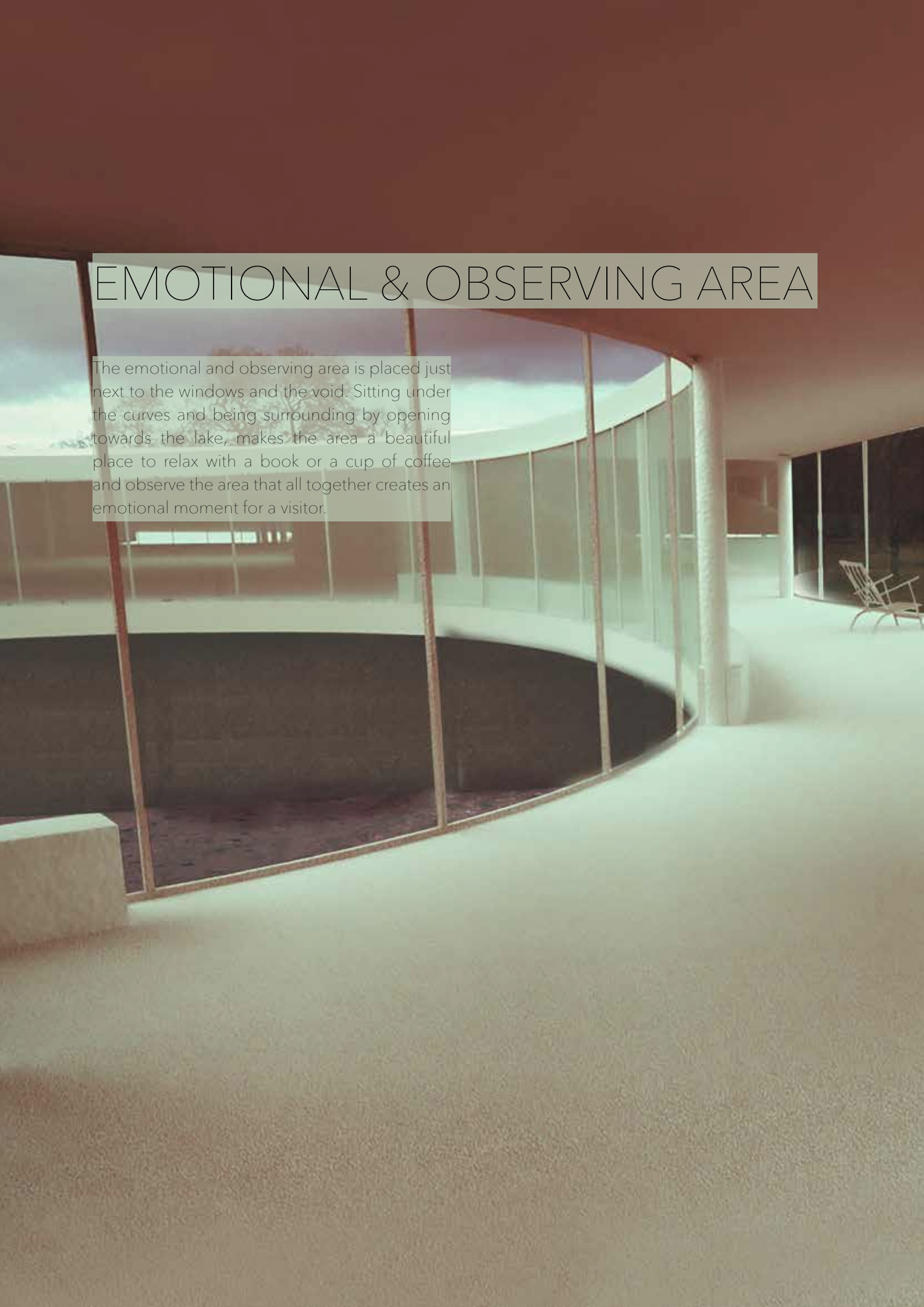
ENTRANCE

While entering the building, one will find them self in a big, white and smooth atmosphere. The foyer and the cafe/lounge will be at the right side, the reception at the left side and the biggest study room in the front. Already from the first step, the visitor will get the feeling of being on a bridge with the lake surrounded and visible from the large windows. The curves continue also inside the building with the walls. The bookshelves are integrated with the wall/ curves of the study room that provides a unique and an exciting interior design.



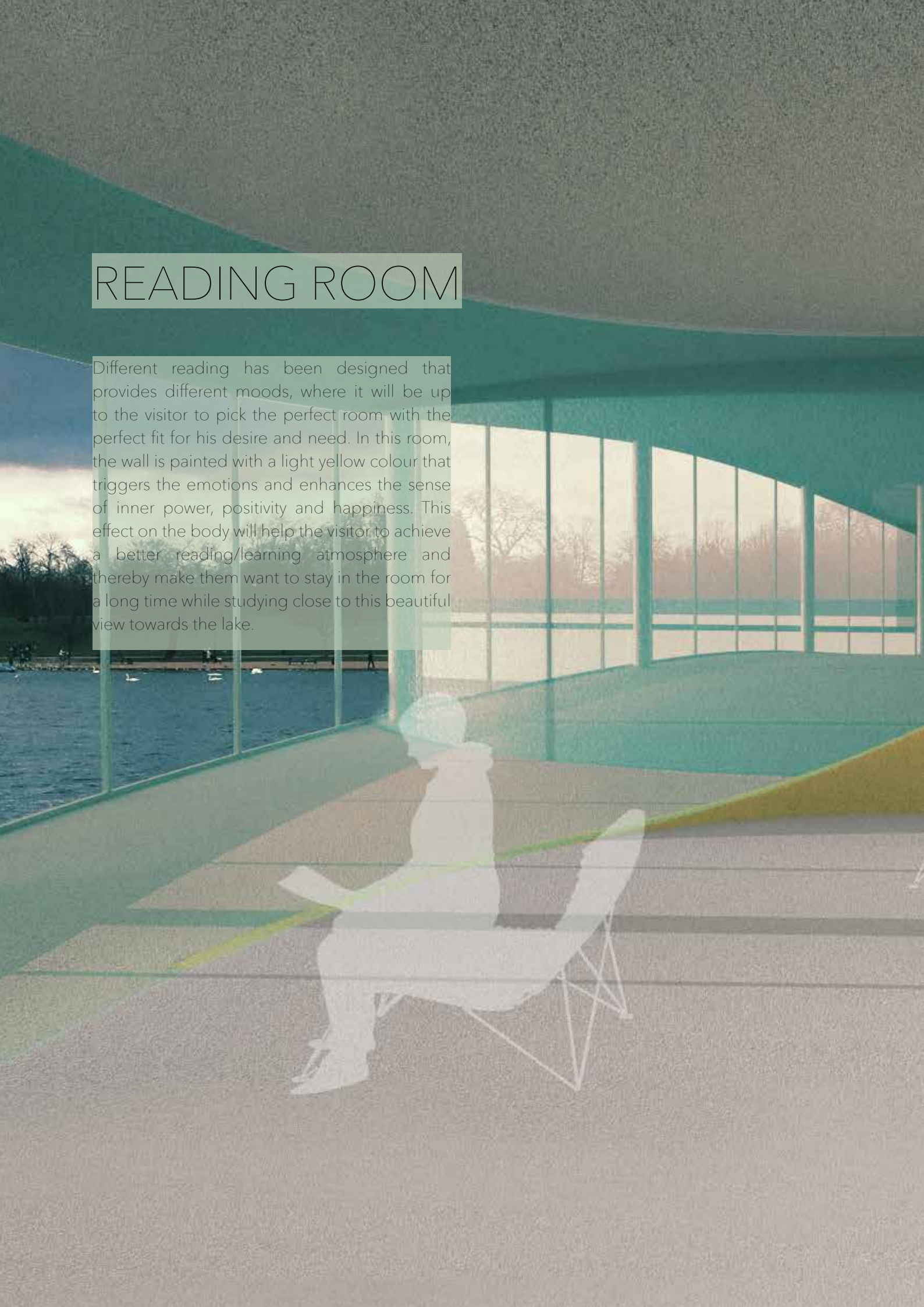
EMOTIONAL & OBSERVING AREA

The emotional and observing area is placed just next to the windows and the void. Sitting under the curves and being surrounding by opening towards the lake, makes the area a beautiful place to relax with a book or a cup of coffee and observe the area that all together creates an emotional moment for a visitor.

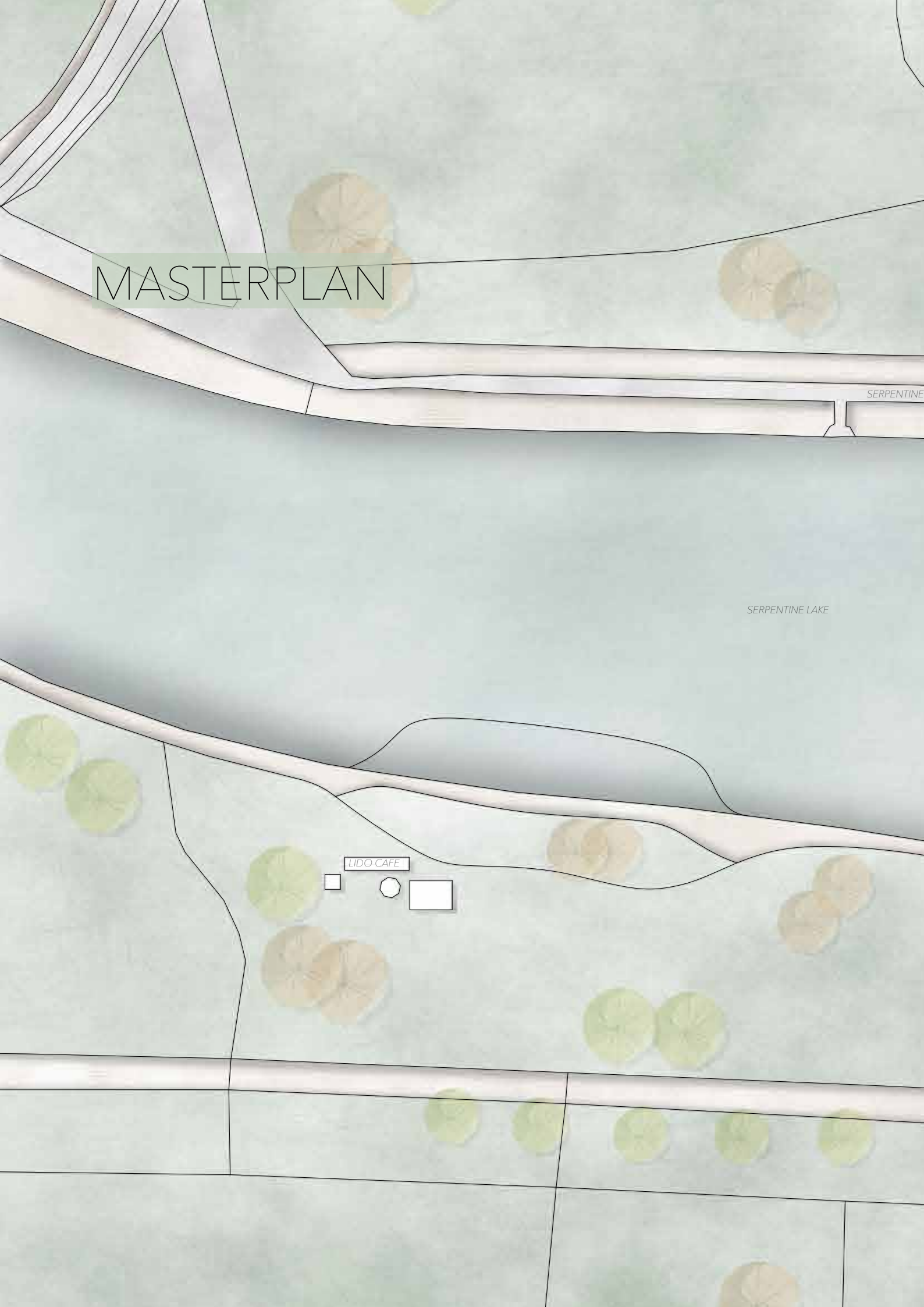


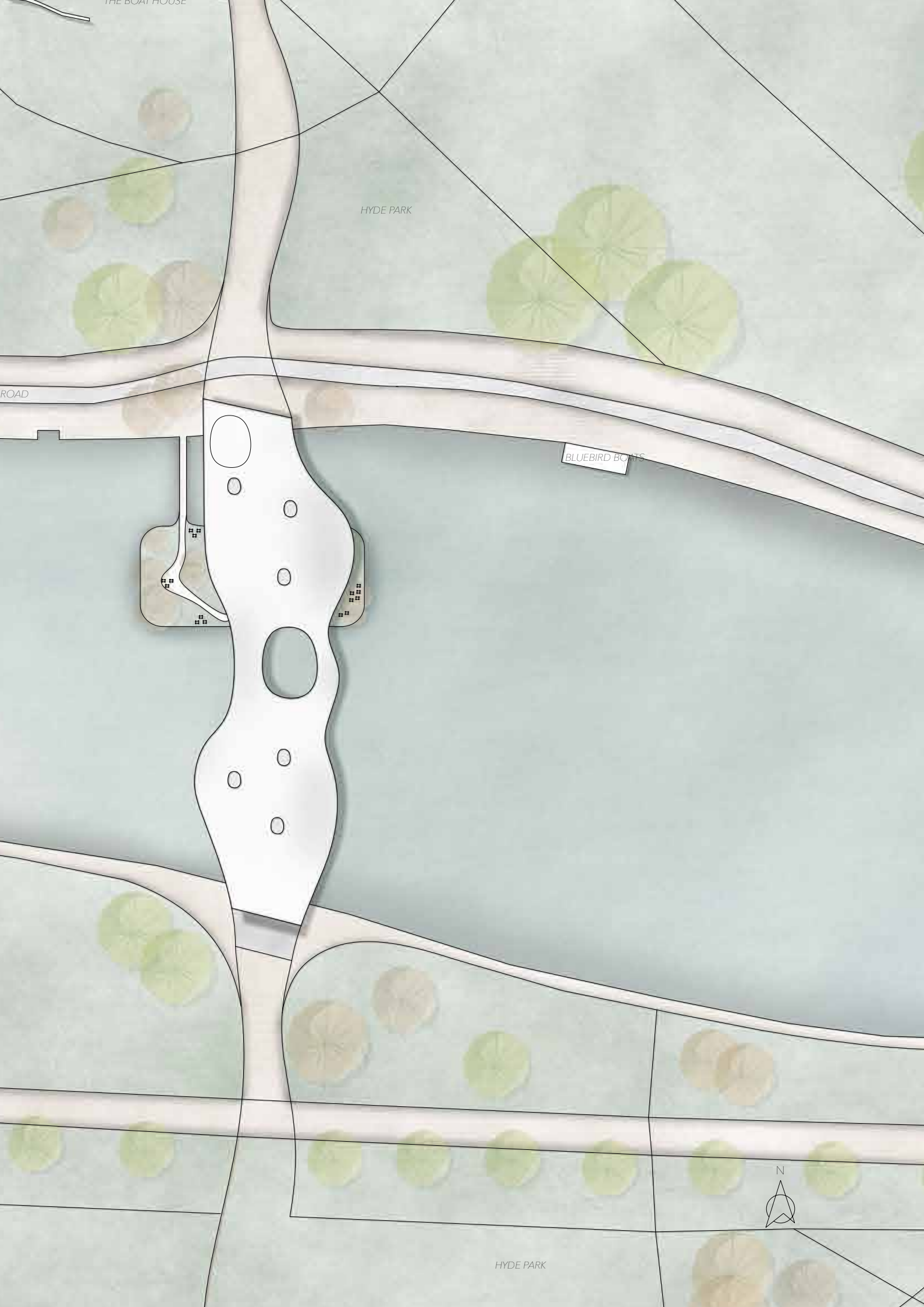
READING ROOM

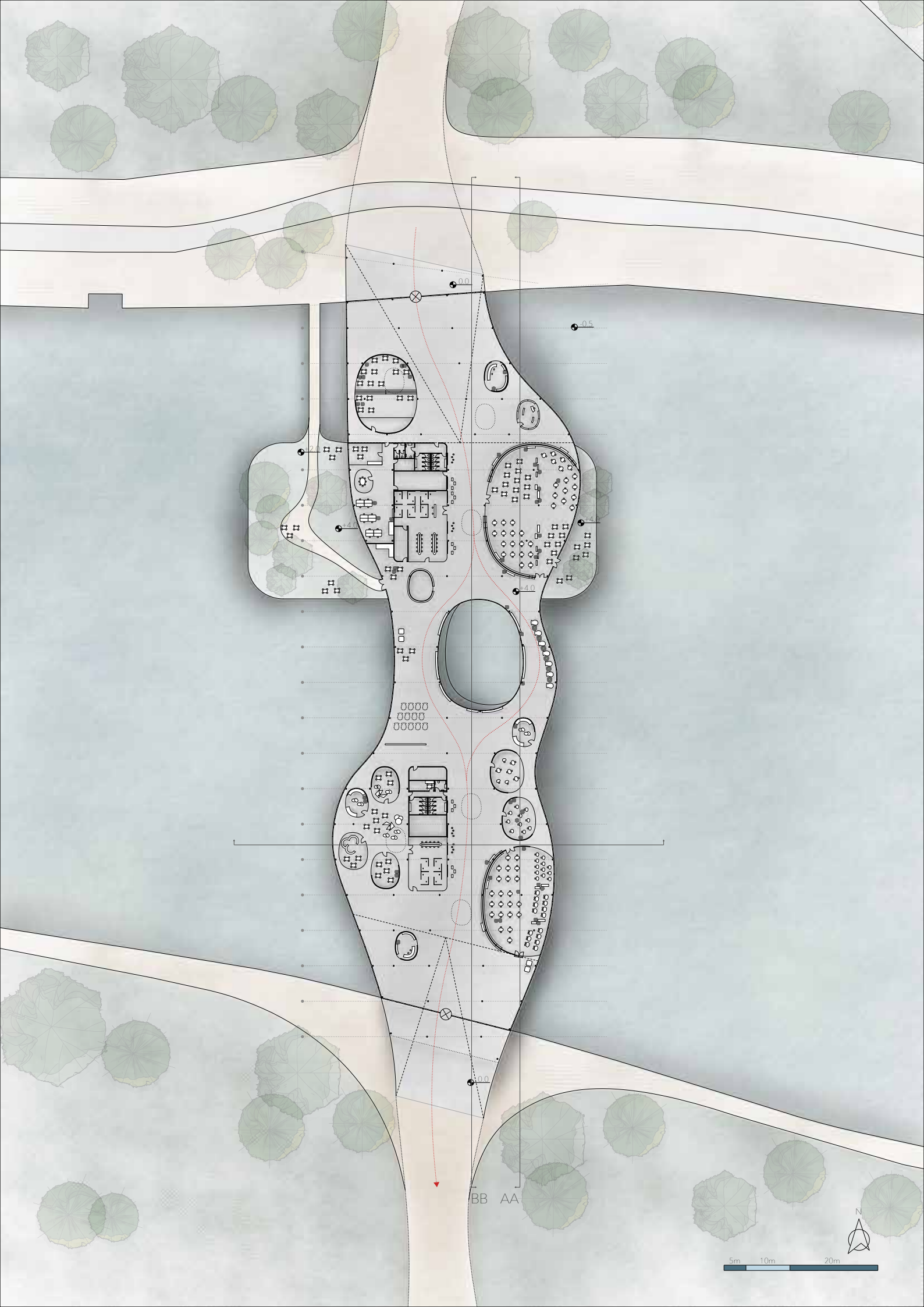
Different reading has been designed that provides different moods, where it will be up to the visitor to pick the perfect room with the perfect fit for his desire and need. In this room, the wall is painted with a light yellow colour that triggers the emotions and enhances the sense of inner power, positivity and happiness. This effect on the body will help the visitor to achieve a better reading/learning atmosphere and thereby make them want to stay in the room for a long time while studying close to this beautiful view towards the lake.



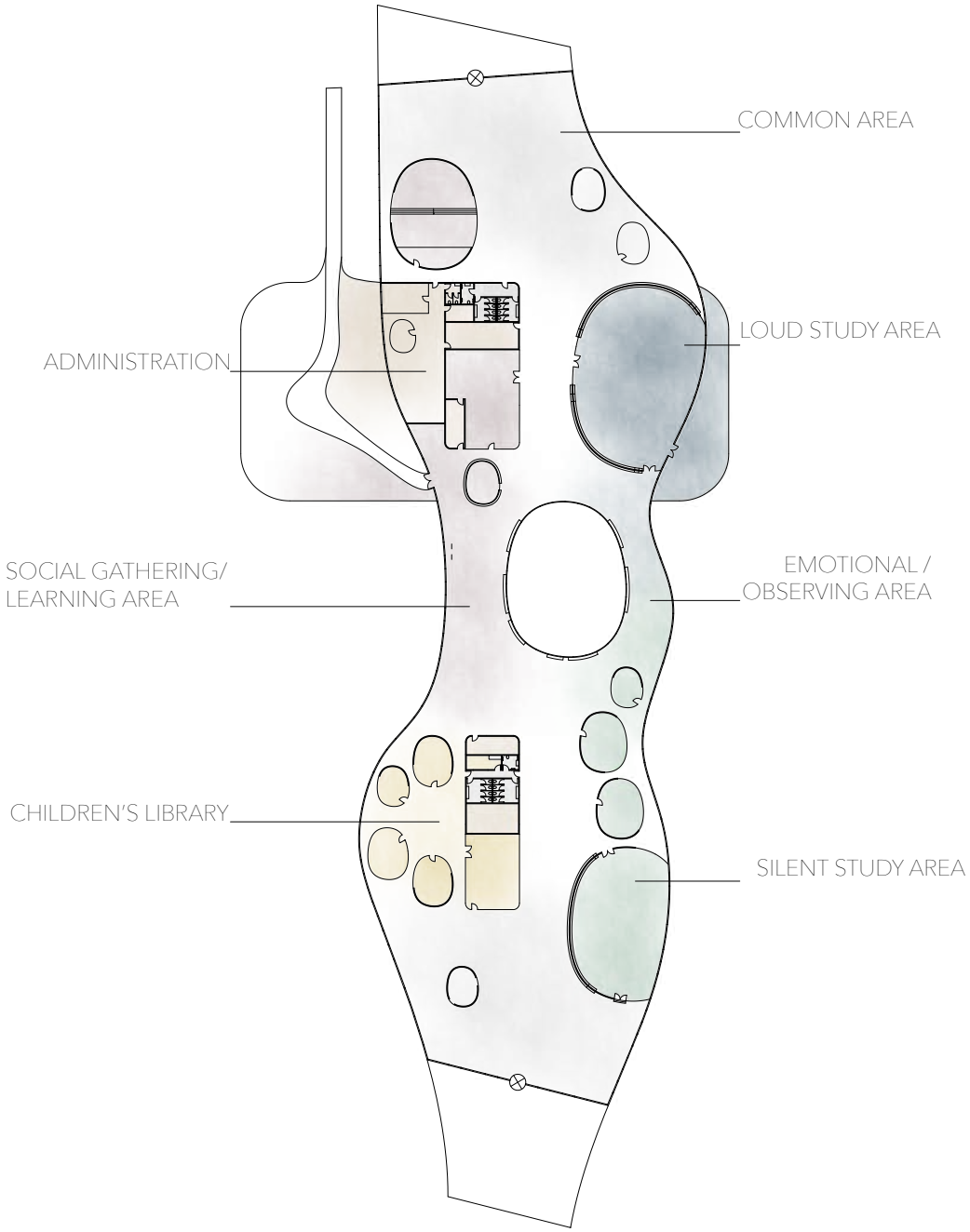
MASTERPLAN




THE BOAT HOUSE
HYDE PARK
ROAD
BLUEBIRD BOATS
N
HYDE PARK


-0.0
-0.5
+2.0
+4.0
+4.0
+4.0
-0.0
BB
AA
N
5m
10m
20m

PLAN & ZONING



Ill.41 Diagram of Zoning

PLAN EXPLANATION
DESCRIPTION AND POSITION

The building is divided by intersections of the four bodies (described earlier by Sara Robinson) and different rooms and spaces are defined and placed according to these intersections. The mental and emotional body are linked together and placed at the eastern part of the building, while the physical and social body is linked together at the western part of the building. The middle part will be where all bodies will meet, unite and become the journey path for a visitor.

Each room and space is therefore defined and placed according to the relation with these bodies, the specific room settings and the relation to the nature and needs of natural light.

As earlier described the room shapes takes inspiration of a water drop from the lake that provides a smooth relation with the context as well as providing smooth interiors that benefit the reading purposes especially for the children's library section.

The main entrance will be at the northern part of the building where the foyer and lounge will be just next to it. The functions starting from the entrance to the edge of the island will be on a ramp, which means the rooms will be placed on a platform, however, the positions and scale of each room ensure a relatively low platform. The northern part will hereby by the more social and loud section while going toward the south, the functions become more individual and silent. The children´s library section is anyhow placed at the southern part but still ensures a small distribution for the study rooms with the long distance between them and with the inner divisions.

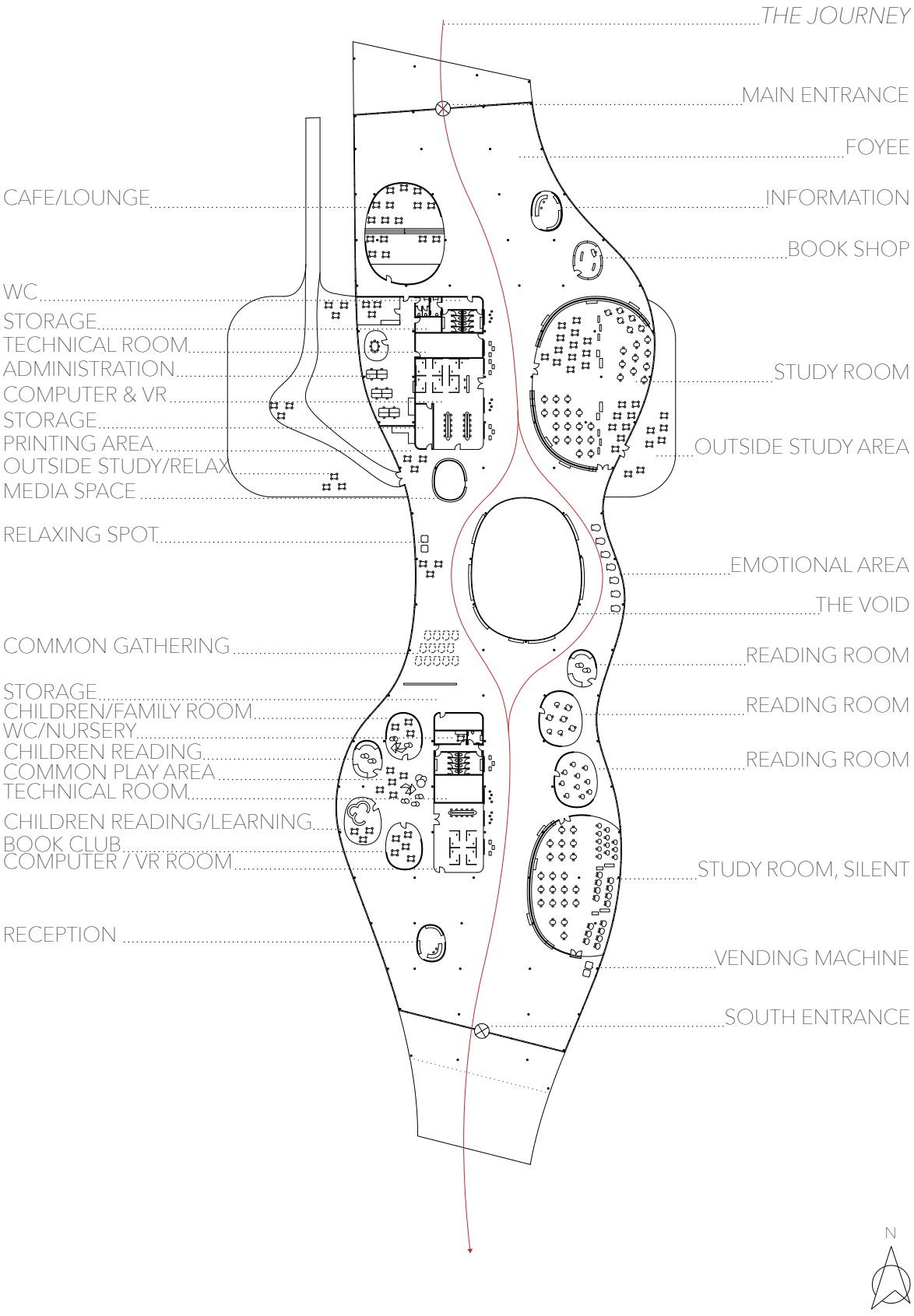
The newer technology for learning and entertainment purposes will be accessible both side of the building and hence also on the corridors that make the atmosphere more joyful and inviting.

One of the advantages of having the building lying on the island is the accessibility of green outdoor spaces. By lying the building more to the eastern side of the island, a more enclosed and private outdoor area will be achieved that will serve as a study area in the forest and next to the lake.

The path will guide one throughout the building, will make a fluent flow through the functions and creates a journey where it will be easier to find the right area/function that fits with every single visitor´s needs.

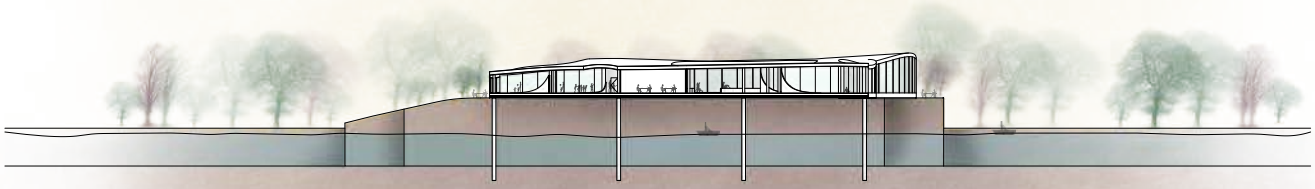
PHYSICAL & SOCIAL BODY

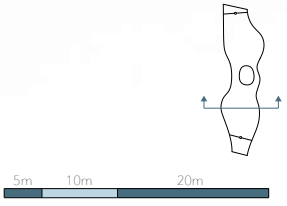
MENTAL & EMOTIONAL BODY



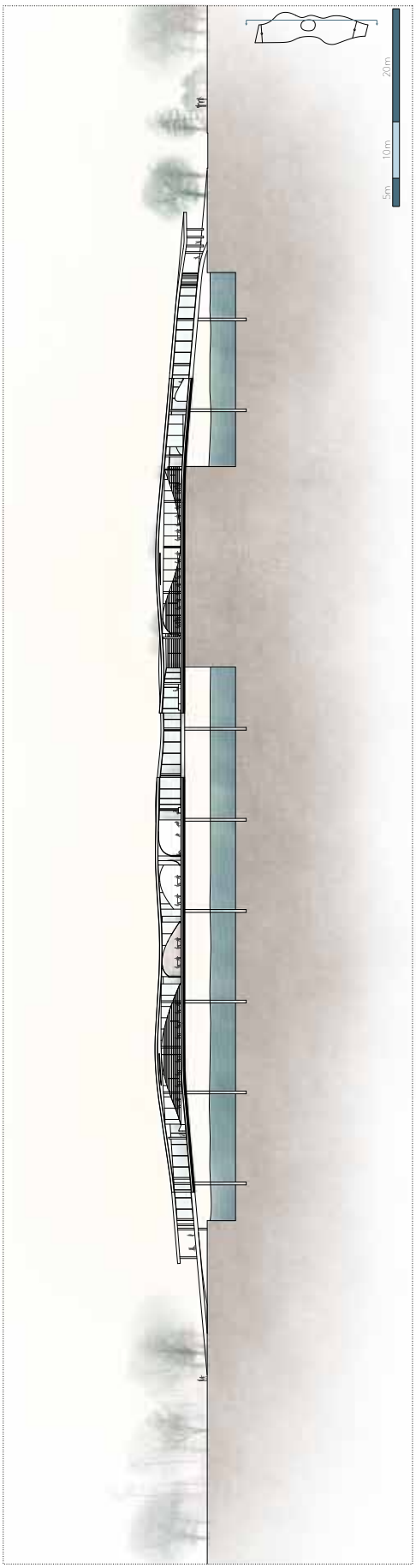
Ill.42 Diagram of Plan Explanation

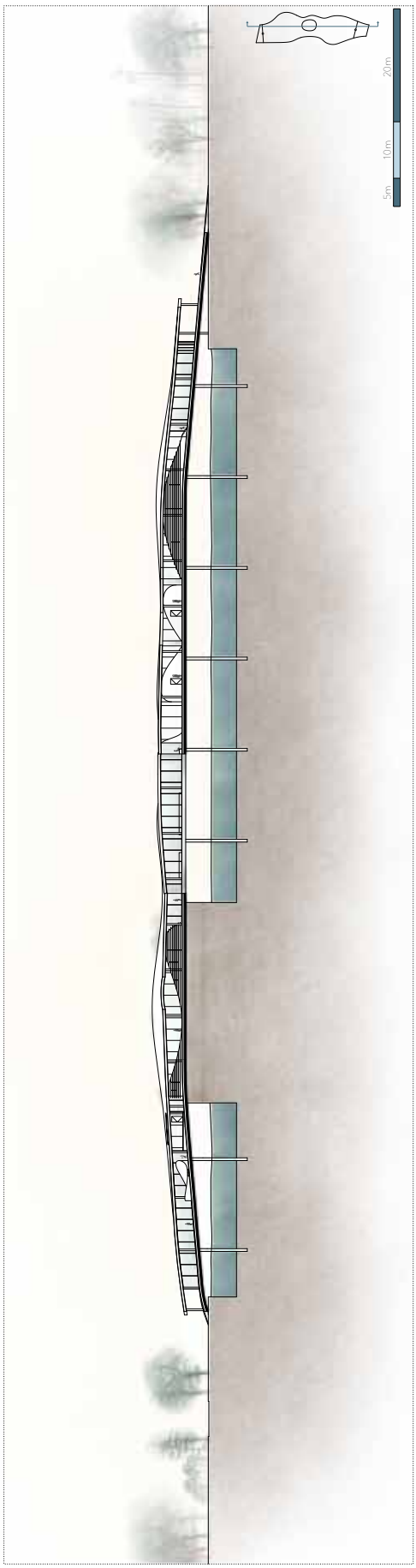
SECTION DRAWINGS
CROSS- & LONGITUDINAL SECTIONS





III.43 Cross-Section



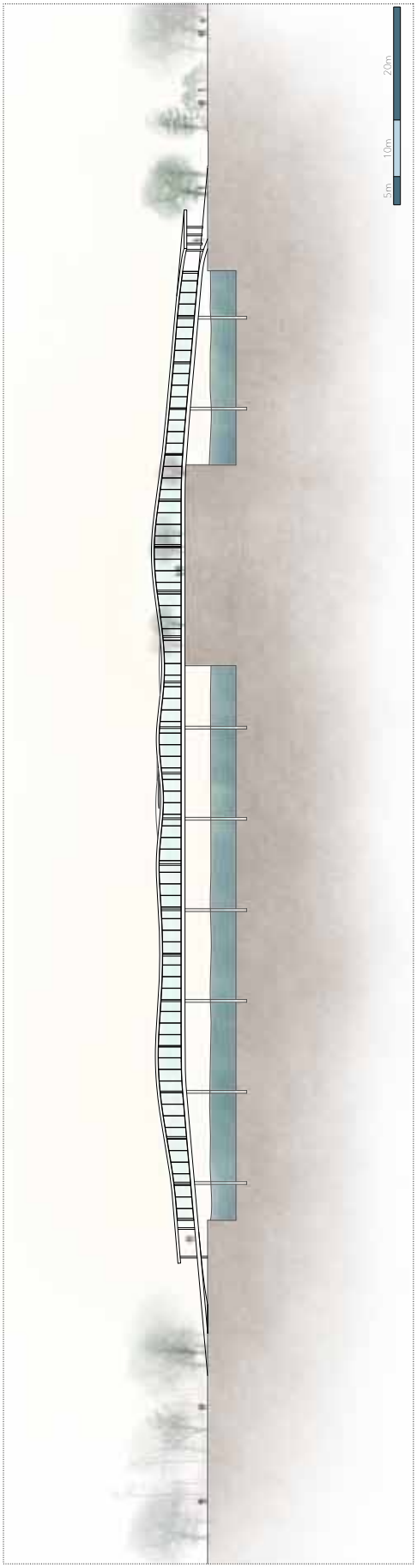


Ill.44 Longitudinal Section AA

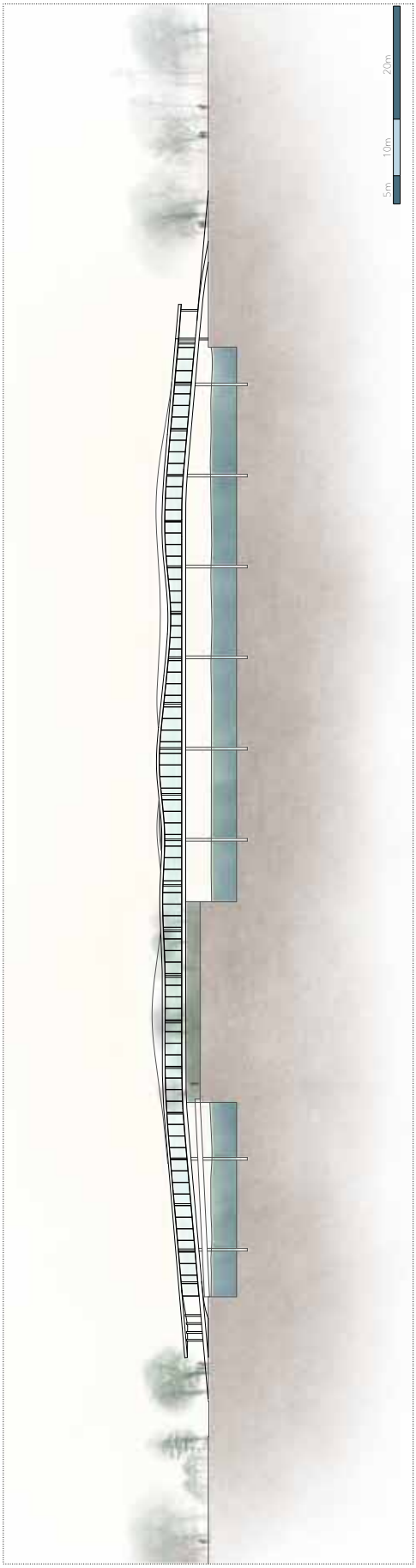
Ill.45 Longitudinal Section BB

ELEVATION DRAWINGS
EAST & WEST ELEVATION WITH NORTH & SOUTH ENTRANCES

The East and West elevations show perfectly how gently the roof is waving and has a good interaction with nature. Since the lake has a more green/blue colour, the chosen glass for the facades is with a green glow that also contains a lower g-value for a better energy quality.

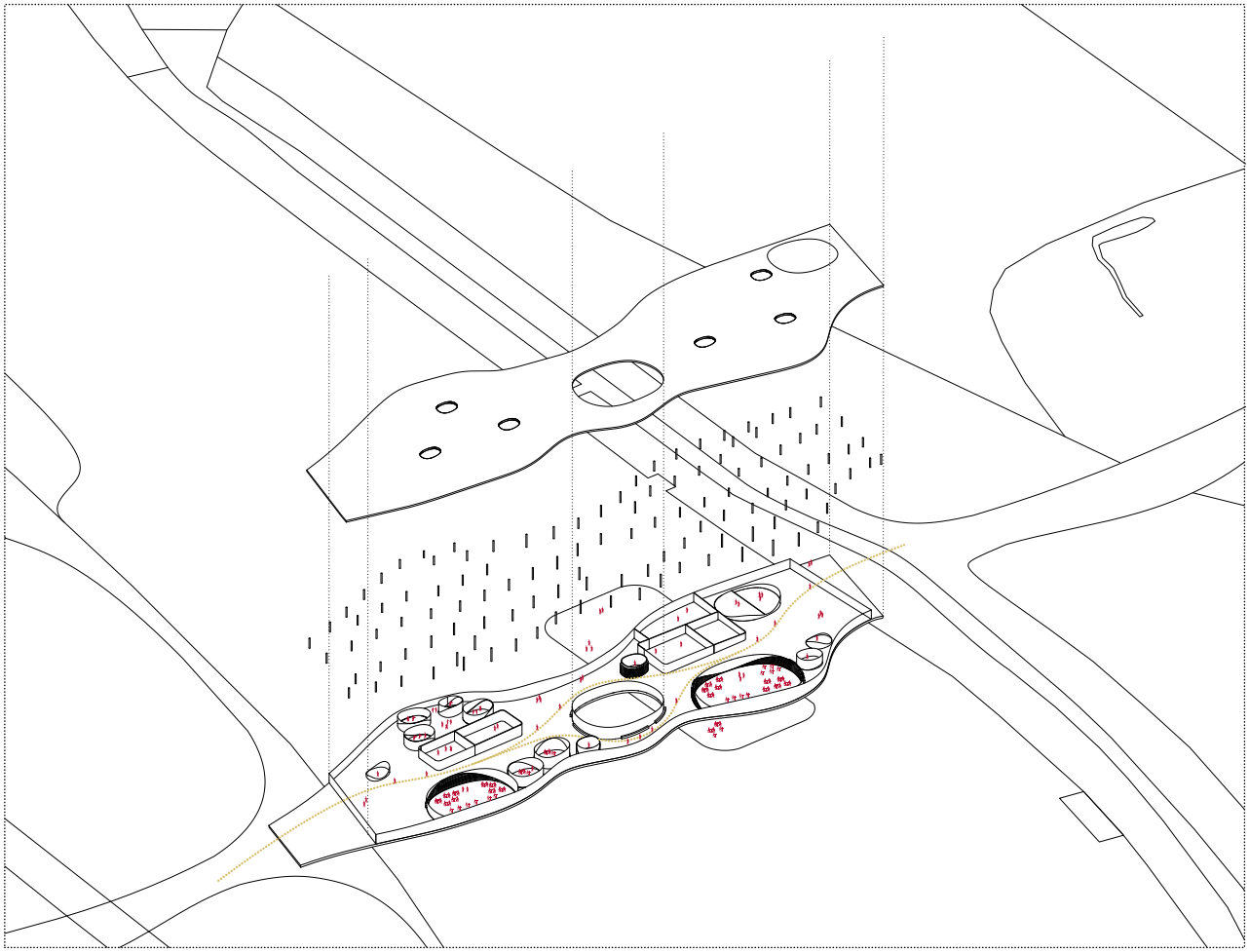


Ill.46 Elevation East

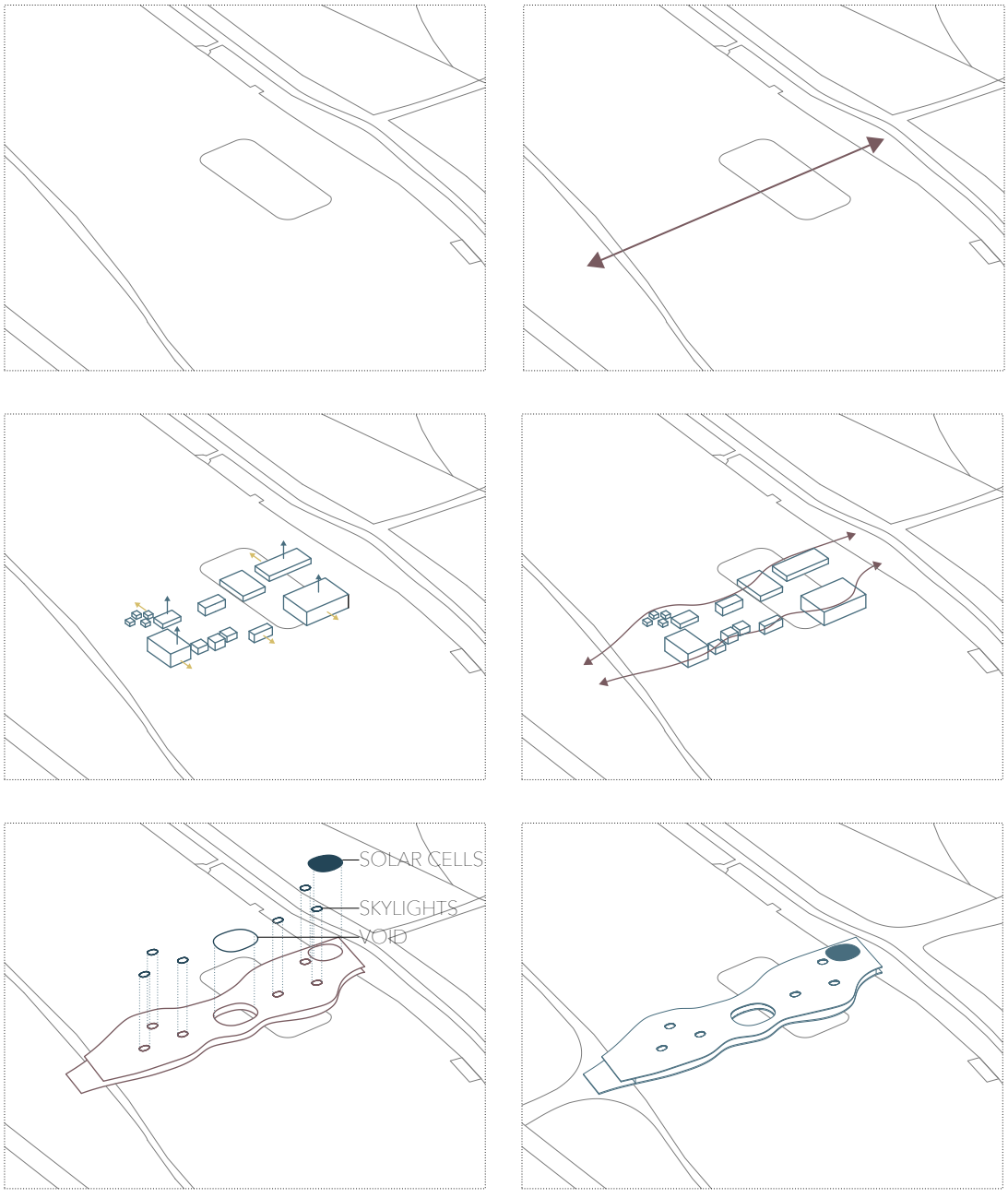


Ill.47 Elevation West

DESIGN DIAGRAMS
EXPLODED ISOMETRIC & STORY LINE DIAGRAM



Ill.48 Diagram of Exploded Isometric



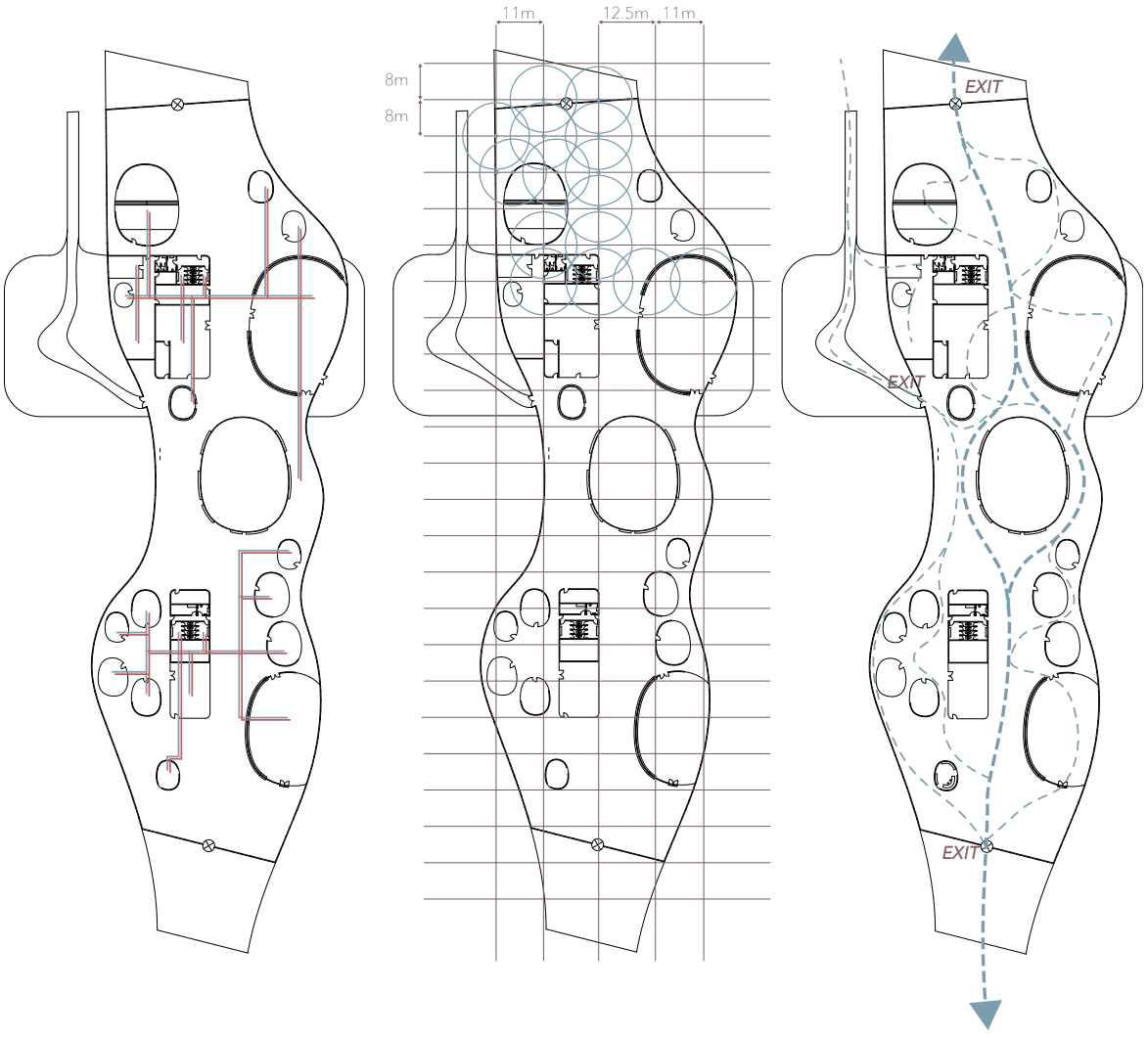
Ill.49 Diagram of Story Line

DESIGN DIAGRAMS
VENTILATION, STRUCTURE & ESCAPE

The ventilation unit is placed in the technical room at each part of the building. From each unit, the ventilation ducks reach each room and area where people stay for a long time. The ventilation will be placed above the suspended ceilings and will be as invisible as possible. The window facade provides a good possibility for natural ventilation as well and together with the mechanical ventilation, the building will consist of hybrid ventilation.

The structure of the building consists of an 8 m by 12.5 m grid system that takes inspiration from a book for dimensioning of beams and columns. (Ahler, 2010). Horizontally, the span is 8 m, which is binding, however, vertically, the grid is not binding. Here, the 30 cm (ø) columns will be placed more freely that ensures less distribution for the flow and will be placed more closely to an inner wall. The span between each one of the columns will still not exceed 12.5 m. Concerning the columns under the building, the grid will here be every 16 m and with a thicker column section, that ensures a relatively realistic look and placement.

As the illustration 52 describes, the rooms are placed with an at least 1.2 m distance between one another and allow a smooth escape and flow route. The escape doors are will be at the entrances at the northern and eastern part as well as an exit on the island with a separate and smaller bridge.



Ill.50 Diagram of Ventilation *Ill.51 Diagram of Structure* *Ill.52 Diagram of Flow & Escape*

BUILDING PERFORMANCE
ENERGY CONSUMPTION

The energy use for the final design is 45,2 kWh/m2 per year with a supplement of 4,7 kWh/m2 during the winter period with a service life more than 45 hours per week, where the mechanical volume of air will be above 1,2 l/s/m2.
Due to a large amount of the glass area including the skylight, some of the areas will be cooled down in order to ensure a better indoor climate. This means that the building will need 245 sqm of solar cells in order to provide the energy that will need to meet the requirements.

The building consists of glass with a relatively low g-value that decreases the solar gains and together with a tight building envelope they will have an effect on the final energy use of the building. The building will use hybrid ventilation, means that there will be both mechanical and natural ventilation throughout the year.

GEOMETRY	
TOTAL FLOOR AREA	6400 m²
TOTAL ENVELOPE AREA	13330 m²
TOTAL WINDOW AREA	1599 m²
FLOOR/ENVELOPE RATIO	0.48
WINDOW/FLOOR RATIO	0.25
VENTILATION	**STUDY ROOM**
MECHANICAL	1.75
NATURAL	2.22
INDOOR CLIMATE	**STUDY ROOM**
HOURS ABOVE 26°C	86
HOURS ABOVE 27°C	21
AVERAGE DAYLIGHT FACTOR (%)	3-5
MEAN CO2 CONCENTRATION(ppm)	615,1
MEAN AIRCHANGE (/h)	1,1

Ill.53 Diagrams og Energy Consumption

7 EPILOGUE

CONCLUSION
REFLECTION
REFERENCE LIST
ILLUSTRATION LIST

In this chapter, I will write the conclusion of the project where I will determine my ideas, intentions and the final results of the library´s design. Furthermore, I will write a reflection of my thoughts about project´s details.

CONCLUSION

The result of this thesis project is a design proposal for a public library located on the Serpentine lake in Hyde Park, London, UK. The design is in close relation with the landscape and acts as a bridge for the area as well as becoming a fruitful journey for each visitor. The library provides different reading and studying areas and atmospheres both for children and older students. By placing the building on the lake, the interaction with nature, architecture and visitors will be one step closer to one another and provides different reading and learning spaces in close relation with the landscape.
Designing a library for the 21st century means that the only use in the building is unfortunately no longer only books, but also newer technologies especially for the younger generations. Therefore, while designing the spaces, providing areas with new technologies such as virtual reality, media space and computer/ Learning Center has been under considerations.

Throughout the thesis process, I had the intention to investigate and understand how the architecture and environment can have an impact on the human bodies and how human beings experience architecture. In order to achieve knowledge from different fields that will help to understand the impact and influence of architecture and the environment on the mental and physical well-being of the human beings, the methodology research-informed design have been used. By using this methodology, it has been a more clear way to gain knowledge from different fields that concern with cognitive science. Through these studies, I was able to understand that considering the spatially needs of the human beings, and for this project, the visitors, the architecture will achieve a higher quality for the people. Hence, by linking psychology with architecture and engineering together will become a way to improve the quality of life and make a project that will be socially sustainable.

Studying the impact of the architecture and the environment for the bodies, mind and mood will not be a requirement for designing a library, however by studying cognitive science and by implementing some of the strategies that different researchers, architects, professors have proven to have a positive impact for the mind, behaviour and not but least the reading culture, the architecture will only be in higher level of poetic and serve a better quality for the human beings. By doing this, the architecture will have a stronger effect on inviting the lost visitors, as well as providing new spaces that will stimulate and trigger one´s mind and emotion and influence the reading and learning atmosphere among the youngsters.

Furthermore, my intentions have been to study how the interior spaces/functions can serve the visitors, area and the city in the best possible way. It has been a priority to study what kind of study rooms, reading rooms or areas that will serve a good atmosphere and trigger the emotions in a positive way that benefits the learning environments. For this reason, when designing the architecture, the bottom line has not been to design an outstanding landmark for the context, but quite the contrary, to understand the interior, spaces and thereby designing from inside and out.

REFLECTION

Cognitive science contains a complex and deep field, which means that applying insights from cognitive science to an architectural design requires an intense study. During the design process, I tried to apply as much knowledge from the fields that I have been investigating as possible, however, in order to achieve the concept for each single study room or areas in the future more detailed studies will be done. Some of the design strategies, such the different colours on the wall painting, depends on the interpretations, and therefore, in the future, it would be a good idea to make some 1:1 test rooms where different colours can be studied that would help to find the perfect fit. However, there will always be different ways to approach the design of a public library, but my intentions from the beginning was to study the relation with architecture and psychology which indeed is a very subjective topic and the ways to use and even sometimes understand the field can be different and can be interpreted in several ways.

As the building has turned out to be much bigger than expected due to the bridge design idea, some of the rooms or areas, unfortunately, has not been detailed enough as intended.
During the design process and the final design, I was able to meet the requirements of the building regulations 2015 both for indoor and energy quality. However, I resulted in using cooling on some of the areas for some time during the year. In the future, the design of the roof could be studied more detailed that could result on using less window area for the facade in order to lower down the heat gain for instance. Furthermore, since the main technical concerns and intentions with the project have been about understanding the indoor quality, the construction has unfortunately not been as detailed as intended. The dimensions of the columns and beams are determined by a reference, but in the future will be detailed with calculations and with more detailed investigations.

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ILLUSTRATION LIST

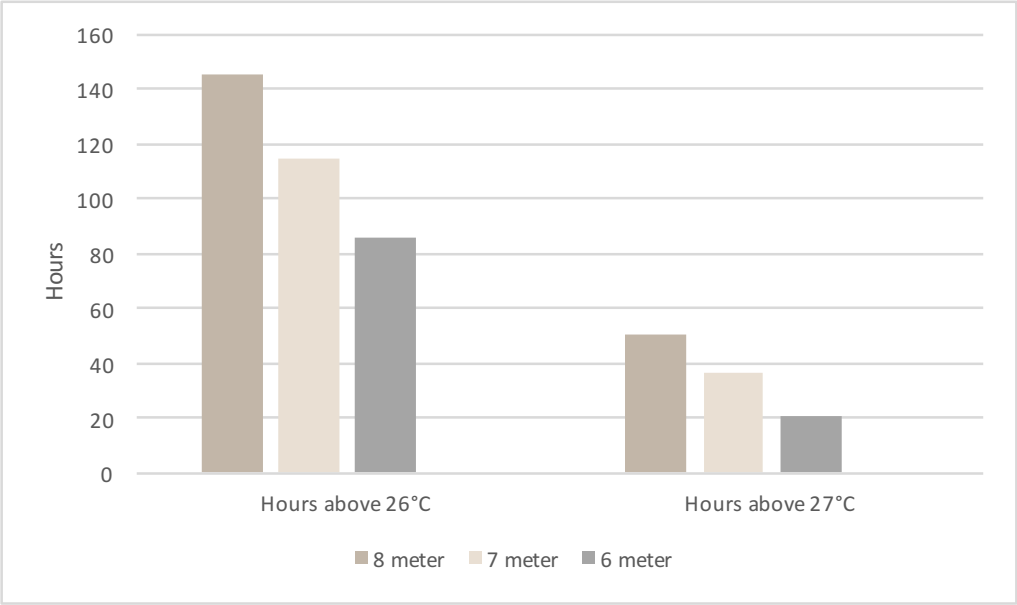
8 APPENDIX

BSIM
BE18
U-VALUE
WIND
DAYLIGHT
MODELS
ILLISTRATION LIST APPENDIX

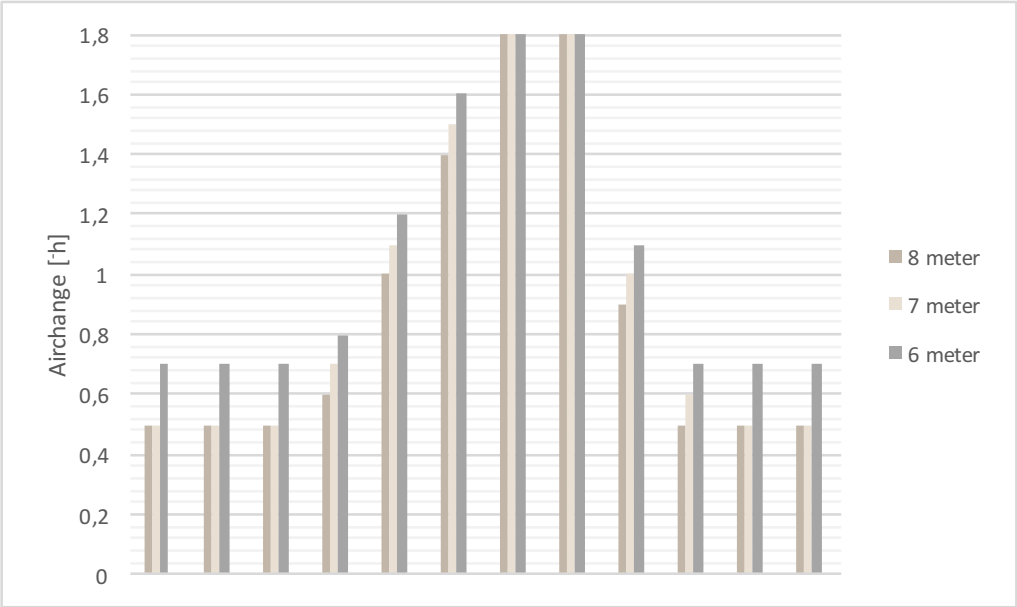
This chapter demonstrates the details of the technical calculations and observations. Furthermore, I will show some of the physical models that have been used during the design process.

BSIM
INDOOR QUALITY

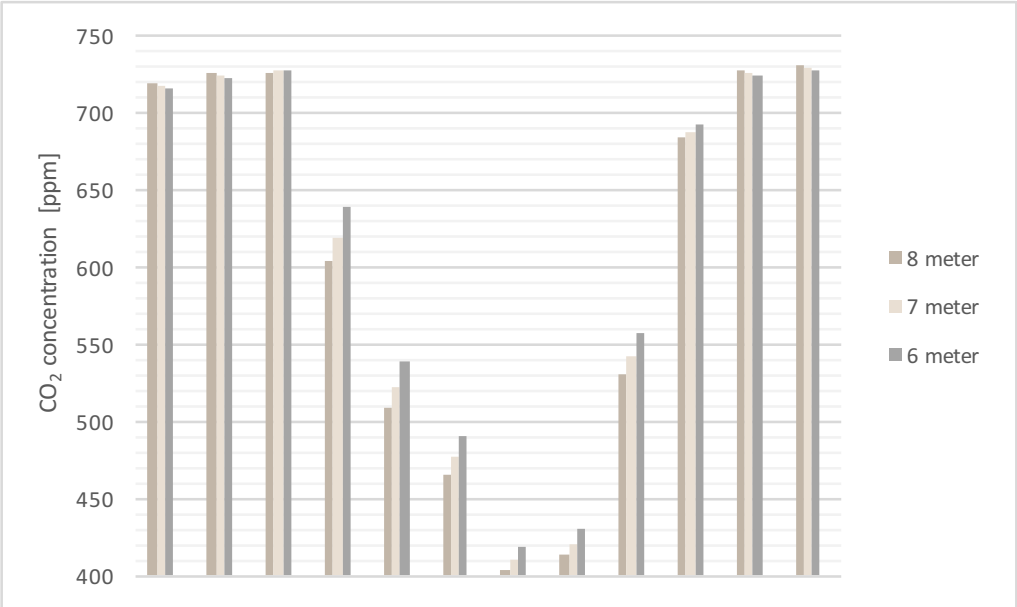
In order to examine the indoor climate of the chosen study room in the northern part of the library, several iterations with BSim have been done. These iterations with the changes in the ceiling height helped to define the right ceiling for the study room that ensures the best indoor climate and CO2 concentration inside the room. Since the 8 m ceiling room consists of a larger area of glass, the room will have more hours above 26 degrees than 100 which is the requirement. Even though some of the results are relatively close to one another, the chosen ceiling height is 6m, that is still slightly better than the others and meet the requirements of BR15 and DS 474. Following, the different simulation tables are to be found.



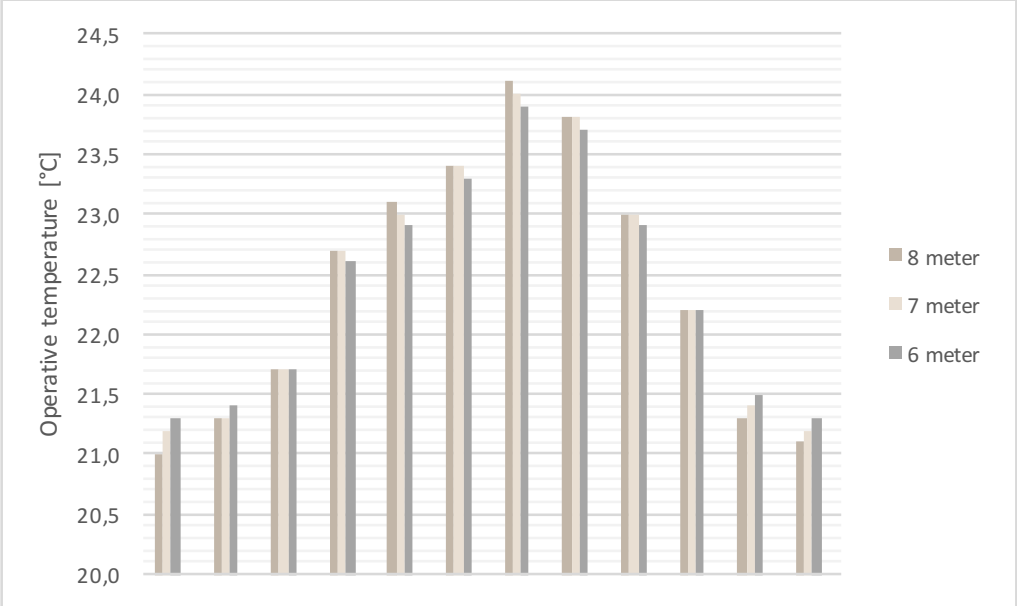
Ill. 1 Hours



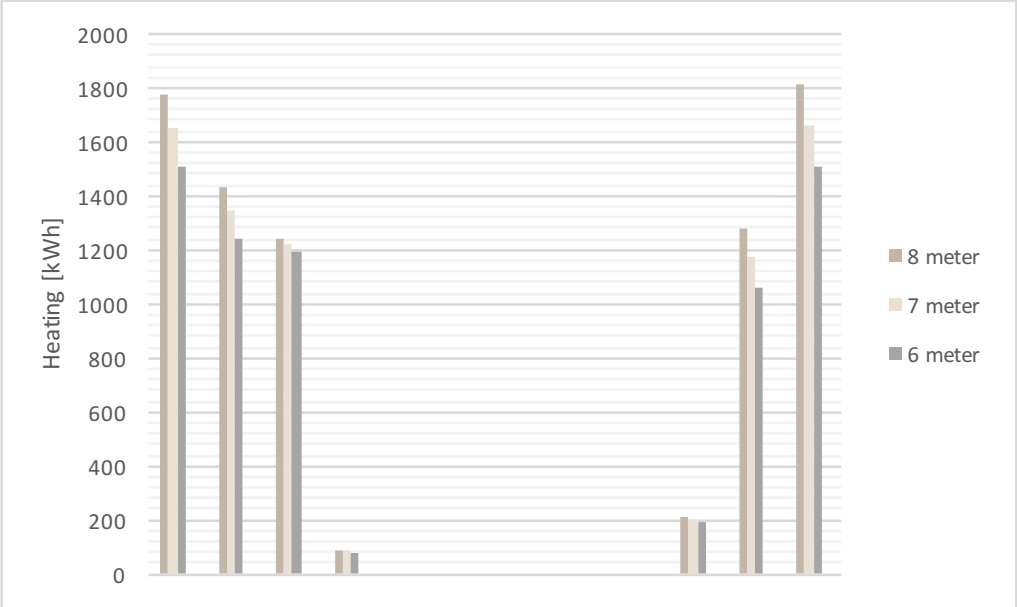
Ill. 2 Air Change



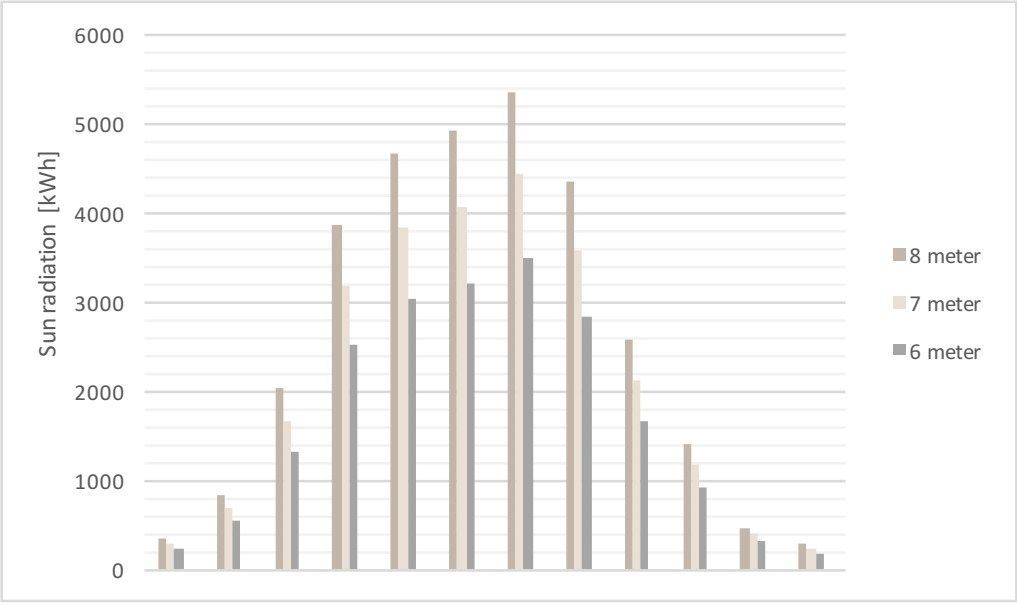
Ill. 3 CO2



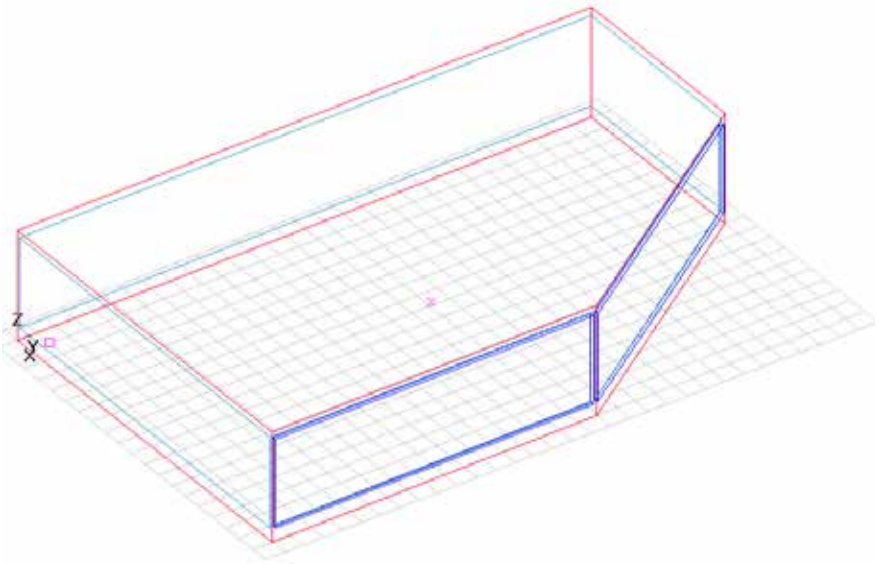
Ill. 4 Operative Temperature



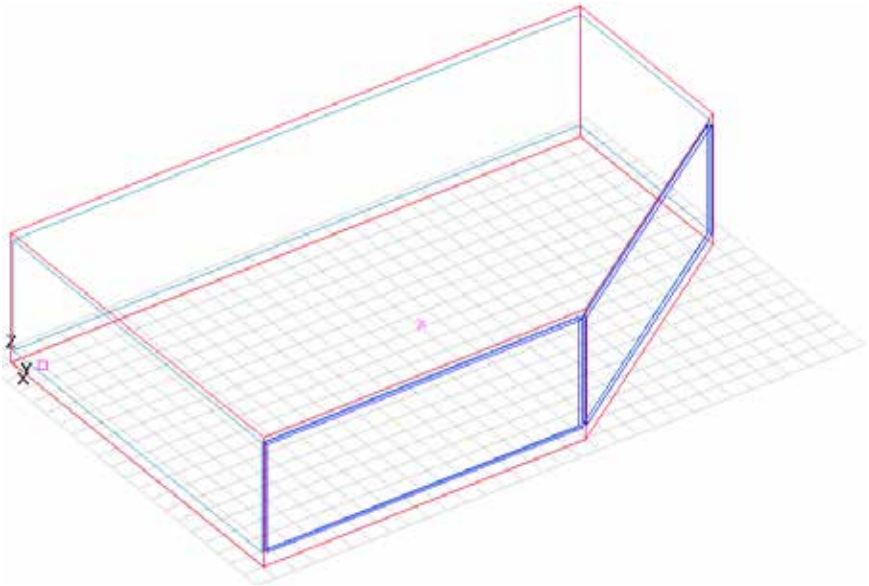
Ill. 5 Heating



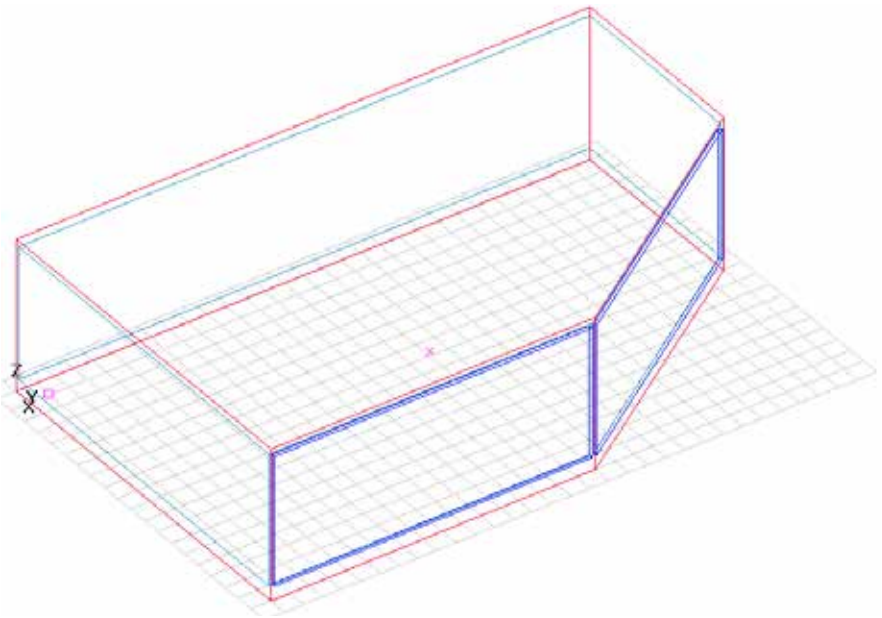
Ill. 6 Sun Radiation



Ill. 7 6m



Ill. 8 7m



Ill. 9 8 m

6 meters

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14
heat balance													
ThermalZone83	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	6788,83	1509,03	1245,34	1194,18	80,75	0	0	0	0	0	187,65	1062,14	1509,73
qCooling	0	0	0	0	0	0	0	0	0	0	0	0	0
qInfiltration	-7719,9	-957,59	-877,85	-1037,56	-693,94	-522,05	-398,06	-270,77	-261,27	-373,47	-568,53	-806,25	-952,57
qVenting	-9182,21	0	0	-3,45	-684,8	-1595,59	-1963,7	-2108,21	-1787,52	-948,17	-90,78	0	0
qSunRad	20260,52	232,8	546,82	1322,35	2512,29	3037,99	3203,58	3496,08	2829,96	1672,89	920,41	305,78	179,57
qPeople	26292	2184	2016	2268	2184	2184	2184	2226	2226	2184	2184	2184	2268
qEquipment	9651,23	814,99	740,28	823,05	795,46	814,99	795,46	819,02	819,02	795,46	814,99	795,46	823,05
qLighting	2824,76	379,95	264,65	209,45	165,44	149,76	142,01	145,23	157,06	185,01	259,96	360,73	405,51
qTransmission	-28598,22	-3417,12	-3164,09	-3685,05	-2556,71	-1928,72	-1489,6	-1039,44	-1052,62	-1507,69	-2230,21	-3044,61	-3482,37
qMixing	0	0	0	0	0	0	0	0	0	0	0	0	0
qVentilation	-20317,01	-746,05	-771,15	-1090,98	-1802,5	-2140,38	-2473,69	-3267,91	-2930,64	-2008,03	-1477,5	-857,25	-750,93
Sum	0	0	0	0	0	0	0	0	0	0	0	0	0
tOutdoor mean(°C)	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C)	22,4	21,3	21,4	21,7	22,6	22,9	23,3	23,9	23,7	22,9	22,2	21,5	21,3
AirChange(/h)	1,1	0,7	0,7	0,7	0,8	1,2	1,6	2,2	2,1	1,1	0,7	0,7	0,7
Rel. Moisture(%)	41,2	33,8	33,9	30,8	33,8	39,1	47,7	53,1	51,7	49	47,2	38,8	35,6
Co2(ppm)	615,1	715,4	722,5	726,8	639,2	538,6	490,1	418,5	430,2	556,2	692,3	724	727,5
PAQ(-)	0,3	0,5	0,5	0,5	0,4	0,3	0,2	0,1	0,1	0,2	0,3	0,4	0,5
Hours > 26	86	0	0	0	0	0	7	47	28	4	0	0	0
Hours > 27	21	0	0	0	0	0	0	15	6	0	0	0	0
Hours > 28	1	0	0	0	0	0	0	1	0	0	0	0	0
Hours < 20	4	4	0	0	0	0	0	0	0	0	0	0	0
FanPow	8277,57	625,95	565,38	625,95	605,76	667,06	737,02	1004,56	945,13	643,11	625,95	605,76	625,95
HtRec	36779,54	5586,93	5103,97	5929,77	3226,05	1871,78	976,27	235,7	218,5	878,14	2617,71	4584,86	5549,86
ClRec	0	0	0	0	0	0	0	0	0	0	0	0	0
HtCoil	5025,83	999,95	850,49	941,07	240,99	64,69	17,25	0	0,16	20,95	185,9	711,19	993,2
ClCoil	-3420,04	0	0	0	-0,3	-74,12	-466,65	-1463,34	-1245,57	-169,73	-0,34	0	0
Humidif	0	0	0	0	0	0	0	0	0	0	0	0	0
FloorHeat	4525,89	1006,04	830,24	796,19	53,83	0	0	0	0	0	125,03	708,05	1006,51
FloorCool	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPumpPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCoolingPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPump	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCooling	0	0	0	0	0	0	0	0	0	0	0	0	0

Ill. 10 6 meters Bsim output

7 meters

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14
heat balance													
ThermalZone83	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	7326,87	1648,4	1342,54	1219,15	83,49	0	0	0	0	0	201,61	1172,96	1658,71
qCooling	0	0	0	0	0	0	0	0	0	0	0	0	0
qInfiltration	-7429,35	-916,91	-842,24	-998,85	-669,78	-504,3	-385,15	-264,55	-254,04	-360,9	-547,48	-772,36	-912,79
qVenting	-11976,49	0	0	-13,27	-1068,88	-2122,88	-2504,83	-2673,6	-2258,5	-1203,47	-131,04	0	0
qSunRad	25649,82	294,2	691,43	1673,07	3181,12	3847,44	4055	4426,45	3584,86	2118,06	1164,7	386,58	226,92
qPeople	26292	2184	2016	2268	2184	2184	2184	2226	2226	2184	2184	2184	2268
qEquipment	9651,23	814,99	740,28	823,05	795,46	814,99	795,46	819,02	819,02	795,46	814,99	795,46	823,05
qLighting	2509,45	336,85	223,43	177,79	146,91	138,24	134,15	135,16	142,74	161,08	222,97	316,65	373,48
qTransmission	-31119,22	-3694,75	-3432,44	-4029,71	-2800,2	-2118,35	-1636,24	-1148,83	-1152,37	-1640,6	-2419,01	-3284,9	-3761,81
qMixing	0	0	0	0	0	0	0	0	0	0	0	0	0
qVentilation	-20904,32	-666,78	-739	-1119,23	-1852,11	-2239,14	-2642,39	-3519,65	-3107,71	-2053,62	-1490,73	-798,39	-675,56
Sum	0	0	0	0	0	0	0	0	0	0	0	0	0
tOutdoor mean(°C)	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C)	22,4	21,2	21,3	21,7	22,7	23	23,4	24	23,8	23	22,2	21,4	21,2
AirChange(/h)	1	0,5	0,5	0,5	0,7	1,1	1,5	2,1	2	1	0,6	0,5	0,5
Rel. Moisture(%)	41,2	34,3	34,2	30,9	33,4	38,7	47,4	52,7	51,3	48,8	47,2	39,3	36
Co2(ppm)	608,4	717,2	724,3	727	619	521,7	476,2	409,8	420,8	541,6	687,9	725,8	729,3
PAQ(-)	0,3	0,5	0,5	0,5	0,4	0,3	0,2	0,1	0,1	0,2	0,3	0,4	0,5
Hours > 26	115	0	0	0	0	0	10	63	37	5	0	0	0
Hours > 27	37	0	0	0	0	0	0	29	8	0	0	0	0
Hours > 28	9	0	0	0	0	0	0	6	3	0	0	0	0
Hours < 20	10	10	0	0	0	0	0	0	0	0	0	0	0
FanPow	8379,43	625,95	565,38	625,95	608,24	678,95	761,54	1041,1	967,92	646,73	625,95	605,76	625,95
HtRec	36733,75	5581,7	5099,92	5923,87	3226,76	1873,81	964,64	239,55	214,35	860,55	2608,52	4588,35	5551,75
ClRec	0	0	0	0	0	0	0	0	0	0	0	0	0
HtCoil	5138,65	1049,97	869,05	926,04	233,63	58,91	14,19	0	0,07	20,32	187,2	740,93	1038,34
ClCoil	-3615,06	0	0	0	-0,3	-75,59	-511,96	-1540,35	-1313,57	-172,96	-0,34	0	0
Humidif	0	0	0	0	0	0	0	0	0	0	0	0	0
FloorHeat	4884,58	1098,95	895,04	812,83	55,66	0	0	0	0	0	134,34	781,94	1105,82
FloorCool	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPumpPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCoolingPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPump	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCooling	0	0	0	0	0	0	0	0	0	0	0	0	0

Ill. 11 7 meters Bsim output

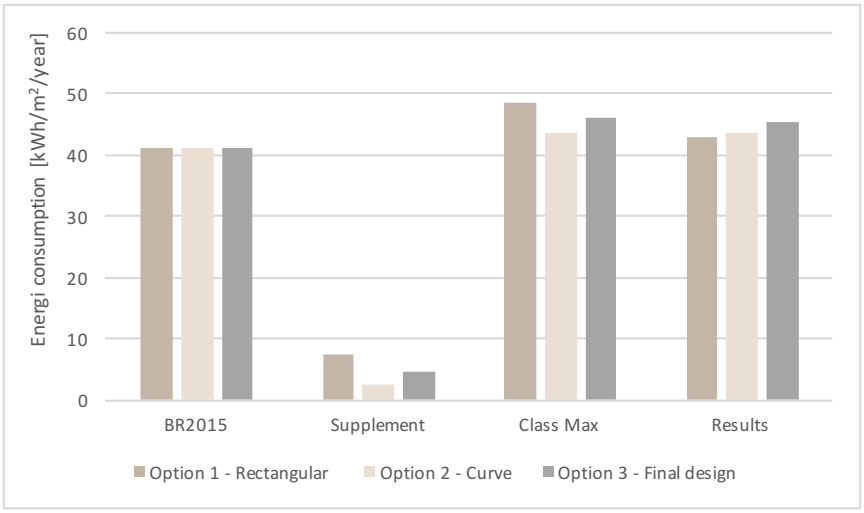
8 meters

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14
heat balance													
ThermalZone83	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	7836,75	1771,59	1431,27	1243,23	87,22	0	0	0	0	0	213,74	1279,28	1810,41
qCooling	0	0	0	0	0	0	0	0	0	0	0	0	0
qInfiltration	-7234,15	-888,21	-818,21	-973,14	-653,05	-492,6	-377,08	-261,32	-249,86	-352,38	-533,9	-749,02	-885,38
qVenting	-14839,35	0	0	-31,79	-1462,27	-2648,47	-3051,58	-3245,89	-2746,58	-1476,02	-176,74	0	0
qSunRad	31042,69	355,61	836,09	2024	3850,41	4657,5	4906,93	5357,46	4340,37	2563,52	1409,13	467,39	274,27
qPeople	26292	2184	2016	2268	2184	2184	2184	2226	2226	2184	2184	2184	2268
qEquipment	9651,23	814,99	740,28	823,05	795,46	814,99	795,46	819,02	819,02	795,46	814,99	795,46	823,05
qLighting	2320,28	306,53	201,54	162,89	137,58	134,88	130,99	133,5	137,54	150,59	202,67	279,08	342,48
qTransmission	-33641,4	-3970,71	-3703,92	-4374,86	-3040,09	-2305,97	-1788,09	-1259,28	-1253,71	-1771,05	-2610,33	-3524,52	-4038,87
qMixing	0	0	0	0	0	0	0	0	0	0	0	0	0
qVentilation	-21428,06	-573,81	-703,05	-1141,38	-1899,27	-2344,32	-2800,63	-3769,5	-3272,8	-2094,11	-1503,56	-731,67	-593,96
Sum	0	0	0	0	0	0	0	0	0	0	0	0	0
tOutdoor mean(°C)	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C)	22,4	21	21,3	21,7	22,7	23,1	23,4	24,1	23,8	23	22,2	21,3	21,1
AirChange(/h)	0,9	0,5	0,5	0,5	0,6	1	1,4	2	1,9	0,9	0,5	0,5	0,5
Rel, Moisture(%)	41,2	34,9	34,6	30,9	33,1	38,5	47,1	52,3	51	48,6	47,2	39,8	36,5
Co2(ppm)	603	718,5	725,5	725,9	604,2	508,9	465,2	403,4	414,1	529,8	683,4	727	730,6
PAQ(-)	0,3	0,5	0,5	0,5	0,4	0,3	0,2	0,1	0,1	0,2	0,3	0,4	0,5
Hours > 26	145	0	0	0	0	0	11	77	51	6	0	0	0
Hours > 27	51	0	0	0	0	0	0	39	11	1	0	0	0
Hours > 28	16	0	0	0	0	0	0	13	3	0	0	0	0
Hours < 20	23	18	0	0	0	0	0	0	0	0	0	1	4
FanPow	8488,59	625,95	565,38	625,95	614,83	695,39	786,05	1077,96	989,67	649,75	625,95	605,76	625,95
HtRec	36769,78	5583,1	5099,42	5919,11	3254,9	1888,99	966,48	246,97	212,6	847,89	2602,96	4593,5	5553,85
ClRec	0	0	0	0	0	0	0	0	0	0	0	0	0
HtCoil	5280,63	1103,33	890,56	914,73	230,25	54,21	12,1	0	0,04	19,9	187,41	777,93	1090,16
ClCoil	-3796,05	0	0	0	-0,3	-82,71	-557,43	-1601,05	-1373,31	-180,91	-0,34	0	0
Humidif	0	0	0	0	0	0	0	0	0	0	0	0	0
FloorHeat	5224,5	1181,08	954,19	828,89	58,15	0	0	0	0	0	142,42	852,82	1206,95
FloorCool	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPumpPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCoolingPow	0	0	0	0	0	0	0	0	0	0	0	0	0
CentHeatPump	0	0	0	0	0	0	0	0	0	0	0	0	0
CentCooling	0	0	0	0	0	0	0	0	0	0	0	0	0

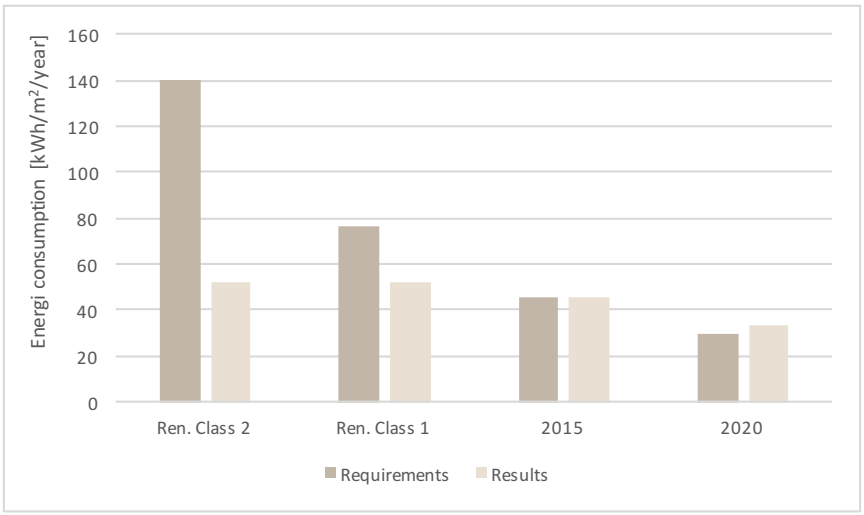
Ill. 12 8 meters Bsim output

BE18
ENERGY CONSUMPTION

In order to understand the energy use in the building and how it differs according to the design, two iterations have been examined with Be18. Following the results of the two options are shown together with the result of the final design.



Ill. 13 Energy Consumption



Ill. 14 Energy Consumption

RECTANGULAR OPTION

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	7,3	142,8
Samlet energibehov		49,3

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,5	7,3	78,8
Samlet energibehov		49,3

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,1	7,3	48,4
Samlet energibehov		43,0

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	7,3	32,3
Samlet energibehov		31,7

Bidrag til energibehovet

Varme	31,8
El til bygningsdrift	7,0
Overtemp. i rum	0,0

Udvalgte elbehov

Belysning	3,6
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	5,7
Pumper	0,1
Køling	1,3
Totalt elforbrug	30,4

Netto behov

Rumopvarmning	22,1
Varmt brugsvand	8,1
Køling	0,3

Varmetab fra installationer

Rumopvarmning	1,7
Varmt brugsvand	2,8

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	3,7
Vindmøller	0,0

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	0,0	135,5
Samlet energibehov		40,0

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,5	0,0	71,5
Samlet energibehov		40,0

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,1	0,0	41,1
Samlet energibehov		33,8

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		25,0

Bidrag til energibehovet

Varme	31,1
El til bygningsdrift	3,6
Overtemp. i rum	0,0

Udvalgte elbehov

Belysning	2,3
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	3,1
Pumper	0,1
Køling	1,7
Totalt elforbrug	21,3

Netto behov

Rumopvarmning	21,4
Varmt brugsvand	8,1
Køling	0,4

Varmetab fra installationer

Rumopvarmning	1,6
Varmt brugsvand	2,8

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	3,7
Vindmøller	0,0

Ill. 15 Rectuangular Option

CURVY OPTION

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	4,2	139,7
Samlet energibehov		51,1

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,5	4,2	75,7
Samlet energibehov		51,1

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,1	4,2	45,3
Samlet energibehov		44,2

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	4,2	29,2
Samlet energibehov		32,6

Bidrag til energibehovet

Varme	34,7
El til bygningsdrift	6,6
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	24,9
Varmt brugsvand	8,1
Køling	0,8

Udvalgte elbehov

Belysning	3,6
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	5,7
Pumper	0,1
Køling	3,8
Totalt elforbrug	32,9

Varmetab fra installationer

Rumopvarmning	1,6
Varmt brugsvand	2,8

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	6,6
Vindmøller	0,0

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	0,0	135,5
Samlet energibehov		43,7

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,5	0,0	71,5
Samlet energibehov		43,7

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,1	0,0	41,1
Samlet energibehov		36,9

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		27,5

Bidrag til energibehovet

Varme	33,8
El til bygningsdrift	3,7
Overtemp. i rum	0,5

Netto behov

Rumopvarmning	24,1
Varmt brugsvand	8,1
Køling	1,1

Udvalgte elbehov

Belysning	2,3
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	3,2
Pumper	0,1
Køling	4,8
Totalt elforbrug	24,4

Varmetab fra installationer

Rumopvarmning	1,6
Varmt brugsvand	2,8

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	6,6
Vindmøller	0,0

Ill. 16 Curvy Option

FINAL OPTION

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	4,7	140,2
Samlet energibehov		52,3

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,6	4,7	76,3
Samlet energibehov		52,3

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,2	4,7	45,9
Samlet energibehov		45,2

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	4,7	29,7
Samlet energibehov		33,4

Bidrag til energibehovet

Varme	35,3
El til bygningsdrift	6,8
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	25,3
Varmt brugsvand	8,2
Køling	0,7

Udvalgte elbehov

Belysning	3,8
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	6,0
Pumper	0,1
Køling	3,2
Totalt elforbrug	33,9

Varmetab fra installationer

Rumopvarmning	1,7
Varmt brugsvand	3,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	6,3
Vindmøller	0,0

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
135,5	0,0	135,5
Samlet energibehov		43,4

Renoveringsklasse 1

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
71,6	0,0	71,6
Samlet energibehov		43,4

Energiramme BR 2015 / 2018

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
41,2	0,0	41,2
Samlet energibehov		36,5

Energiramme Byggeri 2020

Uden tilæg	Tilæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		27,2

Bidrag til energibehovet

Varme	34,3
El til bygningsdrift	3,5
Overtemp. i rum	0,3

Netto behov

Rumopvarmning	24,4
Varmt brugsvand	8,2
Køling	0,9

Udvalgte elbehov

Belysning	2,4
Opvarmning af rum	0,0
Opvarmning af vbv	0,1
Varmepumpe	0,0
Ventilatorer	3,3
Pumper	0,1
Køling	4,0
Totalt elforbrug	24,7

Varmetab fra installationer

Rumopvarmning	1,7
Varmt brugsvand	3,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	6,3
Vindmøller	0,0

Ill. 17 Final Option

U-VALUE

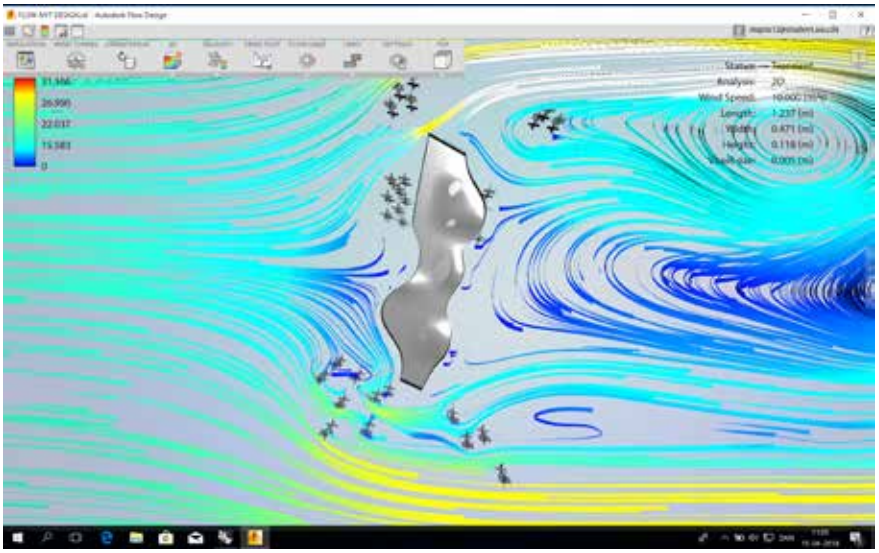
To ensure a tight construction envelope that meets the requirements with minimal heat loss, the u-values of both the roof and the deck has been calculated.

BUILDING ELEMENTS:	Terrændæk mod udetemp./ deck agains outdoor temp.												
			Homogene layer			Inhomogene layer					Luftspalter/air gaps		
LAYERS		d	R	λ		λ_a	Andel (a)	λ_b	λ'		ΔU'	ΔU_g	R
		m	m²K/W	W/mK		W/mK	-	W/mK	W/mK		W/m²K	W/m²K	m²K/W
Udvendig overgangsisolans/ external transitional isolation			0,04										0,040
Beton/concrete		0,300		2,440									0,123
Isolering/isolation		0,320		0,034							0,00		9,412
Beton/concrete		0,050		1,200									0,042
Indvendig overgangsisolans/internal transitional isolation			0,17										0,170
												ΣR =	9,786 m²K/W
* wood pr. 0,6 m filled with iso/air:		0,6										U' =	0,102 W/m²K
Total thickness:		0,670							Luftspalter/air gaps			ΔU_g =	0,000
									Binds			ΔU_f =	0,000
U-value of construction elements:												U =	0,10 W/m²K

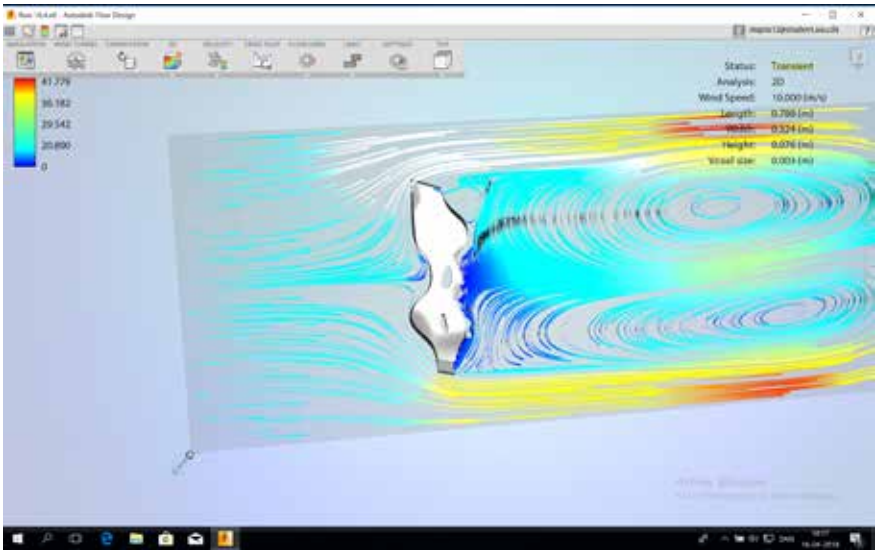
Building elements:	Tagkonstruktion/roof construction												
			Homogene layer			Inhomogene layer					Luftspalter/air gaps		
Layers		d	R	λ		λ_a	Andel (a)	λ_b	λ'		ΔU'	ΔU_g	R
		m	m²K/W	W/mK		W/mK	-	W/mK	W/mK		W/m²K	W/m²K	m²K/W
External transitional isolation			0,04										0,040
Tagpap/roofing felt		0,008		0,200									0,040
Plade/plate		0,009		0,120									0,075
Træ / ny isolering*/wood/new isolation		0,400				0,120	0,100	0,034	0,048		0,00	0,00	8,276
Træ / ventileret*/wood ventilated		0,045				0,120	0,045	0,281	0,269				0,167
Gipsplader/plasterboard		0,026		0,180									0,144
Indvendig overgangsisolans / internal transitional isolation			0,10										0,100
												ΣR =	8,843 m²K/W
* wood pr. 0,6 m filled with iso/air:		0,6					Rockwool calculation tool					U' =	0,113 W/m²K
Total thickness:		0,488							Luftspalter/air gaps			ΔU_g =	0,000
Binds 8 pr. m2 stainless stål (5,5 mm)	x	2							Binds			ΔU_f =	0,000
U-value of construction elements:												U =	0,11 W/m²K

Ill. 18 U-value

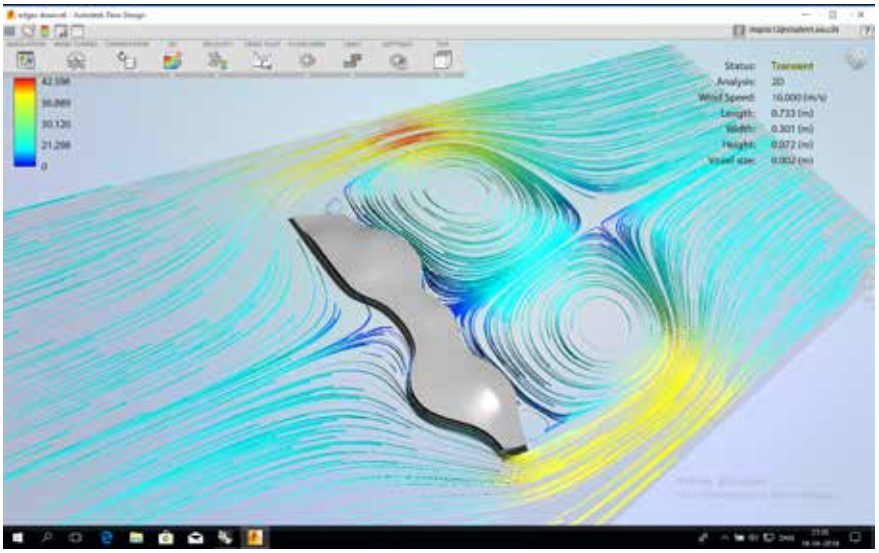
WIND



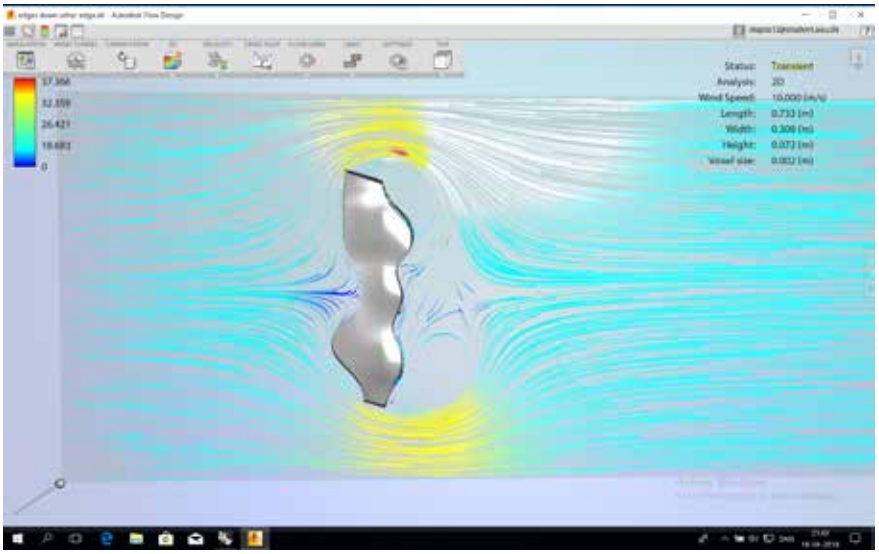
Ill. 19 *Wind Simulation 1*



Ill. 20 *Wind Simulation 2*

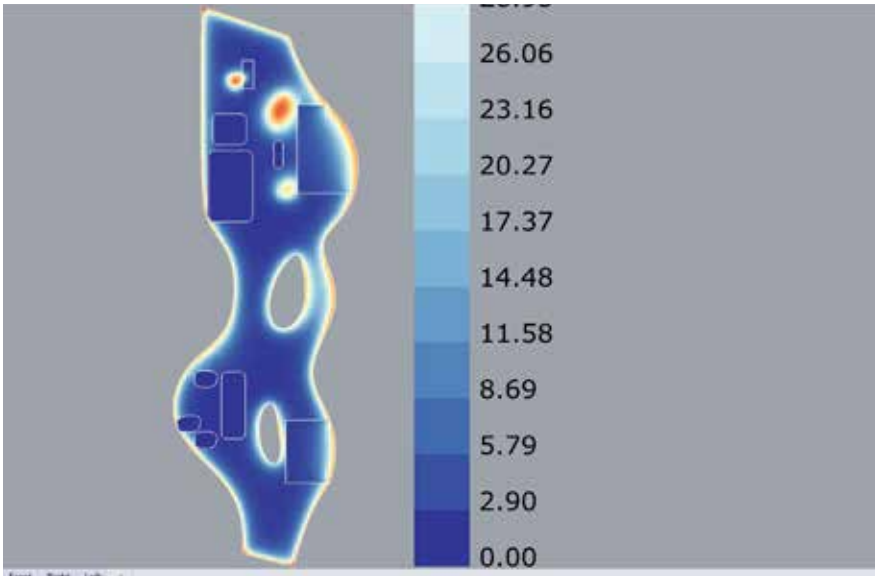


Ill. 21 *Wind Simulation 3*

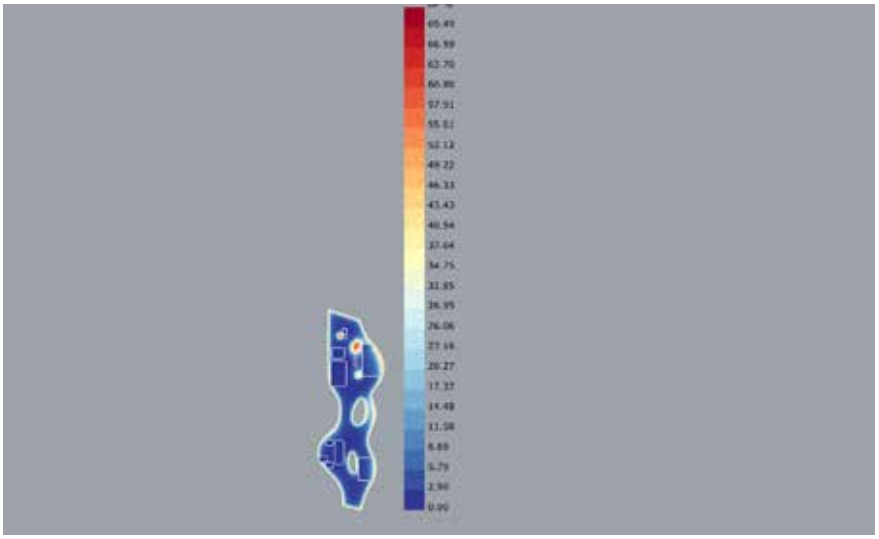


Ill. 22 *Wind Simulation 4*

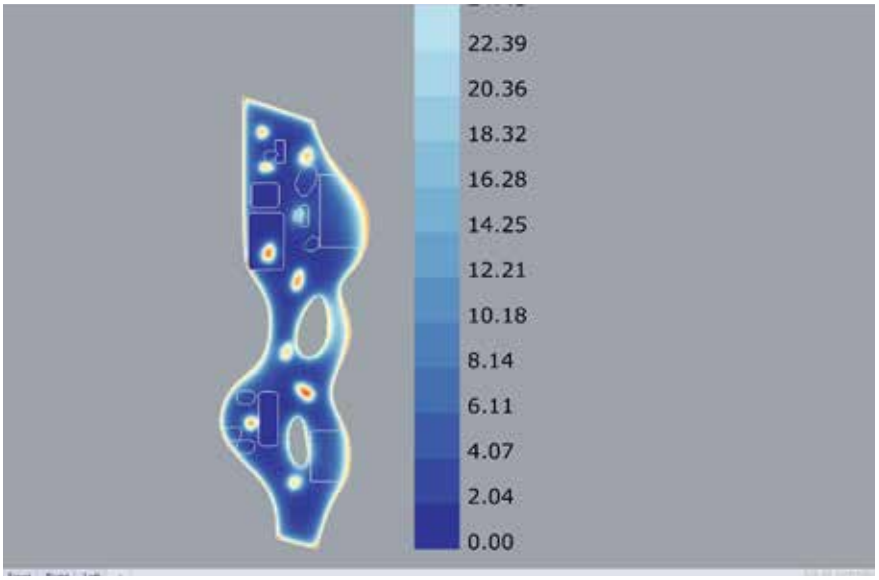
DAYLIGHT



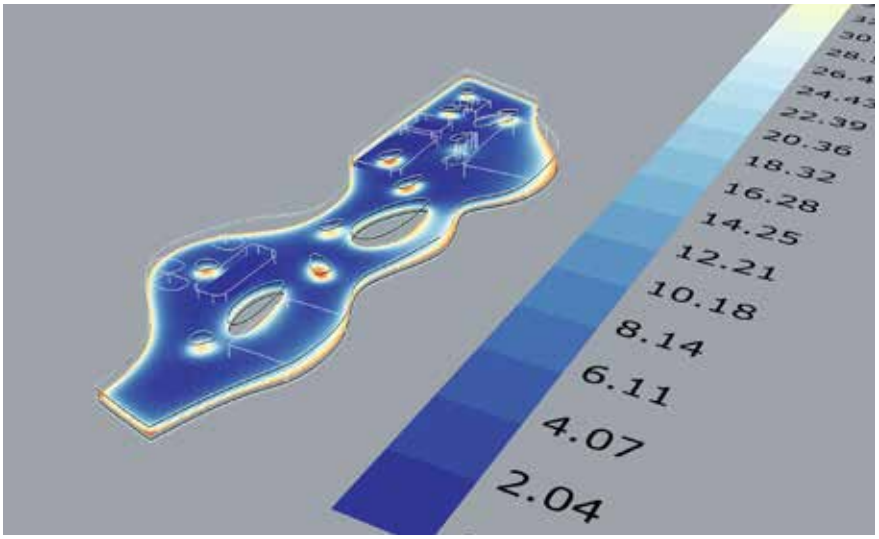
Ill. 23 Daylight Simulation 1



Ill. 24 Daylight Simulation 1

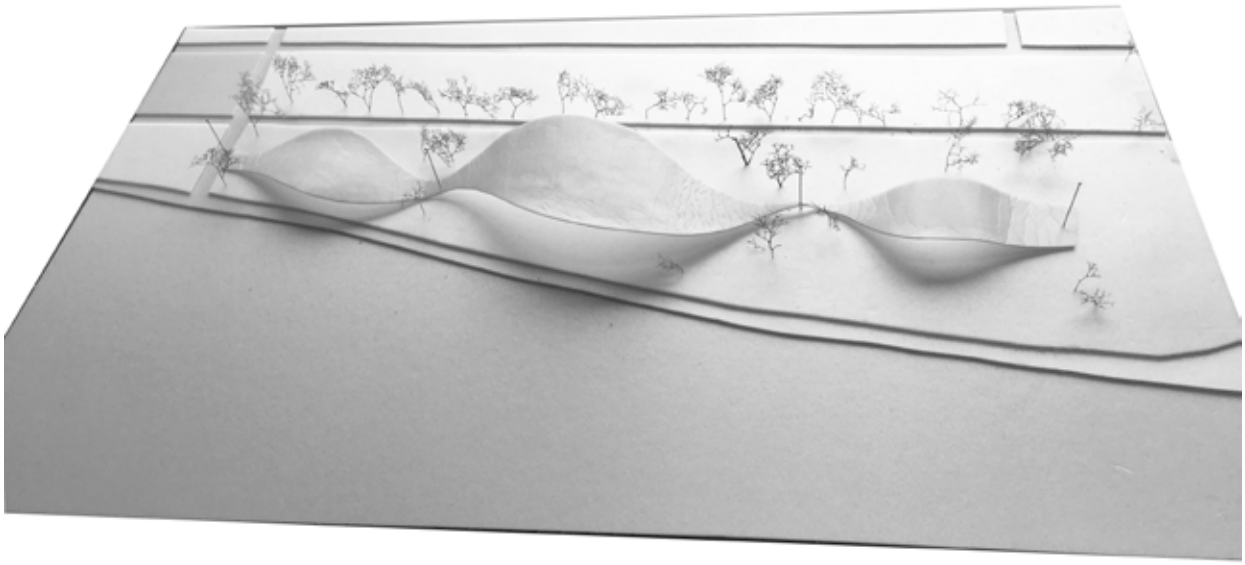


Ill. 25 Daylight Simulation 2

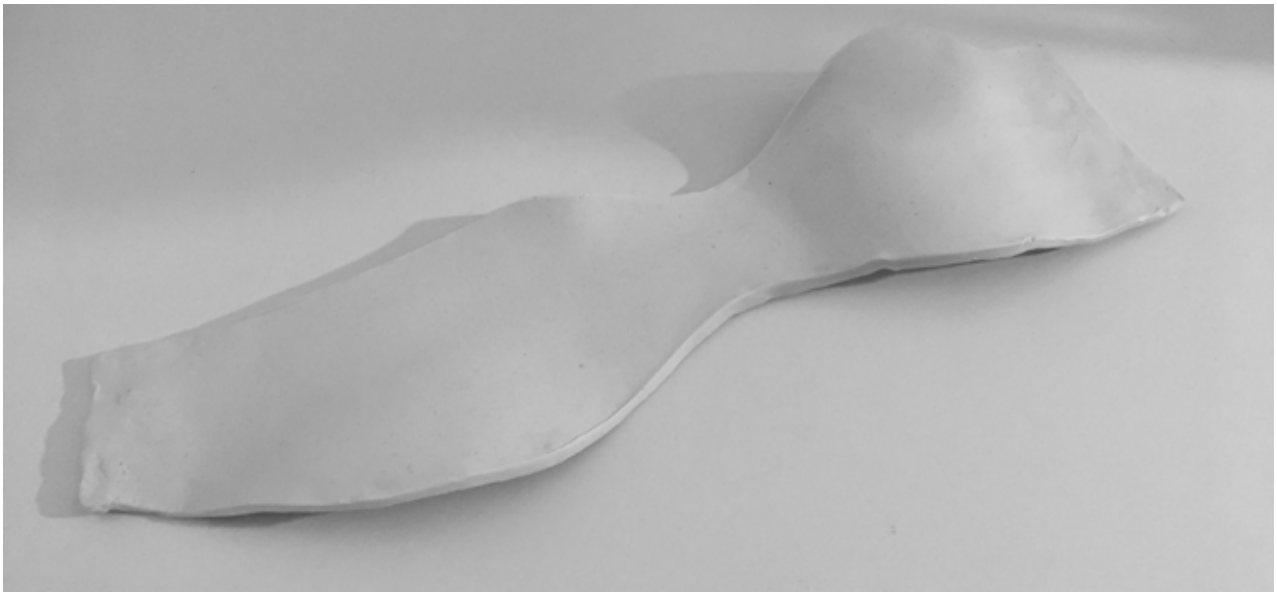


Ill. 26 Daylight Simulation 2

MODELS



Ill. 27 Models



Ill. 28 Models

ILLUSTRATION LIST APPENDIX

OWN ILLUSTRATIONS