YALE SCHOOL



Activity-based learning school in Nye.

Aalborg University
Architecture & Design
MSc04 ARK

Architectural Design
ma4-ark17

Main Supervisor
Andrea Jelic

Co-supervisor
-

Pages
132

Appendix
29

Iraklis Katsouleas



ABSTRACT

Creativity is a very important factor in cultivating children's thinking. The most successful classes are the ones where students are encouraged to create their own ideas, based on their experience and theoretical training.

The teacher is the only one responsible for developing and promoting creativity and this is an aspect of the educational process that we must not overlook. The teacher, rather than teaching students how to find information, should teach them how to generate their own ideas.(K. Robinson, 2016)
In general, all education should teach students how to think for themselves using the information available at any given time and not to "load" them with the knowledge that they often do not even process.

Encouraging creativity in the classroom is a skill that not all teachers have because we have all grown up with a different perception of education. But those who have cultivated the creativity of their students through various activities, have managed to engrave forever in the memory of children. Teachers who have promoted creative thinking are essentially the ones who have equipped their students to face many of the challenges of adulthood.
Some children can not learn at all if we do not let them express themselves creatively. They can not understand, why learn a language or some mathematical theory, if they can not apply them in a real situation, for some purpose or some result. (K. Robinson, 2016)

Children (and all people) are motivated, inspired or strongly challenged to create something worthwhile if in some way this is directly related to what they are.

Creativity improves students' self-confidence when they can see their ideas being the ones that solved a problem or created a construct. Through the result, they understand what they are capable of achieving.
In general, creative thinking is very important in real life. It is part of our ability to survive by developing certain strategies, it is the driving force of our personal growth and the evolution of our culture.

READER'S GUIDE

In this report, the reader will be introduced to the first face of the design process, the methodology and the outcome of our research and design process which is the design of a School for Activity-based learning in Nye. The different analyses have been chosen to get a wide knowledge and understanding of the site, contextually and environmentally such as the functions, character, etc. The case study was chosen to demonstrate the approach a school can take to support the claim that Architecture can play a very important role in the development of a child and assist in its cultivation and development.

CONTENTS

Motivation 6

Introduction 7

Tectonic Approach 8

Integrated design process 10

Methodologies 12

Theory
Architecture and school 16
Reproduction - Renewal 16
Individual to Society 17
Space and Learning 18
Activity-based learning 20
Natural Light in Architecture 22
Tectonics of the Building 26
Wood in Architceture 28
Indoor Climate 30
Conclusion 32

Case Study 36

Design Criteria 38

Mapping
Denmark 42
Aarhus 43
Nye 47
Urban tomography 52

Program 55
Sketching 58

Project
The concept 67
Structural system 74
Evolutionary princeiples 79
Result 86
Classroom 119
Conclusion 122
Reflection 124

List of references 126

Illustrations list 128

Image list 130

MOTIVATION

Our educational system is based on the fundamental of academic ability. Meaning, that students are judged by how well they perform in certain subjects at school, which was set to be the most important and met the needs of industrialism. Schools, as we know them today, were none-existed before the 19th century, thus, public schools were set to create a hierarchy so they can serve the needs of industrialism. This hierarchy promoted that the most important subjects for becoming part of the system are at the top of the chain, thus we were subconsciously forced to give up on things we liked with the fear that we might not get a job. In addition to that, academic ability has indeed obfuscated our understanding of intelligence. The entire system judges' student's intelligence by how well they perform in the "main subjects" and completely neglect or stigmatize an entire creative world within the educational system. And the result? Countless creative and highly intelligent people are not being valued or even make-believe that is not intelligent due to that stigma. (K. Robinson, 2016)

The thesis topic proposal emphasizes the role architecture can play through this distinct transformation from solely literacy-oriented education to a more balanced approach and educational process.

In education, creativity is as important as literacy and we should treat it with the same status. How can architecture and space, inspire students to be creative and seek knowledge and not have it forced or imposed on them? How the design of spaces can assist educators and students to enhance their creativity and creative learning?

The topic also has an engineering aspect to it, willing to study the daylight of the interior spaces of the school, with the goal to analyse how it can affect students to be more productive, creative, less stressed, balanced, as well as create comfort to enhance their urge to be oriented towards learning and eager to solve problems to achieve a deeper and concrete knowledge.

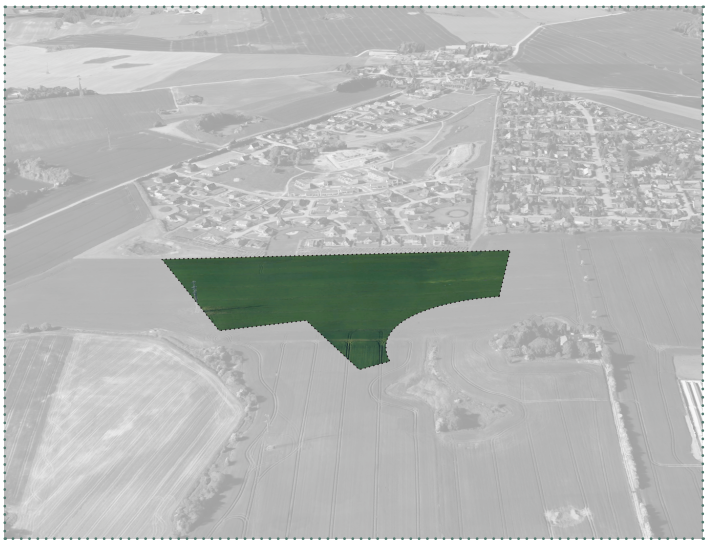
INTRODUCTION

The project takes place in Denmark and more specifically in Nye, a new district north of Aarhus near Elev and the artificial lake of Egå Engsø. It aims to design a school in the local environment of Nye, through the analysis of numerous elements and the effective use of tectonics.

The main focus of the project is to design a school with a primary focus to accommodate all the creative and learning needs of the students of the new district as well as create an inspiring paradigm to follow. It will study the effect architecture can have in the proper learning experience and creative endeavours of the users.

The main construction, as well as a decorative material, shall be wood since contextually it will follow the design language of the entire district and the direction of it.

Furthermore, the design of the school shall seek the ultimate synthesis and will emphasize the interaction between architectural, tectonic, sustainable and functional aspects of the design process and the effect it will have on the students.



Ill. 1: Site Overview

TECTONIC APPROACH

Adolf Heinrich Borbein in his 1982 philological study states that:

"Tectonic becomes the art of joinings. "Art" here is to be understood as encompassing tekne, and therefore indicates tectonic as assemblage not only of building parts but also of objects, indeed of artworks in a narrower sense. With regard to the ancient understanding of the word, tectonic tends toward the construction or making of an artisanal or artistic product."

In the field of architecture, tectonics doesn't only refer to the construction that carries out specific functional and structural demands, but also to the process or the design that elevated the structure to a form of art. Tectonic expression transforms the functional aspect of the building and its construction into structural art and expression. It forms its own design and construction language many times difficult to identify with a glance, but present with its harmonic and artistic expressiveness.
The goals of this project shall be the creation of a structural system that not only works on a structural level but also on an aesthetic and practical level. A system that is dynamic and adjustable.

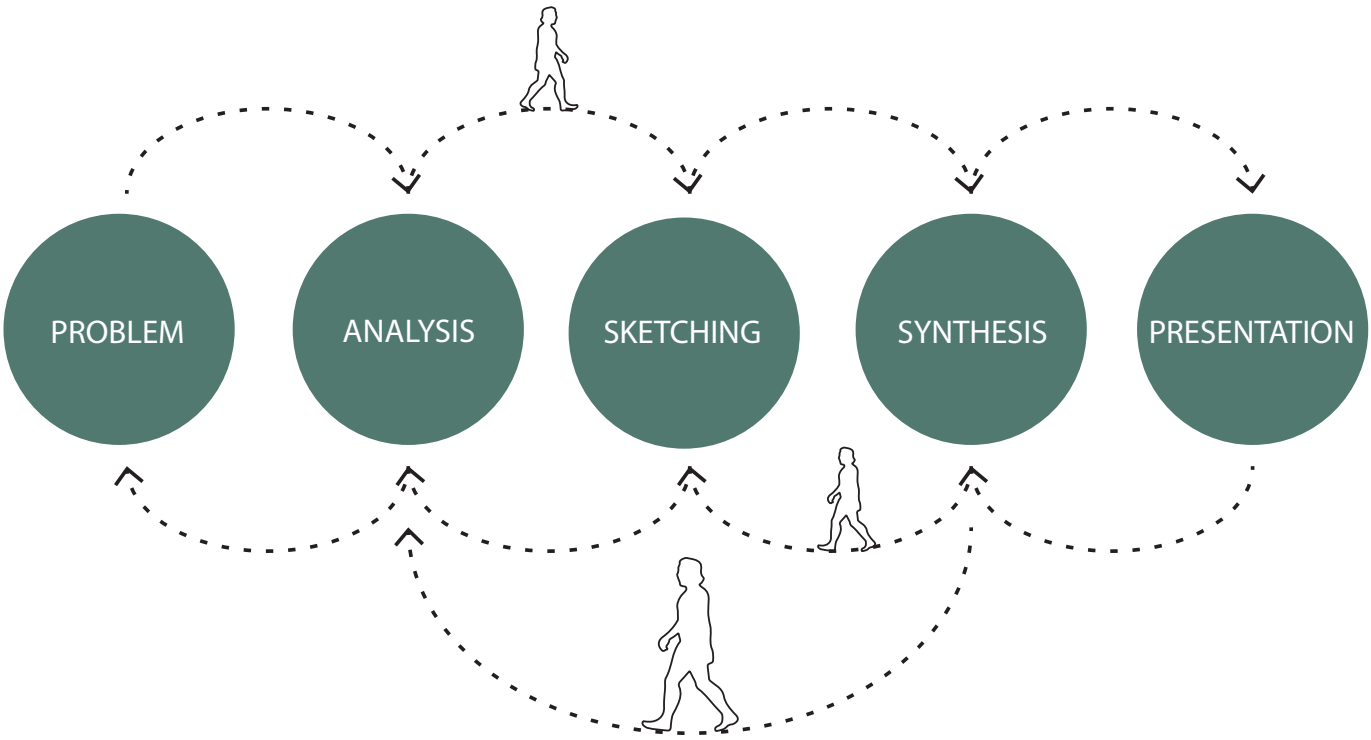


img. 1: Riikonen, 2015 Otaniemi Chapel in Finland by Heikki & Kaija Siren



THE INTEGRATED DESIGN PROCESS

The integrated design process, which comprises of five stages that are closely interrelated, will be used to organize and develop the whole project. These stages are as follows: the problem area, the analysis stage, sketching, synthesis and the presentation of the material.
The problem area explains the real task, or in this case, the foundation upon which the project of the activity-based learning school will be founded. Following that, in the analysis phase, numerous analyses and studies will be done and gathered to give information and understanding of the site, as well as the first development stage required to address the problem. Many various criteria will be developed during this stage for a better knowledge of the project, and the specific phases of this analysis will lay the groundwork for the sketching phase.
The sketching step integrates and blends all of the facts and conclusions acquired from the analysis phase to produce the synthesis's first phase. During this stage of the project, all of the technical, creative, and aesthetic qualities are merged and developed to produce an idea or volume. Various methods can be researched, analyzed, and built to build a conversation and, ultimately, the first design language for the synthesis.
The project's final shape and design language are formed during the synthesis phase. The third and perhaps most crucial step, that of presentation, is where the project and all components of the project are displayed and communicated to the audience. It is generally difficult since we strive to convey all of the many stages that took part in the project's development.
A very crucial and interesting aspect of the integrated design process is that the entire process is a constant back and forth between all the previously mentioned phases and stages of the development of the project. However, it allows us to detail the project even further with the final outcome being as technically and aesthetically pleasing as possible. (Knudstrup, 2004)



Ill. 2: The Integrated Design Process

METHODOLOGIES

RESEARCH

What: Literature

Why: TTo start understanding the basics of the subject and construct the idea on a foundation.

How: From papers to books to websites and articles, the initial process of the research and understanding shall feel hectic. However, going further in the process, the knowledge collected from these various methods shall lay a strong foundation upon which the project and the idea will be based. The challenge will be to figure out which information to keep and what to discard since the topic is new and the task is yet unknown..

MAPPING

What: Area maps and site maps

Why: To read the site, its limitations, accessibility, materials etc.

How: Mapping is an essential stage in every architectural project. It allows us to understand the location, the various parameters that form the site as well as its potential limitations, barriers or its prospects. A proper mapping will help understand the design area and set the foundation for a more precise development of the project. It will allow me to move to the next stages with knowledge of the situation upon which I will be basing my design.

SKETCHING

What: Hand sketching

Why: To initiate a dialogue between oneself and establish a direction or simply seek for ideas.

How: There will be a variety of approaches utilized to build the project during the entire process. The primary and first design approach will be analogue and digital sketching. The drawings must be used to quickly clarify the concepts and bring them into context as the initial stage of the design to examine the form, shape, volume, and details of the structure such as joinery or general tectonic language. Quick drawings will allow the formulation of a notion to be laterally more analyzed and developed or originally discarded in the beginning.

MODELING

What: Analogue and digital modeling

Why: Shall set the basis for a better understanding of the site and the volume of the structure.

How: Modelling, as a method of concept development, will play a critical and integral part in the project's early stages as well as its later stages. It will enable for a scaled volumetric analysis and the transition from a 2D sketch to a 3D volume, which will aid in the understanding of the volume and overall perception of the structure in space. Digital modeling in Rhino and Grasshopper will also enable for the correct start-up calculations, such as sun radiation and structural or conceptual integrity.

SOFTWARE

What: Autocad, 3Ds Max, Rhino, Grasshopper

Why: These are the tools that will further allow the project to be developed, tweaked and finalized for the presentation.

How: During the design process, Rhino and Grasshopper will be utilized to study the structure's overall structural and indoor climate integrity. Following the integrated design process, the use of appropriate tools for studying various aspects of buildings will guide the project to completion and, via trial, will recommend an outcome. There will always be a need for some major "pinch and pull" in terms of structural and indoor climate integrity until a satisfying result is achieved. AUTOCAD, 3Ds Max, and Vray will be used to complete the project's final visualizations and drawings.

SIMULATION

What: Grasshopper, Velux

Why: Will set the foundation for a better detailing of the entire structure and the finalization of the details.

How: Grasshopper will be utilized during the design phase to study the building's internal climate, solar radiation and daylight, as well as structural integrity. Simulations are a very significant and critical stage in the integrated design process because they allow for the adaptability to various requirements that may arise and the implementation of the required adjustments to the entire structure or a portion of it.





THEORY

ARCHITECTURE & SCHOOL

Architecture and pedagogy, two sciences at first glimpse quite different and without an obvious connection between them, seem to approach each other into a dialect in the field of the school buildings. Both architecture and pedagogy have acquired a social role, as they are both called through the design of a building and an educational process to take on the fundamental role of educating young people. The school, as a building but also as a series of operations and procedures, is structured and organized in such a way as to serve the needs of the individual society they belong to. For this reason, before we look at the contribution of the architectural space to the educational process, we will talk about the role of the school in today's society.

REPRODUCTION - RENEWAL

The school, as an institution, has a dual role, which on one hand is the social reproduction and on the other, the social renewal. It has a multifaceted and versatile role, as in addition to the transmission of knowledge, the cultivation of the intellect and skills of young people, it must aim at their comprehensive moral cultivation, to provide a deeper and more substantial education.

The school contributes to the "self-preservation" of the society, preserving the culture of the past generations, as well as ensuring its transmission to future generations. Education sculpts and constructs the cultured person of society, as in addition to the transmission of knowledge, skills and culture, it aims at the social integration of the individual, which can take two forms: moral and mental. One of the main functions of education is the transmission of standards and values. These elements, to the extent that they are internalized and assimilated by the students, lead their action to a common orientation. The educational system equips individuals with a specific, common way of thinking and perhaps because of its function, it can be considered a mechanism for the reproduction of society and its dominant ideology. (R. Kasimati. 2013)

At the same time, however, and in addition to this function, the educational process aims at the evolution of society. This is achieved through the social awakening and emancipation of people. The school must educate responsible, self-aware, critical-minded, cultured, socially sensitive citizens, with ideals, principles and values, and the ceaseless crave for creativity and expression.

Citizens that are aware of their roots and their traditions, that know

where they come from, understand the present and plan the future. Education plays a constant role in all areas of our lives, as when we are aware of the pros or cons of a decision, position or point of view, then we will have better judgment.
The ability of the individual to function autonomously and freely, combined with the realization of their responsibilities and the discipline that should characterize them as members of a society with common goals and aspirations, is the very essence of the institution of education. In their totality, people can sustain progress only when they know when improvement is necessary for the general good of humanity.

INDIVIDUAL TO SOCIETY

The educational process invites the child for the first time to join a wider social context, that of his peers. The school environment is the first public space in which a child is going to act and immediately familiarize himself with society. This activity of the child in this new space and social context is accompanied by his gradual independence from the family environment.(R. Kasimati , 2013) The school environment is the space that will bring the child in contact with stimuli of all types and It will affect his mental and emotional development and socialization in various ways.(S. Tinis, 2016)
Essentially, school is a place of transition, from home to the city, from the individual to society, from childhood to adulthood. In this new reality, the child will not only be taught new knowledge and skills but also a way of behaving. He will realize that not everything is forgiven in this area, as is often the case in the family, and his relationships with others are not characterized solely by emotion or kinship. The child socializes and becomes autonomous, takes responsibility and makes decisions. The school will try to teach the person how to learn, meaning, how to acquire the tools of understanding the world, as well as how to act so that he is productive in his field of action. At the same time, during the school years, the child will understand for the first time the relationship between individual and collective, will learn how to live with others, how to participate in their lives and work with them.
Education must give people the freedom of thought, judgment, expression of feelings and imagination, but also discipline in decision making, to develop their skills and the ability to control, as much as it depends on them. , in their lives. (R. Kasimati, 2013) In other words, the school must equip people with the supplies they need so that they can learn how to live and exist as active members of society

SPACE AND LEARNING

School today is a multi-complex concept. It aims at social cohesion but must also represent social innovation. It is not just a place of learning and teaching, but also a place of living, socializing and a place of transition. "School", then, as a word, has a dual character, as on one hand, it refers to a process, while on the other it brings to mind a building. Essentially, it is a building-shell that houses the process, but at the same time a building-symbol, as the space of school is a "place" that is a set of non-material factors, which come from the social environment, knowledge, memories, experiences and exploitation. (D. Germanos, 2006) Therefore, the school space plays an essential role in the educational process, as it can not be limited to oral teaching and transmission of knowledge regardless of the environment, the space that surrounds it. (G.Mesmin, 1978)

"Space" is understood as a "dual-meaning" concept: that of the space of objects, which includes the material elements of the environment, which are distinguished by their geometric and architectural characteristics, and that of the experiential space, which connects the subject with his social environment and shapes his forms of behaviour and actions.(M. Gaitanidi, 2010)
Modern perceptions of the child, the pedagogical process, education and learning, consider space and the environment (physical and social) as frameworks of education that can be fields of stimuli and learning. (E. Siggolitou, 1997)According to Environmental psychologists, the natural framework can not provoke or prevent learning on its own but can interact with non-environmental factors to favour or hinder the learning process. (K. Tsoukalas 2002)
Thus, from school building architecture, we do not simply expect to house the educational process, but at the same time to illustrate, in spatial terms, what the visionary teachers believe will make the material of the school potentially didactic.
The school building must maintain a dual nature. For the student, it is a learning universe, a space to explore and create, in which he can socialize and develop his personality. For the city, it is a built body, which helps it to consolidate its spatial and mental structures. The school must intervene in the lives of city dwellers, children and adults, meaning that it should influence the urban space and be influenced by it. The school must offer a higher quality living space - it is not a simple building type, as the regulations and norms mean. The school is a matter of urban planning.

Space, the educational environment must stimulate the child and help it experience Learning. Space acquires the role of a teacher assistant, who influences the children, gives them stimuli and creates conditions that will promote the development of their skills and abilities (Dudek 2005). For this reason, the space should be able to be shaped and adapted to the needs of the pedagogical program. In this way o space helps the learning ability of children, creating the foundations that strengthen their commitment and energy. Through the environmental influence, the multimodal type of learning enhances both knowledge retrieval as well as critical ability on (Shah and Miyake 2005).

According to Bronfenbrenner (1979) theory, which incorporates and discusses the effects that the environment has on the child's development, investigations took place to research man in relation to his surrounding environment. This theory focuses on "specific development environments", ie. personal spaces where children spend time, such as home and school and compares the relationships between them within a particular space. In this way, he distinguished benefits relating to the development of academic skills, personal development, socio-emotional development, the development of life skills and connection To the local community.

Wake (2007) argues that children's involvement in the design of the school environment can enhance a number of developmental behaviours and skills, such as enhancing autonomy, collaboration, self-esteem, enthusiasm, and self-confidence. Further research has shown that when children are involved in the design of their environment, they are psychologically empowered as the sense of effectiveness and self-control increases, as they feel active in organizing their daily life (Zimmerman 1995)(Tsevreni, Pantazis, Tousis and Panagiotatou 2008). Beyond that, children begin to develop more positive relationships and bonds of trust with the teacher and this results in them being emotionally liberated and feeling safe in order to explore the learning environment in which they participate. According to Dimitris Germanos (2010), the redesign of the school space is interdisciplinary.

From a pedagogical point of view, the application of water-centred teaching and learning methods in the classroom emphasizes collaborative learning. From a psychosocial point of view, the transformation of the classroom into a collectivity based on the development of creativity, pleasure and democracy between children, as well as in their interaction with its social and cultural environment emphasizes self-esteem and

self-knowledge. Finally, from an architectural point of view, the creation of space conditions that will facilitate the development of the potential that characterizes the sought-after modern form of educational environment is still one of the key issues in the field of education.

ACTIVITY-BASED LEARNING

Learning is a complex psychophysiological function of man that is activated by endogenous and exogenous factors and aims at the acquisition of knowledge and skills. Humans ability to learn appears at birth and is maintained until the end of his life, and is a basic condition for the completion of his personality. The character but also the purpose of learning follow the human in his evolutionary course towards maturity and self-realization. Thus learning from a simple mental event-reaction to the stimuli of the environment gradually becomes conscious and purposeful energy that meets its ultimate goal which is creation. Learning provides the person with the necessary resources to utilize his creativity in a way that is essential for himself and the society in which he participates. The dynamic and two-way relationship between creativity and learning is given and does not require special analysis. Learning is by definition a creative process and every creative expression is a source of learning for humans.

Activity-based learning is a student-centred methodology that encourages students to learn and apply knowledge and skills through an exciting experience and active exploration of real-world problems (Dewey, 1997). Project-based learning, in contrast to traditional teaching as it does not depict a linear course of knowledge but instead raises questions and problems, thus allowing learning through action (learning-by-doing).

In the traditional educational system, projects are usually limited in scope and duration. It's a good way for students to work with content they have already learned. In project-based learning, on the other hand, students learn through projects. However, in traditional classroom projects, students only participate in part of the research process. The teacher does the planning, the research, the questions and then presents all the material to the students. Then the students create something. The teacher and the student work together to improve it and then the student presents the project to the class or at best hangs it on his wall.

On the other hand, a typical Activity-based learning scenario suggests a question or problem that needs to be addressed. The project focuses on the teaching of students, important knowledge and skills, derived from models and basic concepts, which are even found in academic classrooms. Activity-based learning is often multidisciplinary and broader in scope, while problem-based learning is mostly about a single topic. In general, Activity-based learning follows general steps, while problem-based learning provides specific steps. Importantly, Activity-based learning often involves authentic tasks that solve real problems that have an impact on the real world, while problem-based learning uses scenarios and cases that may be less relevant to real-life (Larmer, 2014).

Architecture school be made for the people. Its essence and functionality should be meticulously considered to accommodate the needs of the occupant. Designing a school for activity-based learning, we should above all consider the needs of a student for its development and when I say development I don't mean only its academic progress, however, a multilevel development that will equally house the blank canvas of a child and allow it to grow its skills. Hence, one of the main criteria of my design should be to allow the students and the teachers to create the foundation of their own journey, give them the tools to use the space according to their needs and inspire them with their own freedom through the creation of open as well as diverse common spaces that will allow the students to socialize and spend time exchanging ideas as well as learning playing. Private spaces where students can build their own spaces according to the needs of the subject or the needs of the particular project or task.

NATURAL LIGHT IN ARCHITECTURE

Cambridge dictionary

light /lait/ (noun)

Louis Khan

'I can't define a space really as space unless I have natural light . . . natural light gives mood to space by nuances of light in the time of day and the season of the year, as it enters and modifies the space'.(Louis Khan, 1961)

Derek Phillips Daylight, Natural light in Architecture (2004)

'The importance of orientation is acknowledged in the setting of the building on its site and its relationship to the sun path to achieve the optimum natural lighting solution for the building's function, whilst a knowledge of the world outside assists an individual's understanding of his whereabouts within a building.'(D.Phillips, 2004)

The philosophical architectural background of the constructions is reflected through the general treatment and use of natural light. For some architects, natural light has been the subject of experimentation in an effort to understand the greatness of architecture, for others an integral part of technology, a means of highlighting the superiority of construction. Natural light falls on all buildings, but its handling, from the moment it reaches the limits of the building shell, is the subject of elaboration and priorities of the architect.

Natural light is not just used to complement the already built environment, it often comes to build a separate environment. No spatial problem is more characteristic in the work of the architect than the need to see the outside and the inside as elements of the same conception. The qualities that innately give light to an architectural composition are considered superficial in relation to the possibilities offered by light when used from the outset as a composition tool. Specifically, since ancient times people have created architecture according to the quality of light and the properties of the material that they had at their disposal. For Le Corbusier, who used natural many times light as a basis and tool of architectural design: Architecture is the learned game, correct and magnificent, of forms assembled in the light.(L. Corbusier, 1923)
Many times the synthetic path is developed directly related to the processing of lighting. For example, in cave architecture, light is a key synthetic choice and not a secondary one. In other words, the desired light effect can be a key objective of the synthetic process.

The use of space and its form play an important role in the quality of its lighting. For example, some spaces require controlled natural lighting, some lighting from a specific angle, some not at all-natural lighting, while in others the intrusion of light rays inside them is a key need. In particular, in temples, natural light is a primary synthetic issue. The sanctuary is designed to face east (with an east-west axis), being the primary synthetic movement of the architect-composer. At the same time, in some cases, they are places that need the evocative presence of "divine" light from above. In other places, such as libraries or painting workshops, the penetration of northern neutral light is extremely important.

The architect uses light to give life to the building. Many times he wants to emphasize different images inside, which is achieved and stands out with different intensity at different times of the day, depending on the position of the sun. For example, the direct lighting of the walls of a building emphasizes their solidity and stagnation, while the linear sharp shadows give a movement to the figures, emphasizing their guiding nature.



"A room is not a room without natural light. "
Louis Kahn

img. 2: The Architecture Of Light, The Guggenheim | James Turrell

Students that have the most daylight in their school progress:

20%
faster on math test

26%
faster on reading tests

Students that had properly deisgned skylights in their classrooms improved:

19-20%
faster than those who did not have one



Source: VELUX | BUILDING BETTER SCHOOLS | SIX WAYS TO HELP OUR CHILDREN LEARN

Students that could open windows in their classrooms progressed:

7-8%

faster than those who had fixed windows in their classrooms

George Loisos for The California Board for Energy Efficiency Program (1999)

Test score results for over 21,000 students in 2000 classrooms from districts, located in Orange County, California, Seattle, Washington, and Fort Collins, Colorado



TECTONICS OF THE BUILDING

Cambridge dictionary

tectonic /tek'tɑ:.nik/ (Adjective)

The root of the word tectonic is the ancient Greek word tektonikos (τεκτονικός). The word tektonikos (τεκτονικός) is defined by the Cambridge Dictionary as something "relating to the structure of the surface of the earth and the way it is formed, changed, and moved by forces inside it".

Robert Maulden
"Tectonics in architecture : from the physical to the meta-physical"

In the field of architecture, the same word is described by Robert Maulden, "Tectonics in architecture: from the physical to the metaphysical", as the "science or art of construction, both in relation to use and artistic design". As well as the fact that it does not only indicate the "activity of making the materially requisite construction that answers certain needs but rather to the activity that raises this construction to an art form."

Kenneth Frampton
(Studies in Tectonic Cultrure)

Kenneth Frampton, defines the word tectonic, in his work "Studies in Tectonic Culture", through the greek source of the book saying that: "...the term tectonic derives from the word tekton, signifying carpenter or builder. The corresponding verb is tektainomai (τεκταίνομαι) . This in turn is related to the Sanskrit taksan, referring to the craft of carpentry and to the use of the axe.

The term has a very wide use from the ancient Greeks, and more specifically it appears in Homer where it is more universalized to the art of construction. However, the poetic association to the term tectonic first became apparent in Sappho, where the carpenter (the tekton) assumed the role of the poet:(p.3) "Raise high the roof beam, carpenters. Like Ares comes the bridegroom, taller far than a tall man."

The term "tekton" undergoes a further evolution from something that is specific, physical and unambiguous to a term more universal assisting the concept of making or creating, further unfolding the idea of poesis that is embedded in the word. Thus, the word tekton undergoes a metamorphosis to architekton (αρχιτέκτων).

Karl Otfried Muller
Handbuch der Archaologie der Kunst (Handbook of the Archaeology of Art)

The primary use of the term in the architectural universe is in Germany which dates back to 1830. This year, a German scholar and philodorian, and an admirer of ancient Sparta, published "Handbuch der Archaologie der Kunst" (Handbook of the Archaeology of Art), where he defined the word "tektonische" as the application to a series of art forms "such as utensils, vases, dwellings and meeting places of men", which on one hand form and develop as a result of their application and on the other hand as a result of their conformity to sentiments and notions of art.

The understanding of tectonics and the origins of the term is indeed crucial in the design of the new school in Nye, since its overall design and tectonic approach will aim as a catalyst for the students and will indeed try to have a major impact on the human and the perception of space. The design of it needs to assist the proper distribution of daylight as it has been set as a pre-requisite for the development of the project.



"The art of architecture studies not structure in itself, but the effect of structure on the human spirit"
Geoffrey Scott

img. 3: A Room for Archaeologists and Kids in Pachacámac | ETH Zurich + PUCP

WOOD IN ARCHITECTURE

Cambridge dictionary **wood** /wʊd/ (noun)

There are many who return to the classic and authentic constructions but in combination with elements of modern technology. Genuine wood products give authenticity and genuineness to the constructions and enable the Architect to create. Such products are those produced from solid wood or from the welding of boards or veneers, such as poles, sawn timber, chipped wood, glued laminated timber, plywood, cork products, etc.

It is a product of biological processing and is produced by nature continuously on the condition that man manages the forest according to the principles of forestry science and sustainability.
Wood due to its chemical composition is possible after mechanical and chemical treatment to give us products. It is constantly reproduced by nature when all other raw materials are exhausted.
It has great aesthetic value because it is available in endless combinations of colours and designs.
It is a warm material with a special sense of touch and sight.
It has great mechanical strength in relation to its weight. It is an insulating material in heat and electricity. It does not oxidize and does not pollute the environment.
Finally, it is an excellent building material with huge construction possibilities and great architectural value.

However, the use of wood has its drawbacks and one should be quite careful using it. It is a hygroscopic material, meaning that it absorbs moisture from the atmosphere and swells and releases moisture into the atmosphere and shrinks. It is also an anisotropic material, meaning that both its structure and its mechanical strength and its properties differ in different directions within its mass.
It is burned and infected by insects, fungi and other microorganisms.
Its proper use presupposes knowledge of its properties, its structure as well as its advantages and disadvantages.
But it is a fact that we can eliminate or reduce some of its disadvantages by applying various manipulations, such as impregnation with various chemicals that make it flame retardant or invulnerable to fungi and insects.

The combination of wood with other materials such as concrete, metal, aluminium, crystal and polymers in building constructions opens new horizons and promotes architectural design. However, it presupposes the application of technology rules due to the differences in the properties of the materials. Thus the wood must be dry, have dimensional stability and withstand weather events. This is achieved by special treatments for ingraining the wood with oils and preservatives.

In Nordic architecture traditionally, the main building material for building houses has been and remains wood, or rather, calibrated or glued laminated timber. The natural beauty of wood is not hidden behind a layer of paint, but, on the contrary, they try to emphasize, treating the walls only with a transparent or shade protective coating. At the same time, natural shades are preferred: beige, brown, grey-green, earthy black.



"You feel a certain way in a glass or concrete or limestone building. It has an effect on your skin - the same with plywood or veneer, or solid timber. Wood doesn't steal energy from your body the way glass and concrete steal heat. When it's hot, a wood house feels cooler than a concrete one, and when it's cold, the other way around."

Peter Zumthor

img. 4: Anthony Timberlands Center for Design and Materials Innovation | Dorte Mandrup

INDOOR CLIMATE

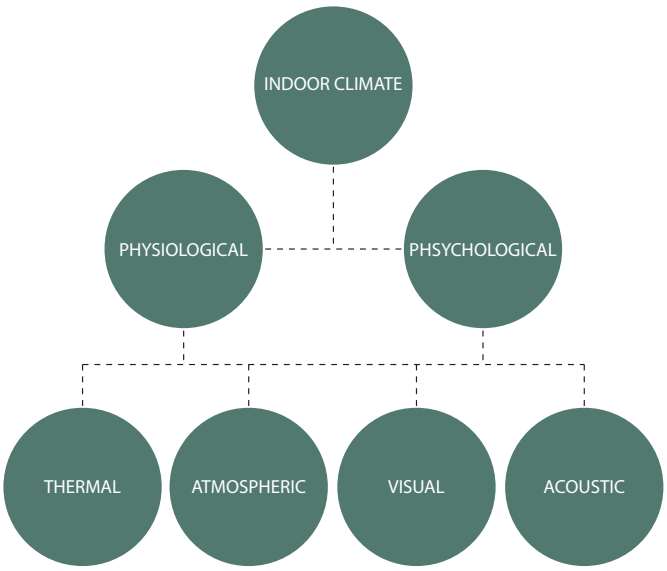
Indoor Climate When designing a building, it's of great importance to form positive that the indoor atmosphere is of a satisfactory commonplace. The term "indoor climate" refers to the physical components that have control over the interaction between humans and the indoor space (GKB, 1997). Additionally, the psychological facet is necessary as well once addressing the indoor conditions, as there's a powerful relationship between the physical factors of a precise climate and the way these area units perceived psychologically. As such, addressing the human level of comfort in numerous aspects is the basis for making a satisfying indoor climate. Factors of the indoor climate and the proper indoor environment are thermal comfort, atmospheric comfort, visual comfort, as well as acoustic comfort.

Thermal Comfort Thermal comfort is that condition of thoughts which expresses pleasure with the thermal environment". In simple words, is a cushty situation in which someone isn't feeling too warm or too cold.

Atmospheric comfort The atmospheric comfort belongs to the thermal comfort category, however, it is studying the air quality and its appropriateness for human.

Visual comfort The visual comfort of a building is basically the amount of daylight the interior spaces of the structure gets during the day and the quality of it.

Acoustic comfort The acoustic comfort of a building is actually the well-being of the building concerning the acoustic environment of the structure



Ill. 3: Indoor Climate



"Enough light to see by is not enough light [...]
The daily light dose received by people in the Western countries might be too low, possibly detrimental to our well-being."
Jennifer Veitch

img. 5: The Heart in Ikast | C.F. Møller Architects

CONCLUSION

The four components that will combine the school at Nye and its architectural manifestation are the tectonics in architecture, the internal environment of the school, natural light, and the prominent use of wood. The structure of the building shall reach its artful expression through the proper use of the foundations of the tectonic approach in architecture, and the structure can become a conversation initiative and a source of inspiration, not only for the children to exploit their artfulness and cognitive potential, but also for the teachers. The tectonic synthesis and its comprehension should be founded on the painstaking composition of details, with the majority of wood and joinery methods utilized to harmonize the building exterior and its impression on the visitor. A good interior climate will help the entire system reach its full potential by properly establishing thermal comfort, acoustic comfort, air quality, and, of course, the actinic environment. The light should be employed as a construction material to support the philosophy and many symbolisms behind it, as well as a source of light and a reference point. In addition to that, spaces shall be designed to assist the cognitive development of the students. It shall be re-arrangeable and multidimensional to follow the various needs of such a school.







CASE STUDY

ERLEV SCHOOL - HADERSLEV, DENMARK

Architects: Arkitema Architects
Area: 5800 m^2
Year: 2020
Renders: Arkitema Architects

Pernille Svendsen
Associated Partner, Arkitema Architects (DK)

"The vision for Elver School is to create a model for future sustainable and playful school buildings."

The use of timber in the design of the school, gives it the exceptional qualities that the material is the carrier of allowing it to have its own pleasing and light architectural language, and at the same time, giving it a very sustainable foundation.

Arkitema Architects

"Timber has remarkable qualities that give a great opportunity to create a learning universe that undoubtedly will make a difference to the people using the school and the facilities around it, in the next decades ."

The design of the school has very high ambitions and goals for the future. The school believes in activity-based learning, which could be an extension of creative learning, meaning that the school supports the fact that children learn best through playing. Hence, the entire building is designed in a way that supports activity-based learning, as well as teaching.
To back the method of activity-based learning, the structure is designed "as a series of simple and open geometries - a tight grid with columns, where each part has been designed with different elements together with the users in a co-creation process" like the company characteristically states.
Further, analyzing this, the school is designed with a plethora of spaces to accommodate the needs of the activity-based learning form. Spaces such as large common spaces and traditional classrooms, as well as smaller communication spaces and niches. The idea and the foundation of the design approach were to create spaces where the teacher will be in the role of the person who animates, initiates, supports, and inspires children to learn and progress collectively as well as individually.



img. 6: Erlev School, Haderslev, Denmark by Arkitema Architects



img. 7: Erlev School, Haderslev, Denmark by Arkitema Architects



img. 8: Erlev School, Haderslev, Denmark by Arkitema Architects

DESIGN CRITERIA

Create spaces to give the children chances to socialize.

Support the learning process through the creation of diverse spaces.

Design classrooms that would allow the students to shape it and change it according to their needs.

Bring the classrooms in nature and vice versa.

Design a properly distributed skylight system.

Access to the outdoors from the majority of classrooms and labs.

Create a structural system to support skylights.

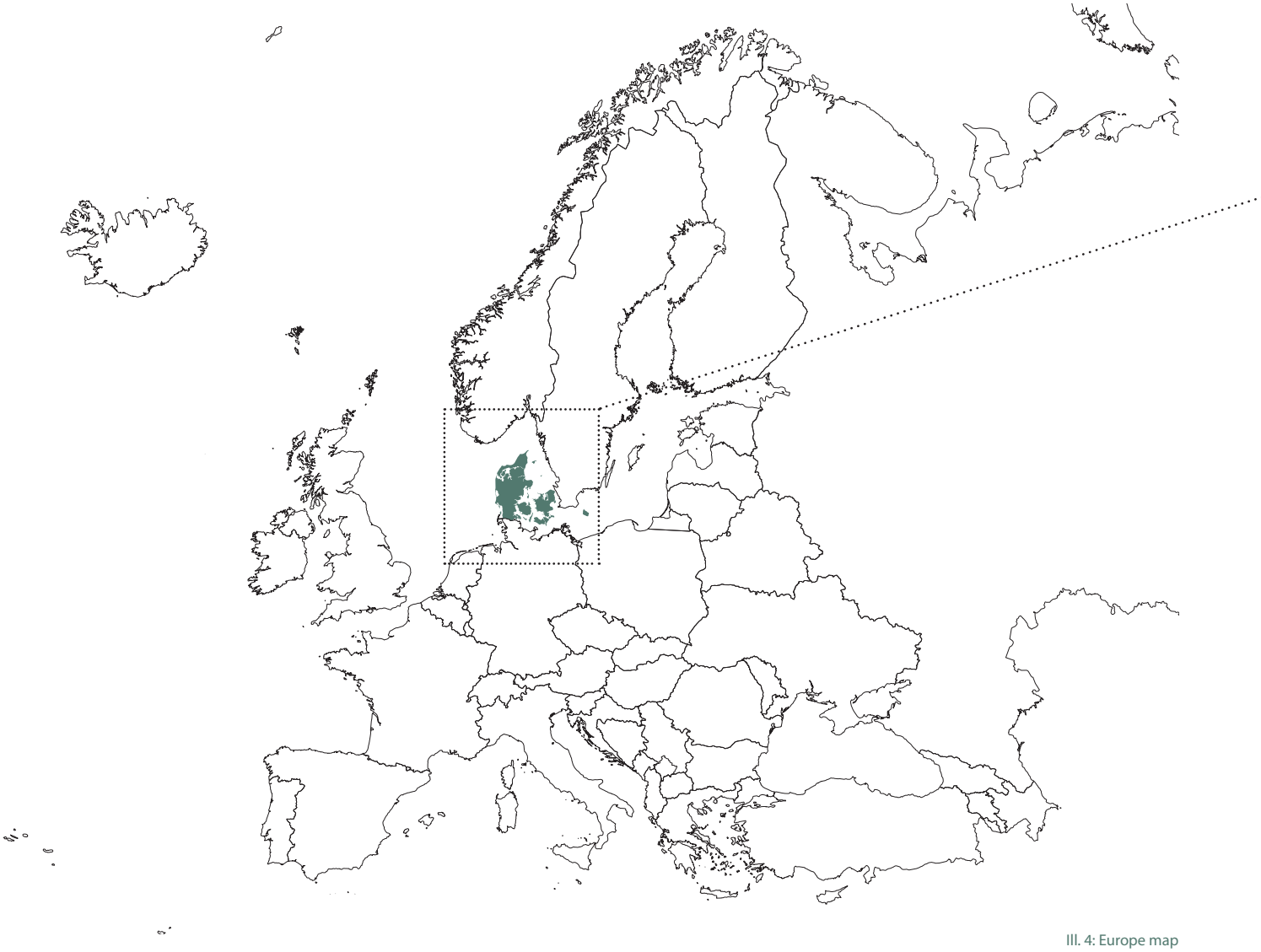
Materials with tactile surfaces and natural patina.







MAPPING



Ill. 4: Europe map

DENMARK

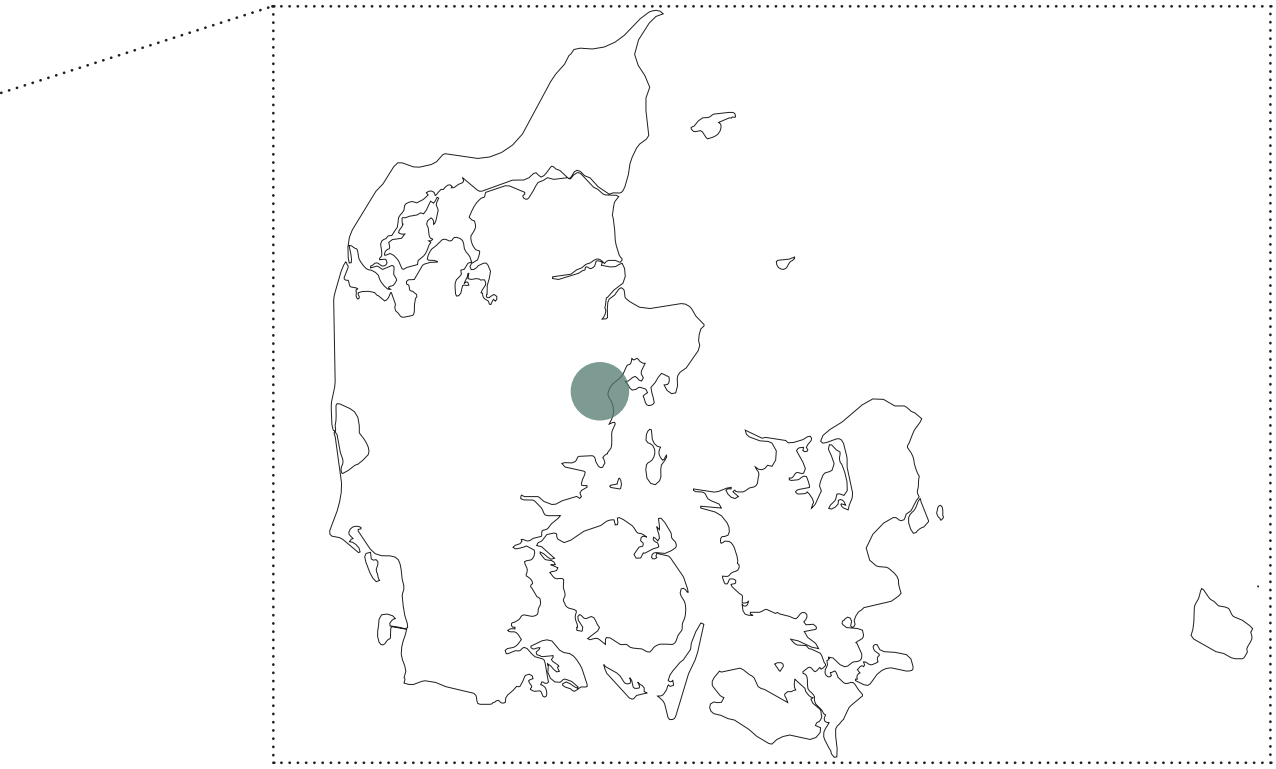
Danish Danmark
Coordinates 56.2639° N, 9.5018° E

Local

Denmark is a Nordic country in Northern Europe and the southest country of the Scandinavian countries. The country is in the south of Norway and southwest of Sweden, and on the south, it borders with Germany.

Denmark appeared unified in the 8th century. It is famous for its flat land and sandy coasts, and of course it's temperate climate.

The country has a population of 5.83 million as of the 2020 demographics and Copenhagen being its capital, it's the largest city in Denmark with a population of 794.128 citizens. Apart from Copenhagen, Denmark has numerous historically and architecturally important cities such as Odense, Aalborg, Esbjerg and Aarhus being the second largest city in Denmark with a population that reaches 300.000.



Ill. 5: Denmark

AARHUS

Location Jutland, Denmark
Coordinates 56.1629° N, 10.2039° E

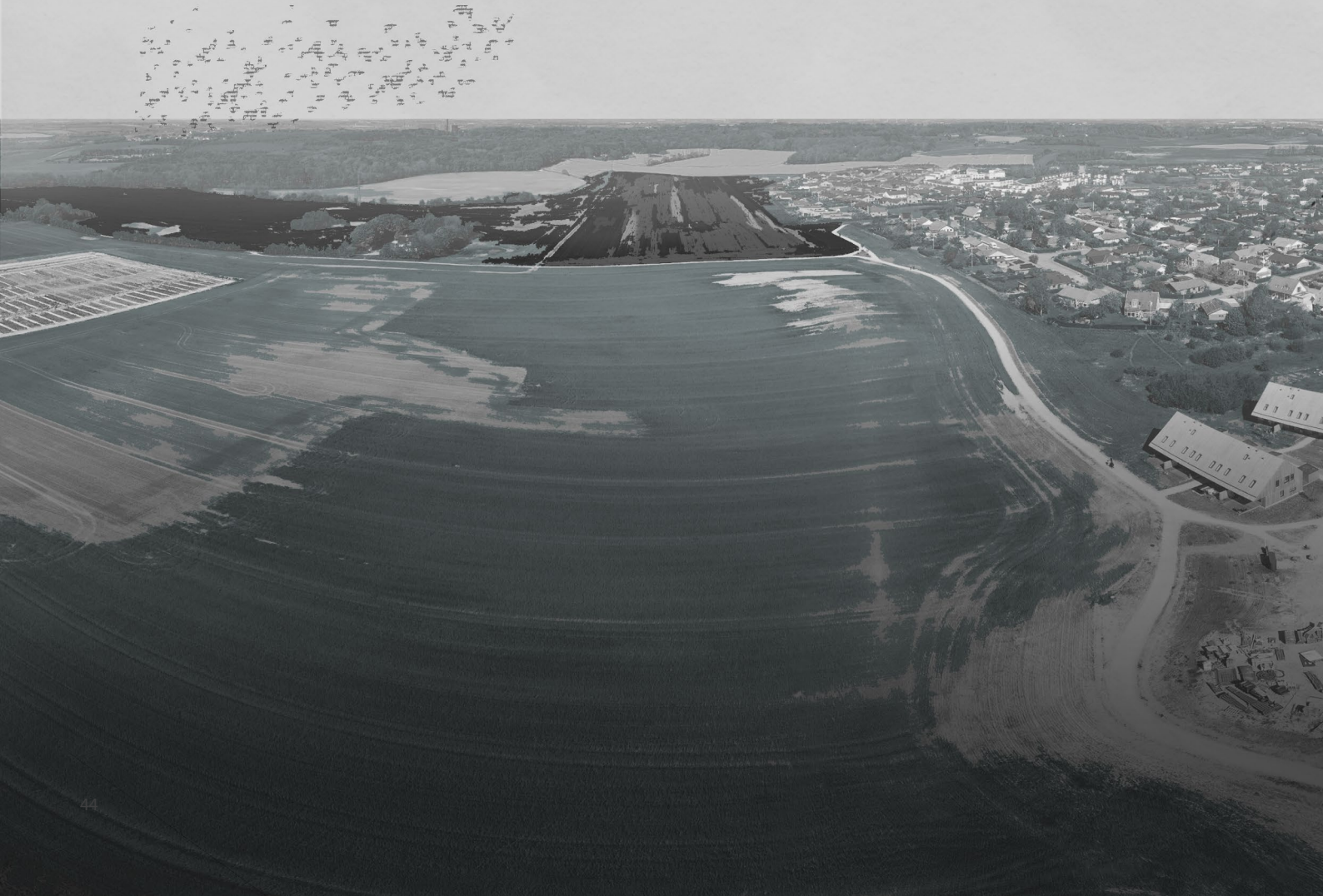
Local

Aarhus is the second largest city in Denmark and it is located in the Kattegat sea in the eastern shore of Jutland. Aarhus is roughly 190 kilometers from the capital of Denmark, Copenhagen.

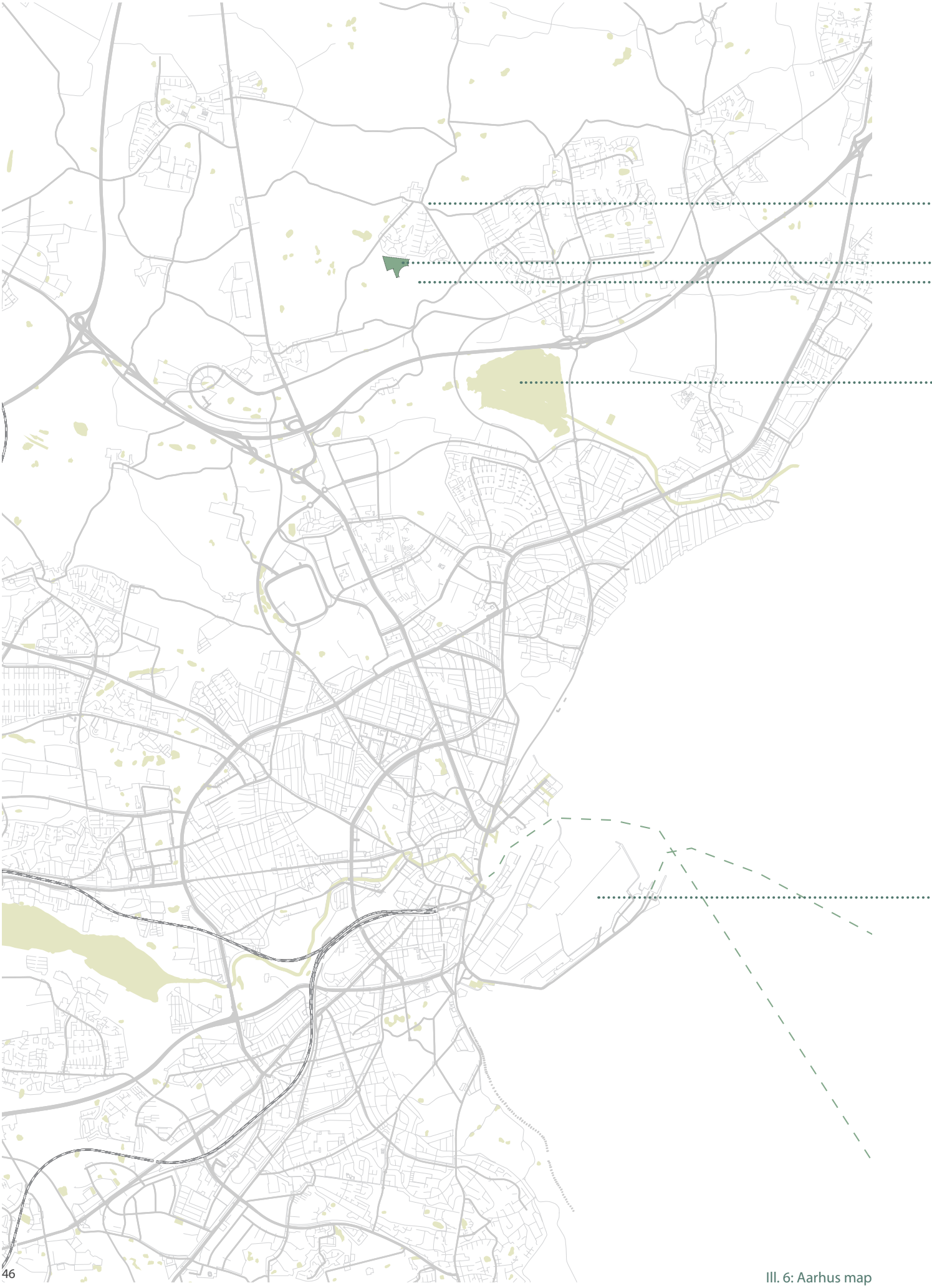
The city was founded in the 8th century and it is situated on a very interesting and important trade route which was primarily a military installation that later grew to a trade hub and in 1441, Aarhus, was granted a Market town privileges which meant that it had the right to host markets.

During the industrial revolution, the population grew rapidly and in 1934 the first university in Jutland was established in Aarhus making it today a very important university city and the largest trading center, industry and tourism in Jutland.

NYE







Ill. 6: Aarhus map

NYE

Location Jutland, Denmark
Coordinates 56.2334° N, 10.1940° E

Local

Nye (=new) is a new district north of Aarhus near Elev and the artificial lake of Egå Engsø. The development of Nye started in 2016 and it has the ambitious aspirations to accommodate 650 houses. One of the main principles in the design of Nye's district is that the buildings are concentrated in smaller areas so that there is a significant amount of extra space left between the houses to breathe and create separation.

The whole project includes also the realization of a school that will replace the Elev Skole which was built in 1911 and was taken into use in 1912.



Ill. 7: Site



img. 9: Nye aerial view (Google maps)



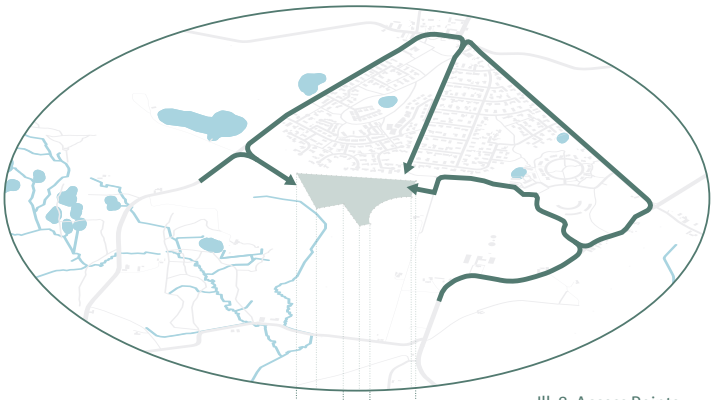
img. 10: Nye (google maps)



img. 11: Nye, (https://aart.dk/en/projects/nye)



img. 12: Nye, (https://aart.dk/en/projects/nye)



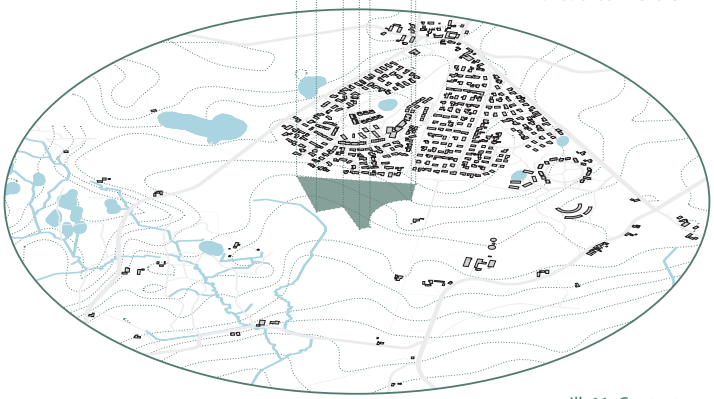
Ill. 8: Access Points



Ill. 9: Urban Voids



Ill. 10: Urban Textile



Ill. 11: Context

Access Points

The site has three obvious access points that might be used to guide the design of the school, predefining the main and secondary access points to the structure. More specifically, the access points are oriented towards the north, with a small bike pedestrian path, the east where the future development of Nye shows and the west, connecting it to the Koldkilde.

Urban Voids

The study of the urban volumes and voids is conducted on a 2D surface. The point of the study is to show the overall urban development and philosophy of the context. In this case, we see the surroundings of the site have a suburban quality with its spacious gaps and low scale structures.

Urban Textile

The urban texture on the other hand aims to study the connections between the volumes and the voids. It will help us mimic the existing urban texture or discard it.

Context

As previously stated, the context is characterized by suburban qualities with large and spacious voids and small volumes. The presence of nature is strong and the primary characteristic of the area around the site is the dominant presence of water which can be potentially used to guide the design development of the structure.

URBAN TOMOGRAPHY

What: A study of the materiality on the site.

Why: The examination offers a more profound comprehension of the site's materiality by expressing the site's history, development, character, etc.

How: The study employed tomographic imaging, which includes the use of a series of pictures to gain a better understanding of the content's characteristics and structure. It is concerned with the senses since the technique is phenomenological. Physical observation is combined with the material's agility and on-site experience. As a consequence, both subjective and objective elements impact the outcome.

This method is inspired from urban tomography, which is based on the idea that mapping and many pictures can help you comprehend a specific area better. This enables the creation of a large amount of content that helps to the study of urban environments as a whole. Tomography allows us to understand an event through the selection of different events that provides an overall understanding of the event as a whole (Krieger, 2011).



img. 13: Urban tomography

Our site is characterized by a plethora of materials, though, all of them have a very natural and earthy “essence” and source. The dominant material in the close proximity to our site is brick varying from grey and red to rich ochre and yellow , to wood and it’s dark and bright colorizations. Being a suburban area and newly developed and of course undergoing development, the patina on the materials is still fresh and it’s in the process of giving its unique character to the area.



Ill. 14: Schematic plan

PROGRAM

Space	Function	Area [m^2]	Number of rooms	Capacity [people]	Total area [m^2]
Primary School	Classroom	72	31	25	2232
	Toilet	2	30	25	360
	Music zone	144	1	40	144
	Theatre Lab	144	1	55	144
	Music Lab	144	1	12	144
	Arts Lab	144	1	40	144
	Sculpture Lab	144	1	40	144
	Science Lab	216	1	40	216
	Workshop	36	9	12	324
	Teachers room	144	1	50	144
	Large meeting room	36	2	28	72
	Small meeting room	16	2	8	32
	Office	16	6	2	96
	Courtyard	108	2	30	216
	Storage	36	1	-	36
	Sport centre	864	1	800	864
	Common area	4355	1	850	4355
	Locker room #1	57	1	34	57
	Locker room #2	72	1	34	72
	Storage #2	37	1	-	37
sum		-	95	-	**9833**





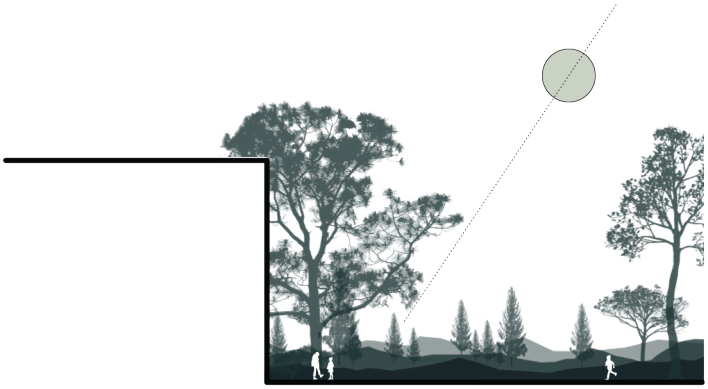
DESIGN PROCESS

SKETCHING

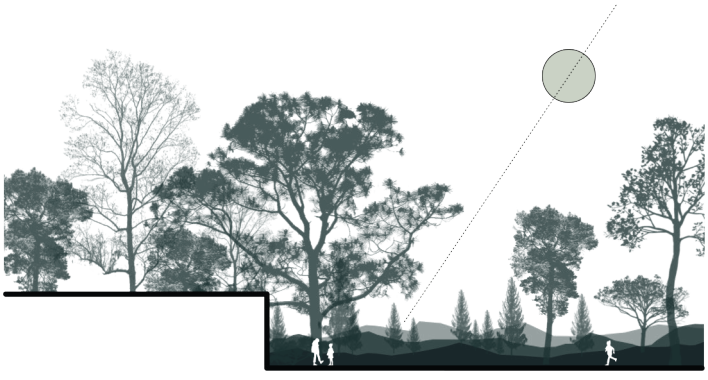
Initially, the sketching process was quite chaotic and abstract due to the fact that originally I wanted to experiment with the form and volume of the school. To begin, I remembered a very characteristic phrase that stuck in my head from the first day at Dorte Mandrup and was, "We approach architectural design from an artistic starting point. Experimentation is at the heart of What we do and we love to explore the sculptural and material qualities of architecture. Ideally, this leads to the creation of architecture as art and art as architecture - and architectural design that both understands and challenges its users and audiences."(Dorte Mandrup, 2020)

Hence, my goal was to experiment on the sculptural aspect of the building and challenge myself with various iterations that would indeed bear an artistic value as well as test the tectonic approach and the artistic and functional design of the structural elements. Of course, the sketches and the models were based on the pre-defined study of the materiality of the site, the context and the scale of the structure. Since the beginning of the effort, a concept that would wander in my thoughts and would later become the main element upon which I'd develop the entirety of the project was "human scale". A huge part of this thought process played out during my internship at Dorte Mandrup, due to the fact that it was present in our every artistic and architectural endeavour. Hence, during this process, it became a driving force and a centrepiece of my experimentation. A creation of architecture that can be experienced at its totality from its users and can be comprehended without complications and barriers.

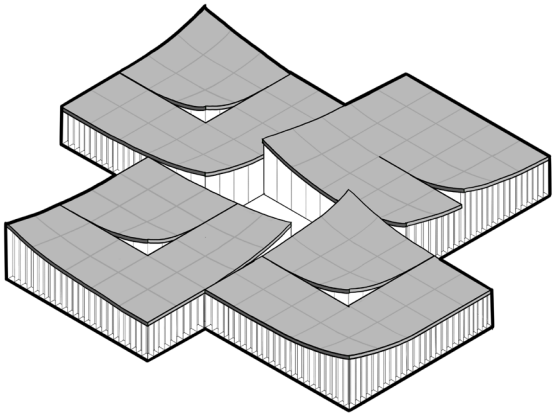
The experimentation process started with the production of various sketches of details and structural elements, as well as zoomed-in sketches of the human within space. The sketches were made to initialize a design thought and process that would allow me later to develop more concrete concepts and visualize different iterations of either the same idea or completely different ideas that would demonstrate the multi-dimensionality of the site and its potential.



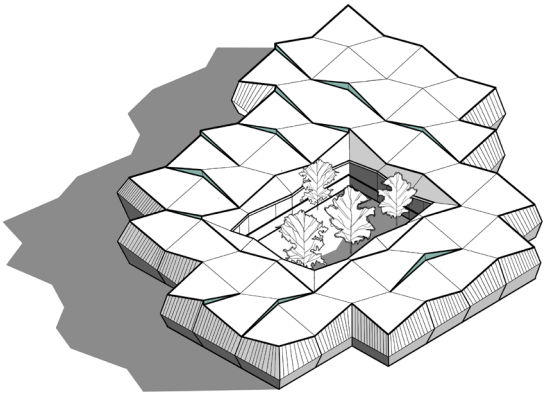
Ill. 15: Stacked



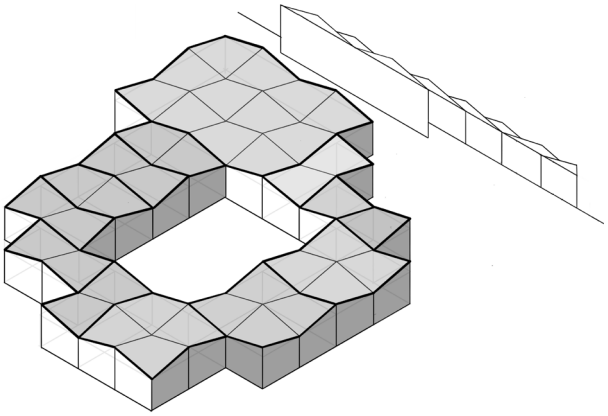
Ill. 16: Human scale



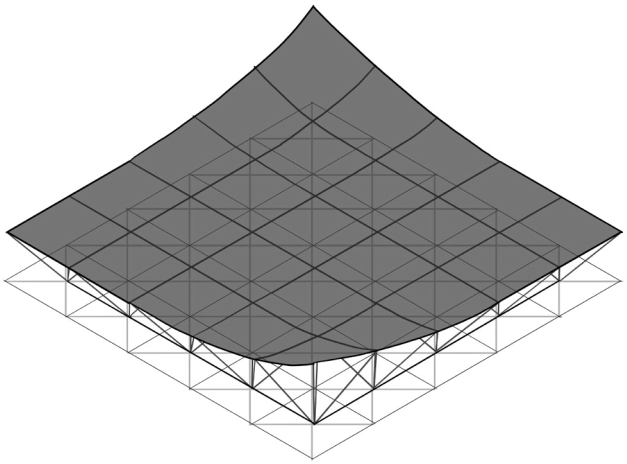
Ill. 17: Sketch #1



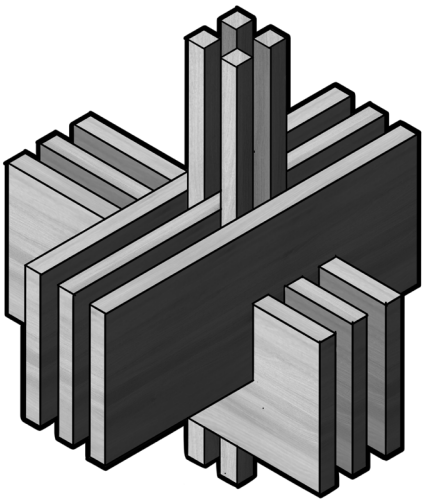
Ill. 18: Sketch #2



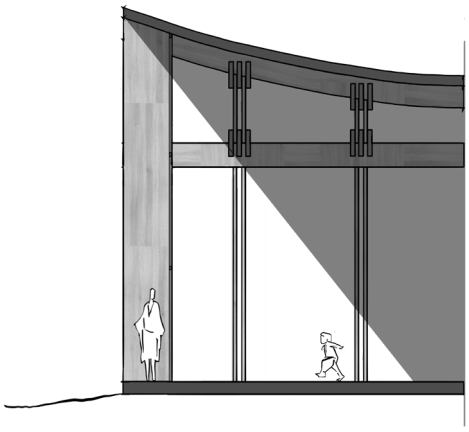
Ill. 19: Sketch #3



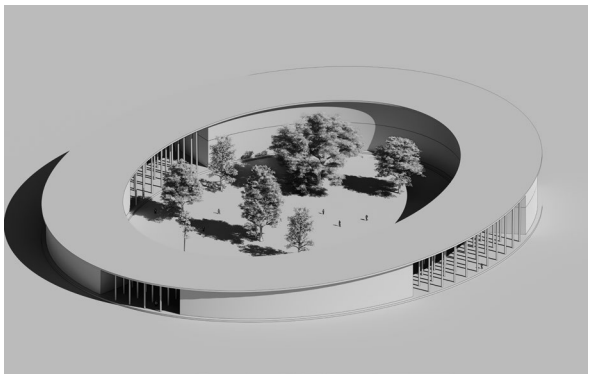
Ill. 20: Sketch #4



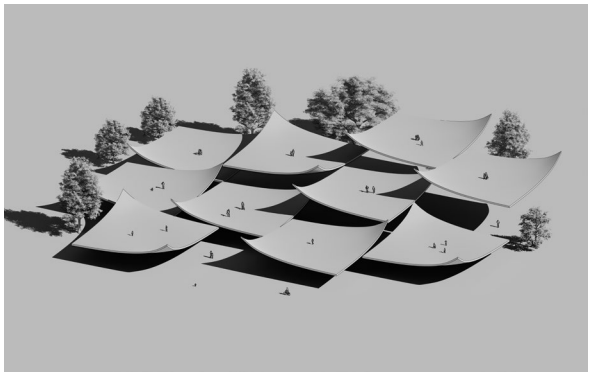
Ill. 21: Sketch #5



Ill. 22: Sketch #6



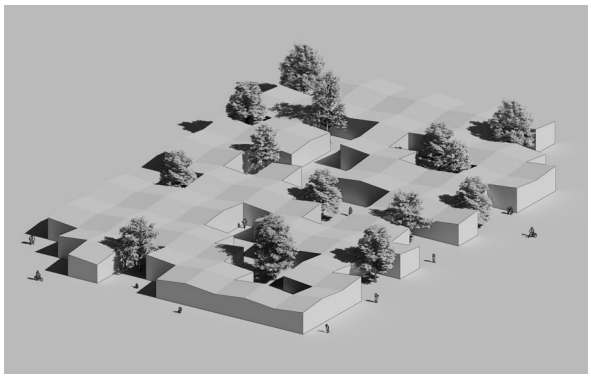
Ill. 23: Unity



Ill. 24: Falling pieces



Ill. 25: Gardens



Ill. 26: Suburban

The sketching phase was divided into two parts. The brainstorming where different ideas and visual stimuli were integrated into the development of ideas and design language, and the second phase, which had a more "caged" or "boxed" approach which would drive me towards the realization of the particular concepts and visualize them within the space and the site limitations. Even though the second phase was more concrete comparing it to the first phase, the ideas remained abstract and would still approach the building and its design in a more sculptural way.
The outcome of the sketching was four different from each other variations that represent four completely different ideas and have diverse philosophies.

Starting with the first one, we have the 'Unity'. An oval-shaped volume with the main characteristic of it that it allows the surrounding nature to become part of the building due to the fact that the various functions of the building surround a large courtyard. To support that idea, there are three large, covered openings in the south, the east and the west, supported by columns and creating a shade for the subjects. The south phasing volume is a one-story height and the volume in the north is a two-story height volume. This would allow the sun to penetrate the courtyard and offer proper daylight to all the premises.

Following, we have the 'Falling pieces'. A quite straightforward and "banal" representation of paper falling and shaping the roof of the structure which will house the various spaces of the school. The roof would be separated into different sections to allow different formations as well as different heights to create numerous skylight opportunities. The various heights of the roof could accommodate roof terraces the would allow the building to become part of the natural fabric and the terrain.

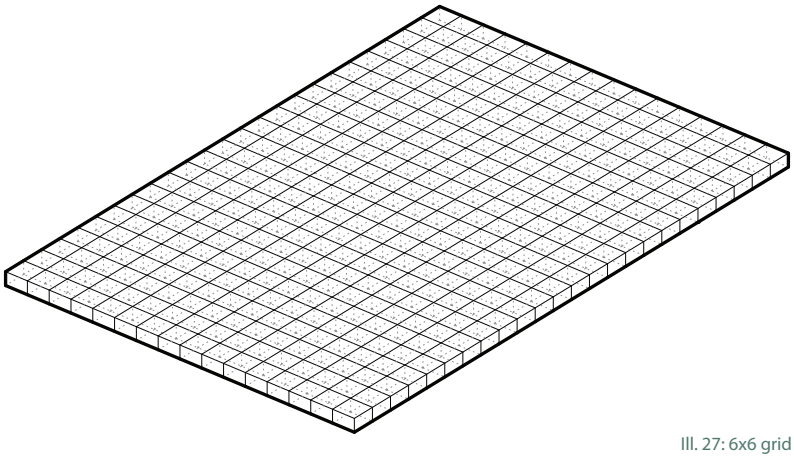
Coming up next is the 'Gardens' where the main idea is to create inclosed spaces but also allow the building become the landscape itself and introduce modularity. The idea was to create a seamless transition from land to building and vice vesa. This would allow for the use of the entire site where the introduction of gardens and outdoor spaces would have been an integrated part of the architecture and the design process, as well as of the idea of "human scale" and "human-centered" architecture. In addition to that, the modules of the structures that are lifted way above the land, would create an covered space for children and other subjects to occupy it and various activities to take place, such as outdoor theatrical, concerts, creative venues, etc.

Last, we have the "Suburban" formation of the building. Its main objective is to create numerous pockets to visually reduce the way the volume is perceived and allow it to have a more scattered, suburban formation and arrangements in space. The pockets shall accommodate gatherings, as well as protection from wind or shade for the warmer weather.

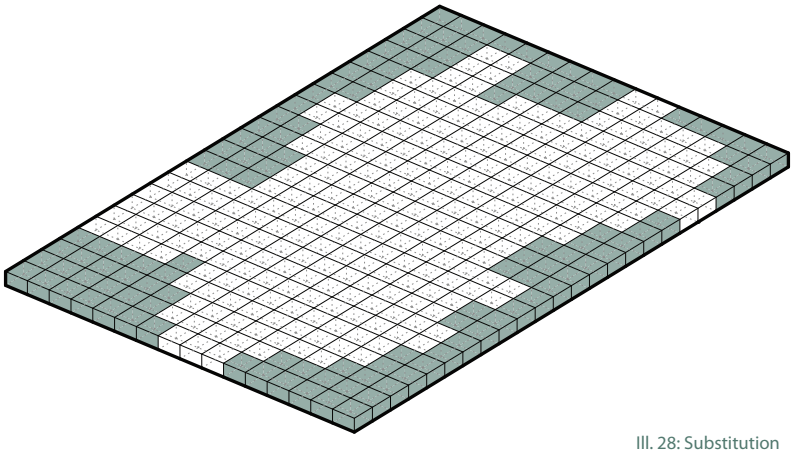




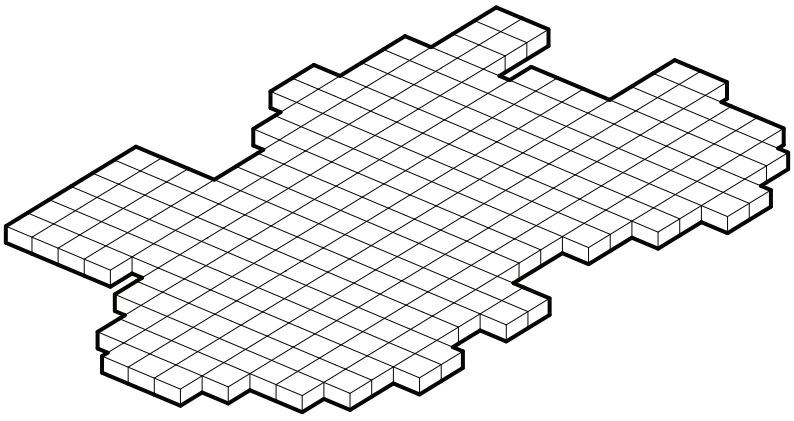
PROJECT



Ill. 27: 6x6 grid



Ill. 28: Substitution



Ill. 29: Volume

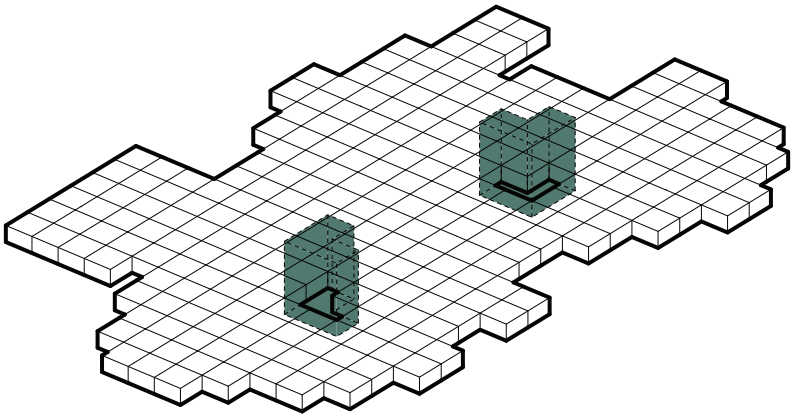
THE CONCEPT

As the studies initiated a direction and a design language, and the sketching and brainstorming process was concluded, the path towards the development of the project and the concept itself was quite straightforward. The evolution of the project started with the creation of a 6 by 6 grid (26.) within the site, after the arrangements of the various functions within the site limit came to an end. The 6 by 6 grid would allow the creation of properly sized classrooms to accommodate the necessary number of students within the classes, as well as the creation of the rest of the spaces required for the proper educational process.

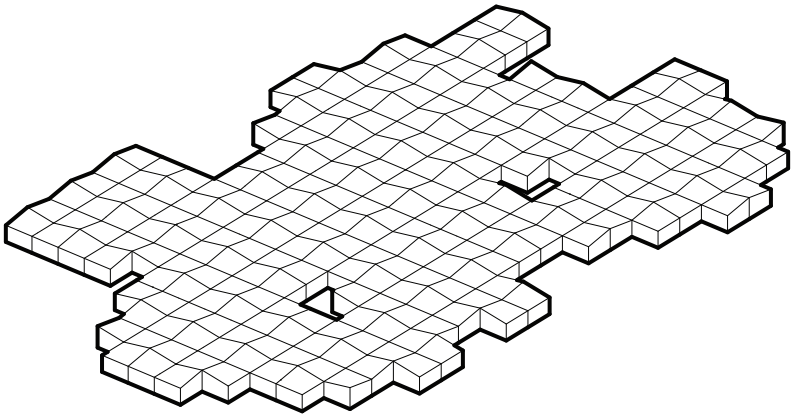
The procedure started by adding and subtracting volumes within the grid (26.), following of course the pre-arranged and studied program that was created during the initial program development and was later, gradually optimised during the process.

The subtraction and addition of volumes in the space was not abstract or frivolous, but a conscious decision to form spacious niches or pockets with main goals to, primarily form and optical, or even better, a spatial "illusion" that would allow the subject to perceive the scale of the building in more human-centred perspective and experience it at its totality, even though the footprint of the structure is quite large for such statement, as well as, form spaces where students and teaches can organize venues or outdoor activities.

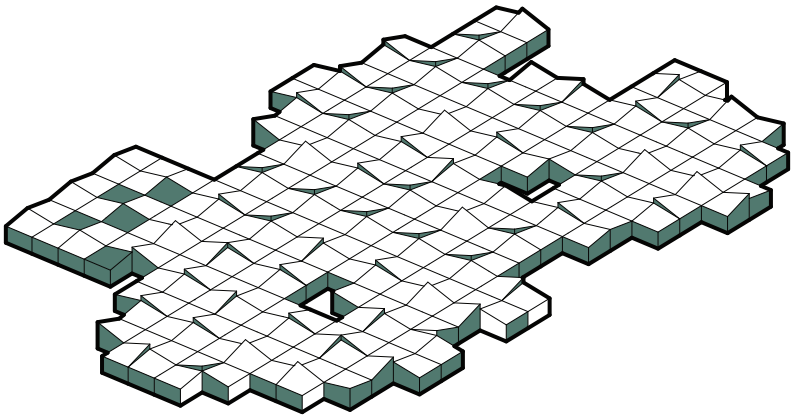
The main idea, concerning the spaces within the school was to, of course, create classrooms that will be interpreted with the traditional definition of the word classroom but will also allow the students to form it and shape it according to their needs, as well as allow it to have direct access to the outdoors and the nature. Hence, my primary instinct was to place all the classrooms perimetrically and embrace the rest of the structure and the common spaces. The idea was to create individual creative "labs" that will have access to the outside and would allow the interior spaces to become part of nature and nature to become part of the interior shell.



Ill. 30: Courtyards



Ill. 31: Roof elements



Ill. 32: Skylights and openings

Following the definition of the volume, initial daylight studies showed that the interior premises of the building would be quite dark due to the fact that the only natural light source that the building had by the time was the glass facade in the perimeter of the structure. This was the catalyst that initiated a conversation about creating a courtyard (26.) that would bring nature within the building and of course act as a natural light source for the common areas of the construction.

\From the initial stages of the formation on the theory, the usage of the skylight has been mentioned several times, hence the next stages were to find modules or parameters that would allow the building to easily accommodate skylights and shape an interesting design language.

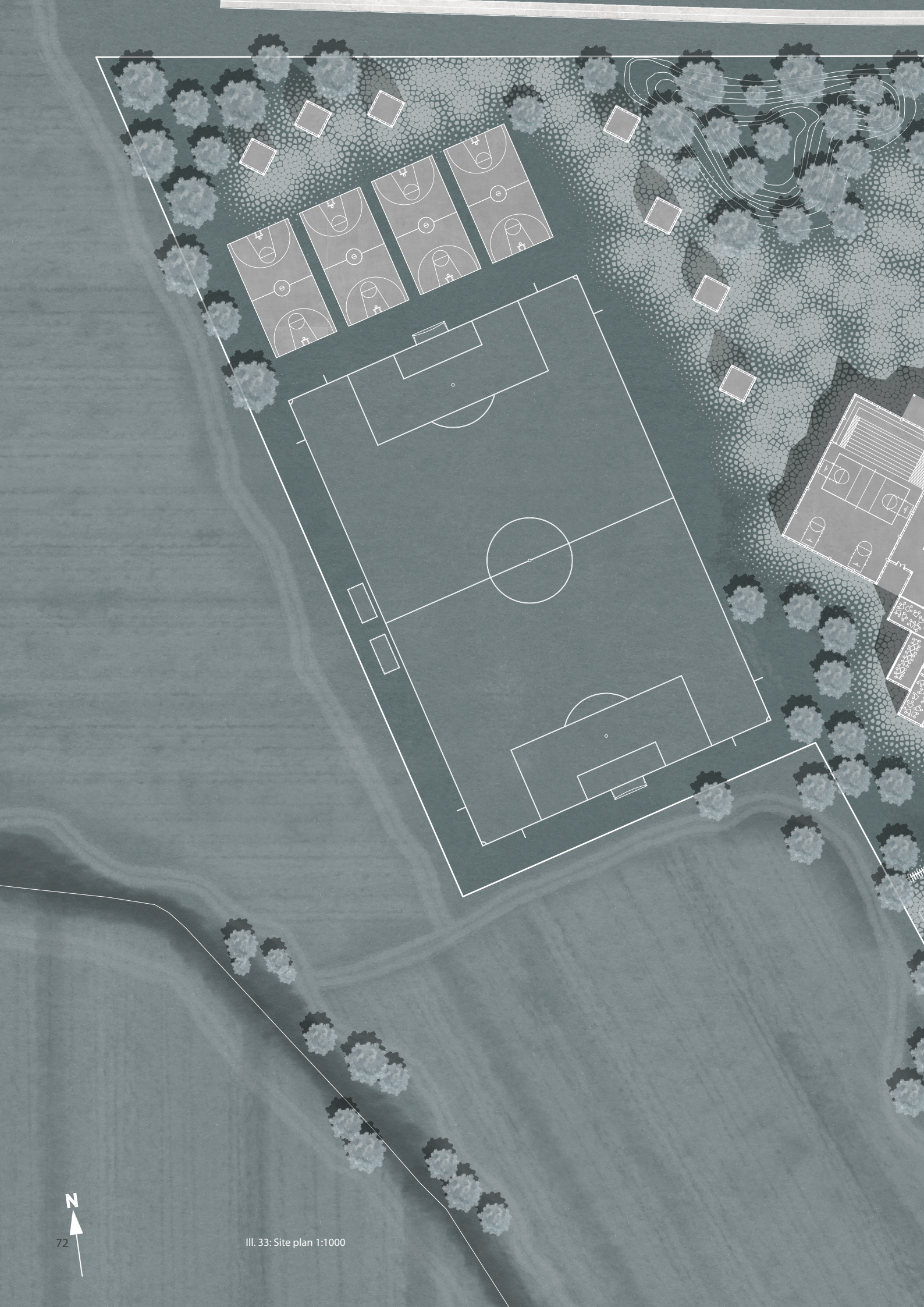
Using the grid that was made in the previous stages, I created a structural scheme for the roof (26.) that would later give me the opportunity to optimise the daylights using the structure. This was achieved by detailing one of the modules in the grid and assigning its roof corners different heights. This would, in total, create an irregular surface that would initially follow a pattern but will set the foundation for an optimisation that will follow in the next stages of the design process.

The final diagram (26.) demonstrates the ambition of the structure. It demonstrates its wide openings in the perimeter of the buildings, as well as the courtyards that are cut within the centre of the structure and the multi-directional skylights in the roof.

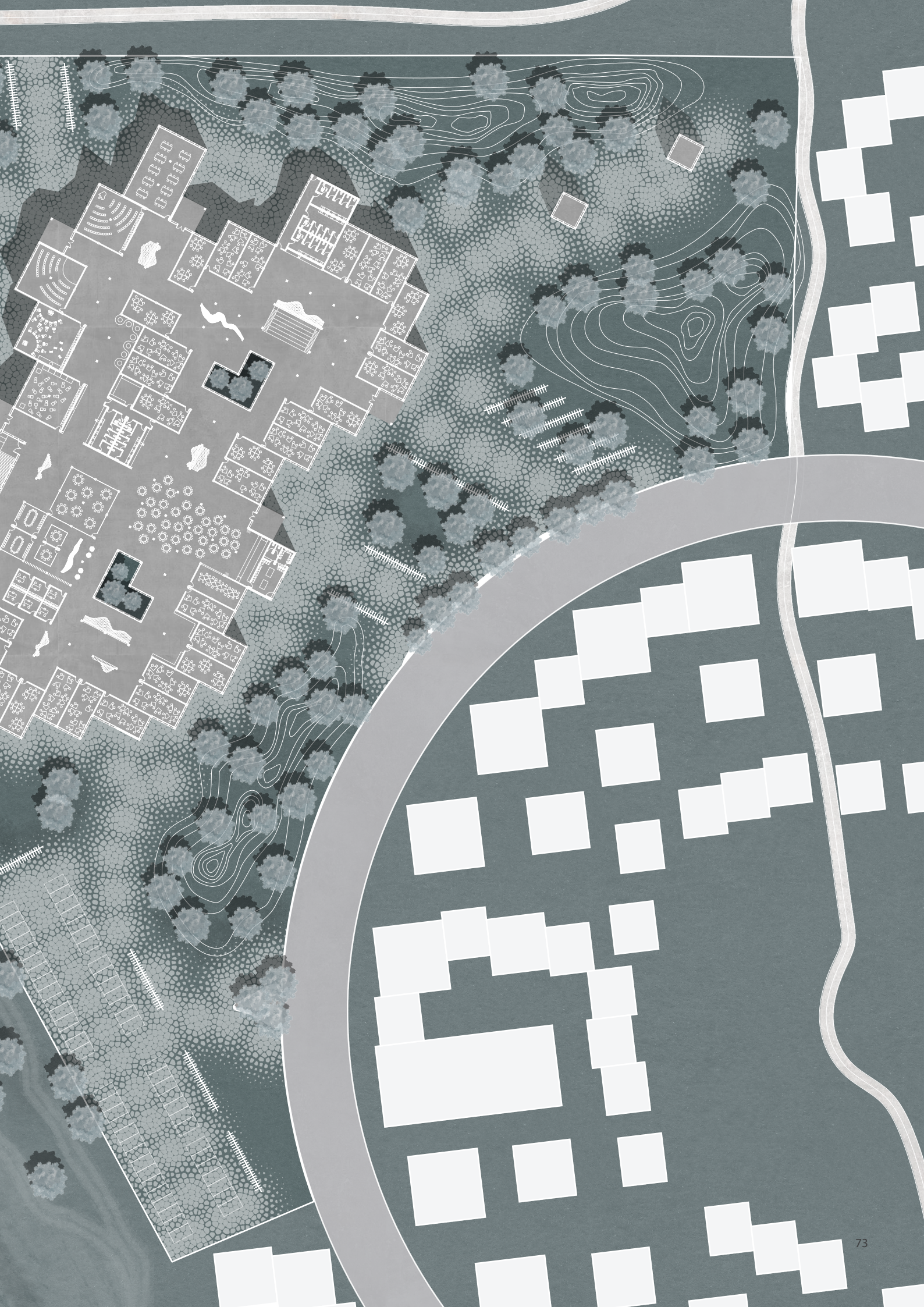




img. 14: Render

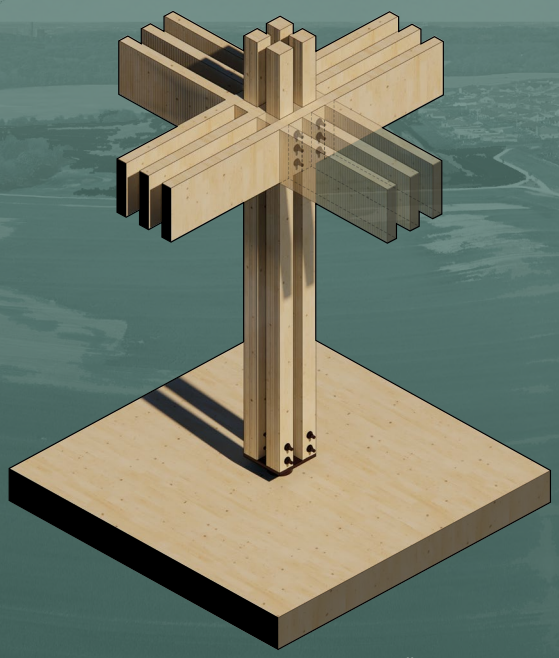


Ill. 33: Site plan 1:1000

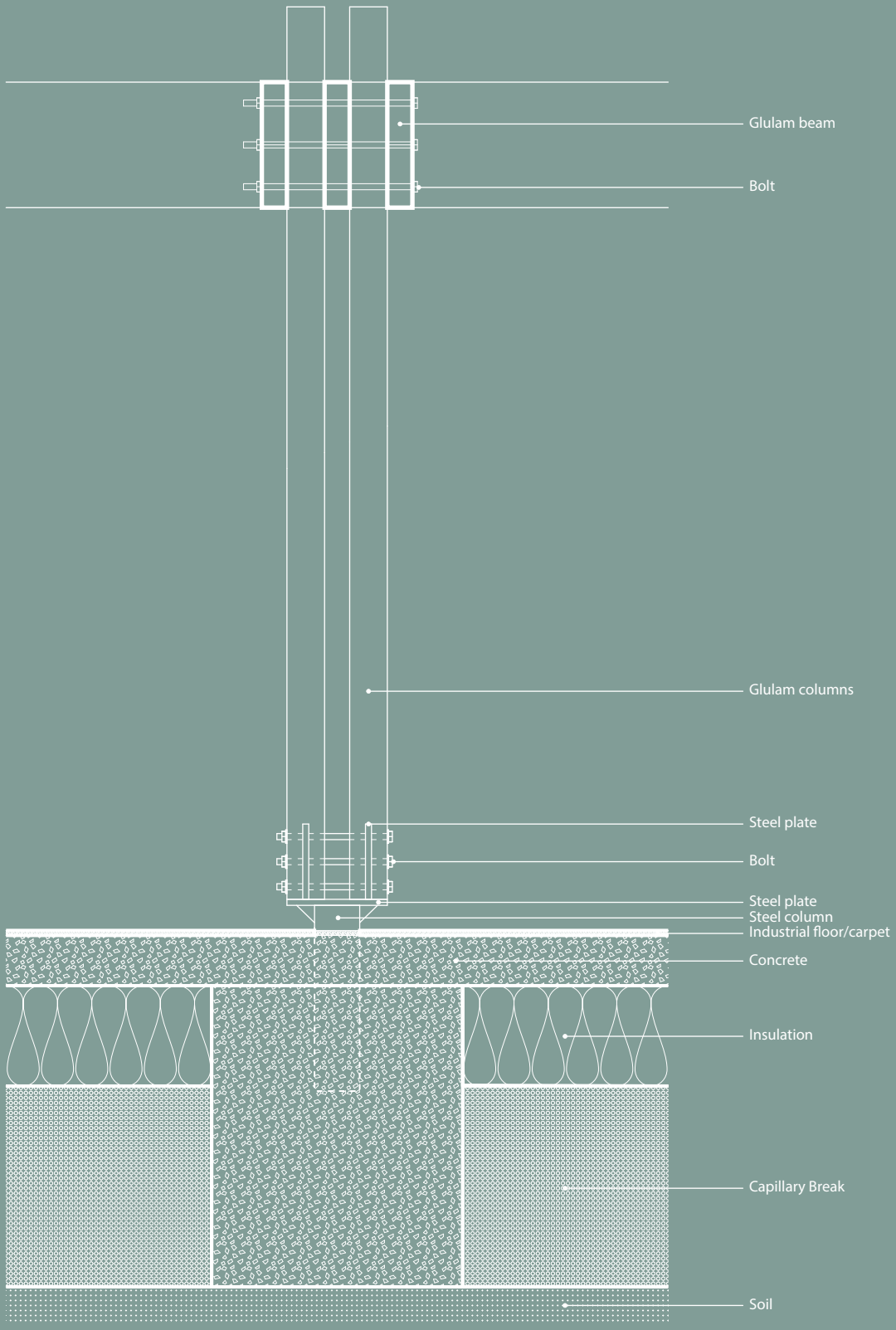


STRUCTURAL SYSTEM

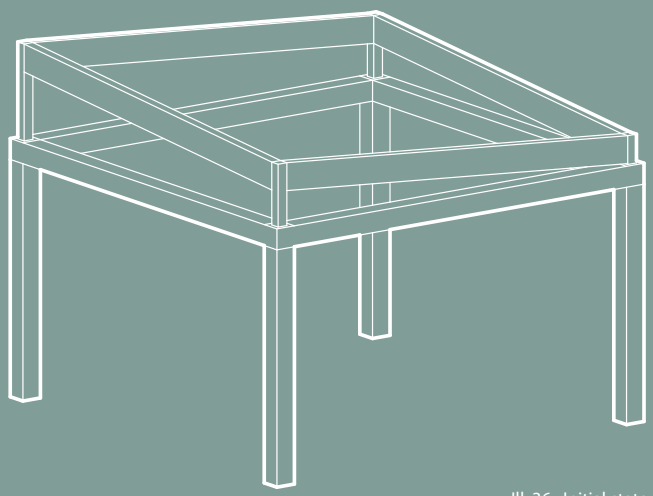
The design of the structural system was made to, primarily accommodate the different variations and sizes of the roof, as well as create a tectonic language that would highlight the structural diversity of the building. The concept was to create a primary structural grid that will house the columns and beams necessary for the stability and integrity of the construction, as well as the secondary structural elements that will be diversified according to the needs of the roof. To do so, I created a six by six modular system with a stable primary structure. initially, it was programmed to be modified individually and later in the process to be added within the structural fabric creating a system. The idea was to make a simple secondary structure that will, however, showcase the complexity of the roof. The various heights of the roof structured would be based on the amount of daylight necessary for the building and the main calculation and simulation tool will be Grasshopper with the use of the Ladybug tools. Looking at the diagrams on pages 78 and 79, we can see an abstraction of the module with the primary structure being stable and the secondary roof structure moving on the Z-axis to assist the creation of the openings necessary for daylight.



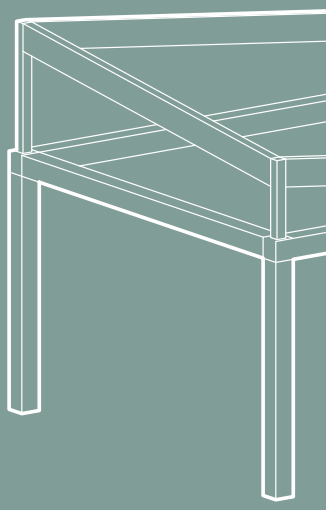
Ill. 34: Strucutre axo

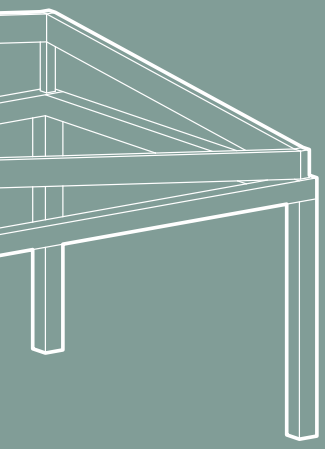


Ill. 35: Structure detail 1:25

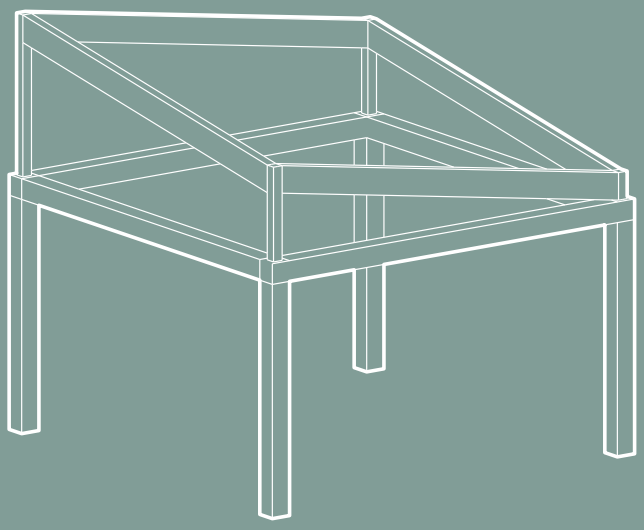


Ill. 36: Initial state

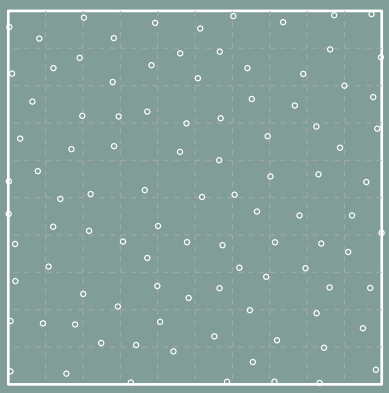




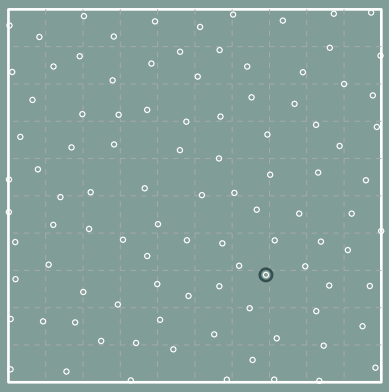
Ill. 37: Average state



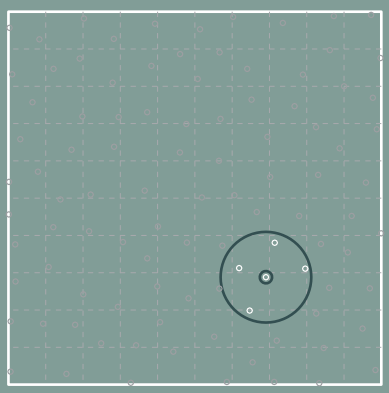
Ill. 38: Exaggerated



Ill. 39: Genome map



Ill. 40: Selection for mating



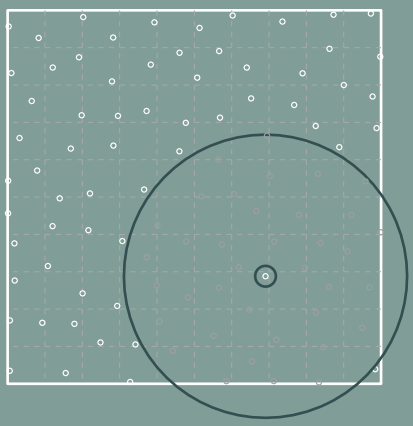
Ill. 41: Partners in the immediate neighbourhood

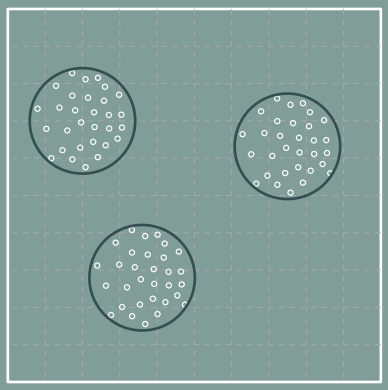
EVOLUTIONARY PRINCIPLES

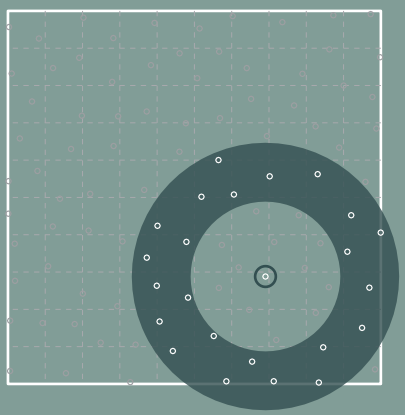
The conclusion of the structural system, allowed me to establish the structural language upon which I would base the optimisation of the daylight through the formation of various skylights. Taking the basic geometry, as well as the structural system, I started forming a grasshopper script to, initially simulate the daylight in the building using a basic state of the structure and the roof. The performance of the building was quite poor since the only natural light sources were the perimetrical glazing and the light through the courtyards. Taking these calculations as the foundation, a complicated task of creating the script started since I had to construct a rather intricate path, based on the daylight simulation as well as the structural system, which would work to optimise the amount of daylight in the building. The logic behind the development of the roof structure is based on evolutionary principles in nature or even better, a genetic algorithm. To simplify things, I will go through the bais of the evolutionary solver used in this case(Galapagos) to outline its complexity and rather fascinating application in architecture.

Within Evolutionary computing, we refer to the variables (values that are allowed to change) as genes, or simply the input variable. To make the process more comprehensible, let us name the genes Alpha and Zeta. As the gene Alpha changes throughout the process, the condition of the entire model changes and it either gets better or worse. Hence, since one of the genes within the model change, the fitness of the model, or the output, in other words, changes as well, going either up or down. Withing the fitness model we also have the gene Zeta, which naturally changes as well, resulting in either a better or worse state of the combination. Every combination of these genes, Alpha and Zeta, have as a result a particular output and this output is manifested as the height of the fitness landscape(which always depends on the goal we have defined initially).

Due to the fact that the evolutionary solving software has no idea of the model space, its primary job is to randomly populate it (meaning



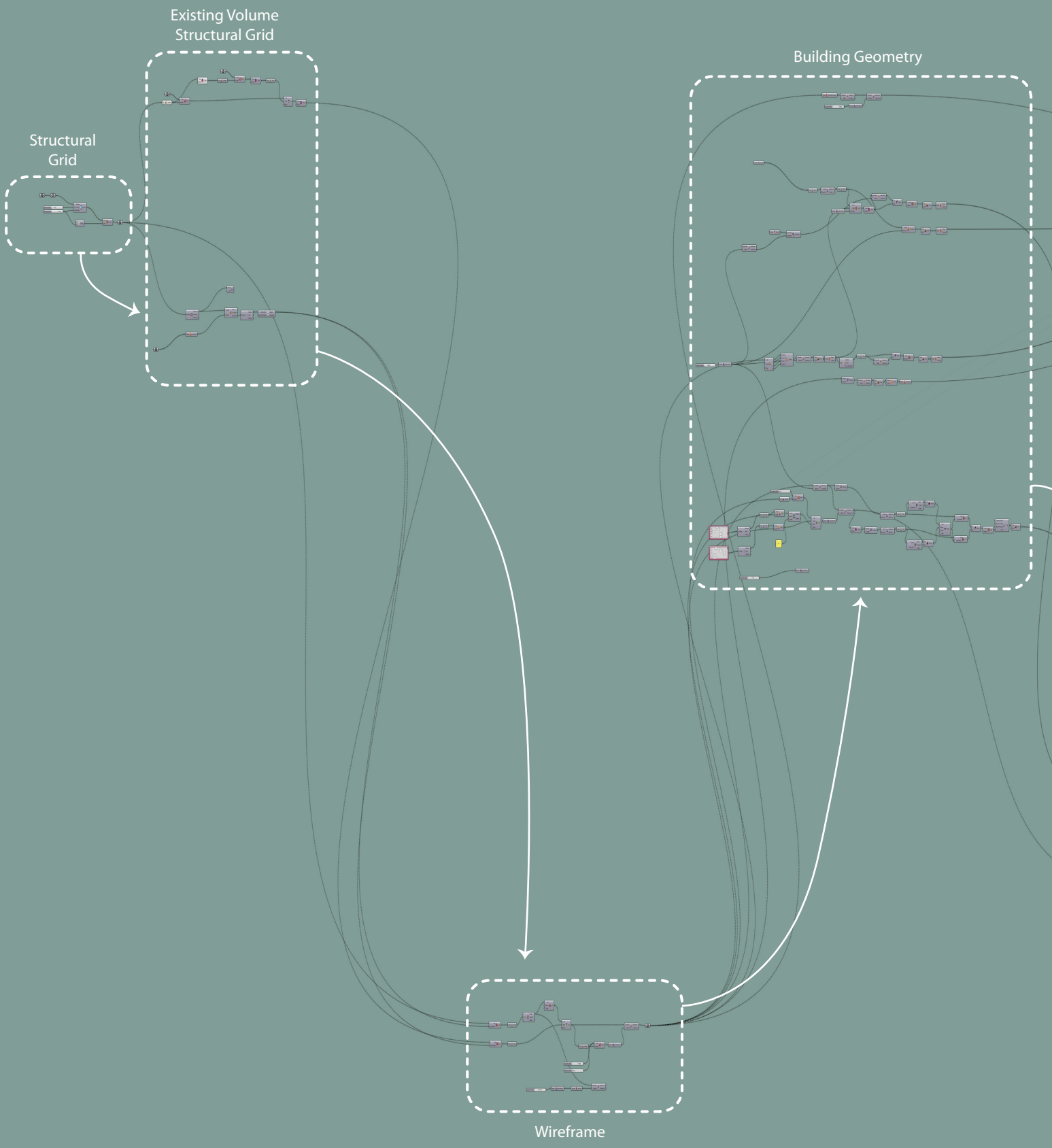


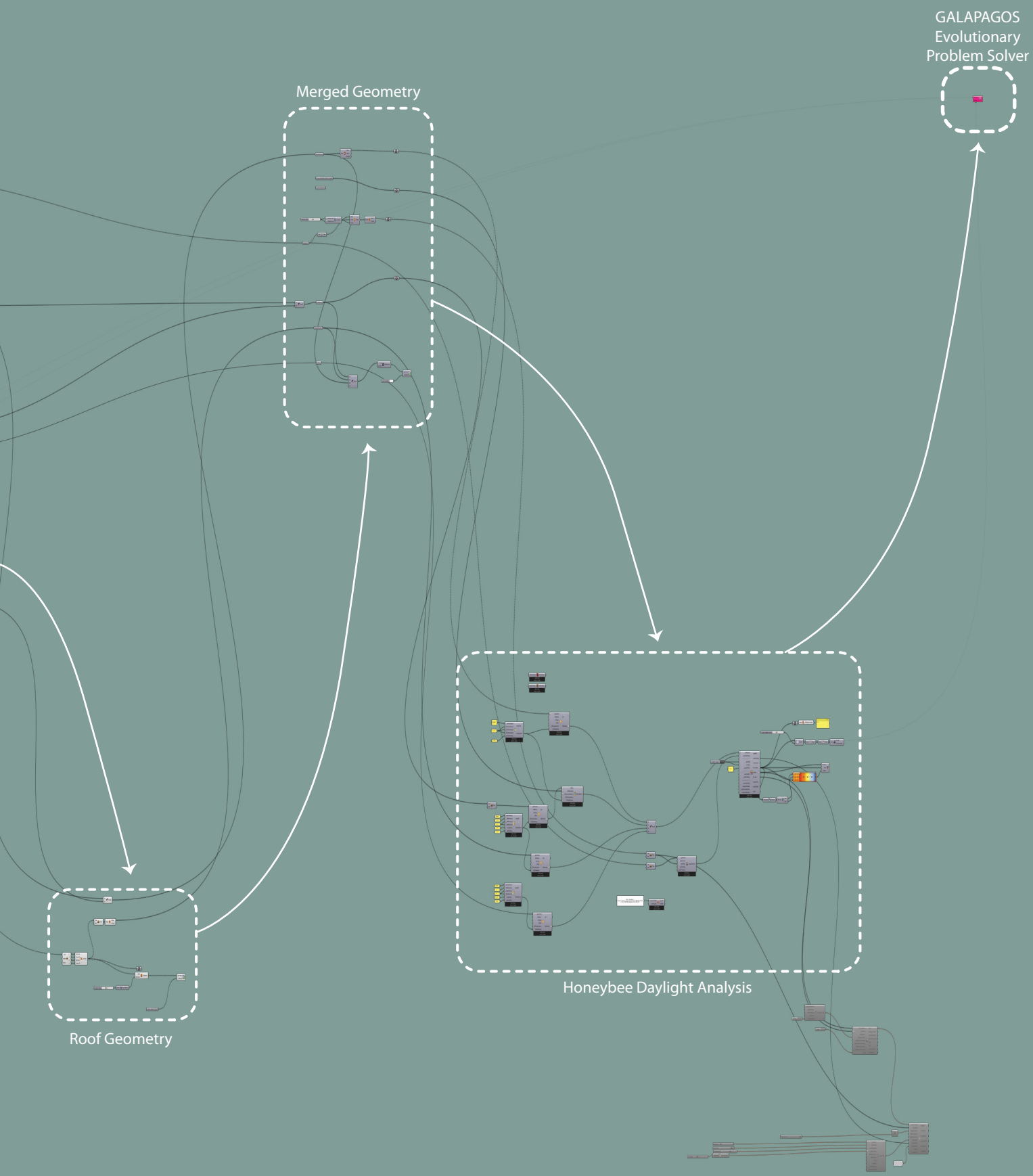


that the calculations are done to initiate a sequence and to explore paths) with genomes, which are basically specifically defined values of a gene. hence, the main task of the solver during this stage becomes to randomly scatter genomes within the model meaning that at this stage it is completely unstable(ill. -). As the process goes on, and the solver continues with solving the generations (in my case 25 populations, meaning that the system populates the model 25 different times to find the fittest one based on the input) it creates clusters (slowly becomes stable) around the fittest ones and discards the rest of the genomes that do not fit with the pack. This process allows it to form stronger fitnesses progressing to a denser cluster
The genome with the strongest fitness, the output closer to the goal, breeds with the genomes of the rest of the generations to finally resolve the problem and provide us with the solution.

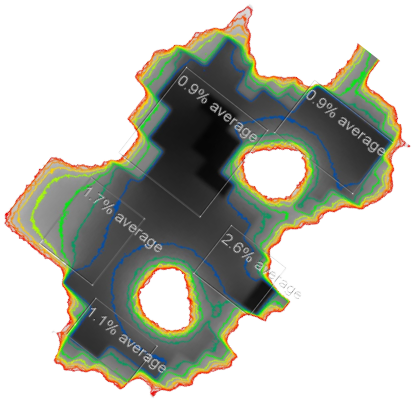
Taking this complicated algorithmic procedure and applying it to the roof structure, I programmed the resolver to run a daylight simulation for each and every genome (25 in a generation) to find the strongest fitness within it. I allowed it to run infinitely till it reached a result that was optimal for the daylight of the building, always considering the initial input and the predefined goal of the system. To get the final result (the geometry of the roof) the resolve was running for more than 50 hours, constantly analyzing the genomes and breeding with the other generations.

For this procedure, I decided to remove the perimetrical glazing of the building and allow the calculations of only the skylight due to the fact that I needed the solver to concentrate on optimizing the geometry of the roof. At the end of this procedure, however, and after adding the facade in the simulation, I found out that the heart of the building requires more light since there were several spots that were quite dark. Hence, I proceed with the addition of skylights above these spots, using a waffled structure, to optimise the amount of daylight.

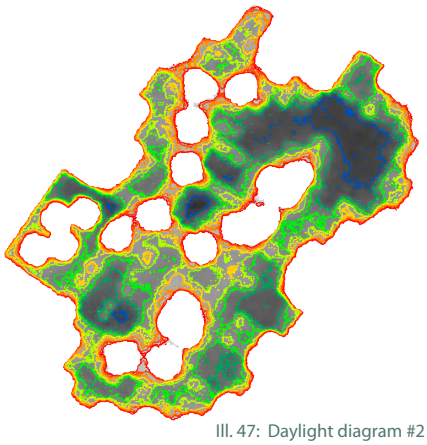

Existing Volume
Structural Grid
Structural
Grid
Building Geometry
Wireframe



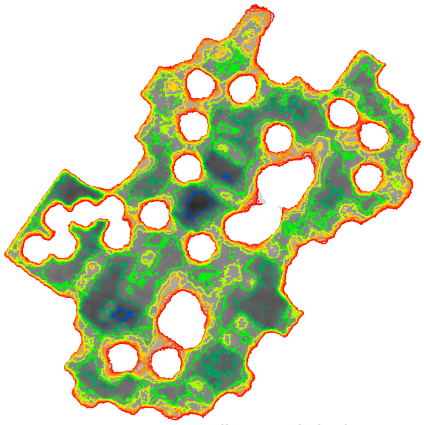
Ill. 45: Main grasshopper skript and solver



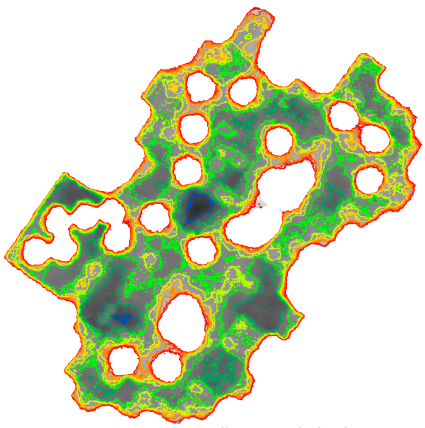
Ill. 46: Daylight diagram #1



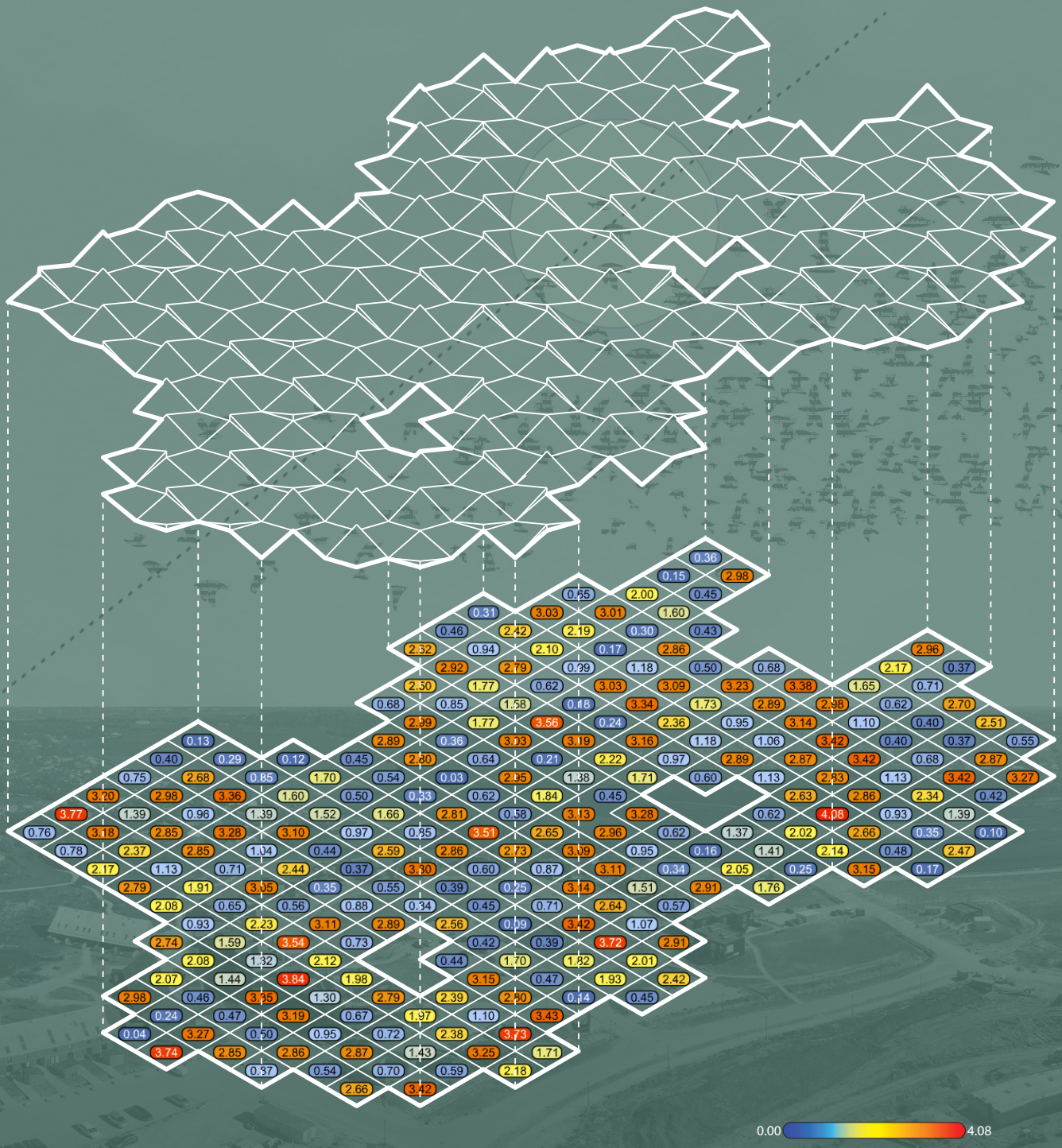
Ill. 47: Daylight diagram #2



Ill. 48: Daylight diagram #3



Ill. 49: Daylight diagram #4



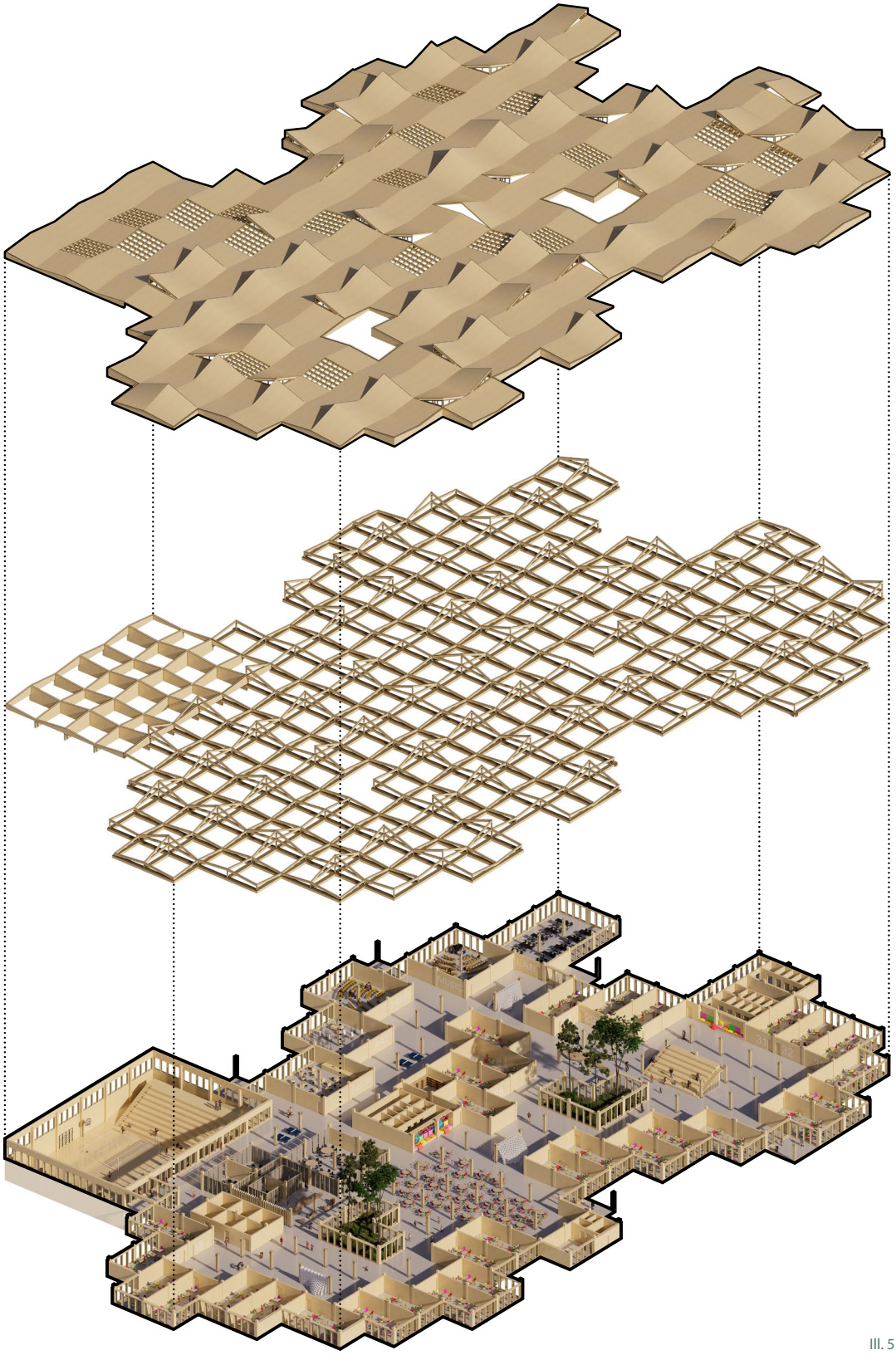
Ill. 50: Optimal skylight diagram

RESULT

Combining the layers together, we get three separate structural systems that form the building.
The first and foundation of the building are the basis layers with the floor plate, the wall structures and the spaces within the building as well as the column system, the foundation grid and the entire footing. Following up next, there is the primary structural system with the main beams that hold the entirety of the structure together and last is the secondary structure and roof grid, with its skylights and the secondary beams and column system, sitting on the primary structural system.

The goal of this system was to create a concept that can be applied not only to this particular project, however, but its basis can also be modified and applied to various circumstances and variations.
The genetic algorithm managed to produce several iterations that performed the same as the final version. Meaning, that the architecture may vary and the result does not only depend on the outcome of the evolutionary solver but should also depend on the architect himself, his artistic and scientific background, as well as the goal of the building, the proper use of materials.

The evolutionary solver and its complex but familiar nature is merely a tool that assists the architect the create architecture based on his ambitions and goals and should not be used as a tool to “design”.

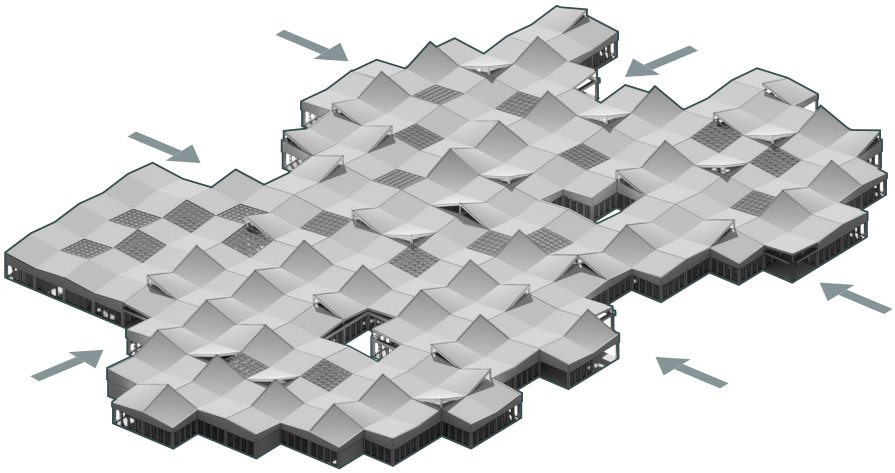


Ill. 51: Exploded axo

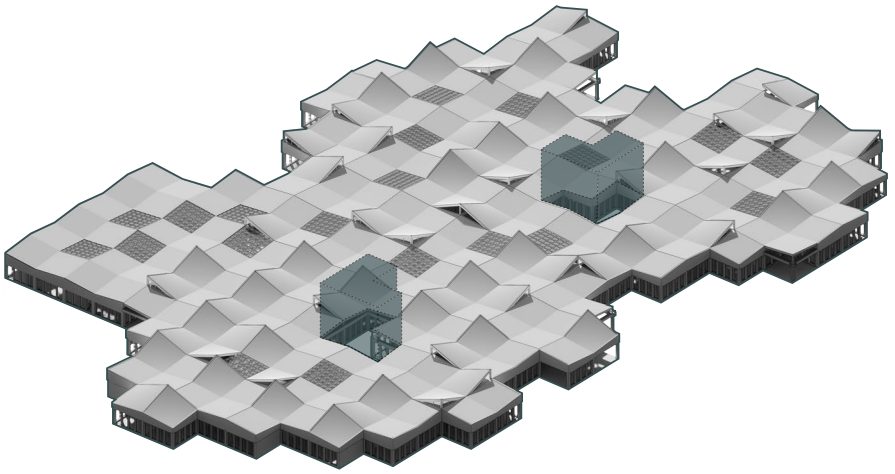




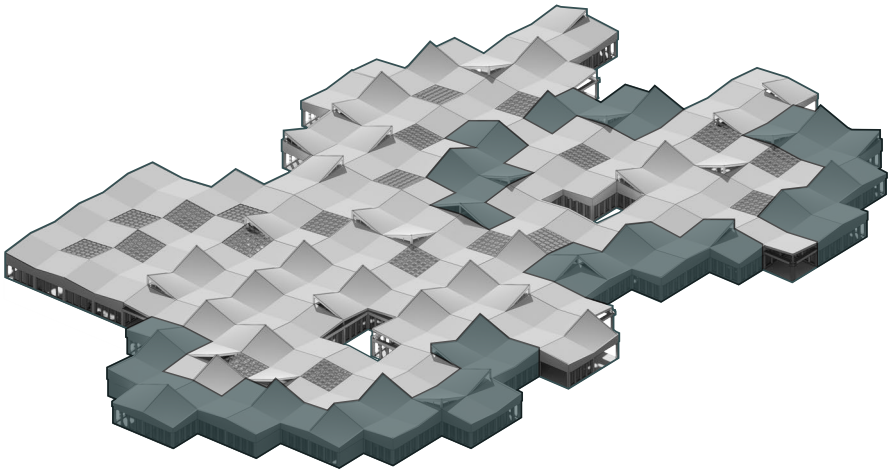
img. 15: Render



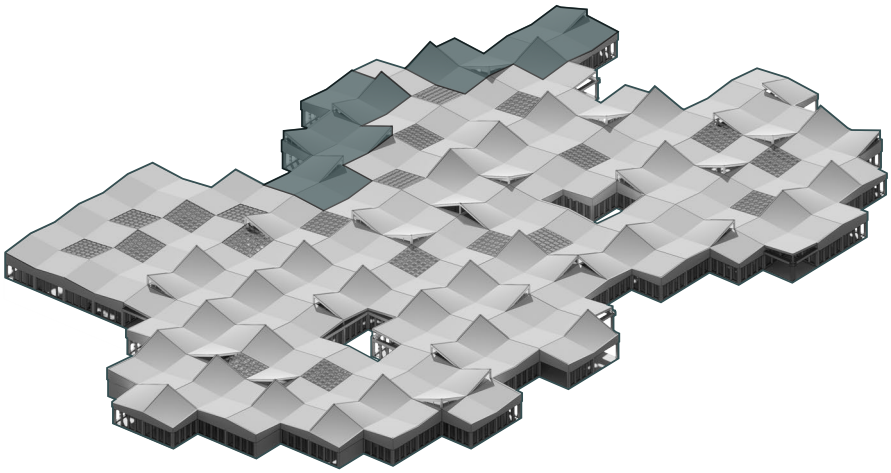
Ill. 52: Entrances



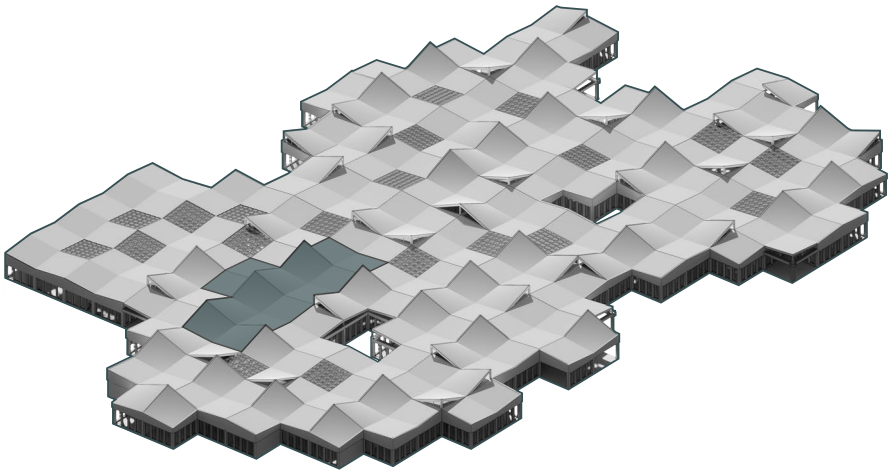
Ill. 53: Gardens



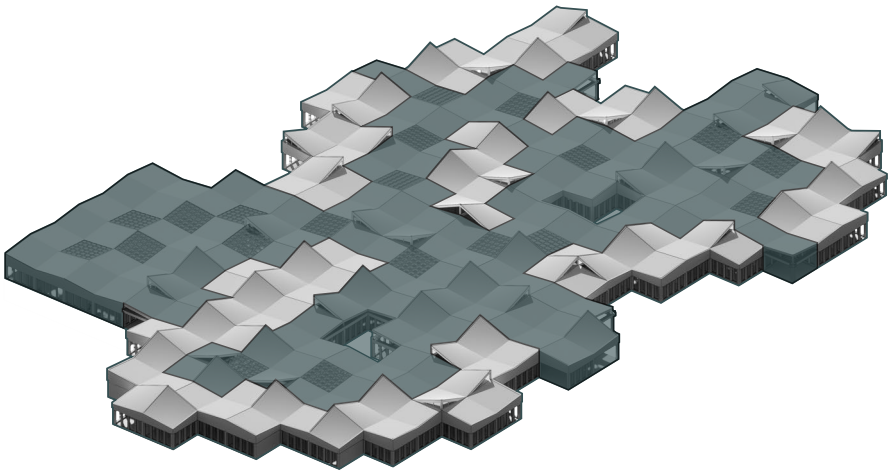
Ill. 54: Classrooms



Ill. 55: Labs



Ill. 56: Administration



Ill. 57: Common spaces





Ill. 58: East Elevation 1:400





Ill. 59: South Elevation 1:300


CANTINE



img. 16: Render



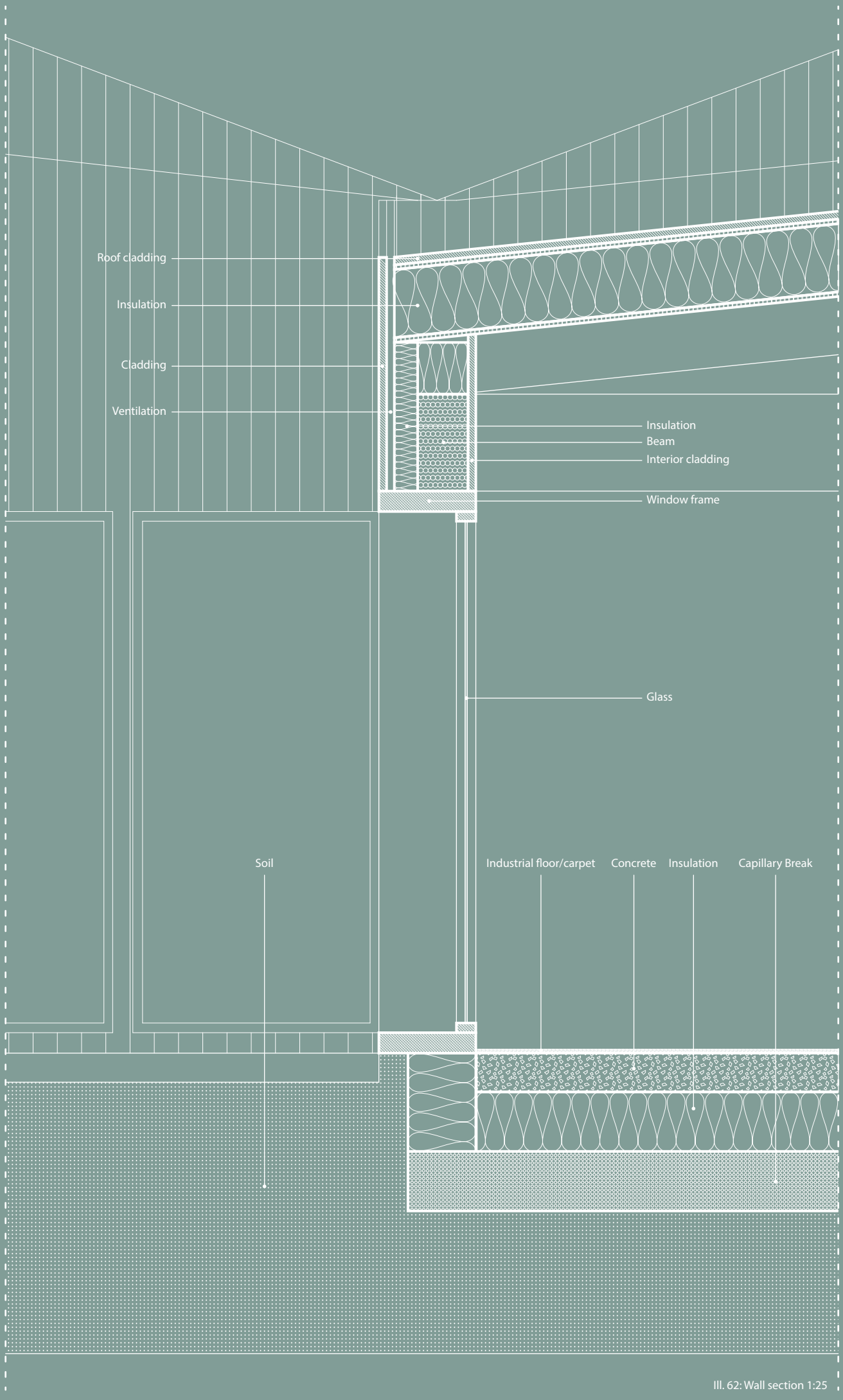


Ill. 60: Section A-A 1:400





Ill. 61: Section B-B 1:300



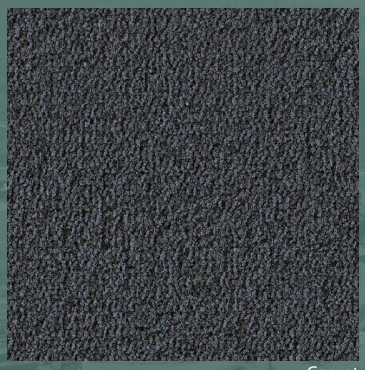
Ill. 62: Wall section 1:25



Timber cladding



Industrial floor



Carpet





Ill. 63: West Elevation 1:400





Ill. 64: North Elevation 1:300





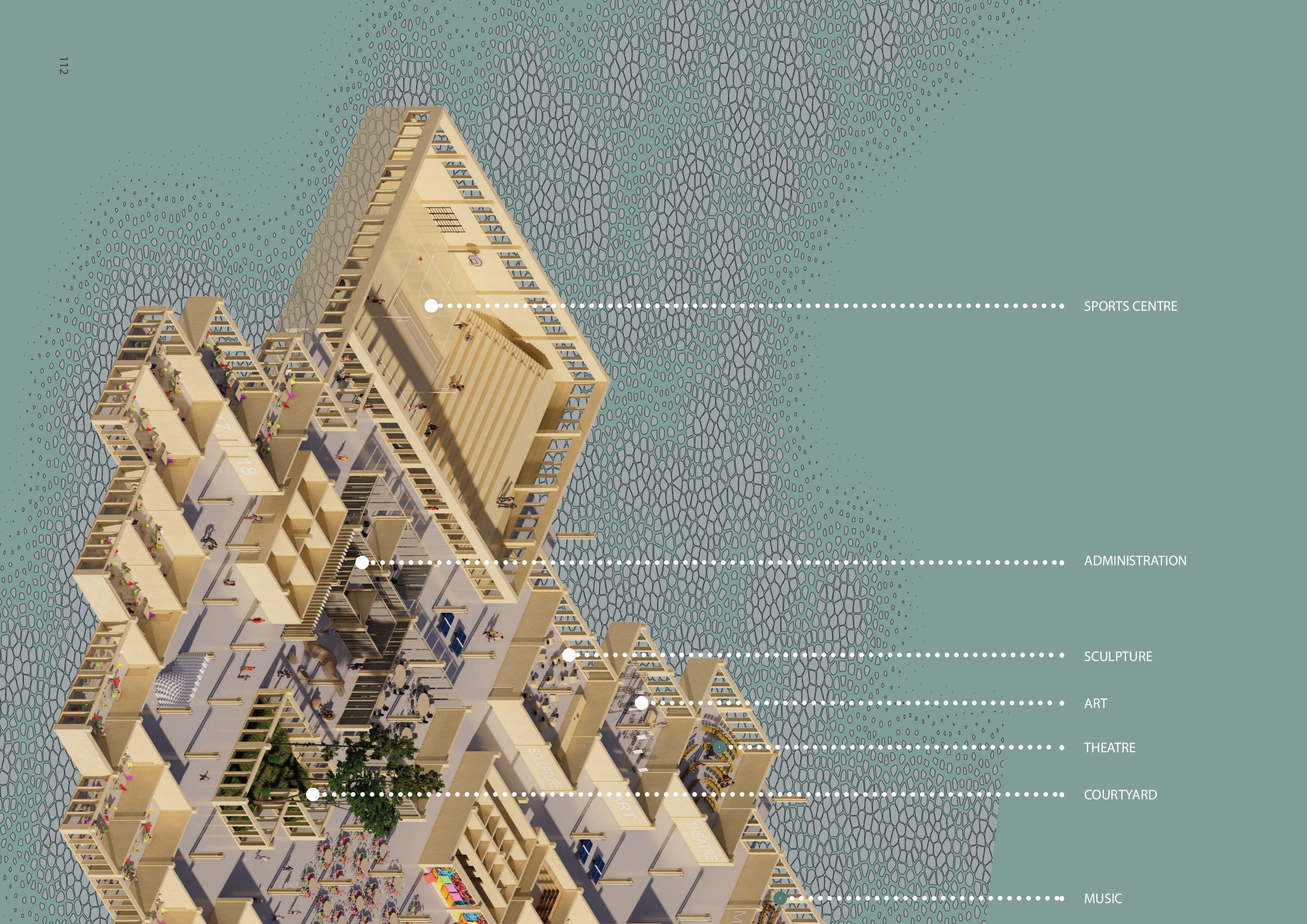
img. 17: Render



1. Entrance
2. Classrooms
3. WC
4. Corridor
5. Science Lab
6. Music Lab
7. Theatre Lab
8. Arts Lab #1
9. Arts Lab #2
10. Sports Centre
11. Offices
12. Small meeting rooms
13. Large meeting rooms
14. Teachers room
15. WC
16. Storage
17. Public stairs
18. Courtyard
19. Gathering point
20. Cantine
21. Kitchen
22. Storage
23. WC

Ill. 65: Floor plan 1:500


1.
2.
3.
4.
5.
6.
7.
8.
9.
16.
17.
18.


SPORTS CENTRE
ADMINISTRATION
SCULPTURE
ART
THEATRE
COURTYARD
MUSIC

Ill. 66: Functions axo





img. 18: Render





img. 19: Render



Ill. 67: Clustered



Ill. 68: Scattered



Ill. 69: Linear



Ill. 70: Nature

CLASSROOM

Based on the theory was established initially, stating the important role it plays in the development of the children to have control over their space and re-arrange it the way they want and is necessary of each activity, the diagrams show some very basic configurations or no, in space that can be achieved through very simple design decision and that will assist students and teaches to apply this method.

The students can be divided into various clusters and work as groups to resolve problems and conclude tasks, be scattered within space to work individually, form a single group that would be consisted of the entire class and also bring nature within the classroom or bring the classroom in nature.





img. 20: Render

CONCLUSION

The proposal for an activity-based learning school in Nye is made to fulfil the Nye local plans vision and become an integrated part of the educational system, as well as a major gathering point for students, teenagers and parents due to its diversity and spatiality. In addition to that, the school needs to realize its primary role and hence create the best possible conditions for a child to grow by activating their creative and problem-solving potential and supplying them with a diverse learning experience that will teach them the essentials to expand their capacity.

The school today is not just a place of learning and teaching, but also a place of living, socializing and a place of transition, thus the proposal aims to accommodate this multidimensionality and be the catalyst for the transition of the children. The human scale of the structure tries to "blend in" with the existing development of Nye and be the focal point for the future growth of the area. Its tectonic language aims to, first of all, set the foundation for the student's interest and be the framework for their integration and knowledge sharing. Studies have shown that children are more interested in the things they can control, so the overall structure is designed to trigger their cognitive abilities, allow them to interact with their surroundings and change them or alter them according to their needs. To achieve so, the space is designed to enclose them in a safe environment but at the same time inspire freedom to them with the use of open floor plans and the integration of courtyards that allow the natural light to be diffused within the heart of the school.

The visual and physical associations within the school have been the point of convergence, as adaptability and variety in space and spatial characters give the best system for dynamic learning and advance casual experiences in development. Consequently, the classrooms, labs and other spaces of the school have been arranged perimetrically of the heart of the school to create a unified centre that will bring together children of all ages and set the foundation for their interaction in space.

The skylights and the visual complexity of the structure aim to activate their curiosity, as well as enhancing their cognitive abilities. As studies have shown, the presence of skylights within an educational institution increases students abilities to progress and develop 19-20% faster, hence the concept of an optimised system was part of the process since the beginning and got developed to support the claim. Concluding, these design drives, the school aims towards the future of education moving itself away from the traditional educational institutions and setting a strong paradigm as a contemporary building that can house a complex system of activities and users.



REFLECTIONS

The drive I had since the beginning of the project or, to be more precise since I first saw the folder about Nye and its school project, was a very romantic in a way reason since it awakened my rather bad relationship with the institution. Coming from Greece and growing up in a society that has shaped prison-like schools with the dry goal to reproduce mere tools for its societal development, and the preaching of religion, I was always the black sheep of the so-called microcosm of my class. This due to the fact that by nature, I was quite rebellious. Without any particular reason many times. Frequently, simply with the goal to say a big "no" to their "yes"-es. But more importantly, because, since I was a kid, I was always interested in the things I was actually interested in. Let me elaborate. It was very easy for me to learn the things that triggered my interest. In a blink of an eye, one would say. However, it was impossible to listen or to be present and absorb the things that couldn't trigger not one bit of that complex interest of mine. The things that would attract my attention would usually surround subjects or tasks that would require a creative approach or holistic participation in resolving a problem.

Being raised in a family with one rather creative designer (my mother) I was always attracted to beauty, especially if we talk about buildings. Hence attending school in Greece always felt as if I was going to prison. Daily. With an appointment. So, the task of designing a school building was a bit challenging since, first of all, I had to deal with my childhood trauma and try to reshape it and make something out of it.

Therefore, I began the process by researching the things I was the least familiar with. Reading books about schools, how the educational system has changed and continues changing and evolving at this very moment, and how architecture plays a very significant role in the cognitive development of the child. This friction with this new world that started unfolding in front of my eyes, did indeed trigger my interest so I started researching more and more about it. The research continued even when the design process has started taking me further down in the rabbit hole. Even though this new world seemed exciting and promising, I started daunting myself since I realized that it's a rather complex topic that can have many potential answers and solutions to its problem. However, it was rather late when I came to this realization hence I only was forward.

Doubting myself and the fundamentals of my concepts and ideas, I tried to establish focal points and base my development on them. Points such as students socialization, daylight, constructive spaces, diverse spaces, recognizable spaces, etc.
This only scratches the surface of what a school can be or mean, not only to children but also to society and its development. Do we want people that have the capacity to think, create, solve, progress, and shape the future, or our goal as a society is quite the opposite? Since the problem is so diverse and multidimensional, I strongly believe that the majority of these questions have not been answered within this project. Nevertheless, it sets a strong foundation for my personal cognitive development and understanding of the value of school in society.



LIST OF REFERENCES

K. Robinson, L. Aronica, 2016. Creative Schools, The Grassroots Revolution That's Transforming Education, Penguin Books.

Jun'ichirō Tanizaki, 1977. In Praise of Shadows, Leete's Island Books.

K. Frampton, 1980. Modern architecture, Thames & Hudson; Fourth edition

L. Kahn, 1993. Light and Space, Urs Buttiker

A. Deplazes, 2009. Constructing Architecture: Materials, Processes, Structures : a Handbook. Birkhäuser Architecture; 2nd edition

C. A. Bovenzi, 1984. A TECTONICS APPROACH TO ARCHITECTURE: A New Church Building for Buffalo. Massachusetts. M.I.T.

D. Phillips, 2004. Daylighting: Natural Light in Architecture. Oxford. Architectural Press; Routledge 1 edition

Frampton, K. and Cava J. ed., 1995. Studies in Tectonic Culture – The Poetics of Construction in Nineteenth and Twentieth Century Architecture. Chicago: The MIT Press.

Nils-Ole Lund & James Manley, 2008. Nordic Architecture. Arkitektens Forlag, The Danish Architectural Press

P. L. Nervi, 1966. Aesthetics and Technology in Building. Cambridge, Massachusetts. Harvard University Press.

R. Kasimati, et al., 2013. Sociology, Athens, Computer technology institute and press, 2013

S.Tinis, September 4 2016. The importance of education in society ,https://paideia-news.com/i-simasia-tis-ekpaideysis-stin-koinonia22679d

D. Germanos, 2006. The walls of Knowledge: School spacem and leaning, Athens, Gutenberg

G. Mesmin, 1978. The child the architecture and the space, translation P.Pantelikos, Athens, Μνήμη

M. Gaitanidi, 2010. The pedagogy of the space: school architecture, Volos, University of Thessaly

E. Siggolitou, 1997. Environmental psychology, Athens, Ελληνικά Γράμματα

K. Tsoukala, 2002. Trends in School Architecture, From Child-Centered Functionality to the Postmodern Approach, Thessaloniki, Παρατηρητής

Dudek, M. (2005). Children's spaces. Oxford: The Architectural Press

Bronfenbrenner, U. (1979). The ecology of human development Q Experiments in nature and design. Cambridge, MA: Harvard University Press.

Shah. P. και Miyake, A. (επιμ.) (2005). The Cambridge handbook of visuospatial thinking. UK: Cambridge University Press.

Γερμανός, Δ. και Κανατσούλη, Μ. (επιμ.) (2010). ΤΕΠΑΕ 09. Πρακτικά επιστημονικών εκδηλώσεων του ΤΕΠΑΕ ΑΠΘ, 2007-09. Θεσσαλονίκη: ΑΠΘ/University Studio Press.

Wake, S. (2007). Children's gardens: Answering the call of the child? Built Environment

Zimmerman, M. A. (1995). Psychological empowerment: Issues and illustrations. American Journal of Community Psychology

Τσεβρένη, Ι., Πανταζής, Β., Τούση, Ε., και Παναγιωτάτου, Ε. (2008). Μεγαλώνοντας στην Αθήνα. Ένα πρόγραμμα περιβαλλοντικής Εκπαίδευσης για τη συμμετοχή των παιδιών στη διαμόρφωση του περιβάλλοντος τους. Αθήνα: Κοινωφελές Ίδρυμα Ι.Σ. Λάτσης/ΕΜΠ.

https://ieatbugsforbreakfast.wordpress.com/?s=galapagos

https://www.jstor.org/stable/1566863?seq=1

https://commercial.velux.com/inspiration/ebooks/building-better-schools?consent=preferences,statistics,marketing&ref-original=https%3A%2F%2Fwww.google.com%2F

ILLUSTRATIONS LIST

Ill. 1: Site Overview	7
Ill. 2: The Integrated Design Process	11
Ill. 3: Indoor Climate	30
Ill. 4: Europe map	42
Ill. 5: Denmark	43
Ill. 6: Aarhus map	46
Ill. 7: Site	47
Ill. 8: Access Points	50
Ill. 9: Urban Voids	50
Ill. 10: Urban Textile	50
Ill. 11: Context	50
Ill. 12: -	-
Ill. 13: -	-
Ill. 14: Schematic plan	54
Ill. 15: Stacked	59
Ill. 16: Human scale	59
Ill. 17: Sketch #1	60
Ill. 18: Sketch #2	60
Ill. 19: Sketch #3	60
Ill. 20: Sketch #4	61
Ill. 21: Sketch #5	61
Ill. 22: Sketch #6	61
Ill. 23: Unity	62
Ill. 24: Falling pieces	62
Ill. 25: Gardens	62
Ill. 26: Suburban	62
Ill. 27: 6x6 grid	66
Ill. 28: Substitution	66
Ill. 29: Volume	66
Ill. 30: Courtyards	68
Ill. 31: Roof Elements	68
Ill. 32: Skylight and openings	68
Ill. 33: Site plan 1:1000	73
Ill. 34: Structure axo	74
Ill. 35: Structure detail 1:25	75
Ill. 36: Initial state	76
Ill. 37: Average state	76
Ill. 38: Exaggerated	77
Ill. 39: Genome Map	78
Ill. 40: Selection for mating	78
Ill. 41: Partners in the immediate neighbourhood	78
Ill. 42: Exluded neighbourhood	80
Ill. 43: Cluster	80
Ill. 44: Proper mating	80
Ill. 45: Main grasshopper skript and solver	83
Ill. 46: Daylight diagram #1	84
Ill. 47: Daylight diagram #2	84
Ill. 48: Daylight diagram #3	84
Ill. 49: Daylight diagram #4	84

Ill. 50: Optimal skylight diagram	**85**
Ill. 51: Exploded axo	**87**
Ill. 52: Entrance	**90**
Ill. 53: Gardens	**90**
Ill. 54: Classrooms	**90**
Ill. 55: Labs	**91**
Ill. 56: Administration	**91**
Ill. 57: Common spaces	**91**
Ill. 58: East elevation 1:400	**93**
Ill. 59: South elevation 1:300	**95**
Ill. 60: Section A-A 1:400	**99**
Ill. 61: Section B-B 1:300	**101**
Ill. 62: Wall section 1:25	**102**
Ill. 63: West elevation 1:400	**105**
Ill. 64: North Elevation 1:300	**107**
Ill. 65: Floor plan 1:500	**110**
Ill. 66: Functions axo	**113**
Ill. 67: Clustered	**118**
Ill. 68: Scattered	**118**
Ill. 69: Linear	**118**
Ill. 70: Nature	**118**

IMAGE LIST

img. 1: Riikonen, 2015 Otaniemi Chapel in Finland by Heikki & Kaija Siren	**p. 8**
img. 2: A Room for Archaeologists and Kids in Pachacámac | ETH Zurich + PUCP	**p. 23**
img. 3: The Heart in Ikast | C.F. Møller Architects	**p. 25**
img. 4: The Architecture Of Light, The Guggenheim | James Turrell	**p. 27**
img. 5: Anthony Timberlands Center for Design and Materials Innovation | Dorte Mandrup	**p. 29**
img. 6: Erlev School, Haderslev, Denmark by Arkitema Architects	**p. 35**
img. 8: Erlev School, Haderslev, Denmark by Arkitema Architects	**p. 35**
img. 8: Erlev School, Haderslev, Denmark by Arkitema Architects	**p. 35**
img. 9: Nye aerial view (Google maps)	-
img. 10: Nye (google maps)	-
img. 11: Nye, (https://aart.dk/en/projects/nye)	-
img. 12: Nye, (https://aart.dk/en/projects/nye)	**p. 55**
img. 13: Urban tomography	

Activity-based learning school in Nye.

NYE
SCHOOL