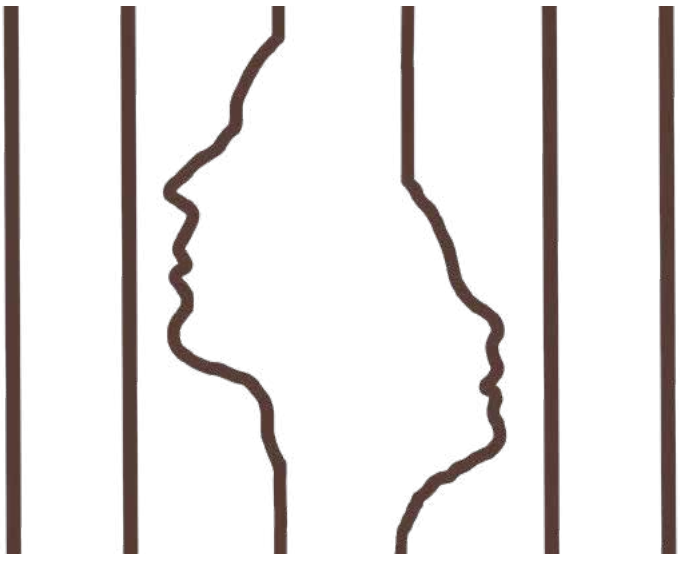
Aja Khalid Hussein & Alane Chayainne Omwanor // MSc04 // June 2025 // Aalborg University



Breaking the Framework:

A Research-Based Inquiry into Institutional Architecture in Schools and Prisons

[thanks to...]

We would first and foremost like to thank our supervisor, Zakaria Djebbara, for his invaluable support, guidance, and for continuously challenging us throughout this process.

We would also like to extend our sincere thanks to:

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The 5th-grade class at Skipper Clement School

Lena Busk Pedersen, Principal at Aalborg Waldorf School

The opportunity to visit these schools and the prison provided us with indispensable insights. In particular, the workshop with the 5th-grade class at Skipper Clement School offered valuable perspectives and a deeper understanding that greatly informed our work.

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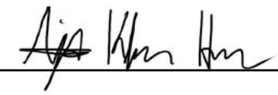

Aja Khalid Hussein

Alane Chayainne Omwanor

[abstract]

This thesis investigates and questions institutional architecture - more specifically, schools and prisons - and the relationship between them. The thesis is divided into three parts, each contributing to the overarching understanding of the connection between research, architecture and human experience. The first part examines the historical origins of institutional frameworks; the second presents an observational analysis of selected cases; and the third delves into key pedagogical theories, case studies, and a design process rooted in site-specific conditions.

The investigation begins with a historical and theoretical analysis of the evolution of schools and prisons, uncovering shared origins and structural parallels rooted in themes such as institutionalization, normalization, and power dynamics.

Through an observational analysis of Horsens State Prison and Randers State School, several aspects were identified that possess both architectural and psychological characteristics. These aspects culminate into a list of design criteria supporting a more informed decision making process. These insights will guide the design of the new Stigsborg School, through an integrated design methodology - combining architectural practice with human-centered research. Emphasis is placed on children's developmental needs, indoor climate, and sensory engagement, aiming to translate theoretical findings into spatial strategies that support autonomy, curiosity, and well-being.
The finalized architectural design proposal reflects a holistic approach, combining traditional and modern educational typologies and responding to the specific site. Furthermore the design addresses the aspects driven from the observational analysis, integrating both architectural and psychological considerations into a cohesive spatial solution.

[reading guide]

The master's thesis is divided into three parts as a result of the revision of the hypothesis - each part contributing to the evolving hypothesis. The project begins with an equal focus on schools and prisons, noted as 50 I 50 on the pages where the hypotheses are stated. As the process progresses, the focus gradually shifts solely to schools, noted as 0 I 100. Alongside this shift, increased attention is given to children's developmental stages and, furthermore, to the project site.
The project site is currently under development; therefore, the analyses conducted are primarily based on the municipality's plans and vision for the area from 2017. Later in the semester, new plans for the area were published, which may result in slight variations from the initial site analyses.

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01

THE SCHOOL OF TOMORROW WILL BE THE FUTURE OF THE PAST

Photo 1. Window bars at Horsens State Prison

[motivation]

The motivation behind this thesis stems from the understanding of architecture as a catalyst in our everyday life. Architecture serves as the framework for nearly every aspect of our lives, shaping the scenery of our daily experiences, which control the way we move. Based on the theory of Enactivism, our cognitive abilities and experiences are affected by our embodied and embedded interaction with our environment (Nesi et al, 2024), highlighting the situatedness of our perception and understanding within the spaces we inhabit. We do not just think with our brain - we think with our body, and within our environment.

This idea encouraged us to center the thesis around institutional architecture, more specifically school and prison architecture. Schools and prisons have similarities when considering both structural and operational aspects. While schools are designed to habilitate individuals by equipping them with knowledge and skills for the future, prisons focus on rehabilitation. Both processes underline the role of structured environments in shaping behavior and personal growth. The educational system plays a crucial role in societal development and in shaping cognitive development and social behavior among students. The scenery that schools create - like prisons - controls movement, behavior and interaction. While schools and prisons are rarely considered in the same context, their parallels made us curious about how two institutions can have two very different perceptions by society and purpose, yet still be so similar.

We hope to contribute to a deeper understanding of how spaces shape cognition, human experience and behavior within institutional settings. By investigating the spatial and psychological effects of different design aspects, we aim to highlight the underlying similarities, questioning how architecture influences control, movement, and interaction. Ultimately, the investigation will result in the design of a school - developed not as the primary goal, but as a byproduct of the broader exploration. The acquired knowledge should be translated into spatial design, supporting growth, autonomy and well-being. The product must be interpreted as an example of execution, and not a final answer.

[introduction]

This thesis investigates the topic of institutional architecture - schools and prisons - exploring architecture's role in shaping experiences within these institutions. The investigation is anchored in a theoretical, historical, and observational background, raising questions such as: What architectural strategies reinforce institutional control? How does design support or hinder development, autonomy and well-being?

The thesis is structured around an evolving hypothesis, allowing for continuous refinement based on insights gained throughout the process, resulting in a more holistic approach. Based on the motivation and initial curiosities, the initial hypothesis is as follows:

If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and operational similarities, as evidenced by patterns identified in historical, sociological and philosophical research.

This hypothesis serves as a lens through which the investigation unfolds, guiding the exploration of school and prison architecture and how design elements influence the spatial experience. The hypothesis is revised twice throughout the report, dividing the report into three parts as mentioned in the reading guide.

[part one]

The methodology chapter explains the overall methodological framework used to answer the hypothesis - the Integrated Design Process by Mary-Ann Knudstrup. This methodology can be a good framework when making architecture, but in order to ensure a thorough investigation of the historical background of institutional architecture and focusing on the human aspect, an additional parameter is added to the methodology: research.
The historical and theoretical chapter gives a historical background for prisons and schools as institutions, where essential themes are addressed. The themes are institutionalization, normalization, and power dynamics. This is followed by two chapters adressing both historical and architectural aspects of the two institutions.

[part two]

The observational analysis chapter analyzes two cases; Randers State School and Horsens State Prison. This serves as a tool to extract themes that are both of an architectural and physiological character - addressing the human experience within these institutions. This provides the historical and theoretical chapters with concrete examples of how, e.g., power dynamics can play a role in the architectural execution of a design. Finally, the chapter concludes with a list of design criteria derived from the analysis, serving as a foundation for the subsequent design of the new Stigsborg School.

[part three]

In part three the hypothesis is revised a final time to encompass the design of a new school in Stigsborg, Aalborg, focusing on child-centered pedagogy, modern school design, and research based design. Part three, as mentioned in the reading guide, is where the focus is fully on school architecture, children and the project site. This part includes theory and research papers addressing children's developmental needs and their well-being regarding indoor climate. A variety of site analyses are conducted to create an understanding of the project site where the school is going to be located in. This segment of part three will conclude with a list of design criteria, guiding and informing the design process.

The design process chapter will first encompass a specification of the new school that will be designed, followed by four case studies. The case studies offer valuable insight and benchmarks for what works and what does not. They expose the project group to a variety of architectural concepts, typologies and educational models. Supporting the case studies is a chapter comparing traditional school architecture with modern, highlighting important aspects for what is perceived as good school architecture and how that actually affects some students.

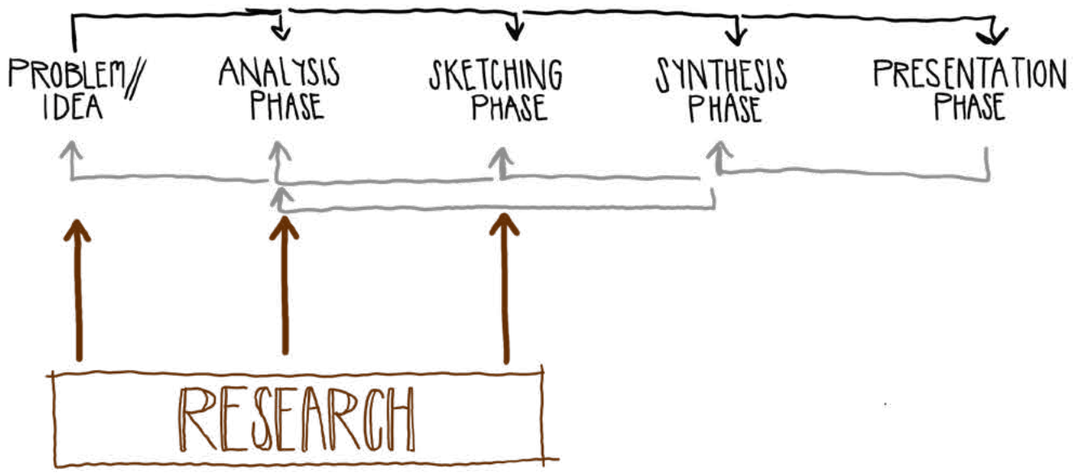
This culminates in a design process showcasing the process of what the new school of Stigsborg should be like. It encompasses initial sketches, design patterns, indoor climate and energy considerations, classroom architecture, etc. Furthermore, a workshop was conducted with a fifth-grade class of Skipper Clement School in Aalborg, contributing with insight from the students and not only from the principals and teachers.

Finally, the finished school design is presented through a variety of illustrations and drawings. As mentioned in the motivation, the design is not absolute, but it is an example of what the school design could be like.

[initial hypothesis]

If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and operational similarities, as evidenced by patterns identified in historical, sociological and philosophical research.

Photo 2. “Gammel celle” at Horsens State Prison



III. 1. Modified IDP with integrated research aspect

[methodology]

The methodology used in the master's thesis is based on a modified version of the Integrated Design Process, as defined by Mary-Ann Knudstrup*. The purpose of using the Integrated Design Process methodology is to ensure: "combining architecture, design, functional aspects, energy consumption, indoor environment, technology, and construction." (Knudstrup, 2004, p. 1). The design process following the IDP is not linear, but is more complex when considering the loops attached to the process (Knudstrup, 2004). It has a similar concept as the hermeneutic circle, in which an ongoing analysis of a subject can lead to a reconsideration of the original premise and the insights gained (Grondin, 2017). A central element in the education of Architecture and Design is not only to "(...) achieve competencies in design, functionality and aesthetics as well as competencies in technical solutions." (Knudstrup, 2004, p. 1), but also to execute a practical synthesis that is manifested as a design solution (Knudstrup, 2004).

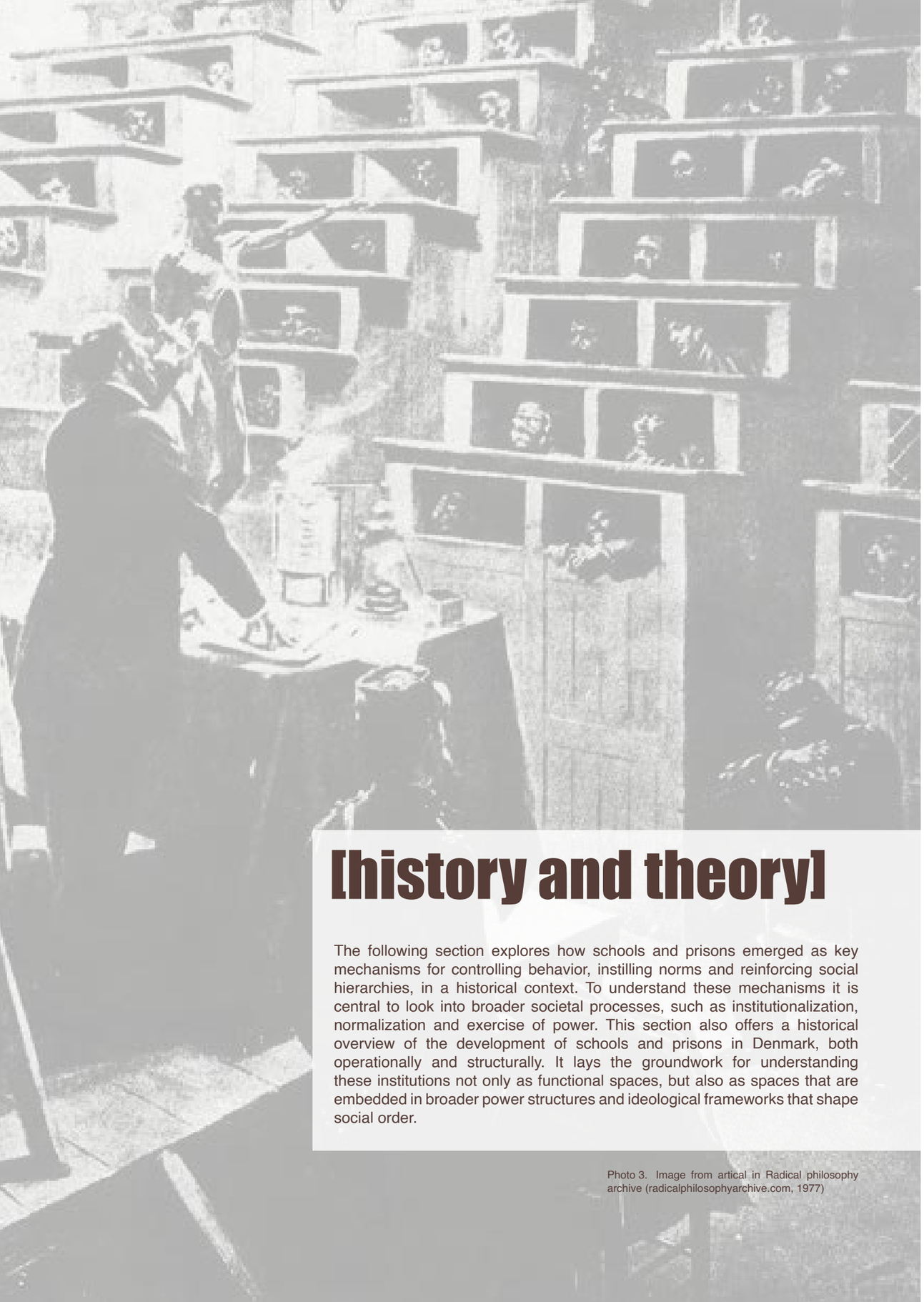
Architecture traditionally only considers the built environment, removing the human body from the design process, which is reflected in the IDP. As mentioned in the motivation, this thesis has a vast focus on architecture's effect on our cognitive abilities and experiences - which is why the IDP alone is not sufficient. The 'deeper understanding' in the report will derive from research, such as empirical insights, philosophy, theoretical, and scientific literature. This research is used as a fundamental tool, parallel with the IDP, providing knowledge that feeds into the different phases - more specifically Problem/Project idea, Analysis phase and Sketching phase.

Integrating research explicitly into the methodology of this thesis will ensure a thorough investigation of the human aspect and ensure the human is represented in the design equation - informing the overall design process.

The project idea in this thesis is formulated as a hypothesis, which is a proposed explanation based on initial evidence, serving as a starting point for further investigation. (Merriam-Webster. n.d.). The hypothesis is not immediately constructed as final for this thesis, but is evolving and takes form as a result of the investigations. This further reflects the recursive and iterative nature of the Integrated Design Process.
The extension of the traditional IDP intends to bridge the gap between architectural design and its impact on human cognition and behavior. This will result in a synthesis that will be rooted in an understanding of human behavior and emotional experience, while still including contextually relevant information considering the site and the practical needs of the users. As a result of the nature and abstraction of complex theories and empirical research, some parts will not translate directly into physical space. To address this, it is important to recognize that some nuances may inevitably be lost in the process. What remains essential is understanding what might be lost and evaluating whether those elements are significant or redundant in the context of the design. This awareness allows for more informed decisions, ensuring that the core insights remain intact and relevant to the design's purpose, while balancing the theoretical and practical aspects of the project.

The thesis presentation - which is communicated through the report - will be presented in a chronological order; however, it does not fully reflect the iterative and dynamic nature of the process. Additionally, the report will reflect the modification and expansion made to the traditional IDP methodology, particularly the incorporating empirical insights, philosophy, theoretical and scientific literature throughout the process.

* Mary-Ann Knudstrup from the department of Architecture & Design, Aalborg University



[history and theory]

The following section explores how schools and prisons emerged as key mechanisms for controlling behavior, instilling norms and reinforcing social hierarchies, in a historical context. To understand these mechanisms it is central to look into broader societal processes, such as institutionalization, normalization and exercise of power. This section also offers a historical overview of the development of schools and prisons in Denmark, both operationally and structurally. It lays the groundwork for understanding these institutions not only as functional spaces, but also as spaces that are embedded in broader power structures and ideological frameworks that shape social order.

Photo 3. Image from artical in Radical philosophy archive (radicalphilosophyarchive.com, 1977)

[theoretical background]

In order to understand the historical conditions of schools and prisons as institutions there are some crucial themes to address. These themes are institutionalization, normalization and power dynamics - both macro- and micro-power. By investigating these themes, an understanding is created of the ways in which they affect behavior, shape individuals' experience and societal roles. This investigation provides a foundation for critically assessing the architectural frameworks of schools and prisons and their impact on human cognition, behavior, and well-being.

According to Norbert Elias, a German sociologist famous for his work on civilization in Western Europe, state formation involved a long and gradual disciplining of social groups (Elias, 2000). This was achieved, among other means, through institutionalization. Institutionalization is both; the action of establishing norms; and a physical space where one can be placed (Oxford Learner's Dictionaries, n.d.). The establishment of norms is a part of the normalization process, which aims to make certain actions or ideas appear 'normal' on both an individual and societal level. The internalization of norms is a central aspect of both normalization and social control. The interplay between institutionalization and normalization ultimately reinforces power dynamics. This type of power is not necessarily about direct control, but rather operates through mechanisms that guide and regulate actions, shaping individuals' behavior and perception. Michel Foucault, a French historian and philosopher, known for his work on power dynamics, explains power as follows:

"(...) what defines a relationship of power is that (...) it acts upon their actions: an action upon an action, on existing actions or on those which may arise in the present or the future."

(Foucault, 1982, p. 789)

Foucault defines the nature of power as an action that affects the actions of others. This can be executed in different ways and on different levels, which will be elaborated on later. It is inevitable to address the phenomenon of power without considering the one upon whom power is exercised - Foucault labels this the subject.

"There are two meanings of the word "subject": subject to someone else by control and dependence; and tied to his own identity by a conscience or self-knowledge."

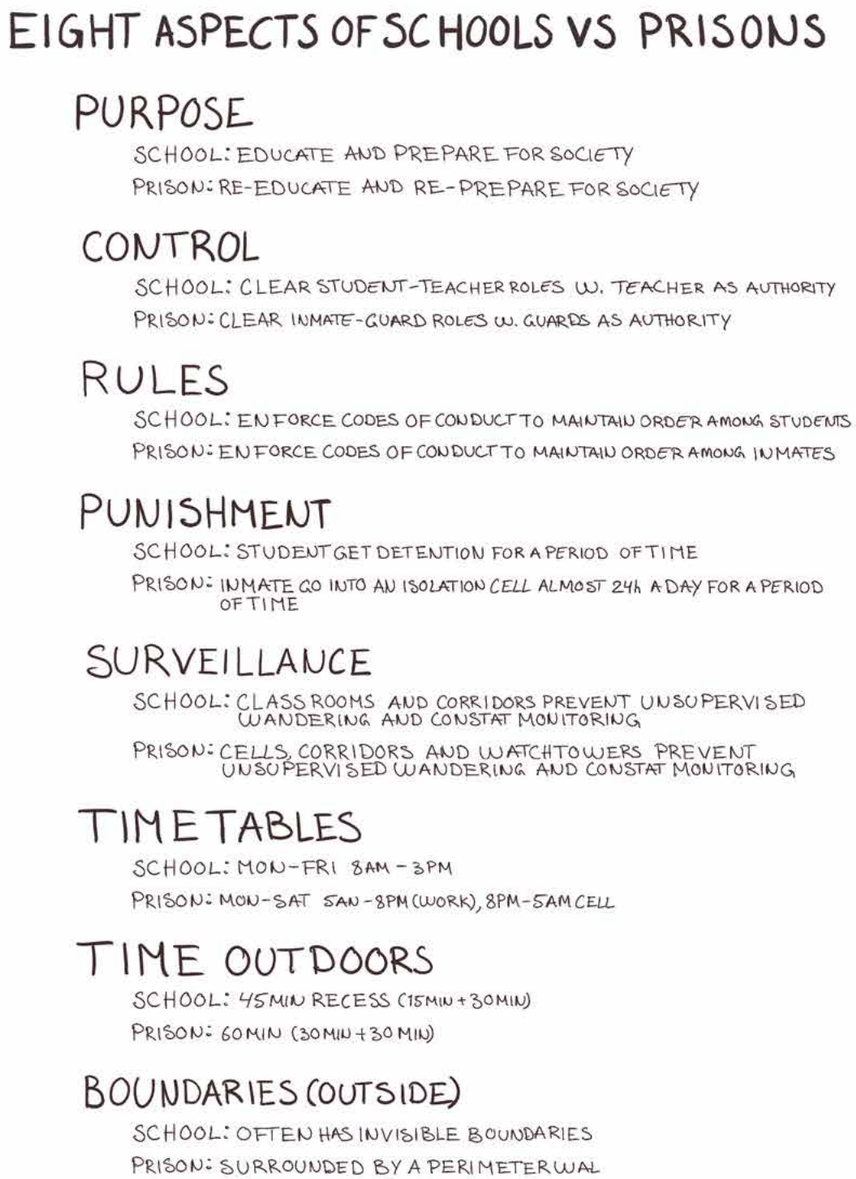
(Foucault, 1982, p. 781)

A subject being tied to his own ideas is one of the main objectives of institutionalization and is the essences of normalization. Both meanings of subject point to a form of power that subjugates and transforms individuals into subjects. It is a technique of power that shapes and constrains individuals in their everyday lives. This form of power is imposed by the state - who integrates a kind of power that prioritizes the interest of the totality over the individuals, combined with the old technique of pastoral power (Foucault, 1982). The pastoral power refers to a form of power that is salvation-oriented - salvation in the interest of the individual. The state can be seen as a modern pastoral power: the structure integrates individuals under the condition that they submit to a set of specific patterns.

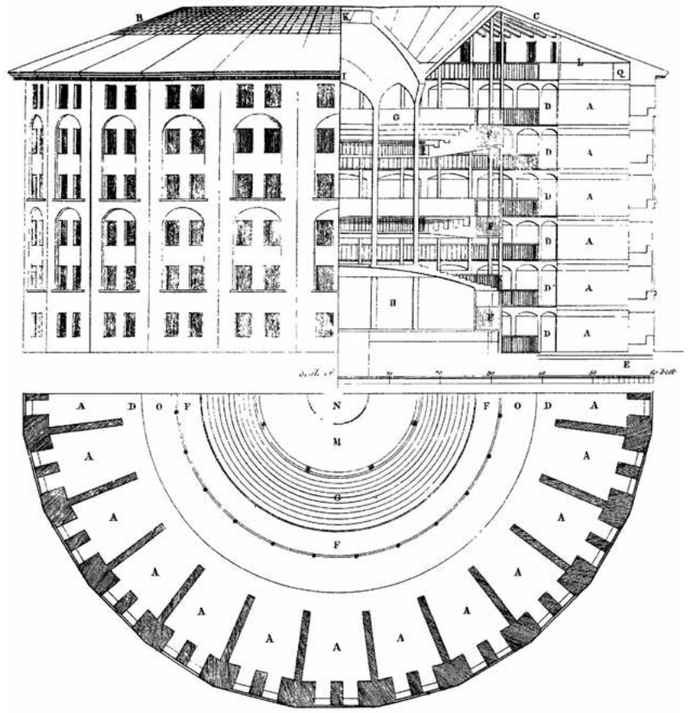
The salvation aspect focuses more on salvation in this life - in the image of health, wealth and security - in contrast to salvation in the next life. (Foucault, 1982)

Humans are turned into subjects through both macro- and micro-power. Macro-power can be understood as power operating on a population rather than individuals. This is exercised through authority over subjects within a country by laws and regulations (Foucault, 1982). Micro-power, on the contrary, is more a strategy that works through disposition, discipline, surveillance, and normalization on an individual level (Heiskala, 2001). In relation to this thesis, it is relevant to consider macro-power as the role of institutions - schools and prisons - in shaping behaviors and controlling populations. Micro-power, meanwhile, is viewed through the lens of how architectural elements such as surveillance, spatial organization, and movement influence individual behavior within these institutions.

These perspectives and this framework are relevant when analyzing and considering the history of these institutions. In both institutions, power is, and has been, used to regulate individuals and impose norms. This provides the foundation for exploring the parallels between the history of schools and prisons and, later, investigate how this is reflected in their architecture.



Ill. 2. Eight aspects of school vs prison



Ill. 3. Image: Willey Reveley, via Wikimedia Commons, CC BY 4.0)

[prisons]

Depending on when and where in history, the means and aims of imprisonment have varied largely. Imprisonment and confinement have been used as e.g., custody, social control, or in connection with political indoctrination and detention of psychiatric patients (Schmidt, 2009). Imprisonment has been a part of the civilizing process, where power structures influenced social behavior and identity formation. (Elias, 2000)

There are, and have been, different approaches and philosophies behind the treatment of inmates over time, one of them being the idea of retribution. Retribution is the notion that punishment must be proportionate to the crime. This penal policy was based on a simplified view of the public's sense of justice, without the consideration for long-term economic and societal consequences. (Schmidt, 2009) A means that was used with the idea of retribution, was torture. Torture was not seen as an extreme lawless act but, according to Foucault, was calculated according to detailed rules:

"Torture rests on a whole quantitative art of pain. But there is more to it: this production of pain is regulated. Torture correlates the type of corporal effect, the quality, intensity, duration of pain, with the gravity of the crime, the person of the criminal, the rank of his victims."

(Foucault, 1977, p. 34)

Based on the analysis of Michel Foucalt, the government would rationalize its use of torture to enforce laws. Later, torture was used as a mean in the investigation process. This shift - from torture being used as a part of the punishment to torture being used as a part of the production of truth, reflected the increasing wealth and productivity of society. It shifted from a physical struggle to an intellectual one, between the investigator and the criminal. (Phúng, 2012)
As mentioned earlier, the goals of imprisonment and confinement have changed over time as a reflection of societal changes. Norbert Elias discusses the gradual process of civilization and the necessity of control by central authorities to manage potential threats (Elias, 2000). Foucault addresses the philosophy of 'the gentle way in punishment', a shift in the purpose of punishment toward a broader societal mechanism, where the aim was not only to punish the guilty but to deter the innocent (Phúng, 2012).

Disciplinary mechanism & rehabilitation
The idea of improving the incarcerated was a part of the general scientific optimism since the 18th century. During the Enlightenment period, around the 18th century, there was a growing opposition to torture and the death penalty, leading to the development of new standards for the treatment of individuals. The concept of rehabilitating criminals was tied to the prison as an institution, especially from 1820 during the breakthrough of the modern prison system.
The approach to and understanding of rehabilitation have evolved through time. Early modern prisons were built on the principle of isolation. Two systems, both emphasizing isolation, discipline, and hard labor (to varying degrees), were introduced. The Philadelphia system transitioned from housing inmates together in large open spaces to individual prison cells, where they remained in total isolation day and night. They worked alone in their cells with no social interaction. In the Auburn system, prisoners were only isolated at night, while they worked silently in common areas, during the day. (Horsens Leksikon, n.d.) The idea was that to improve the incarcerated, they needed to be isolated from all morally bad influences, while undergoing a personal religious and moral cleansing. Not only did the incarcerated need to serve their time, but also be 'cured' from their criminal inclinations. (Schmidt, 2009)

This shift in penal philosophy influenced the architectural design of prisons, as spaces were increasingly structured to enforce discipline and surveillance. One of the most influential prison designs emerging from this period was the panopticon, created by Jeremy Bentham in the late 18th century. According to Foucault, the panopticon was an ideal architectural model of modern disciplinary power, exercised through invisibility. (Fontana-Giusti, 2013) The layout featured a central watchtower surrounded by cells on the perimeter. Crucially, inmates could not see the officer in the tower and thus could never know when they were being watched. As a result, the inmates would behave, and control would be achieved through internal monitoring. The imaginary gaze served as a disciplinary mechanism, affecting the individuals by creating a state of unease and anxiety aggravated by the feeling of being under constant observation. (Fontana-Giusti, 2013) The reasoning behind this form of punishment was to reset the person into a state of obedience (Piro, 2008). Consequently, the individual would discipline themselves to the extent that the behavior felt natural - becoming normalized (Phúng, 2012).

In modern times, rehabilitation within the prison system focuses more on addressing the root causes of criminal behavior through retraining and reintegrating inmates back into society. The core philosophy is centered on the concept of Normalization, where the prison environment mirrors the outside world, preparing inmates for a successful reintegration (Foote, 2012). This is achieved through structured routines where inmates either work or attend school from around 5 a.m. to 8 p.m. (Sørensen, 2025). Achieving normalization in society often requires structured discipline. Foucault argues that discipline can be as effective as torture when considering it a means for getting people to act in a certant way (Phúng, 2012).

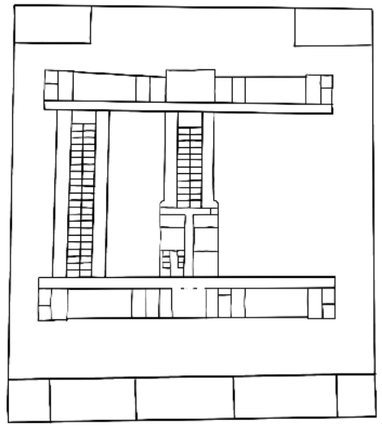
Around 1830 Denmark established its first few training/educational centres for young troubled kids. The philosophy was to cure pathological criminal behavior similarly to how people are healed in hospitals. Control needed to be internalised within the inmates to create self control and a ‘healthy’ mindset. (Schmidt, 2009) Schmidt suggests that the rehabilitation agenda is not necessarily in direct opposition to penal approaches, as both can serve the interests of the state in maintaining social order and exercising power over individuals. Rather than being purely about reintegration, rehabilitation can also function as a form of control, shaping behavior in ways that align with broader political and institutional goals. (Schmidt, 2009)

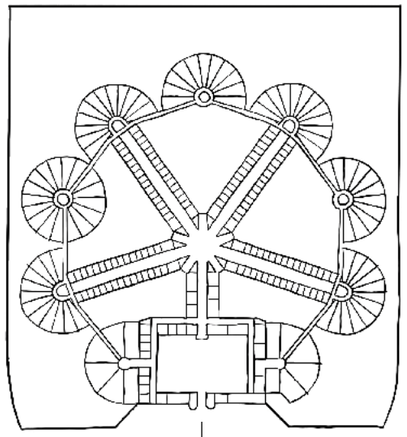
Architecture cannot be seen as neutral or merely aesthetic and functional . It serves as a tool of power, affecting behavior through spatial organization - being an aspect of the disciplinary mechanism. The relationship between discipline, surveillance and space is not only relevant for prisons, but also institutions like schools. By investigating the architectural principles of the panopticon, one can better understand how spatial design functions as a tool for institutional control.

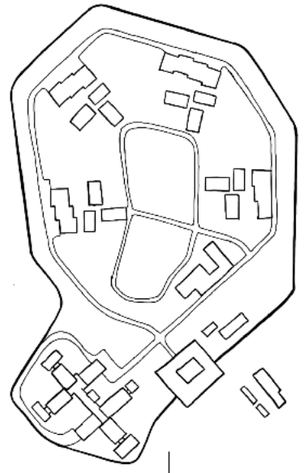
Photo 4. Lockers at Horsens State Prison

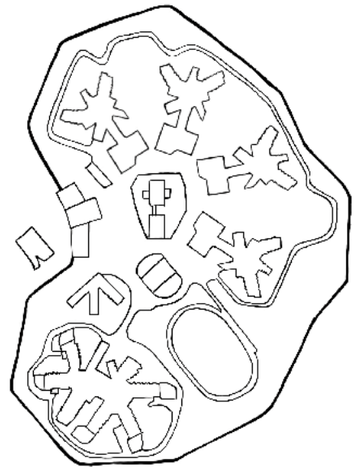
[prison timeline]

The information presented in the timeline is based on following sources: (Johansen, H.C., n.d.), (Tolstrup, et al., n.d.), C.F. Møller Architects, n.d.), (Tidsskriften.dk, n.d.)









BEFORE 1600

“JYSKE LAW” 1241

First written law in Denmark

PUNISHMENT BY: Fines, corporal punishment, death and outlawry

FIRST ‘TUGTHUS’ 1605

Penal labor to establish the state, cheap working force

1700

“DANISH LAW” 1683

PUNISHMENT BY: Fines, corporal punishment and death

*Mitigation of the punishment for theft

VIBORG ‘‘TUGTHUS’ 1736

‘TUGTHUS’ IN EVERY REGION IN THE CONTRY

Working during the day (re-establishing the state) and sleeping in dormatory at night

1800

THE START OF MODERN PRISONS

THE PANOPTICON 1791

THE IMPRISONMENT OF CHILDREN STOPPED 1790

1900

“DANISH LAW” 1866

PUNISHMENT BY: Imprisonment, penal labor in ‘Tugthuse’, houses of correction and death

THE OPENING OF HORSENS STATE PRISON 1853

THE OPENING OF VRIDSLØSELILLE 1859

“CRIMINAL LAW” 1930

Death penalty and corporal punishment were abolishment

PUNISHMENT BY: Imprisonment and fines

NEW PRISONS WERE BUILD AND OLD ONCE WERE RENOVATED

ESTABLISHMENT OF OPEN PRISONS 1945

Opening of new prison types e.g. juvenile prisons

2000

“CRIMINAL LAW” 2003

PUNISHMENT BY: Imprisonment and fines

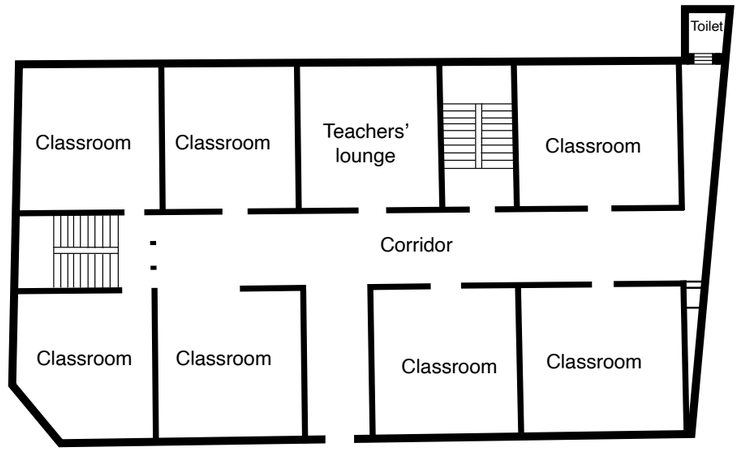
THE OPENING OF ENNER MARK PRISON IN HORSENS 2006

THE OPENING OF STOR-STRØM IN GUNDSLEV 2017

“The world’s most humane prison”

TODAY

III. 4. Prison timeline



Ill. 5. Plandrawing of traditional Norwegian school. (Bergen Municipality, n.d.)

[schools]

Research has linked school history to societal development and change, particularly agrarian reforms and the expansion of state power. A central focus has been the state's role in shaping children's education - viewing schools and educational reforms as tools for ideological and social control.
Traditionally, the school system was described from a top-down perspective, focusing on rulers, bishops, and other authorities. Teachers and students were often seen as groups to whom laws and resources were directed. Dating back to the 18th century, schooling simply took place wherever a teacher "held school." The teacher - whether formally qualified or not - took on the role of educating a group of children in subjects related to books and writing. (Appel et al, 2013).

Schools were never neutral educational institutions; they were designed for specific groups of children. It was not until around 1780 that schooling became a standard part of childhood, regardless of social background or gender. (Appel et al, 2013)
During the period of 1780-1850, researchers focused on the development of pedagogical ideas, drawing inspiration from Jean-Jacques Rousseau's Émile (1762), which will be explored further in a later section. His child-centered pedagogy encouraged children to pursue their natural curiosity while being shielded from societal influence. Educational thinkers experimented with different school models based on these ideas. (Larsen et al, 2013)

To understand why the school system remained relatively static between 1780 and 1850, one must consider the broader historical context. Denmark remained an agrarian society, with 80% of the population living in rural areas. Additionally, it was a patriarchal society where men and women had distinct roles, and different social classes held specific privileges and responsibilities. (Larsen et al, 2013)

Before 1780, curricula were often determined by the teacher, depending on parents' financial contributions and motivation. It was not until the 19th and early 20th centuries that mass education for children became a state responsibility, largely driven by industrialization. In fact, in many countries, compulsory schooling was introduced later than modern prison systems.
The 1814 education reform significantly reshaped the school system. It mandated seven years of schooling for all children until their confirmation age, laying the foundation for the Danish Folkeskole (public school system). (Larsen et al, 2013).

The state sought to make education a public matter, setting regulations for nearly all aspects of schooling - such as school buildings, student discipline, and curricula. However, legislation alone cannot fully explain how or why schools developed as they did, since much of the process was shaped by local negotiations among various stakeholders. (Larsen et al, 2013).

Between 1920 and 1970, the Western world underwent significant economic and technological transformations, which impacted education. Mechanization in agriculture and broader socio-economic shifts led to mass urbanization, suburban expansion, and new workforce demands in Denmark. (Gjerløff et al., 2014)

These changes led to major developments in the school system after World War 1. One of the teachers, Ejnar Mortensen, travelled abroad to study the new German "experimental schools", which were characterized as "free schools" (also known as Waldorf schools). Influenced by new educational theories innovative teaching methods emerged. Education shifted towards child-centered learning, moving away from rote memorization and recognizing students as active participants in the learning process.

Classrooms were being designed to resemble homes, fostering self-directed learning over teacher-centered instruction by shifting the seating arrangements from rows oriented towards the teacher to groups of tables oriented towards each other. Traditional requirements such as rigid curricula and fixed schedules were also challenged. Architects and designers began designing objects and spaces specially for children, with focus on their development. Toys were no longer just a source of entertainment, but a tool to stimulate children's imagination and independent play. (Gjerløff et al., 2014).

Children were increasingly viewed as individuals rather than merely components of society. Intelligence was no longer seen as static and hereditary but as dynamic and shaped by the environment. This led to the establishment of psychological services and special education programs. (Gjerløff et al., 2014).

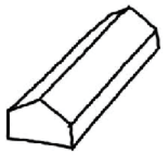
A transformation in school culture also reduced corporal punishment and fostered a more informal student-teacher relationship. (Gjerløff et al., 2014).

Physical punishment had traditionally been an important part of child-rearing, including within schools. In the 18th century, corporal punishment or threats were not considered abuse but rather an integral part of education and maintaining order. It was not only used when the children would refuse to obey, but it was also used as a disciplinary approach and a means of motivation. These punishments were often administered publicly in front of the class to maximize humiliation before teachers and peers, serving as a discouragement to others. Likewise, as with the 'dunce corner,' the primary purpose of punishment was humiliation and discouragement, similar to older public shaming methods like the pillory. By the 1930s, these punishments became more discreet and were carried out away from public view, often taking place in private settings such as the principal's office. (Gjerløff et al., 2014).

Photo 5. Classroom. Randers State School

[school timeline]

The information presented in the timeline is based on following sources: (Uddannelsesudvalget, 2007), (Skole-forældre.dk. (2017),(Drejer, C.M. (2023)



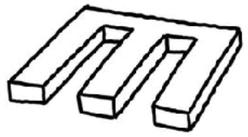
Freestanding building, typically located in the center of villages

THE VILLAGE SCHOOL
1720-1880

Large central School that gathers students from larger areas. Classrooms are placed along a corridor on each level

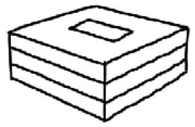
MULTI-STORY SCHOOL
1880-1930

RANDERS STATE SCHOOL
1923/1925



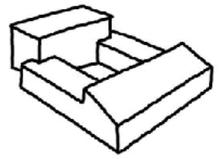
A building sectioned into branches, where each branch contains a specific function

THE FACTORY-MODEL SCHOOL
1960 - 1970



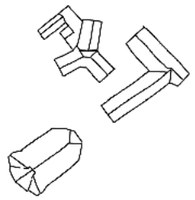
An atrium centered within the building. Classrooms have large windows. Facade is typically concrete or brick

THE ATRIUM SCHOOL
1930 - 1945



School model that supports a teaching strategy that involves students in project-oriented learning

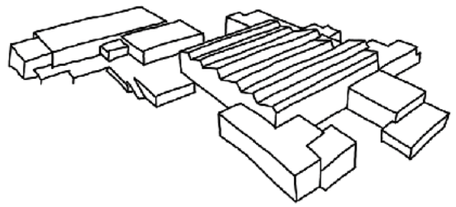
OPENPLAN SCHOOL
1970 - 1980



WALDORF SCHOOL
// AALBORG 1983

Both students and teachers are considered in the design of the school and common areas. Buildingshape varies

THE PROJECT-BASED SCHOOL
1990 - 2013



Winner of:
School of the year, 2024

DYBKÆRSKOLEN
2024

1700

1800

1900

2000

TODAY

"School is where the teacher held School"

1780

School became a standard part of childhood

EDUCATION REFORM
1814

DEVELOPMENT OF PEDAGOGICAL IDEAS
1850

Jean-Jacques Rousseau

POWER PERSPECTIVE
LATE 1800

COMMON CHARACTERISTICS OF SCHOOOL BUILDINGS:
Bodily, spatial, and temporal discilining

WALDORF PEDAGOGY
1919

Establishment of the first Waldorf School in Stuttgart

PUBLIC SCHOOL LAW
1958

A desire for equality and community

No division based on ability

1990

Shift towards a culture of evalutation and measurement

NATIONAL TESTS AND MANDATORY FINAL EXAMS
2007

PUBLIC SCHOOL REFORM
2014

// Longer school days for the oldest students
// 45 minutes of daily physical activity integrated into the school day
// Implementation of supplementary teaching

III. 6. School timeline

[sum-up]

Schools and prisons emerged from societal needs for discipline, control, and integration, shaped by historical processes of institutionalization, normalization, and power dynamics. Institutionalization refers both to the establishment of norms and the creation of physical spaces to enforce them. Michel Foucault further explains power as a mechanism that shapes individual behavior through macro power (laws, regulations) and micro power (discipline, surveillance). The institutions use these techniques to regulate individuals, thereby reinforcing societal norms.
Historically, prisons transitioned from punishment-based models, such as retribution and torture, to rehabilitation-focused systems influenced by the ideas from the enlightenment period. Jeremy Bentham's panopticon exemplifies disciplinary control through surveillance, by the imaginary gaze. Today, prisons emphasize reintegration through education and work programs, yet they remain instruments of societal control.
Similarly, schools evolved from informal, locally governed education to state-regulated institutions, particularly after the danish education reform of 1814, which made schooling compulsory. The 20th century introduced child-centered learning, moving away from rigid discipline while still shaping behavior through structured environments.
While Foucault critiques institutions as mechanisms of control, regulation and structure are not inherently negative. Both schools and prisons impose discipline but also serve essential functions in maintaining order and preparing individuals for participation in society. The challenge remains in ensuring these institutions adapt to societal changes while balancing control with individual agency.

[conclusion on earlier hypothesis]

"If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and operational similarities, as evidenced by patterns identified in historical, sociological and philosophical research."

The initial hypothesis addresses the historical conditions and institutional similarities between schools and prisons. Based on the investigation, they do have structural and operational parallels due to their shared historical origin, this being state formation through societal control, discipline and normalization. In both schools and prisons it is evident that Foucault's notion of power (macro- and micro-power) is a tool that shapes behavior.

Some key structural and operational parallels are; (1) purpose, preparing individuals for societal integration, (2) control and rules, clear authority structures, enforcing and ensuring that the institution's rules are upheld, (3) surveillance, regulation behavior and ensure discipline through physical space and monitoring and (4) disciplinary measures, if individuals don't comply to the rules there are punitive measures.
Although the ideas and methods have evolved over time the architectural elements which influence behavior continue to play an important role in shaping individuals and their experience. For this reason the initial hypothesis is revised, with a vast focus on architectural elements and their effect on the experience of a space.

Photo 6. Control room at Horsens State Prison

02

prison 50 x school 50

[revised hypothesis]

“If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and psychological similarities, shaping the experiences of individuals within these spaces.”

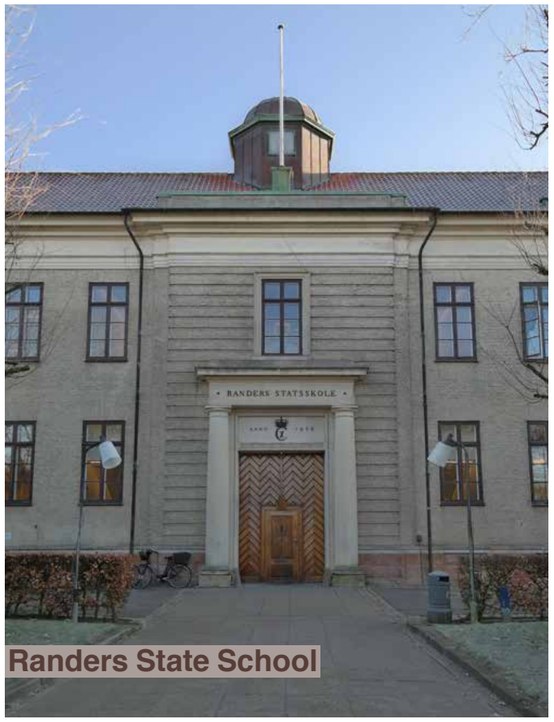
Photo 7. Watch hole at Horsens State Prison. Gaze in to the prison cell

[observational analysis]

A study trip to Horsens State Prison and Randers State School was undertaken. At Horsens State Prison, a guided private tour was conducted with a current prison guard, followed by an interview with Anders Sørensen, the museum inspector (appendix 1). Horsens State Prison was the first modern prison for its time in Denmark and now functions as a museum.
Randers State School, which has served various educational purposes throughout history, was selected due to curiosity sparked by its structural similarities to Horsens State Prison.

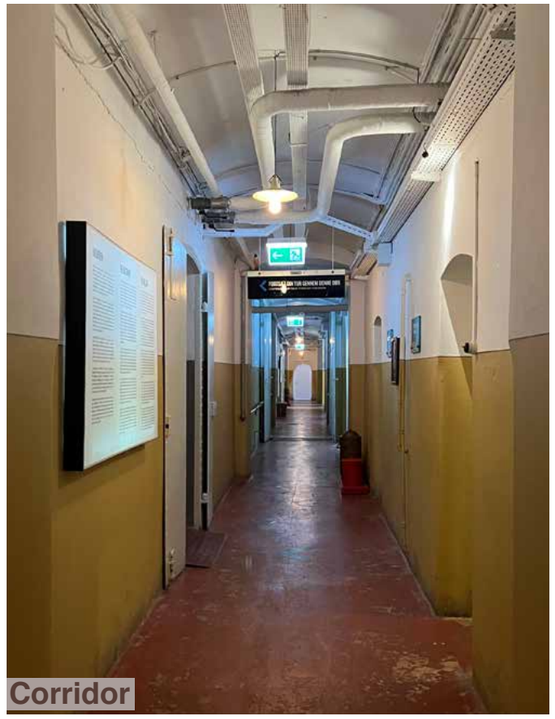
The purpose of the trip was to observe structural and psychological similarities between the two institutions and extract common parameters for further investigation. These observations led to the identification of key psychological and architectural focal points, which are elaborated on below. Ultimately, these focal points will form the foundation for certain design criteria.

Horsens State Prison Entrance



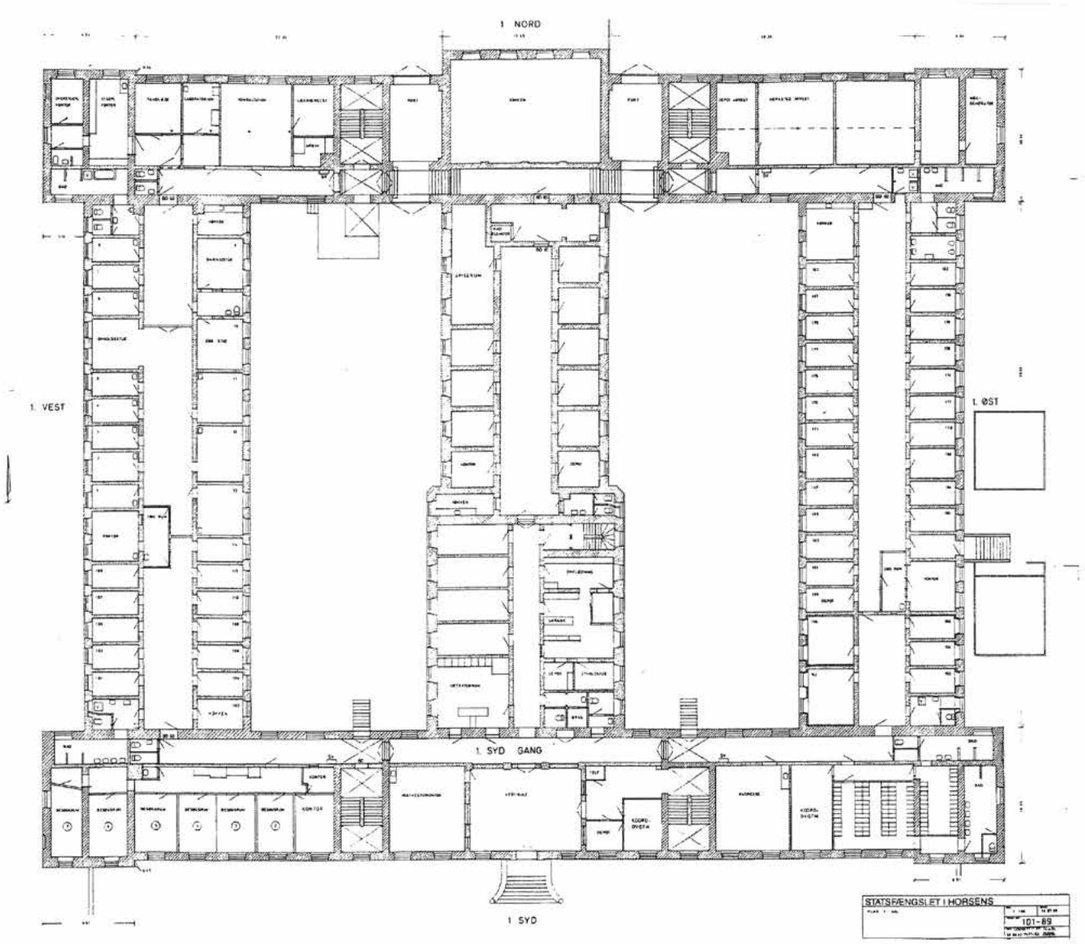
Randers State School

Courtyard


Corridor

Window

Photo 8. Similarities between Horsens State Prison and Randers State School. Prison in the left column, school in the right column.



Ill. 7. Floorplan. 1. floor. Horsens State Prison

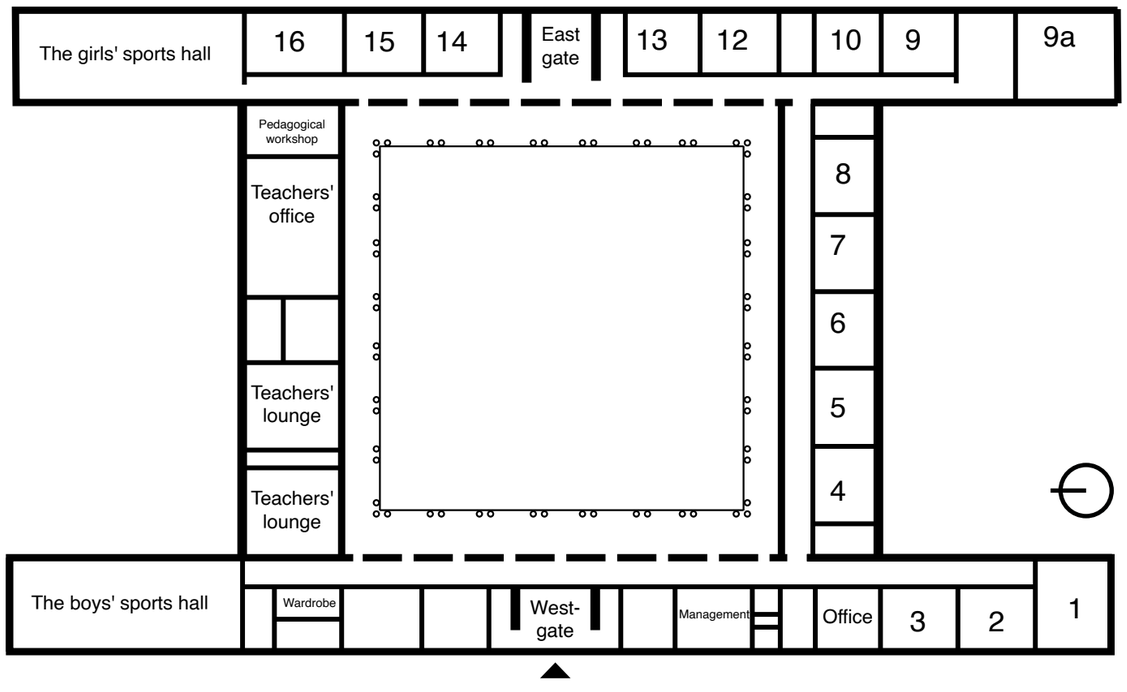
[horsens state prison]

On 25th June 1842, the Danish prison system was reformed and modernized by introducing the two systems - the Philadelphia and Auburn system - which were discribed in the prison section. This laid the foundation for Horsens State Prison. (Horsens Leksikon, n.d.)

Horsens State Prison was established in 1853 as Horsens Tugthus and was designed by architect and royal building inspector Frederik Ferdinand Friis (1793–1865), who also designed Vridsløselille Tugthus. Tughthus was defined as a correctional and work institution for criminals of serious crimes, who were forced to perform hard physical labor (Sørensen, 2025).
Following the new criminal law in 1930 Horsens Tugthus was abolished, and turned into Horsens State Prison. The prison remained operational until its closure in 2006, after which it reopened in 2012 as a museum. (Faengselshistorie.dk, n.d.).

Architectural composition
The prison consists of four wings and a central wing - two horizontal and two vertical. The layout of the prison and its surroundings was important, not only to maintain order and surveillance, but also for helping the guards to navigate within the facility. When the prison was operational, guards could not communicate via their ‘radio’. Due to the uniform appearance of the hallways, it could occur as a challenge for new guards to navigate, when patrolling or escorting inmates. They would look out the windows and rely on landmarks as an orientation tool. (Guided tour)

The prison aims for maximum oversight with minimal staffing, following panopticon principles, evident in e.g. its long, panoptic corridors that allows for constant surveillance (Kilderne.dk, n.d.). Until 1933, the night cells in the prison’s east and west wings were designed to lock the inmates in all night. These 3,2 m2 windowless cells were located in the middle of the room, back-to-back, with no visible light and minimal airflow (ill. 7). A major renovation was carried out after 1933 to meet the new standards. The night cells were expanded across four-stories, with 6,3 m2 single cells running along the outer walls and equipped with a window each. The staircase in the middle of the corridor created a view through the four stories forming the panoptic corridors, which can still be visited in the prison’s central wing, called Gammel Celle. Horsens State Prison became a prison, holding many inmates with psychopathic tendencies and other psychological challenges. The panoptic arrangement had a negative effect, as the inmates triggered each other due to the noises and stress, which subsequently lead to a rearrangement in the cell system in the other wings (Sørensen, 2025).



Ill. 8. Ground floor. Floorplan drawn from (Randers State School, n.d.)

[randers state school]

In 1919 it was decided to build the school building, we today know as Randers State School. The classically inspired building was designed by the Danish architect and royal building inspector Hack Kampmann (1856–1920). In 1992, the school celebrated their 450th anniversary, but its history is even richer and longer, dating back 100 years, when it was functioning as a priest school (pebling school) (Randers Statsskole, n.d.). The school had several challenges throughout time due to financial struggles, declining student count, the Swedish wars, and the plague. Consequently leading to several relocations until 1853 when Randers city decided to build a new, contemporary school building on the existing site at the time - the first building specifically designed for school purposes.

Architectural composition
Structurally, there are some parallels to be drawn between the design of Horsens State Prison and Randers State School. Randers State School also consists of four wings - two horizontal and two vertical - which form a square-shaped, surveilled courtyard: the schoolyard. The main entrance is located in the west wing, with the principal's office found along the corridor.

The layout is repetitive, consisting of classrooms along the façade and long hallways facing the courtyard. (ill. 8) This creates panoptic corridors - linear spaces where movement is limited from one classroom to another. There is little incentive for students to stay in the hallways, as they offer no secluded areas and make individuals highly visible. The design makes it possible for the principal to walk the corridors and observe the classrooms, while maintaining order.

Today, the school has implemented small work areas with couches in the corridors along the classrooms. These work areas result in long, narrow corridors that function as transit spaces, and offer little opportunity for casual social interactions.

[thematic aspects]

The following aspects are focal points, as mentioned in the introduction, that were extracted from the observations made from both case studies.

ASPECTS	PSYCHOLOGICAL	ARCHITECTURE
FLOW/ PASSAGE	◦ CONTROLLED FLOW ◦ LIMITED AUTONOMY ◦ DISCIPLINE & ORDER ◦ RIGID PHILOSOPHY ◦ SENSE OF DISPLACEMENT	◦ NARROW CORRIDORS ◦ LONG CORRIDORS WITH NO BREAKOUT AREAS
THE GAZE	◦ SURVEILLANCE ◦ BEHAVIOR REGULATION ◦ POWER DYNAMICS ◦ STRESS & VULNERABILITY	◦ SPATIAL ORGANIZATION ◦ TRANSPARENCY (MATERIALS) ◦ OPENNESS VS PRIVACY
SIGHTLINES	◦ SENSE OF DISCOVERY ◦ SENSE OF SECURITY & SURVEILANCE	◦ UNOBSTRUCTED PATH ◦ COLUMNS, ARCHES ◦ UNDISTURBED AIR MOVEMENT
DISTRIBUTION	◦ SEGREGATION ◦ HIERACHIES ◦ TERRITORIALITY ◦ AUTONOMY VS. CONTROL ◦ EMOTIONAL GEOGRAPHY	◦ ZONING & FUNCTIONAL SEGREGATION ◦ HIERACHY OF ACCESS ◦ CIRCULATION CONTROL
CONNECTION BETWEEN INSIDE & OUTSIDE	◦ SENSORY STIMULATION ◦ AWARNESS ◦ SENSE OF CONFINEMENT VS. FREEDOM ◦ MENTAL HEALTH	◦ WINDOWS & DOORS ◦ PURPOSE, SIZE, PLACEMENT
DAYLIGHT	◦ WELL-BEING ◦ COGNITIVE FUNCTION ◦ PERFORMANCE ◦ DIGNITY	◦ WINDOWS & DOORS ◦ PLACEMENT, ORIENTATION, SIZE, GLAZING

Table. 1. Table of key notes from the observational analysis

[flow]

The flow of the building was a noteworthy observation that was pervasive in both case studies. The building layouts of Randers State School and Horsens State Prison are remarkably similar, both consisting of four wings that together form a central courtyard. Both cases exhibit a regimented flow within a controlled environment, characterized by straight lines and sharp edges, which amplify the sense of discipline and order. Yet, while one institution allows its ‘occupants’ free will, the other enforces strict rules, leaving them with no rights of their own.

Randers State School follows a structured flow, reflecting the rigid educational philosophy of the time it was established. The school was designed for students to attend class, where the teaching took place, and in many instances, a hall pass was required to use the bathroom or be excused. This strict regulation only strengthens the sense of displacement when wandering through the narrow corridors, which serve exclusively functional purposes and induce a feeling of exposure in a space devoid of belonging. Parallels can be drawn between prisons and schools, where inmates are confined to their cells and only permitted to move under the supervision of a guard.

Ill. 9. Flow in the corridors at Horsens State Prison

[sightlines]

Sightlines are a powerful tool in architecture, shaping how individuals interact with their environment. To understand the principles of sightlines, one must first understand human perception and vision. Sightlines are unobstructed paths that the eye follows, guiding the visual focus and movement while enhancing the aesthetic appeal. They highlight features and frame views, and when successfully integrated, they evoke emotions and create a sense of discovery (DesignHorizons, 2024). At Horsens State Prison and Randers State School the sightlines are highly controlled and clear, fostering a sense of security and surveillance, whereas broader views can evoke a sense of freedom.

Sightlines can manipulate space, perspective and scale, making the space appear larger or smaller and creating a sense of comfort or confinement. Architectural elements such as columns, arches, and ceiling treatments help enhance sightlines, enriching the character and identity of a space. By implementing coffered ceilings with a central focal point, attention is directed upward, creating the illusion of greater height (DesignHorizons, 2024) see image 10. In a corridor with a sequence of arches - or in Horsens State Prison and Randers State School, a sequence of doors - a rhythmic flow is created by the eyes, which improves navigation (DesignHorizons, 2024).

Additionally, unobstructed sightlines can improve air circulation and indoor air quality by facilitating undisturbed air movement. Cross-ventilation can also be achieved by either aligning windows and doors along the sightline or by connecting multiple floors, whereas vertical sightlines encourage the stack effect (Hellwig, 2023). This principle is also applicable for distribution of light. Consequently, enhanced ventilation and daylight measures can reduce energy consumption.

Ill. 10. Sightlines in the corridor at Randers State School

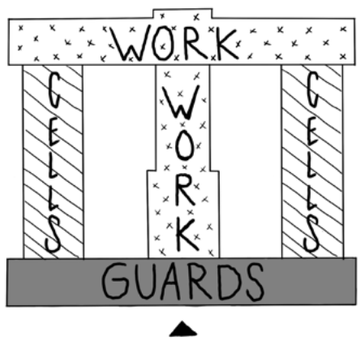
[the gaze]

Ill. 11. Principals office at Randers State School

The gaze refers to the gaze of the person in authority - the watcher - and the students or inmates being watched. The feeling of being watched shapes the individual's behavior. Architecturally, the gaze can be controlled through, for example, window placements, corridors, visibility, surveillance, and openness. School and prison corridors alike are designed with simple layouts that allow visibility through windows in the doors of each space (Stock, 2024).
By applying tools such as the teacher's gaze or the supervisor's presence in the corridor, the classroom becomes an ideal panoptic space for discipline and learning. This reinforces panopticon theory, ensuring that students are on their best behavior at all times. The image (ill. 11) shows how, at Randers State School, the door from the principal's office to the corridor has glass in it. He can observe and keep an eye on what is happening in the corridor, and one could imagine students lowering their voices and walking more quietly when passing through that specific corridor. Furthermore, his office is placed in the middle of the corridor and near the building's entrance, making it difficult not to pass by on the way to class.

Not only can the corridor be a panoptic space, but the classroom also embodies this concept. Through mechanisms like the teacher's gaze, students come to perceive themselves as being under constant surveillance, reinforcing the classroom as a panoptic space for discipline and learning (Stock, 2024).

[distribution]



Ill. 12. Distribution of functions at Horsens State Prison

The distribution of space within the two institutions is quite similar and can be categorized into two main aspects: architectural distribution and segregation. Architecturally, the layout of both buildings is structured with wings - both horizontal and vertical - creating a central courtyard. At Horsens Statsfængsel, the north wing was reserved for civilian staff, with no inmate access (ill.7). The prisoners were housed in the east and west wings, while the south wing was used for outdoor activities and labor. Inside the prison, long corridors were lined with cells facing the façade, while the guard's office was centrally located, allowing for surveillance of inmates and work areas.
This pattern is recognizable at Randers Statsskole, where the basement serves as a common area for lunch and working spaces, while the ground and first floors contain classrooms distributed along the façades. The principal's office is located along the corridor among the classrooms. The door frame consists of two doors; a solid door facing the corridor, allowing for privacy when needed during important meetings, and a door facing the office and featuring a large window, which maintains two-way visibility in the corridors. In both institutions, the presence of an authoritative figure serves as a reminder to ensure order and discipline among students and inmates alike.

Another way Horsens Statsfængsel and Randers Statsskole are distributed is through segregation. Danish prisons imprisoned women and men in men's prisons until 2020 when Jyderup Prison became Denmark's first and only women's prison (Kriminalforsorgen, n.d.). Following the gang wars in the 1990s between the Hells Angels and Bandidos, an increasing number of gang members were incarcerated in Danish prisons. At Horsens Statsfængsel, an all-men's prison, a political decision was made to isolate gang members from the other inmates by establishing a separate section dedicated to them.

The "gang section", as they called it, was designed to prevent conflicts and tensions between inmates. Within this section, gang members had their own facilities and were responsible for their own cooking and cleaning (Janne, Prison guard).

In 1449, when Randers Statsskole operated as a priest and later Latin school, it was exclusively for men, as women were not allowed to pursue this education until 1948. Today, Randers Statsskole functions as a gymnasium with both boys and girls. Students are now distributed according to educational segregation, and not gender or status as back in the days.

[daylight]

Access to natural light in prison has both psychological and physical effects, which can worsen an inmate's well-being and negatively influence the rehabilitation process. This is due to the failure to meet the foundational conditions necessary for rehabilitation. (Gjocaj, 2024) A lack of natural light makes inmates feel disconnected from the outside world and isolated, reinforcing the deprivation of freedom.
Daylight has a significant impact on students' health and behavior, particularly in regulating the circadian rhythm. When the circadian rhythm is disrupted, it can affect cognitive function, leading to decreased focus and productivity. Sunlight exposure also triggers the release of serotonin, which is associated with the feeling of happiness and well-being (Gjocaj, 2024) Additionally, a lack of natural light can contribute to the onset of seasonal affective disorder (SAD), particularly during periods of reduced daylight, such as the winter months (Gjocaj, 2024).

Ill. 13. Window placement in cell at Horsens State Prison

Beyond its impact on health and behavior, numerous case studies have shown that daylight directly influences students' academic success, cognitive performance, and overall well-being. Research indicates that students perform better in well-lit classrooms, demonstrating higher engagement and improved test scores. (Boyd, 2022)
Natural light is also linked to improved mood and reduced stress. In schools, it helps create a more positive and inviting learning environment, promoting student engagement and motivation. In contrast, excessive artificial lighting may negatively affect student participation and performance. (Jenzen, 2024)

Other elements in architecture can be precisely determined, except for daylight (Rasmussen, 1957). It changes throughout the days of the year both in color and in intensity (Rasmussen, 1957), altering our perception of the space as well. Daylight is not merely a physical consideration; it carries symbolic meaning. It represents the pursuit of enlightenment, with the teacher guiding students out of darkness and encouraging them to make "good" choices, such as sharing space and forming friendships. Additionally, light and open spaces ensure that students remain visible, highlighting the significance of the gaze in maintaining discipline and observation. (Stock, 2024)

In summary, (day)light is crucial to human well-being as it improves cognitive performance and function, enhances mood and health, and regulates circadian rhythms.

[inside >< outside]

Ill. 14. View from the window in a cell at Horsens State Prison

The connection between inside and outside happens through the window, which acts as a powerful medium. The design of windows - their placement, size, and purpose - ultimately reflects the institution's intentions. Windows can influence power dynamics, behavior, and mood, either by imposing control and restriction or by encouraging engagement and learning.

A small window, in a prison, provides a limited glimpse of the outside world, which remains out of reach. This can make a space feel more oppressive, reinforcing a sense of confinement and deprivation of freedom, and accentuating the inmates' lack of control and separation from society. In contrast, larger windows create a more open and inviting space, reducing the feeling of entrapment or isolation, enhancing creativity and reducing the sense of restriction in school.

The location of a window depends on its function; it may be designed solely for daylight entry or to provide a view. In Horsens Statsfængsel, as in many other prisons, the barred windows in cells were not intended for observation or connection to the outside world but merely to allow some light to enter. This is evident in their high placement, out of the inmate's line of sight. Studies show a direct association between mental health outcomes and views of nature. In prisons, limited access to windows with a view of nature can make inmates more prone to negative social interactions. (Gjocaj, 2024) In a school environment, however, a connection to nature and the outside world can stimulate students, improve focus, and provide a sense of time.

Operable windows offer psychological benefits by providing a sense of personal control over the environment. Unlike prisons, where barred, fixed windows deprive inmates of this autonomy - increasing feelings of powerlessness - operable windows give individuals peace of mind, knowing they have control over their surroundings. Additionally, operational windows allow for ventilation and temperature regulation, letting in fresh air, which enhances well-being and creates a more comfortable space. The fresh air and scents creates a sensory and physical connection to the outside world.

[design drivers 0.5]

Flow and sightlines
Sightlines must enhance daylight distribution to improve students cognitive performance

A dynamic flow through common areas must create sightlines that support children's creativity, play and social interactions, through moments of discovery

Distribution
Architectural distribution must define areas for the early, middle and upper years students supporting their pedagogical developmental needs, while creating shared spaces which afford informal interaction and a sense of community

Connection between inside and outside
Design a physical connection between indoor and outdoor environments that create hands-on learning spaces

The design must create a visual connection between inside and outside to enhance daylight distribution and stimulate curiosity, foster creativity, and a positive influence on children's behavior and mood

[conclusion on earlier hypothesis]

"If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and psychological similarities, shaping the experiences of individuals within these spaces."

The revised hypothesis addresses the experience of the individual within institutional settings. An observational analysis of Horsens State Prison and Randers State School revealed notable structural and psychological parallels rooted in shared historical and institutional foundations. The two institutions differ in purpose but reveal a variety of similarities. (1) Layout distribution, centralized courtyard surrounded by four-wing building layout promoting surveillance and controlled flow, (2) clear sightlines, reflection Foucault's theory on the panopticon and the internalized gaze, (3) spatial distribution, internal zones reinforcing hierarchy and order, and (4) connection to the outside, windows as both symbolic and functional, to summarize some of the similarities.

While this analysis does not reflect all schools and prisons—and acknowledging that modern institutions have, to some extent, evolved from these rigid layouts—the underlying spatial logics and behavioral strategies often remain embedded in the origins of these institutional models. This conclusion is not to say that schools are prisons, but that their institutional frameworks share common DNA, which shapes the experience of space, authority, and autonomy. Comparing prisons to schools enables a critically understand the origin of institutional design logic, uncover subtle ways control can be embedded in space, and lastly create knowledge to intentionally design something more humane and empowering learning environments.
Furthermore, this investigation doesn't conclude that, e.g., surveillance is inherently bad or that architectural distribution and segregation are either. While some feel like they are being watched, others feel safe knowing there is an authority nearby. Furthermore, architectural distribution and segregation can help with creating a space with a sense of belonging for students and a smaller community within the larger one. This emphasizes that these parameters are more nuanced than the inherently negative connotations often associated with the words.

For this reason, the hypothesis is revised again to encompass a design for a new school which actively acknowledges the inherited institutional frameworks. Acknowledging this, together with research, helps make informed design decisions. Knowing modern schools have evolved from the traditional way of viewing students, and that they are working with a children-centred pedagogy, it is relevant to analyze their architecture - investigating how they design schools and questioning if this way of designing schools is the right way.

Photo 9. View to the schoolyard at Randers State School

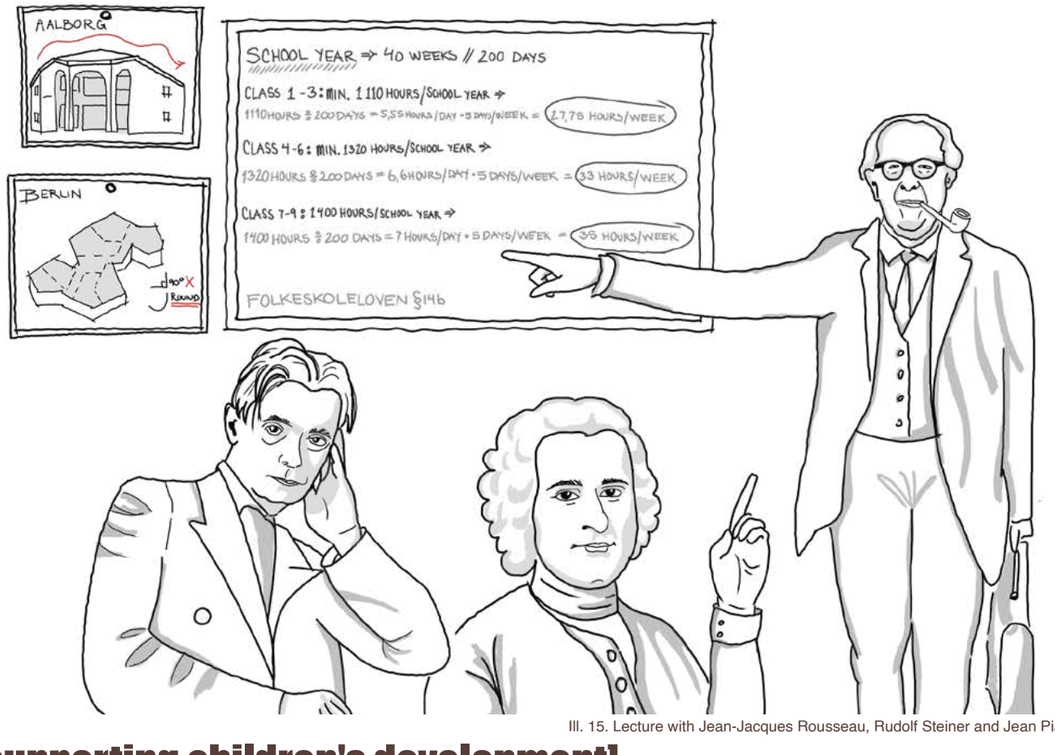
03

prison 0 x school 100

[revised hypothesis]

If schools and prisons evolved from the same historical conditions, then their institutional frameworks will exhibit structural and psychological similarities. By integrating this knowledge together with knowledge about (1) children-centered pedagogy, (2) modern school design and (3) research - investigating the effects of architectural elements on children - it is possible to develop a new school that psychologically fosters a children-orientated and a supportive learning environment.

Photo 10. Cell corridor at Horsens State Prison



Ill. 15. Lecture with Jean-Jacques Rousseau, Rudolf Steiner and Jean Piaget

[supporting children's development]

When designing a school, it is important to be aware of pedagogy. Pedagogy is a science which involves raising, teaching, and educating people (Gyldendal, n.d.). In order to understand how to do so in schools, it is relevant to be aware of children's developmental stages. This information will furthermore help develop an understanding of the necessary architecture that is relevant to support and foster children's cognitive development.
There are a variety of different theories and pedagogical approaches to schooling and children's development. This thesis will investigate Jean Piaget's theory on cognitive development as a starting point for this part, since it creates a foundational understanding of how children develop skills and acquire knowledge. This thesis will further explore both Jean-Jacques Rousseau's and Rudolf Steiner's philosophy of education, as they are more alternative ways of viewing education, and they suggest a different way of schooling compared to the traditional way. The traditional way of schooling in Denmark is influenced by different educational styles such as formation, critical thinking, accountability, child-centeredness, interdisciplinarity, etc. (Danes Worldwide, 2024)

Jean Piaget was a Swiss developmental psychologist, and his theory revolved around the understanding of how cognition and thinking arise and develop. According to Piaget, children learn about the world through an active interaction with it (Nørby, 2024). Illustration 16 illustrates what the key elements in the child's ability to develop skills and acquire knowledge are, at different ages.

As mentioned earlier, this thesis will furthermore investigate Jean-Jacques Rousseau's and Rudolf Steiner's philosophy of education. Jean-Jacques Rousseau, a Swiss philosopher, has had a large impact on our modern education. He believed that human hands degenerated everything good that came from nature. His idea was about letting individuals develop autonomy and independence rather than letting societal standards and values be imposed on the individual too early. He valued experience and exploration over rote memorization and rigid instructions. He believed in an educational system that tailored to each student and valued children's uniqueness, where the educator served as a supportive figure while children acquired knowledge for themselves (Sarkar et al., 2024). Some key aspects of his idea are the following:

- **Child-Centered Education**
- **Learning by Experience**
- **Freedom and Autonomy**
- **Emotional and Moral Development**
- **Natural Development**
- **Importance of Physical Education**
- **Importance of Self-Discovery**

His main contribution to the modern educational system has been child-centered and hands-on learning, among others (Sarkar et al., 2024).

Waldorf pedagogy

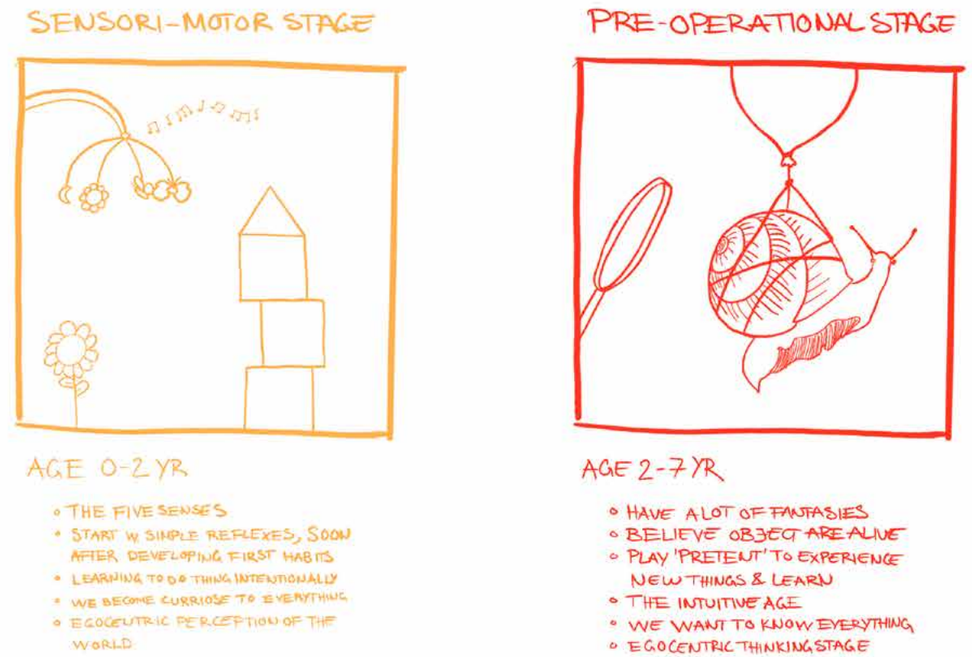
While Rousseau wanted children to be independent during their development and to control their own learning, Rudolf Steiner, on the other hand, believed that without directions from adults and rhythmic patterns, children would be doing numerous activities in a chaotic and superficial way (Lange de Souza, 2012). Rudolf Steiner, an Austrian philosopher, was the founder of Waldorf education. The Waldorf pedagogy encourages a connection between "(...) the intellectual, physical, emotional, social, spiritual and aesthetic aspects of human development" (Lange de Souza, 2012, p. 51) and takes from the principles of anthroposophical philosophy. Anthroposophy, according to Steiner, was the wisdom of humans, and he viewed it as guiding the spiritual in humans to the spiritual in the universe (Lange de Souza, 2012).

The pedagogy was developed on the foundation of a developmental cycle of seven years.

- **0-7: Upright posture (when walking), communication, self-understanding - through movement and exploration**
- **7-14: Emotions, creativity, feelings - through arts and crafts**
- **14 -20: Mental and moral abilities, abstract and complex thoughts**

(Migliani, 2020)

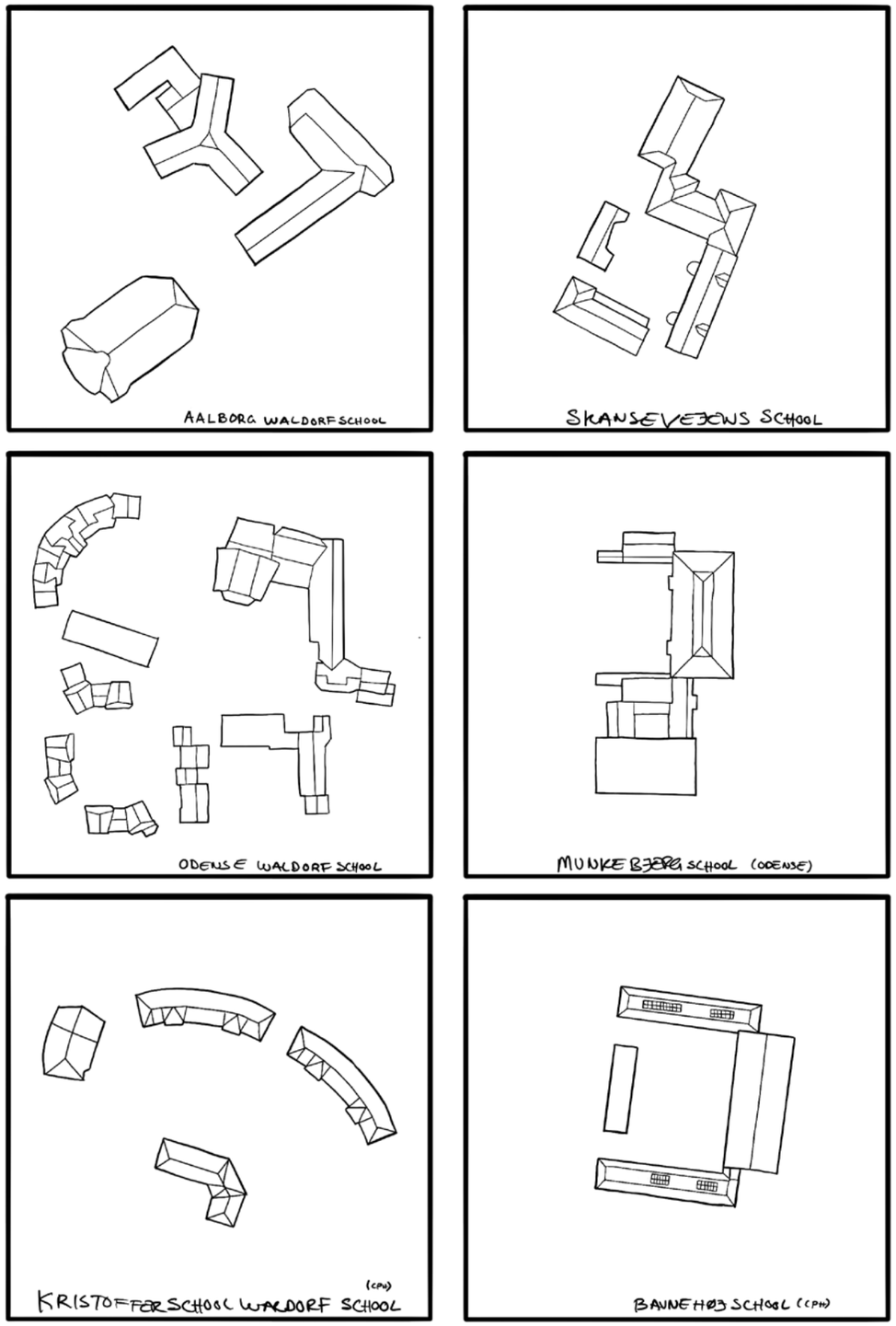
They believe that before one can foster children's intellectual development, their emotional life should be nurtured first. There is a strong focus on imaginative, artistic, musical, and physical work as a way of digesting information and expressing feelings and thoughts. Steiner and his followers suggest that art and artistic ways promote expressing feelings, creating personal connection, different types of learning, socializing, nurturing imagination, creativity, etc.



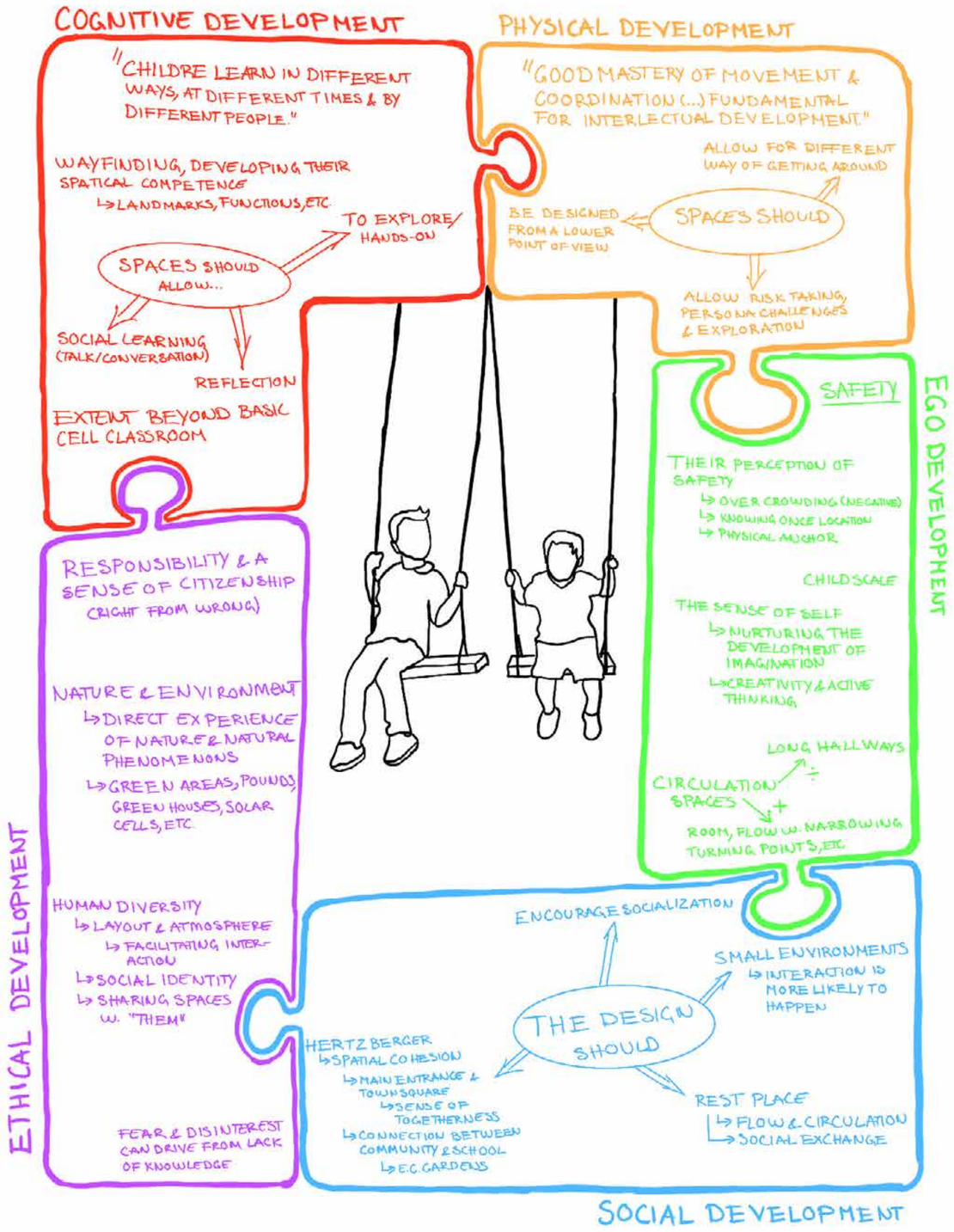
Ill. 16. Jean-Jacques Rousseau's four developmental stages

This would result in individuals who have autonomy that makes them able to create their own opinions about their experience (Lange de Souza, 2012).
In 1919, the first Waldorf School opened (Lange de Souza, 2012), and there are currently 1,092 Waldorf Schools in 64 countries (Friends of Waldorf Education, 2024). The pedagogy style is both liked and disliked by many. There are some crucial aspects that some people are critical about, such as the fact that the Waldorf schools use nearly the same curriculum everywhere and follow the same direction of the first school created in 1919, given by Steiner. The educational framework hasn't evolved with society and neglects the political, economic, cultural, and social aspects of the locations they are established in (Lange de Souza, 2012).

The architecture of Waldorf Schools is highly linked to the Waldorf pedagogy and principles of anthroposophical philosophy - illustration 18 shows three random Waldorf schools compared to three random public schools in Denmark. The developmental stage of the children is reflected in the architecture because the spaces they are in are almost always an active part of schooling. Form, colors, atmosphere, light, nature, and rhythmic elements play a crucial role in shaping spaces that foster their way of doing education. The younger the students are, the more they use organic shapes. As they grow older, the use of shapes becomes more articulated and angular (Migliani, 2020). The architecture of Waldorf schools will be investigated further in the design process.



Ill. 17. The difference in composition between Waldorf Schools and Public Schools



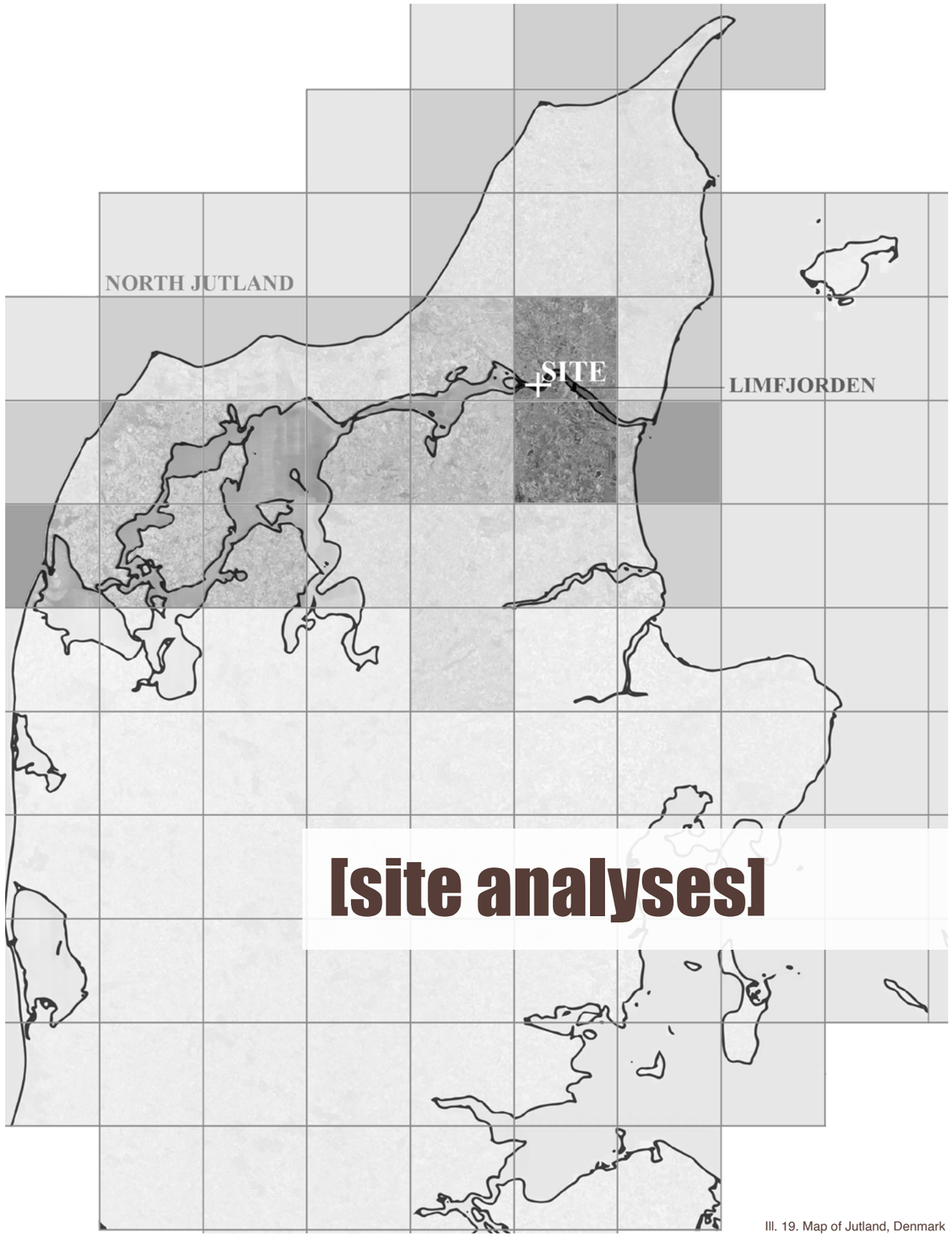
Ill. 18. Supporting developmental stages

[design principles supporting developmental stages]

"(...) the school building and grounds can be considered a three-dimensional textbook, offering curricular information, and helping children learn about social relations and norms (Sutton, 1996)."

(Rigolon et al, 2011, p. 64)

When designing a school, as mentioned before, it is crucial to understand children's developmental stages. Illustration 18 showcases five aspects of children's development where the design has the potential to support cognitive, physical, ego, social, and ethical development. The school building can be seen as a third teacher. The building affords certain behaviors and disregards others; it stimulates the people inside it.
Illustration 18 is based on knowledge from Alessandro Rigolon and Maxine Alloway's article: "Children and their development as the starting point: A new way to think about the design of elementary schools."

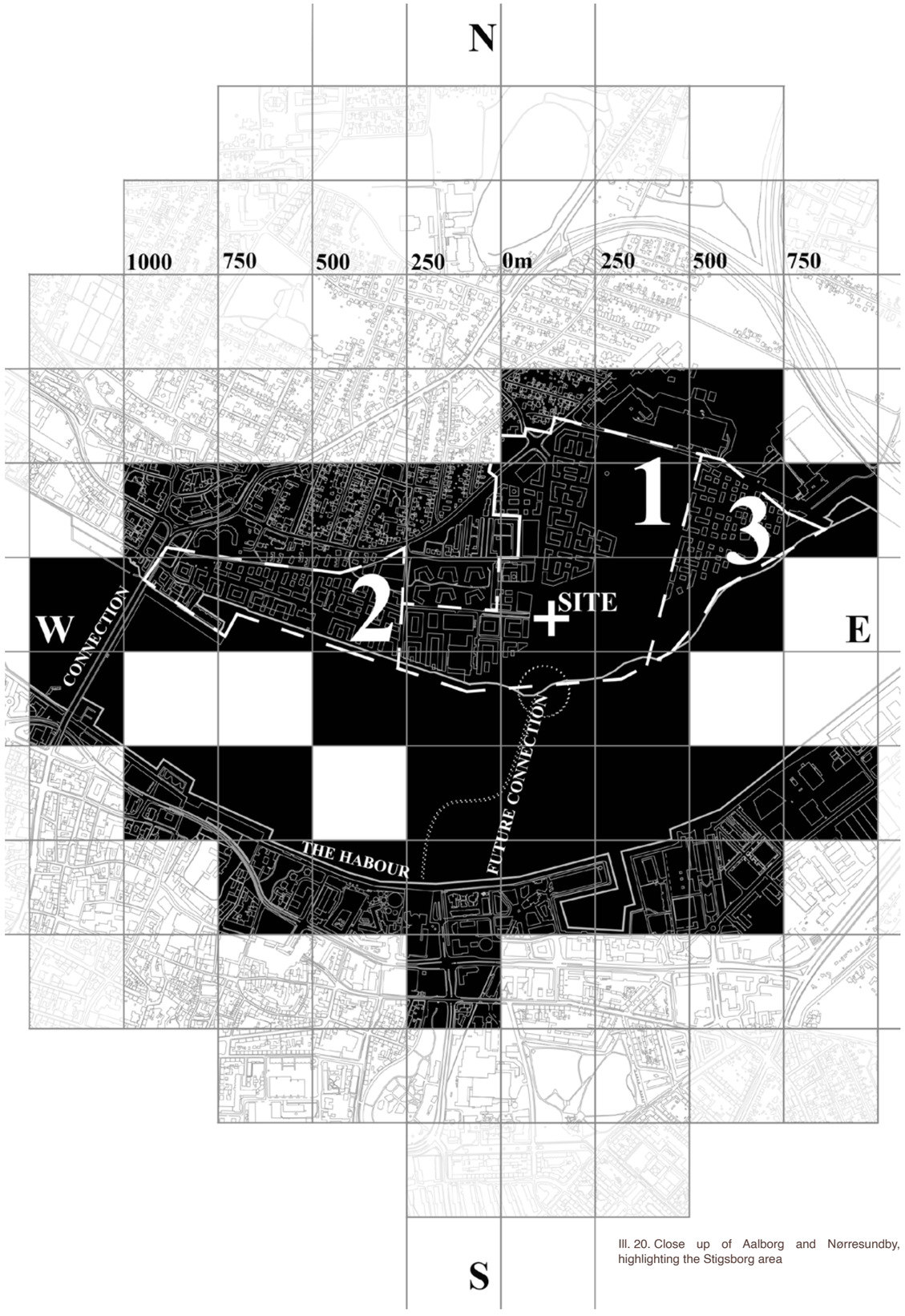


[site analyses]

Ill. 19. Map of Jutland, Denmark

[site analyses & microclimate]

The following section presents a collection of site and microclimate analyses for the project site. The site is located in Northern Jutland, within Aalborg Municipality, in Nørresundby along the harbor. The project site is undergoing large-scale development, transforming into a new city district. As a result, it is currently primarily a construction site. The analyses conducted are based on the development plans for the area, which are under revision during the course of this master's thesis. The phenomenological analysis is based on the portion of the development area that has already been built, as well as the nearby context, providing an expectation for the future area. The microclimate analyses are carried out through a combination of municipal planning documents and original site observations based on the current state of the site.



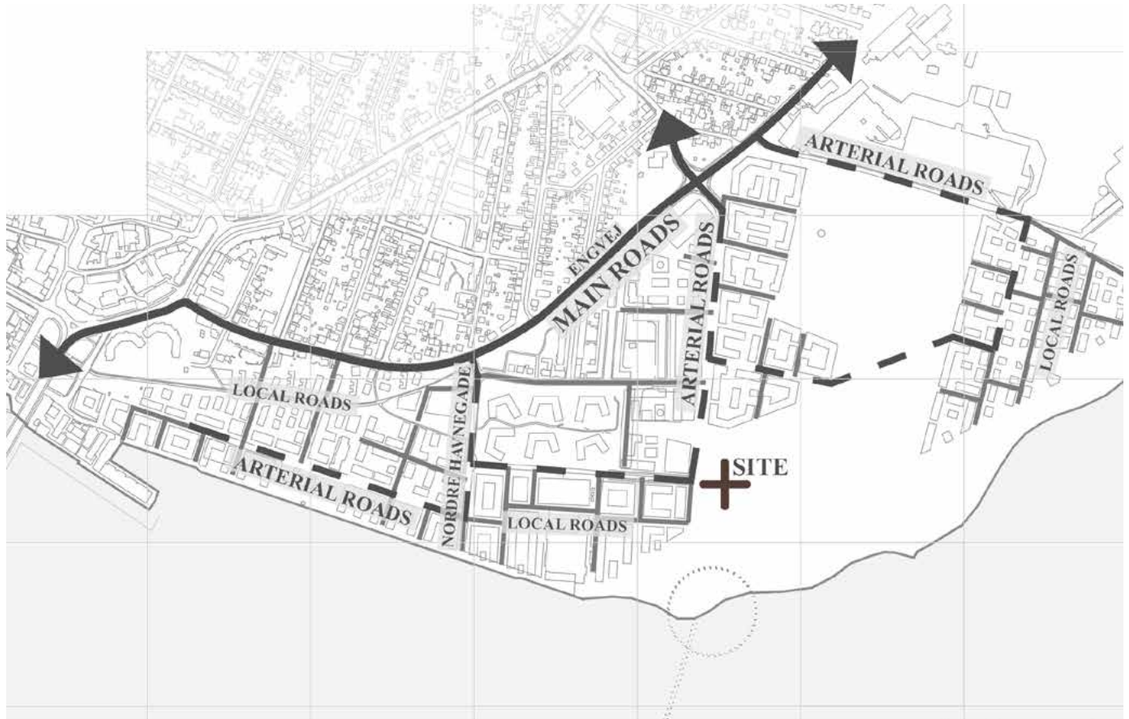
Ill. 20. Close up of Aalborg and Nørresundby, highlighting the Stigsborg area

[municipality vision]

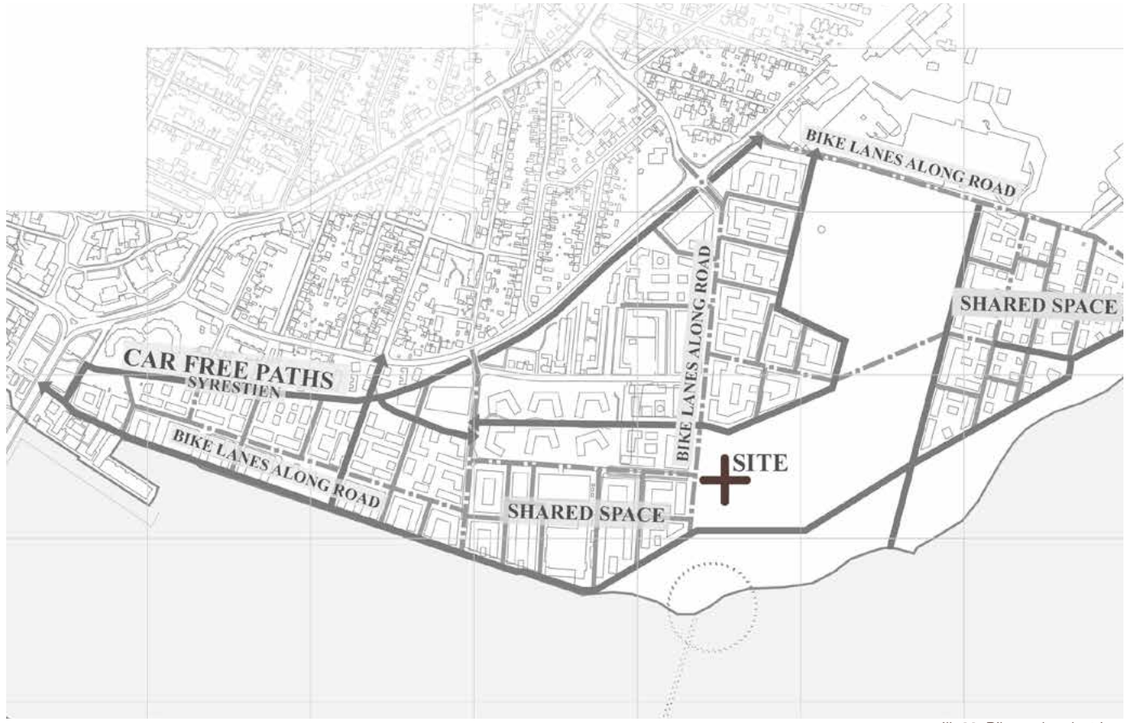
Stigsborg is a city district on the northern side of Limfjorden, across from Aalborg, east of Nørresundby. Stigsborg is one of the development projects that is a part of the larger transformation of Aalborg, from an industrial city to a modern international university city. Aalborg is undergoing a development that does not only focus on new housing and education, but furthermore focuses on creating cultural lighthouse projects as markers of the city. (Aalborg Kommune, 2020) The vision for the area is to create a cohesive Aalborg city centre around the harbour and create a diverse city built on curiosity, quality, diversity and experiments to make Aalborg an increasingly significant growth centre regionally and nationally (Vandkunsten, 2017). The development plan for Stigsborg started back in 2003 and has evolved since then. The area is divided into three stages, each with its own timeframe and character. The three stages are also based on three different neighbourhood formations: Havnekvarteret, Parkkvarteret and Strandkvarteret. The idea of creating a diverse city is also emphasized by the different identities of these neighbourhoods. As a result of the long timeframe for the development of the area, the municipality has dedicated some areas as flexible in order to allow future needs and developments that can't be planned 20 - 30 years in advance (Aalborg Kommune, 2020).

The history of the area
A larger part of Stigsborg was a mound in the Middle Ages, where you could keep an eye out for pirates on the Limfjord. In 1913 the mound was removed and replaced with the first sulphuric acid factory that was built. (Aalborg kommune, 2020)

The Limfjord has historically played an important role in Northern Jutland, serving as a key route for fishing and trade. During the Middle Age, Aalborg became a leading maritime hub, benefitting from the rich herring fishing and maritime trade, fostering significant economic growth. During the 19th century Nørresundby's harbor underwent expansions and modernizations, reinforcing the city's role as a transport hub, laying the foundation for industrial growth (Sarauw et al, 2017). In recent years, Nørresundby's waterfront has been transformed from an industrial area into a recreational urban space, integrating cultural offerings and promenades along the fjord. This development connects the historical harbor activity with contemporary urban experiences (schønherr.dk, n.d.)



Ill. 21. Infrastructure - Cars



Ill. 22. Bike and pedestrian

[infrastructure]

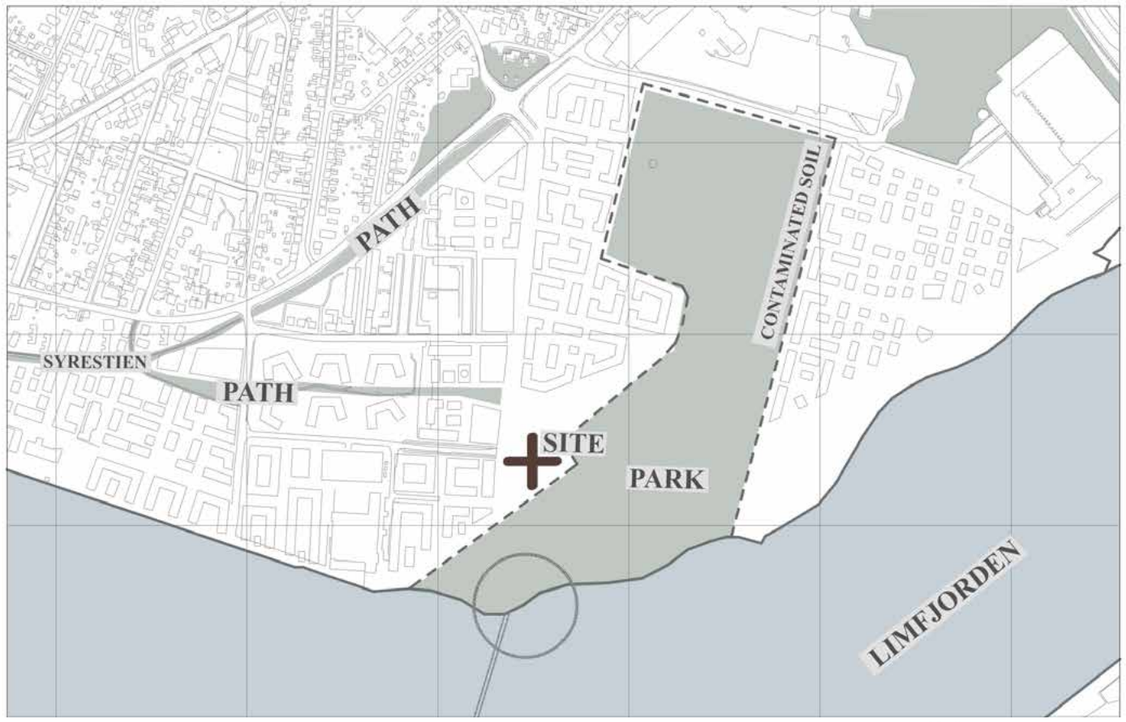
The site is integrated into Aalborg's main infrastructure (ill. 21), which is essential for establishing Stigsborg as an area that opens up to the world. The street structure connects to the existing Engvej via Nordre Havnegade and is a key element in the ambition to create a "city center" character, fostering diversity in both neighborhood and social life. The district's planned density and proximity to everyday necessities encourage residents to leave their cars behind and choose walking or cycling instead (Vandkunsten, 2017).

In Nørresundby, many of the roads are directed towards Limfjorden, creating visual lines. These visual lines are shaped by the topography; the terrain slopes down toward the fjord, forming steep streets that are characteristic of the neighborhood.

In Phase One, three road types are included: main streets, local streets in Havnekvarteret, and local streets in Parkkvarteret. These roads vary in character throughout the area, and the local street system defines the building plots of each neighborhood.

Shared space principles are applied to bicycles and cars to reduce speed in the area (ill. 22). Additionally, in the harbor quarter, cycling takes place alongside the road, while bicycle paths and sidewalks are planned along the arterial roads. 'Syrestien' will serve as the primary green cycling and street connection, running east-west along the old railway track, linking the central city center with the park.

As the area develops, new and upgraded public transportation options will be introduced as a viable alternative to cars, with the shortest distance to a bus stop being 400 meters (Udviklingsplan, 2017). Stigsborg is also working on establishing a bridge for pedestrians and cyclists, providing a strong connection between Aalborg city center and Stigsborg (Stigsborg.dk, 2024).

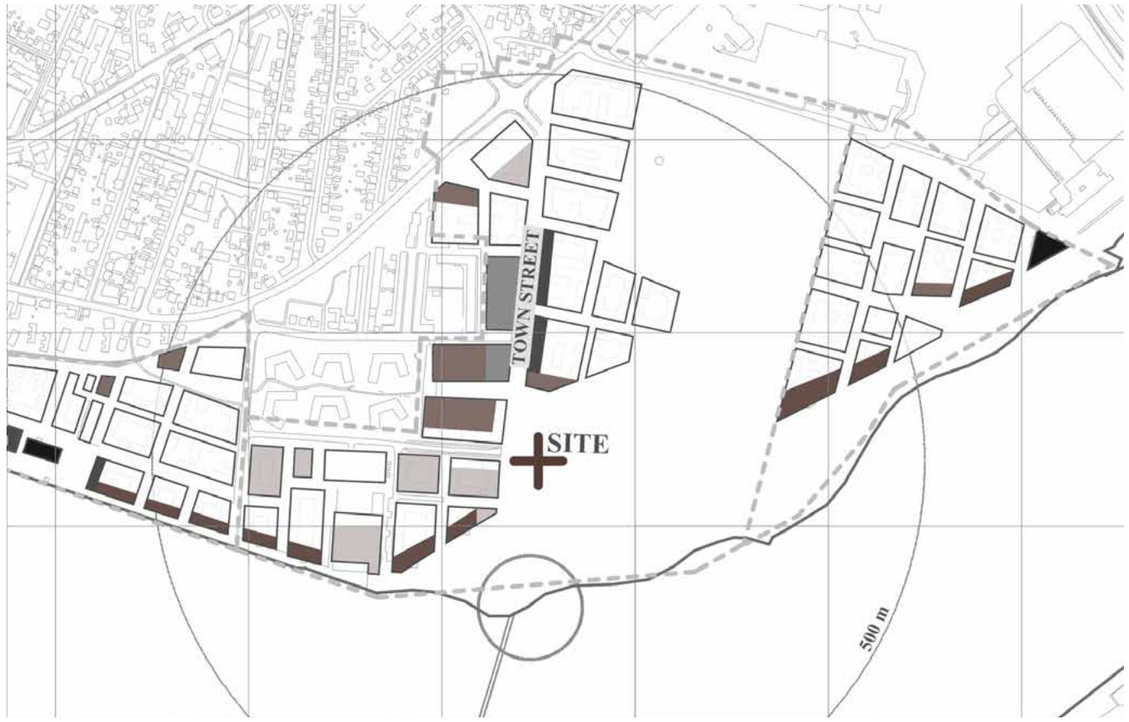


Ill. 23. Green and blue structure

[green and blue structure]

The area of Stigsborg has a noticeable amount of greenery. A large park is under development in Parkkvarteret between Havne- and Strandkvarteret. (ill. 24) The location of the park is a result of the area's sulphuric acid factory history. The area where the factory was located is highly affected by contaminated soil, creating health hazards. Investigations from 2017-18 show that most of the area has a concentration of such a small size that, after cleaning up or covering the areas, it can be used for urban developments (Aalborg Kommune, 2020). The solution decided by the municipality is to cover the entire area, adding a capillary-breaking layer to ensure the contaminated groundwater does not rise to the top layer (Aalborg Kommune, 2020). Furthermore, as mentioned earlier, the paths in the area-especially Syrestien-serve as a green path running east-west, linking the area together and linking it to the existing central city.

The fjord is an important element to the area and to Aalborg in general. The harbor is undergoing a development, giving it different characters and identities depending on the neighborhood. In Strandkvarteret, it is given a more beachy character with sand leading to the water; in Parkkvarteret, the link between water and land is the green, recreative area; and lastly, Havnekvarteret has a more urban character - similar to the harbor on the other side of the fjord. A part of this blue structure is additionally about rainwater and the city's strategy of making it an active part of the urban fabric. This will be further explained later.



Ill. 24. Functions in the area

[urban function map]

The aim of the area is to create a diverse city district with housing, commercial buildings, institutions, and culture (ill. 26). The housing will furthermore consist of mixed typologies that ensure diversity on many levels and ownership types. The three districts will have different degrees of density, which is part of creating diverse identities between them. (Vandkunsten, 2017)

There is a concentration of functions intended to create urban life around the Town Street and the harbor in Stage 1. This way of mixing functions creates a city with life around the clock, and it cultivates a diverse demography.

- Residential
- Commercial
- Institutions
- Restaurants and Café
- Detail
- Office buildings
- Cultural activities

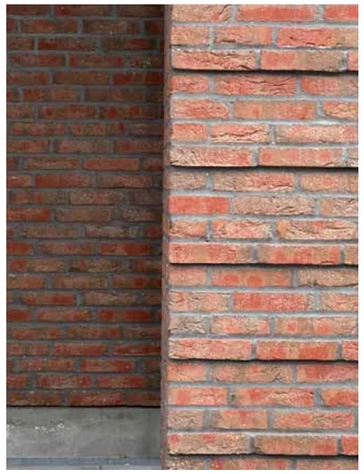
Ill. 25. Collage of Genius Loci

[genius loci]

As Stigsborg transitions from an industrial outpost to a modern city district, its genius loci lies in the balance between memory and progress. Its essence is shaped by the interplay of land and water, where the Limfjord's rhythmic presence meets a growing cityscape defined by renewal and reinvention. Diversity is embedded in Stigsborg's vision. The distinct identities of Havnekvarteret, Parkkvarteret, and Strandparken reflect a layered urban experience. The collage shows how the area is characterized by the dialogue between nature, urbanity, and the fjord. The area is affected by the calmness and loudness of the merging between the built environment and nature. This is also a result of the coastal position, which invites strong winds and shifting lights reflected in the fjord.

Stigsborg and Aalborg share an industrial and maritime history, which is embedded in the city's atmosphere. Elements such as the harbor promenade, sculptural acid tank, and the large green field, which is a result of the sulphuric acid factory that once was there, act as a reminder of the historical values and the Limfjord's essential role. Not only does their shared past connect the two sides, but the fjord dividing them also bridges them together. The two harbors face each other almost like they speak to one another. One cannot walk down the harbor on either side without relating and connecting to the other side.

Ill. 26. Collage of Genius Loci



III. 27. Material Collage of Stigsborg

[materiality and tactile impressions]

To design a site-specific building, it requires an understanding of the context. Through the material collage, the project group has taken a closer look at the details and materiality present on site.

The material collage illustrates the following:

- **How a single materiale can be used to create expression and variation, e.g., the use of brick in different ways through varied brick bonds and depth.**
- **A color palette consisting of red brick, decolored and blackened wood, or steel used on the upper levels of the residential buildings.**
- **The interaction between materials. How hard materials, such as brick, compliment warmer materials, such as wood.**
- **How the urban spaces are experienced as an integrated part of the architecture through repetition of materials.**
- **How material compositions, variation in façade and color variation create tactile and visual experiences that stimulate both children and adults.How well-being and the sensory quality are increased by integrating planted beds and water features into the landscape.**

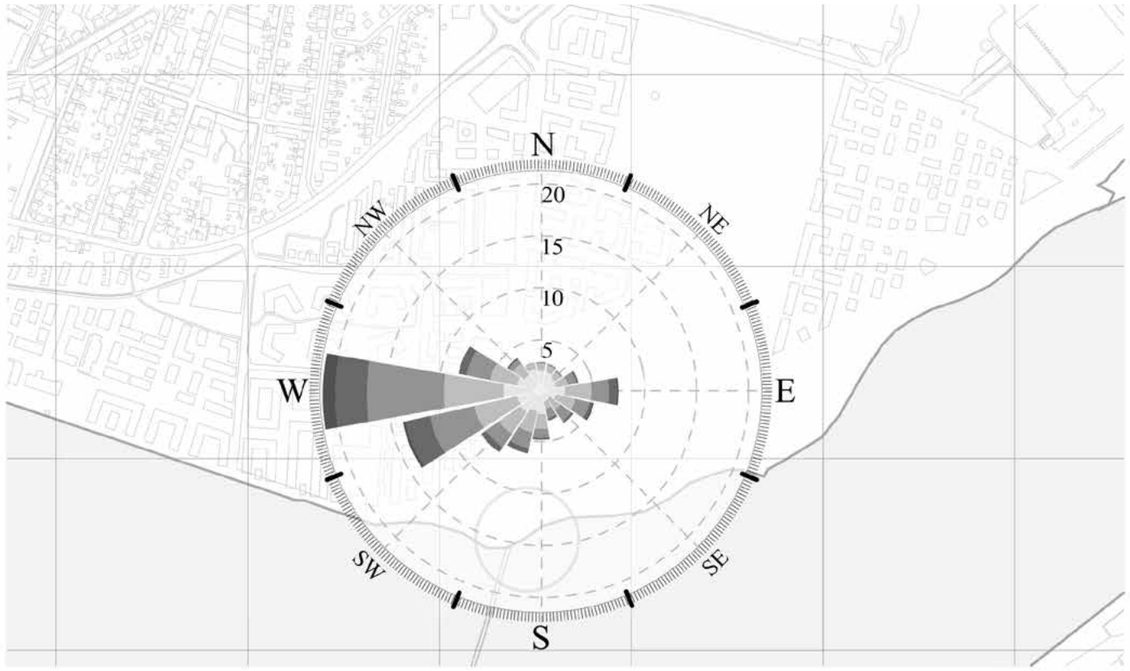
To honor the essence of Stigsborg, the architecture must accommodate the district's diversity, ensuring a coherent area. It must respect the natural elements and the built environment, alongside with the site's history. Therefore, elements from these observations and materials will be incorporated in the design to ensure architectural coherence, respecting the place's genius loci, carrying it forward.

Ill. 28. Rainwater

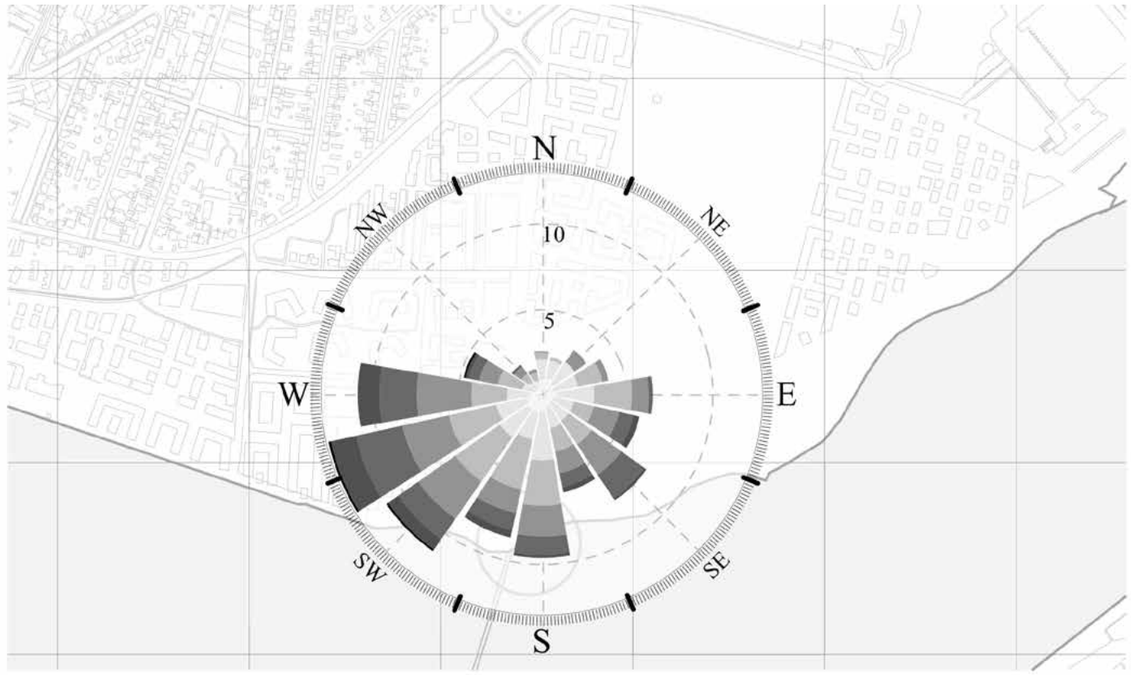
[rainwater]

Rainwater is primarily managed through Sustainable Urban Drainage System (SUDS) solutions, making it both an experiential and visual asset in urban spaces while promoting high biodiversity. ‘Syrestien’ and the roads are integrated into this rainwater management system, featuring continuous open rainwater gutters designed to handle both everyday rainfall and cloudbursts. The collected rainwater is then discharged into the fjord (Vandkunsten, 2017). To safeguard against future sea level rise and storm surges, the district is elevated toward the fjord to a climate elevation of 2.5 (Vandkunsten, 2017).

Photo 11. Stigsborg Harbor



Ill. 29. Wind analysis // April-September

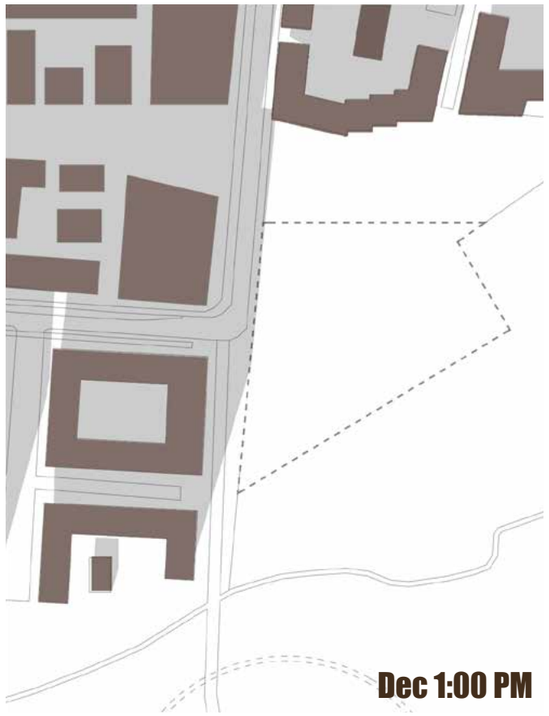


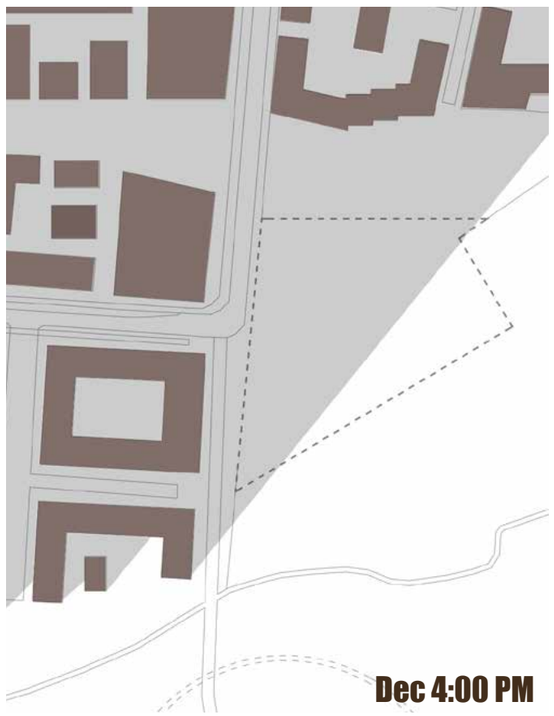
Ill. 30. Wind analysis // October-March

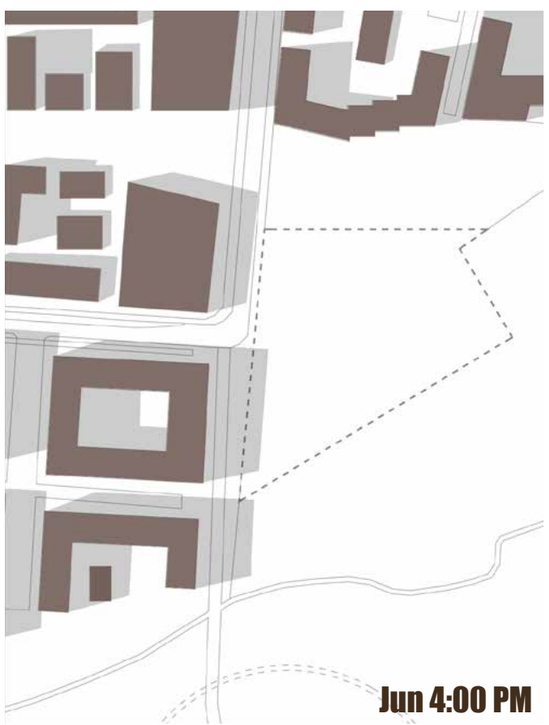
[wind]

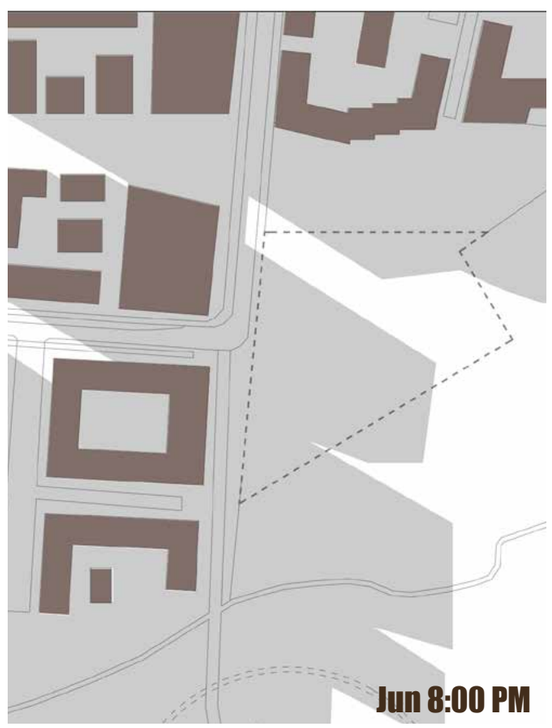
Stigsborg is located in the northern part of Denmark, experiencing a coastal climate heavily influenced by its proximity to the fjord. The illustrations show two wind roses from Aalborg Airport, displaying the wind direction during the colder and warmer months, respectively. The city's wind patterns are characterized by predominantly westerly and southwesterly winds, which are generally moderate to strong. The eastern and southern sides of the site are very flat, due to the green park located there, while the northern and western sides are influenced by housing of four to five storeys. The building heights in the housing area can exacerbate wind tunneling effects. The strong winds have a negative effect on pedestrians' comfort levels, which is important to take into account in the design phase.

- 0.5-1.5 m/s
- 1.5-3.3 m/s
- 3.3-5.5 m/s
- 5.5-7.9 m/s
- 7.9-10.7 m/s
- 10.7-13.8 m/s
- 13.8-17.1 m/s









Ill. 31. Shadow cast on site in the months of december and june.

Ill. 32. Sun path on site

[sun & shadow]

The orientation of the new school building and the orientation of the spaces within play a crucial role in optimizing natural light, thermal comfort, and energy efficiency. By carefully considering the sun's path throughout the day, the project group can enhance both outdoor spaces and the indoor learning environment, creating a more sustainable and naturally lit setting while making full use of the surroundings.

Light from the north and northeast allows for indirect, even lighting. It helps reduce glare and overheating, ensuring a comfortable and productive learning environment.
The south side offers views over the fjord while providing plenty of natural light, fostering a bright and inviting atmosphere. Maximizing south-facing exposure allows for full advantage of daylight and passive heating.
On the west side, the four-to-five-story residential buildings provide natural shading (ill. 31), helping to reduce heat gain in the afternoon and preventing excessive indoor temperatures. Illustration 31 demonstrates how the sunlight interacts with the site throughout the day. It highlights moments when the site is partially and fully shaded, corresponding to high and low sun positioning, respectively.

The east side opens toward a park, ensuring optimal morning sunlight and offering views of a green, calming environment. This contributes to a pleasant and well-lit atmosphere throughout the morning and midday hours, benefiting students' well-being and focus.

[sum-up]

The project site in Stigsborg is undergoing a large transformation, turning into an urban district. As the site is currently under construction and the surrounding area is still in development, the analyses are based primarily on existing plans and the overall vision for the area. The entire area of Stigsborg is divided into three neighborhoods, each with its own identity: one relating to the harbor, one to the park, and lastly one to the beach. The site is placed near the park in the middle of Stigsborg. The area dedicated to the school district is unique. The site is where housing and commercial areas meet the park and harbor.
The history of the area has left parts of the park contaminated, restricting the building site and making it a triangular shape. The buildings in the area architecturally emphasize materiality and sensory experiences, shown by the details in the façades. The area's genius loci needs to be respected by creating a harmonious balance between the past and the future.
Stigsborg's coastal climate is shaped by strong westerly and southwesterly winds, influenced by its proximity to the fjord. While the park to the east provides open, unobstructed space, the western residential buildings can create wind tunnel effects, impacting individuals' comfort. Sunlight exposure varies across the site, giving a variety of potentials, with indirect light from the north reducing glare and strong southern exposure enhancing warmth and energy efficiency. The western buildings provide afternoon shading, and the east-facing park ensures morning light. Rainwater management integrates Sustainable Urban Drainage Systems (SUDS), using open gutters, rainwater ponds, and elevated infrastructure to mitigate flooding and support biodiversity.

[DGNB]

To foster a supportive learning environment for children, the project group should not only focus on the pedagogy but also consider the physical environment in which they are situated. By incorporating DGNB, the focus is on indoor climate and the development of sensory and experiential qualities that create value for the children and their development. Additionally, it emphasizes the relationship between the building and its context, which is an essential consideration when building site-specific.

In 2025, DGNB published new requirements for DGNB certification of renovation and new construction. The system consists of three main categories: social quality, environmental quality, and economic quality, which together consist of 14 criteria used for assessment (DGNB, 2025).

Due to the relevance of this project, it was chosen to work more specifically with social quality. This category includes five subcategories: quality of the building and landscape, air, acoustics, light, and mobility. These areas are all aimed at increasing the building's value for its users, with a focus on promoting comfort, health, and user satisfaction (DGNB, 2025). The qualities are assessed based on criteria such as inclusive design/frameworks and a healthy indoor climate (DGNB, 2025).

In the design process, the DGNB criteria have been used as a guide for achieving a more sustainable and optimized building in terms of the social environment. These criteria will be revisited and evaluated later in the report.
Quality of the Building and Landscape (appendix 2)

Note: The following categories are translated directly from the original source (DGNB, 2025). To see a more detailed description, refer to appendix 2.
This category includes four sub-points:

(1) Evaluation of the building, the surrounding area, and the landscape
(1.1) Registration and value assessment

(2) Differentiated use
(2.1) Extended use of the building and outdoor areas (max 10 pts)
(2.2) The adaptability of the building (max 10 pts)

(3) Immersion and activity
(3.1) Human needs – the personal space (max 10 pts)
(3.2) Human needs – the communal space (max 10 pts)

(4)Relationship between the building and its surroundings
(4.1) The edge zone (max 10 pts)
(4.2) Connection between indoors and outdoors (max 5 pts)

Regarding the four indoor climate aspects - thermal, atmospheric, visual, and acoustic - DGNB refers to the industry guidelines for indoor climate in schools, which is why the project group has actively worked with those requirements in this project. A more detailed description of each aspect follows. As the project focuses on improving the quality of the building and indoor climate, including thermal, atmospheric, and visual aspects, the acoustic aspect was not prioritized.

[design drivers 0.5]

Green and blue structure
The park must actively engage with students' hands-on approach through interactive elements, exploring their curiosity and sensory development

The design must integrate Limfjorden visually and connect to the park, ensuring physical and visual connectivity between the school and city

Genius loci & material
The school design must harmonize with the city's aesthetic and atmosphere, by using locally inspired materials and ensuring urban connectivity

Micro climate
The design must create niches for stay and play that shield from southern wind, while still utilizing sunlight

DGNB
The design must comply with DGNB SOCIAL 2 – building and landscape quality – to promote (1) individual zones for the students within the school, and (2) multifunctional indoor and outdoor use for the city, ensuring social meeting

Pedagogy (distribution)
3. Architectural distribution must define areas for the early, middle and upper years students supporting their pedagogical developmental needs, while creating shared spaces which afford informal interaction and a sense of community

Thermal and atmospheric indoor climate
The thermal and atmospheric indoor climate needs to comply with the Standard + regulations from the industry guide for indoor climate in schools

IT'S NOT ABOUT THE END RESULT, BUT THE PROCESS BEHIND IT

Photo 12. Courtyard. Randers State School

[design process]

The following chapter will showcase the entire design process. The design process consists of an introduction to the school that will be designed. Secondly, four case studies will be conducted, giving a better understanding of school architecture, and will finish with a comparison between modern and traditional school architecture. The chapter will further present the project group's design explorations and sketches. Two main design iterations will be presented together with their daylight analyses, indoor climate considerations, Bsim calculations, etc. The chapter will not only present building design iterations, but also explore more detailed classroom designs and interior design. As mentioned in the methodology, research is used throughout the process, which is also clear in the following chapter.

[the new stigsborg school]

The development plan for Stigsborg states that Skansevejens School in Nørresundby will be relocated to the new school in Stigsborg (Stigsborg.dk, n.d.). Currently, Skansevejens School has more than 500 students across 2-3 classes per grade level from 0th to 9th grade (Stigsborg.dk, n.d.).
The new school in Stigsborg will accommodate a total of 1,000 students - including the current students from Skansevejens School and additional students from the expansion of Stigsborg - 60 nursery children and 100 kindergarten children (Stigsborg.dk, n.d.).

We oppose the development plan and advocate for keeping Skansevejens School, while establishing a new school with space for approximately 500 students across three classes per grade level 0th - 9th grade. We believe that to promote diversity and more educational opportunities in Nørresundby, and accommodate the needs of the new development area, a new school needs to be established. This approach aligns with the existing distribution of public schools in Aalborg Municipality, where the majority are located in Aalborg, while only two are currently established in Nørresundby. In addition to the three classes per grade level, our new school includes after-school care (SFO) and activities for older students. The vision is to create a school that is designed at a child-friendly scale, integrating harmoniously with the surrounding landscape and the city history. We wish for a school building that shields from the four-to-five storey high residential buildings, and opens up towards nature.

The school building will be divided into three departments - early primary school, middle primary school and upper primary/lower secondary school - to support children's developmental stages. We chose middle primary school as our focus, and will therefore go more into depth with this segment within classroom design, needs and calculations.

A study examined the effects of preschool class size on student achievement by reducing the number of students per teacher from 20 to 15 in a classroom. The results indicate that this reduction can benefit children's cognitive development after one school year. (Francis et at, 2019) Children assigned to the reduced classrooms partook in more one-to-one interactions between the teacher and showed greater improvements in general knowledge, social behavior and language (Francis et at, 2019). Therefore, we have chosen to design classrooms for 15 students from grades 0 to 3, and 18 students from grade 4 to 9, in order to strengthen the student-teacher relationship and provide an optimal environment for cognitive development.

Photo 13. Stigsborg

[casestudies]

The following case studies focus on different types of schools (elementary and primary), ranging from traditional to modern, and from private to public institutions. The studies are supported by school visits and provide valuable insight into school design strategies - learning from real-world examples and turning assumptions into evidence.

User involvement is crucial in understanding how the built environment is experienced and interacted with in practice. The case studies and school visits support informed decision-making, enhance the quality of the final school design, and form the basis for the school building concept on which the design is founded. By examining how children interact with the building and by identifying existing challenges and solutions, the project group can establish a stronger foundation and gain knowledge on how to design spaces that best support children's needs and cognitive development.

Additionally, interviews were conducted at Skipper Clement School in Aalborg and Nordstjerne School in Frederikshavn, respectively. The two schools were selected to represent contrasting approaches to school design - one following a traditional model, and the other a more modern approach. These differences were evident not only on an architectural level but also reflected in the schools' values and pedagogical principles. The transcriptions of the two interviews can be found in appendix 3.

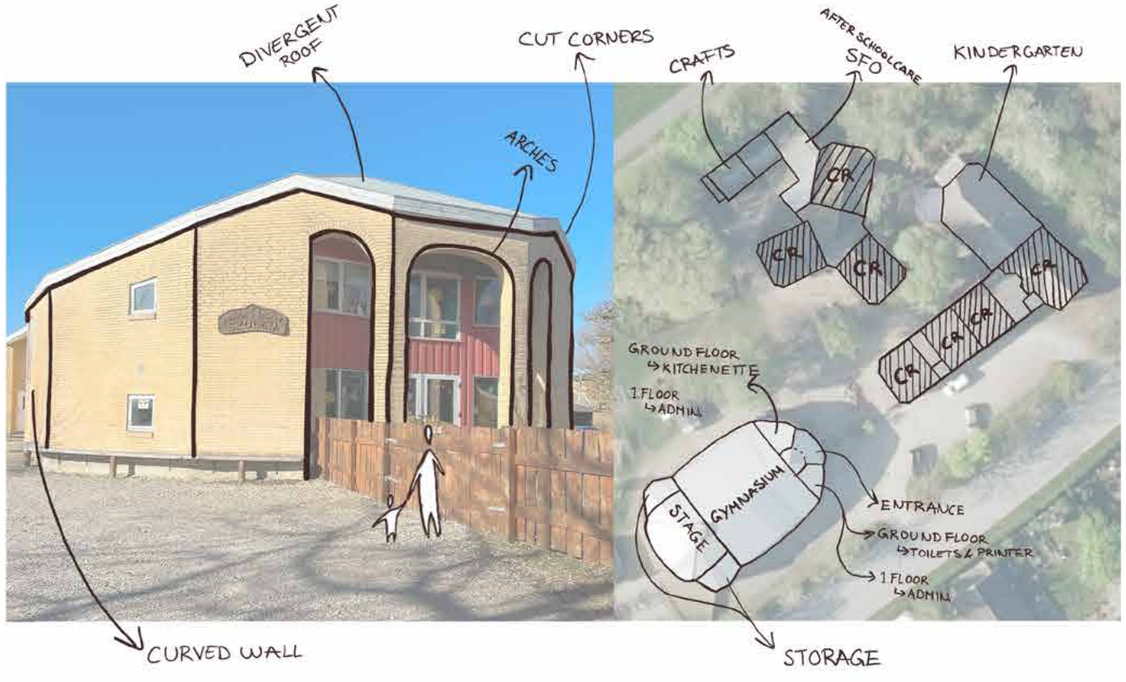
[waldorf school]

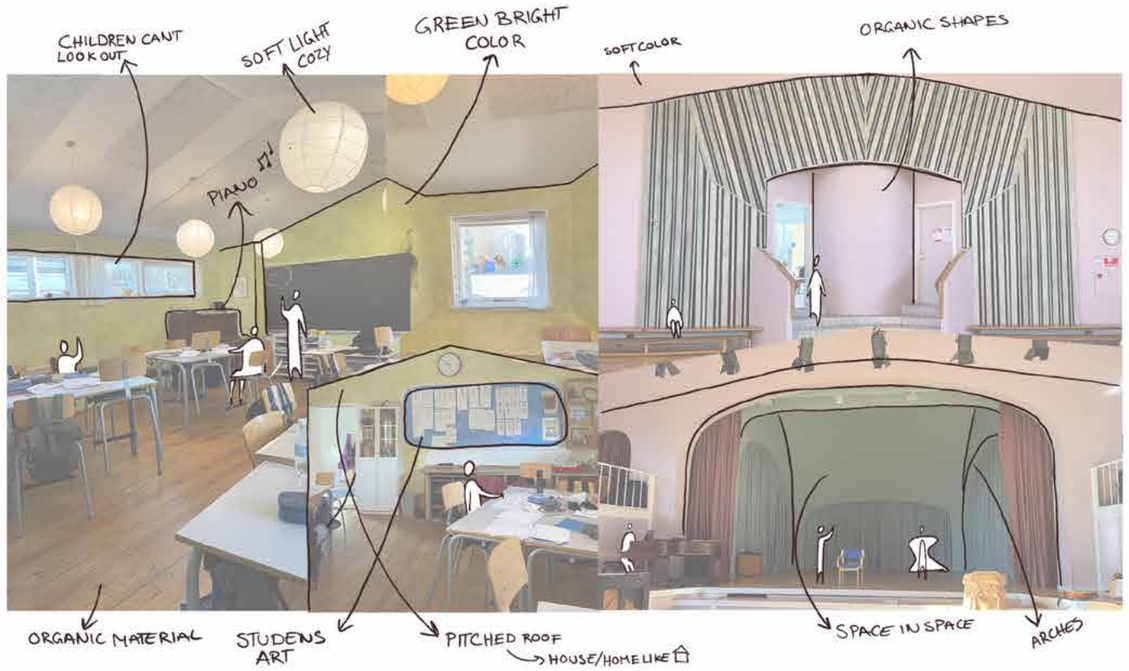
The chapter on 'Children's developmental stages' introduces the Waldorf pedagogy and how the pedagogical approach can be detected in their architecture. A central aspect in this analysis are the foundations of anthroposophical philosophy, which emphasize a holistic relation between the physical, spiritual, intellectual, social, and aesthetic dimensions of an individual's development (Lange de Souza, 2012).
The following architectural parameters can be identified in most Waldorf schools - they are detected by anthroposophical architects. (Migliani, 2020)

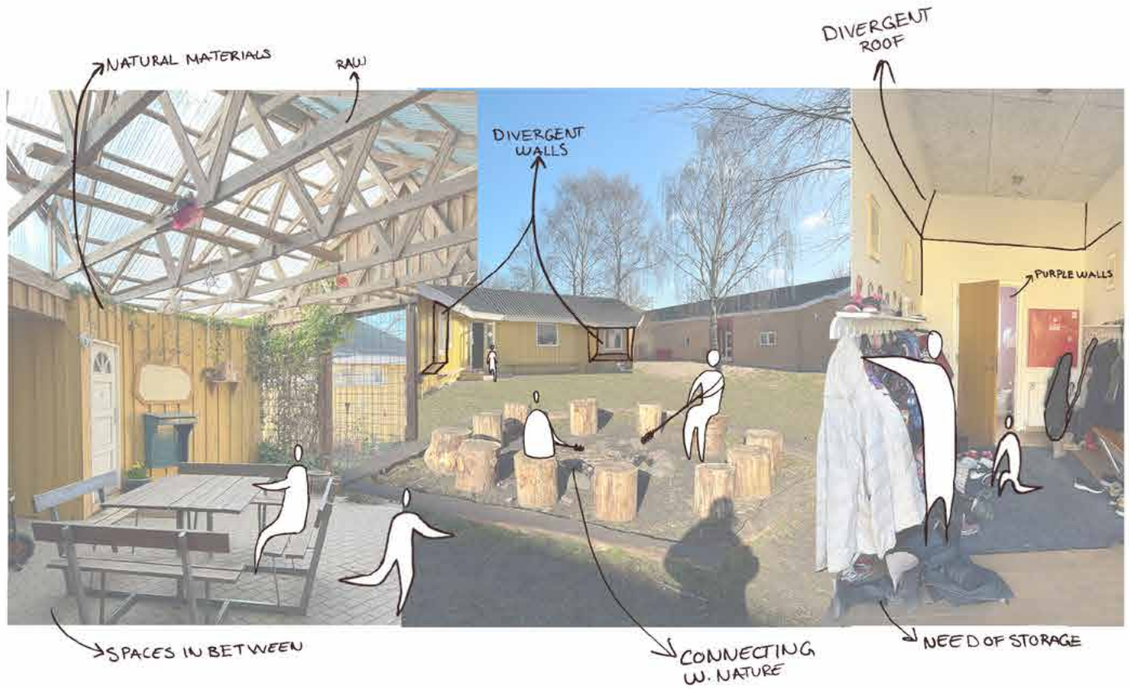
Parameter	Key insights
Comfort	The first seven years it is important to offer "(...) homey, welcoming, safe and stimulating environment." (Migliani, 2020)
Harmony Between the Arts	Måske ikke så central
Rhythmic elements	Music plays an important role in Waldorf school and this is identified in the architecture through repetitive elements - frames, columns, beams, etc.
Nature, Inside and Outside	Direct or indirect Use of natural materials for the building. Offering areas of earth, sand, vegetation in outdoor spaces.
Natural Light	Being connected to nature through the natural light
Color	Different palettes for the different age groups. Warm and light colors (red/orange) are recommended for the young students - active activities. Cool colors (blue/green) for mid-aged students - higher level of concentration. Strong contrasts (black/white) for older children as they are linked to abstract shapes.
Flexibility	Flexible and dynamic interior to accommodate different activities
Geometric Perceptions	Progressive modification of classroom shapes depending on age group. Divergent walls create freedom where convergent walls direct movement.

(Migliani, 2020)

Table. 2. Table of architectural parameters







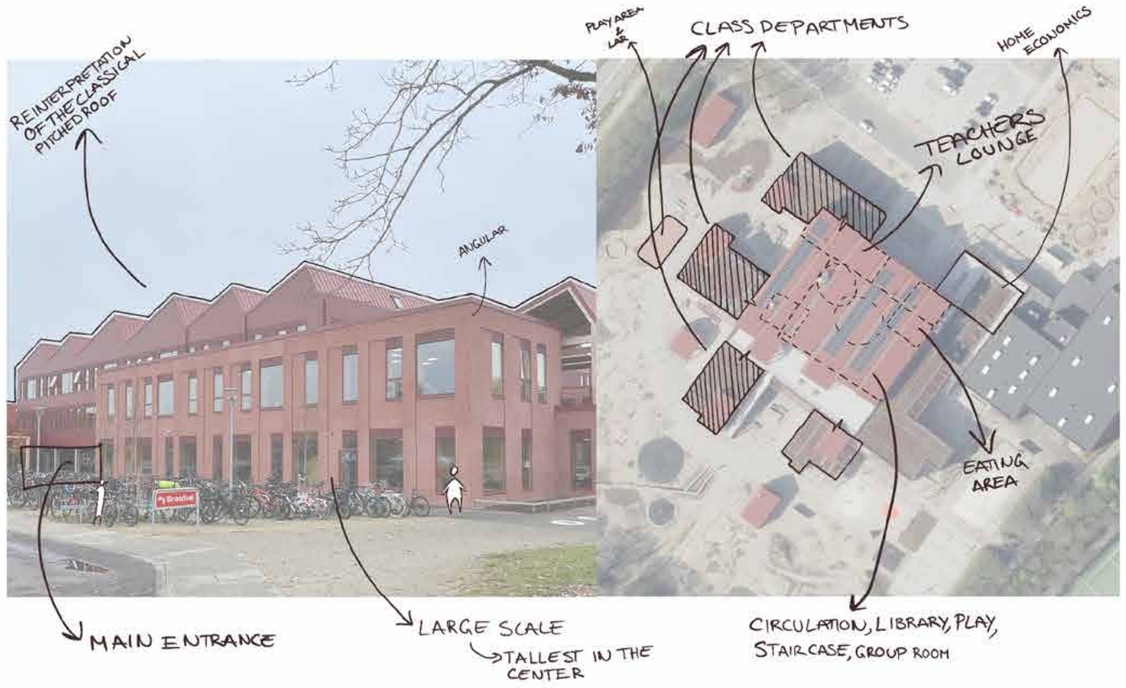
Ill. 33. Collage. Aalborg Waldorf School

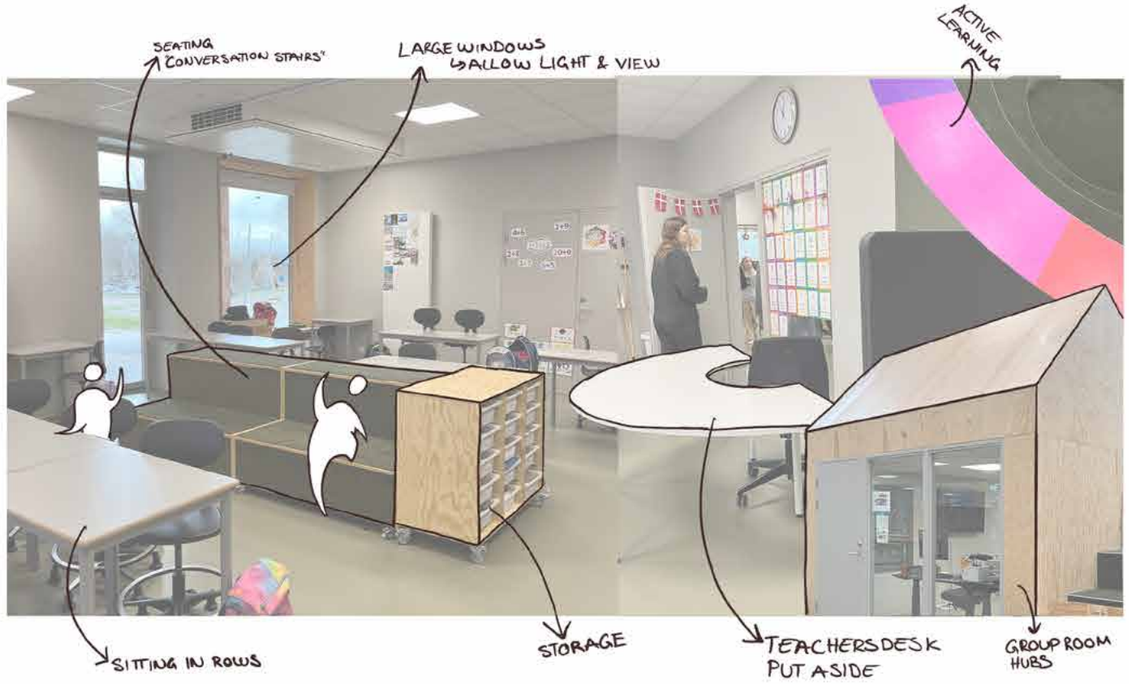
[aalborg waldorf school]

Aalborg Waldorf School was established in 1983 with Waldorf pedagogy as its educational foundation. It is a private school with a close relationship between the school and the parents. The school has a kindergarten and students from 0th to 9th grade (Aalborg Steinerskole, n.d.). The buildings are one story, with the exception of the main building, which is two stories at the front - primarily serving as a sports and drama hall.
The areas between the buildings create space for play, movement, and exploration with their hiding spots. The small scale - being child-friendly - and the use of organic materials make the space feel grounded, inviting children to interact naturally with their surroundings and fostering a sense of curiosity and belonging.

The classrooms are fixed, and there are few to no group areas or academic work environments outside of the classrooms. The classroom in the photo (ill 34) is for fourth grade. The room has a home-like feeling with its small scale and pitched roof. They also use colors on the walls; as mentioned earlier, they use blue/green colors for middle-aged students to foster higher levels of concentration. Divergent walls are incorporated in many of the classrooms to interrupt the classical four straight walls. A small detail to notice is the piano - music is used as an active part of the learning experience.

The main building is designed using a variety of colors and shapes. None of the walls are fully straight, and no connection is at a 90-degree angle. These shapes and colors foster creativity and playfulness.





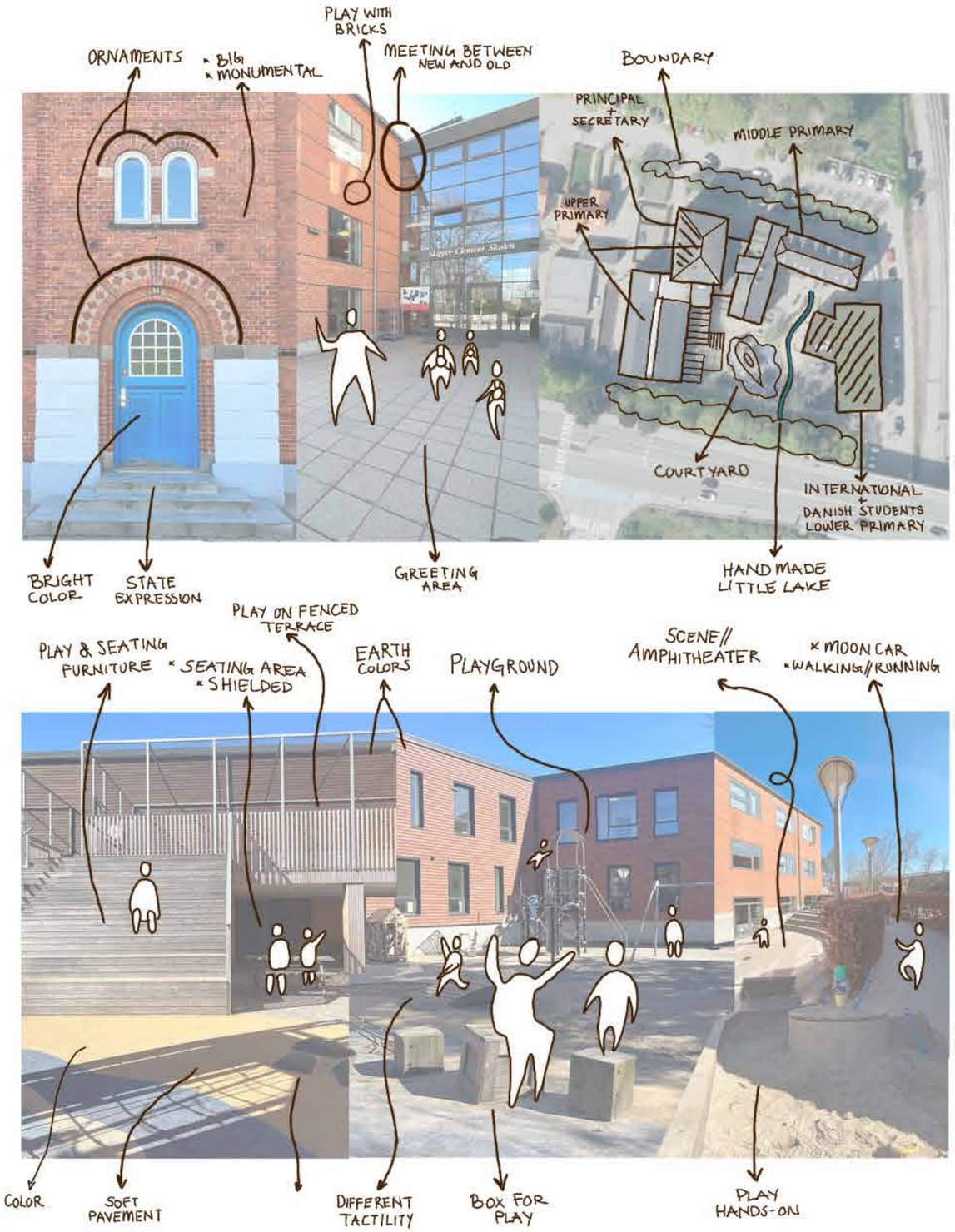
Ill. 34. Collage. Dybkær School

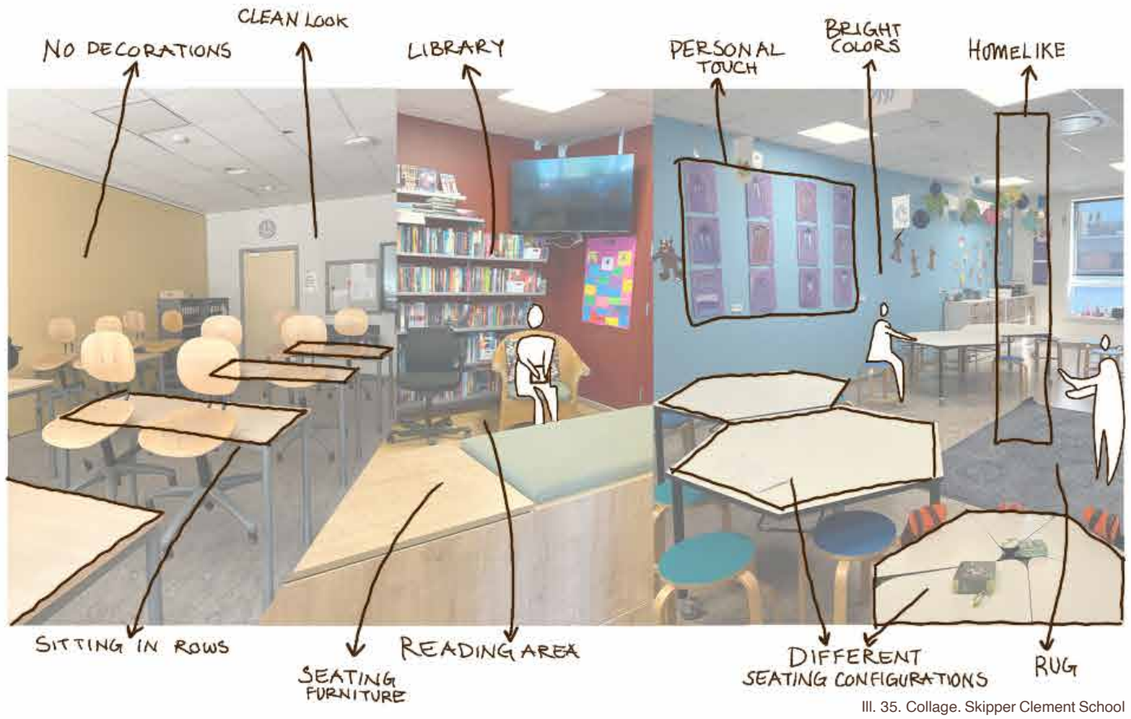
[dybkær school]

Dybkær School was established in 2024 and the same year won ‘School building of the year 2024’. It is a public school with 900 students - 0. - 9. Grade with 3 classes per grade. The school has a unified expression with its red color and one building mass - two and three stories. The school is a combination of the open-plan and the project-based school design.

The building is designed around a large atrium in the middle which accommodates for many functions e.g. circulation, library, play (on/around the stairs), group room hubs, etc. It is a space with a lot of noise and movement. Along the hallways of the school there are many nooks and crannies ‘in the walls’ with soft seating, darker colors, creating a cozy atmosphere. Between the different class departments there are these outdoor spaces, creating a smaller space within the larger one.

The classrooms have the students sit in rows, with an incorporation of ‘conversation stairs’ and the teacher’s desk is located on the side and not in the front. The windows around the school are large, the bottom of the windows are very low to allow the students to look out and the windowsills are deep so the students can sit in them. Between many of the classrooms there are flexible walls allowing joined lectures creating a sense of community.



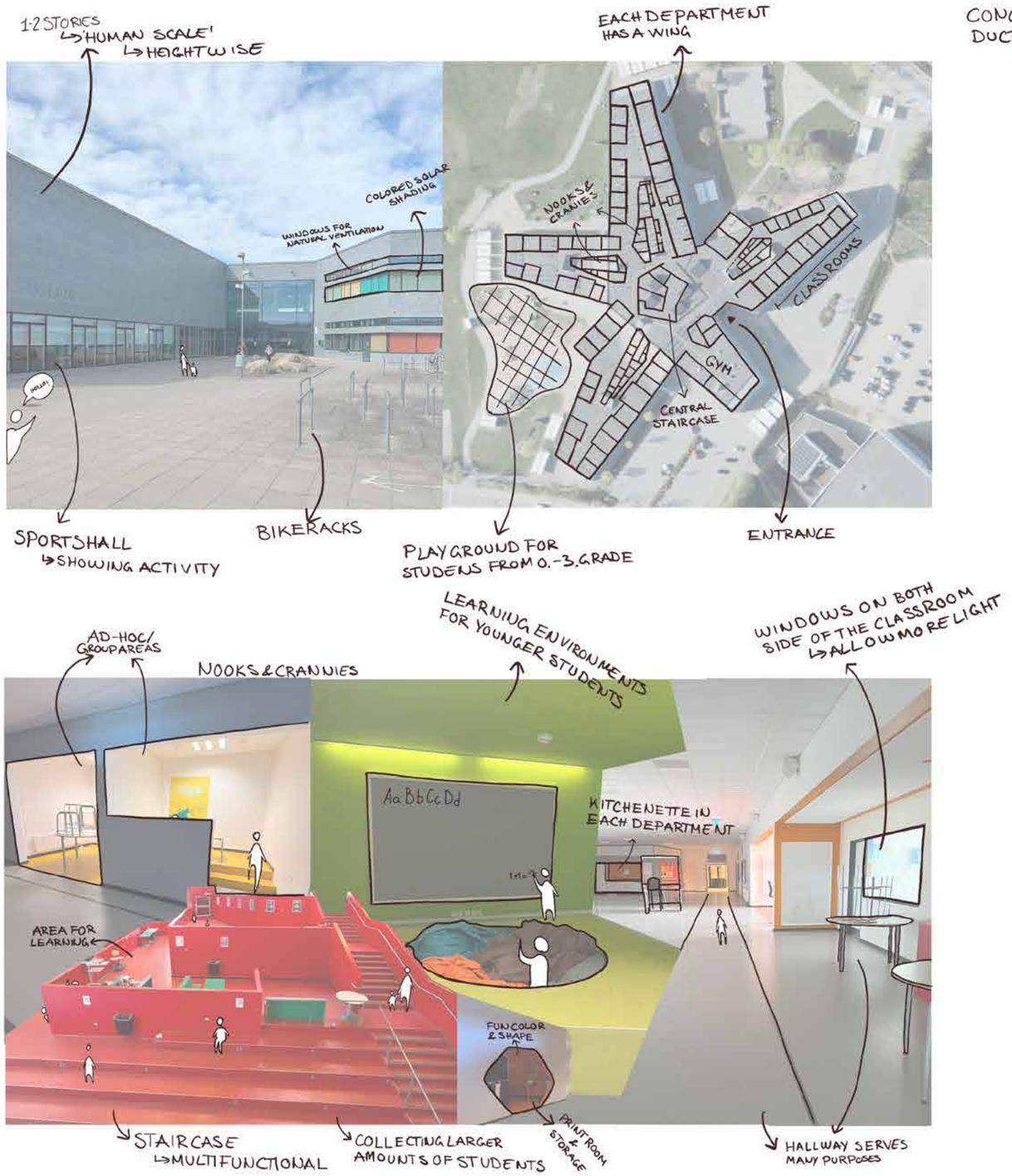


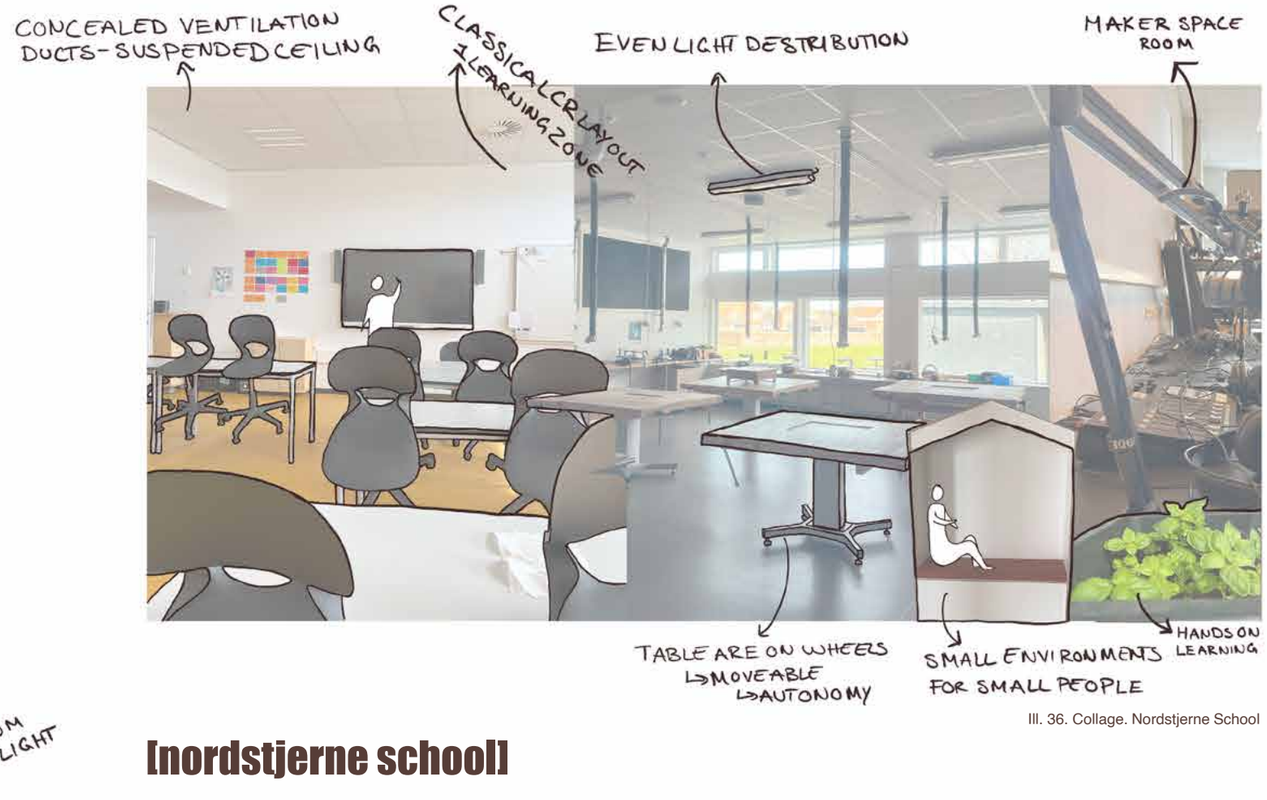
Ill. 35. Collage. Skipper Clement School

[skipper clements school]

Skipper Clement School is a private school established in 1873. It consists of three buildings, and will be expanding in the years to follow. The traditional school values education for a global future through: (1) high professionalism, (2) responsibility and consequence, (3) creativity, (4) the student's independence, and (5) mutual respect (Würtz, 2025). These values are encountered by teachers and students in everyday-life and the building's architectural expression being more formal and orderly.
The buildings are arranged around the schoolyard that offers space for play in various forms, primarily designed for the lower primary school. Due to lack of green and play areas on the school ground, middle primary and upper primary school are located in Kildeparken and Rustenborg.

The traditional school layout resembles Randers State School, with the corridors functioning primarily as transit areas and lacking dedicated spaces for group work or other activities that are not located in the corridors.
The purpose of the classroom - teaching and knowledge gaining - is clearly reflected in the layout, designed with tables and chairs in rows or small groups, orientated towards the teacher. There are no designated areas for socializing, informal conversation, or quiet retreat within the classrooms.
The school includes an international program grade 0 to 9, following the Cambridge model. The difference between the Danish and Cambridge models is noticeable (ill. 35), especially in the lower grades, where the international classrooms are assigned to a teacher and are personalized, featuring bright colors, play and a cozy atmosphere.





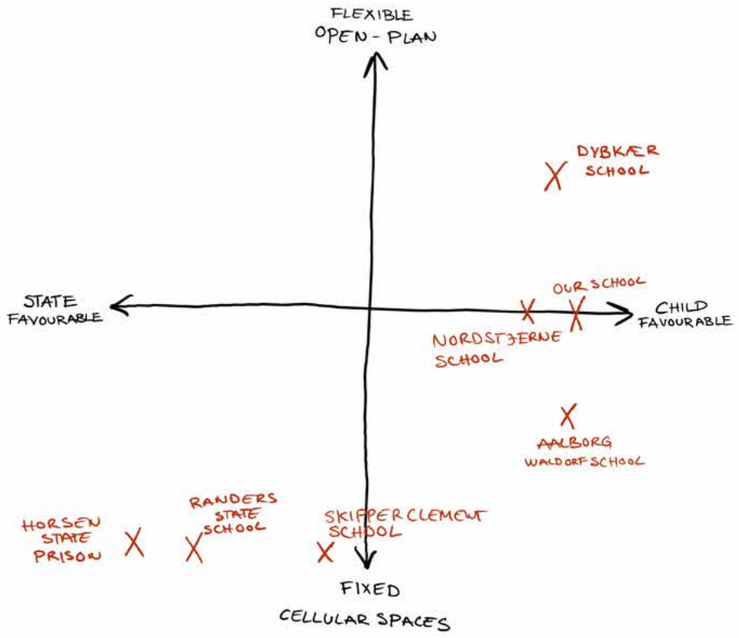
III. 36. Collage. Nordstjerne School

[nordstjerne school]

Nordstjerne school was established in 2012 in Frederikshavn. The school was built for 1200 students, four classes per grade (Arkitema, n.d.), but there are currently around 700 students with two or three classes per grade (Lise, 2025). The school has a unique star-like shape, accommodating each educational stage (early primary, middle primary and upper primary school) and they have a wing for special needs children. At the center of the school they have their red ‘library’ staircase which acts as a place for gathering, play, work and it is the connection between the two stories.

The school is 13.500m^2 (Arkitema, n.d.) but the different wings section the school into smaller schools each having their own areas for play, work and lunch. Each wing has nooks and crannies to create smaller spaces within the larger one - each having a different color and are different depending on the educational stage of the students.

The classrooms have a simple square shape with large windows allowing daylight and a good visual indoor climate. There are further windows on the interior wall of the classroom to make a more transparent building and to have more natural light in the areas between the classrooms. The students sit in rows in their designated classrooms for the most part and have a more dynamic layout in their subject classrooms - which allows different activities.



Ill. 37. Diagram. Traditional vs modern schools

[traditional vs. modern schools]

The project group has investigated a variety of different schools, and there is a clear difference between traditional and modern school architecture.
Generally traditional schools have a rigid cellular structure with classrooms side-by-side connected by a corridor. The classroom's simple design assumed that the way of learning was through transmission of knowledge from the teacher to the students. (Nair et al, 2005) Modern school design challenges this idea and they challenge the idea that people learn the same, at the same time, in the same way and by the same person. The classroom is seen as a learning studio which is flexible and has a few different zones within the same classroom. (Nair et al, 2005) These learning studios aren't necessarily defined by a room with four walls. There are examples of flexible open-plan classrooms with more fluent transitions. Does the evolution of school architecture mean that the modern and new way of designing schools is the right way?

An article by Eva Gjessing, Ph.d. student with a background as an architect and school teacher (Gjessing, 2023), addresses this question. The idea of modern school architecture is to foster creativity, critical thinking and collaborative work, through an open and flexible architecture. It is said that these types of buildings are more inclusive because they allow a variety of different learning styles. They are designed according to what school architecture should provide as stated by Danish School Programs for new schools. These programs make it seem as if it is necessary to revolutionize the way schools are designed. (Gjessing, 2023)

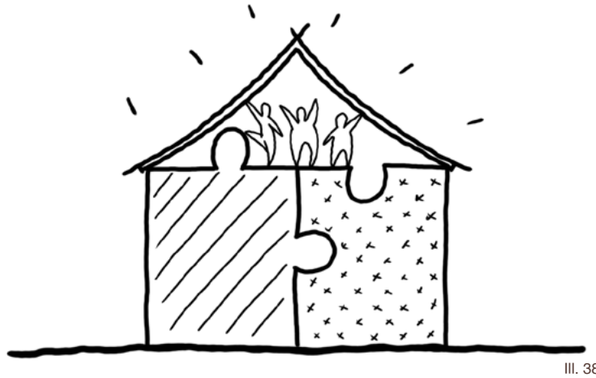
In order to create inclusive education, teachers and students needs to be able to see, hear and find each other, which can be difficult with open and flexible design, according to her research (Gjessing, 2023). A study on 'Better school Architecture through design patterns', focussing on evidence based design through a literature review, addresses how the lack of proper boundaries in the classrooms often seen in full-open and semi-open learning environments leads to increased distractions for students (Kowaltowski et al, 2024). It especially affects the already challenged students, and students generally complain of headaches resulting from noise. A study also concludes that background noise and sudden noises impairs the learning of students. (Gjessing, 2023) This is also relevant when considering the placement of a group room or other study areas. Placing these in the hallways or near circulation spaces can cause unwanted distractions. (Gjessing, 2023)
Furthermore, modern school design often has a high level of transparency, clear sightlines and vista. This is also something that is advocated for by Prakash Nair and Randall Fielding, the authors of the book: The Language of School Design - Design Patterns for 21st Century schools. Their responds to the question on the relationship between distraction and transparency is the following:

Fear of distraction is not a legitimate argument for denying children views to the world outside their classroom.

(Nair et al, 2005, p. 50)

There are many layers to it and while Nair and Fielding emphasize the value of visual connections and openness, they don't fully address the practical challenges highlighted by recent research.
Gjessing further addresses the multifunctional areas and rooms in modern school architecture which are 'clever square meters', but is at the expense of the students. Some of these other users or functions can be after school care programs, leisure clubs and local evening clubs. Students behave in a certain way in a certain room depending on the expected and/or allowed behavior. When spaces become multifunctional it can harm the students 'sense of behavior'.

Sum-up
The differences between traditional and modern school architecture reveals a deeper conversation about how we perceive learning environments, and for whom. Traditional schools offer clear structure and order, while modern school design embraces flexibility, openness and collaborative work. Both approaches have their strengths and their shortcomings, which is why a combination of the two could result in a balanced solution. A solution which offers both open, shared areas and more focused zones to accommodate the students' needs.



Ill. 38. concept drawing

[concept - present]

The new Stigsborg School is a design concept rooted in the cognitive and developmental needs of children, creating a balanced learning environment. It respects the traditional need for structure while integrating open, flexible areas and distinct zones that foster exploration, creativity, and encourage social learning and independence.

[design drivers]

Flow and sightlines
Sightlines must enhance daylight distribution to improve students cognitive performance

A dynamic flow through common areas must create sightlines that support children's creativity, play and social interactions, through moments of discovery

Distribution
Architectural distribution must define areas for the early, middle and upper years students supporting their pedagogical developmental needs, while creating shared spaces which afford informal interaction and a sense of community

Connection between inside and outside
Design a physical connection between indoor and outdoor environments that create hands-on learning spaces

The design must create a visual connection between inside and outside to enhance daylight distribution and stimulate curiosity, foster creativity, and a positive influence on children's behavior and mood

Green and blue structure
The park must actively engage with students' hands-on approach through interactive elements, exploring their curiosity and sensory development

The design must integrate Limfjorden visually and connect to the park, ensuring physical and visual connectivity between the school and city

Genius loci & material
The school design must harmonize with the city's aesthetic and atmosphere, by using locally inspired materials and ensuring urban connectivity

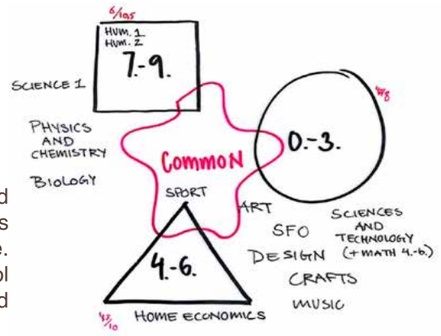
Micro climate
The design must create niches for stay and play that shield from southern wind, while still utilizing sunlight

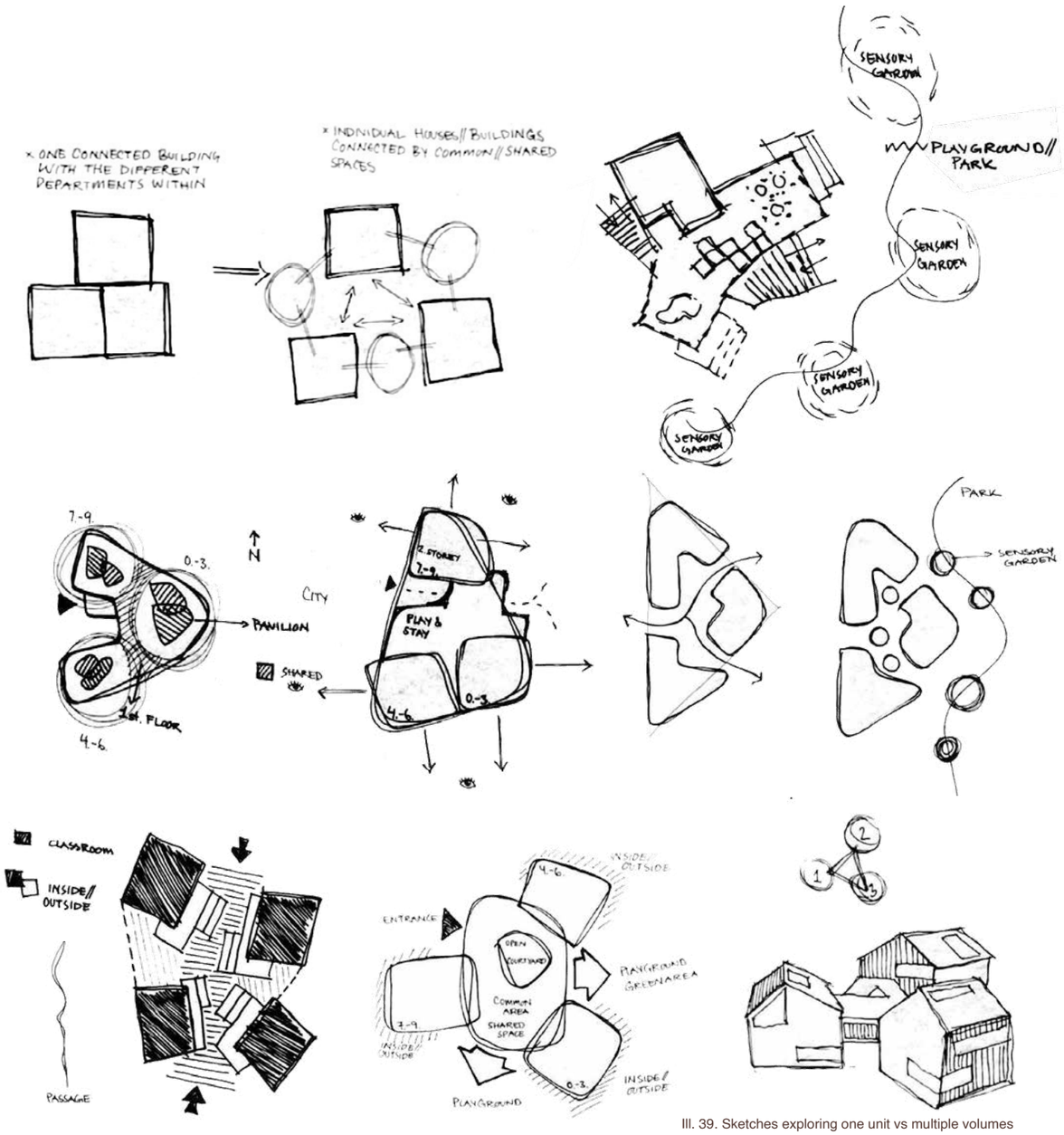
DGNB
The design must comply with DGNB SOCIAL 2 – building and landscape quality – to promote (1) individual zones for the students within the school, and (2) multifunctional indoor and outdoor use for the city, ensuring social meeting

Thermal and atmospheric indoor climate
The thermal and atmospheric indoor climate needs to comply with the Standard + regulations from the industry guide for indoor climate in schools

[initial phase]

A conceptual drawing was created illustrating the three departments and common areas, which lead to the exploration of design principles at various scales. At this stage, the site conditions did not influence the building's shape. The main design principle and initial question concerned whether the school should be conceived as one connected unit or separate volumes organized around a shared central space.





Ill. 39. Sketches exploring one unit vs multiple volumes

[the building shape // the alphabet]

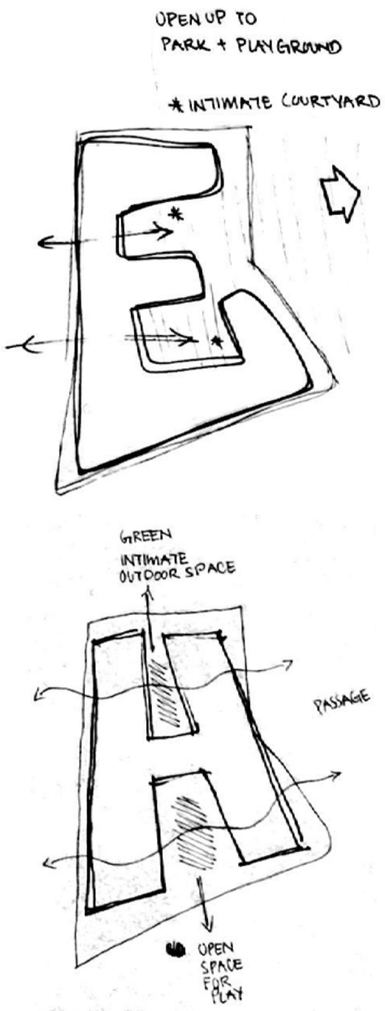
The following sketches explore the School building as one unit, aiming to utilize the available footprint.

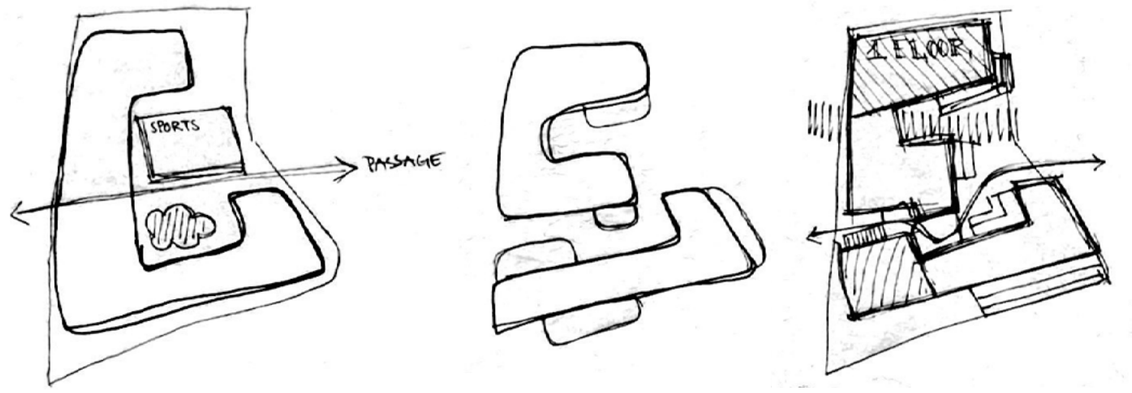
1. The E-shaped design creates a horizontal layout with two intimate courtyards that open towards the park. It offers the opportunity to integrate the landscape with the school environment while also providing a natural shield from the 5-storey buildings. The three wings establish a clear division between the departments.

2. The H-shaped building generates a long vertical flow- and sightlines through each wing of the building, enhancing orientation. In terms of daylight, the façade is optimized towards east and west, while the southern façade is minimized to reduce the risk of overheating. Horizontal passages through the building would help break up the building and avoid long corridors. Two vertical courtyards are formed - facing north and south - each of which can serve a distinct function, such as green areas, playground and outdoor learning.

3. The C-shape allows students - from all departments - to orient toward a large courtyard. It also results in a long building with functions placed along the façade, which optimizes daylight and avoids wasted space at the core. The sportshall is placed as an independent volume, detached from the main school building, encouraging the children to be active during school hours.

4. The S-shaped layout winds through the landscape, allowing for a more playful and flowing spatial experience. The shape creates various outdoor areas on multiple sides, each with different orientation, atmospheres and use. It generates connections between inside and outside, and encourages in between spaces for interaction.

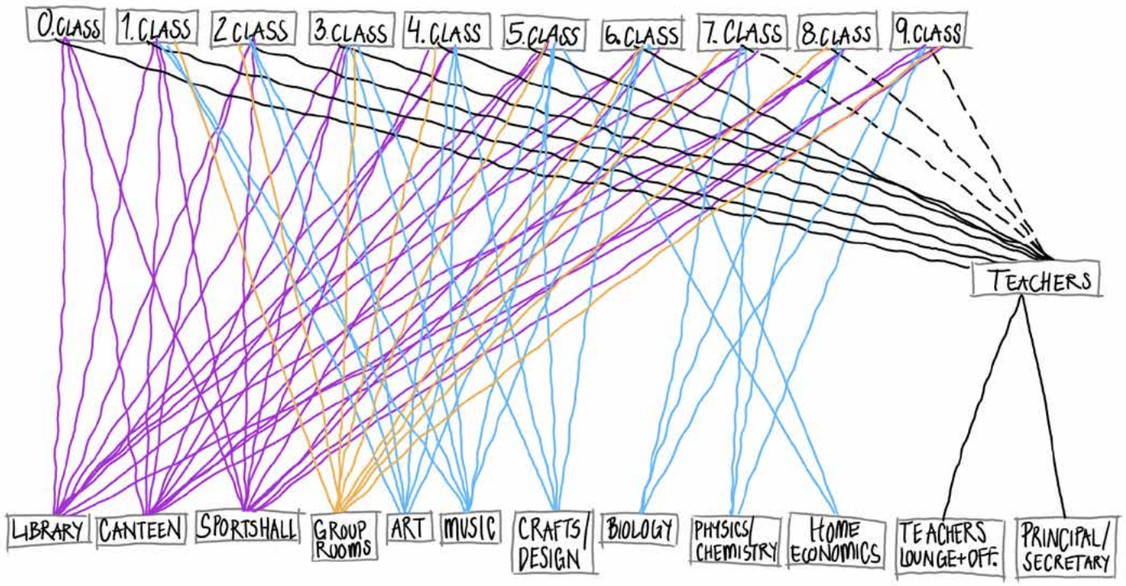




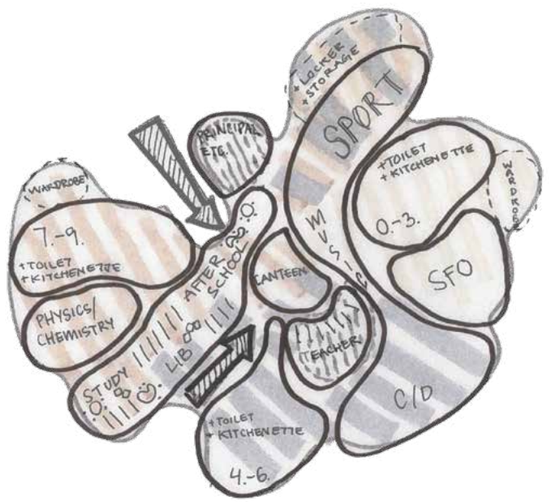
Ill. 40. Sketches exploring the alphabet

[distribution & connection between functions]

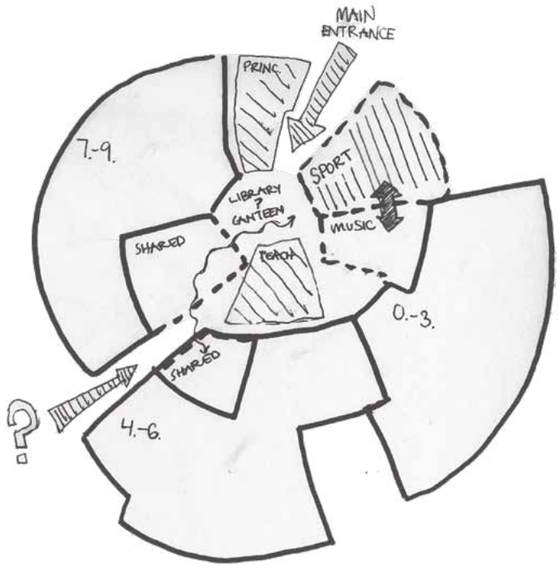
The graph provides a visual representation of the connections between the different functions in the school. It supports the spatial distribution shown in illustration 43 and 44, with a focus on the ground floor.



III. 41. Connection between functions



III. 42. Distribution of functions 01. Ground floor



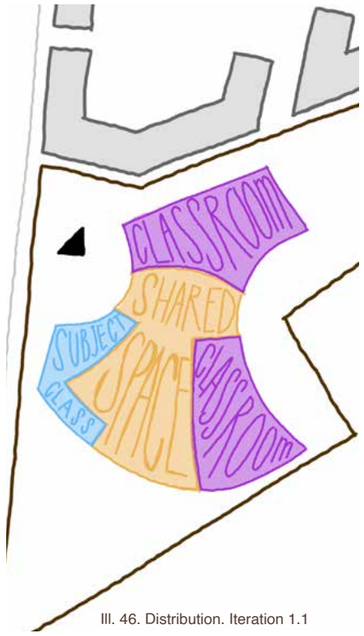
III. 43. Distribution of functions 02. Ground floor

[room program]

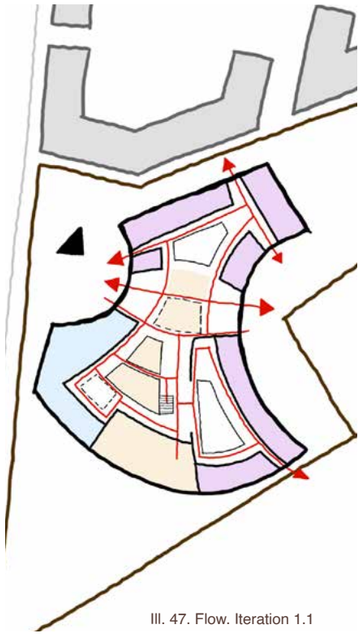
The diagram illustrates a cut-out of the room program. The remaining components of the room program are presented in appendix 4. (The total floor area of the building is approximately 10,000m²)

Category	Notes	People (max)	People (mean)	m2	Number of rooms	Total m2
Class rooms						
Classroom // 0. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 1. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 2. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 3. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 4. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	20	18	60	3	180
Classroom // 5. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	20	18	60	3	180
Classroom // 6. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 7. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 8. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 9. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Special needs classroom	One for each department (Early primary, Upper primary and Lower secondary).	15	10	60	3	180
Level-based class	This is for lower secondary students. If students in 7th, 8th, or 9th grade are behind in a subject, they receive level-based teaching.	15	10	50	1	50
Other study rooms						
Art (1. - 6. grade)	With storage room. The storage room door should be 1 meter wide. Room need cabinets and drawers.	20	17	90	1	90
Music (1. - 6. grade)	With storage room - around 12m2.	20	17	83	1	83
Nature & Technology (1. - 6. grade)	Movable tables, kitchenettes, IT workstations, cabinets, and drawers.	20	17	80	1	80
Crafts (3. - 6. grade)	Craft and Design are two separate rooms, one for crafts and one for design.	20	17	120	1	120
Design (3. - 6. grade)	Craft and Design are two separate rooms, one for crafts and one for design.	20	17	88	1	88
Home economics (5. - 6. grade	Large enough for both theoretical and practical learning, with a storage room, cabinets, and drawers.	20	17	140	1	140

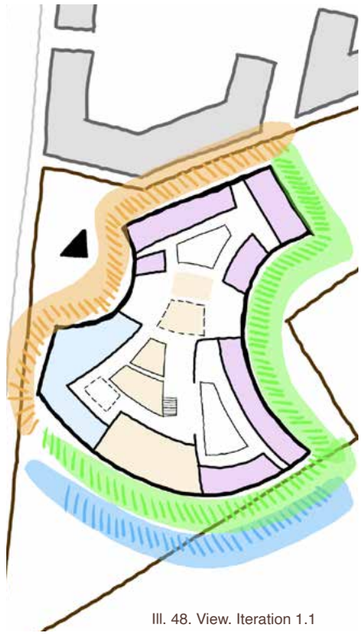
III. 44. Cut-up of room program



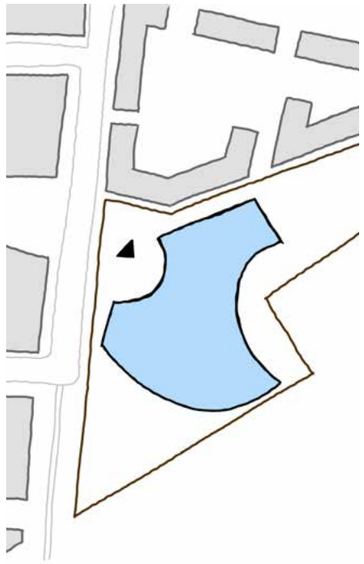
Ill. 46. Distribution. Iteration 1.1



Ill. 47. Flow. Iteration 1.1



Ill. 48. View. Iteration 1.1

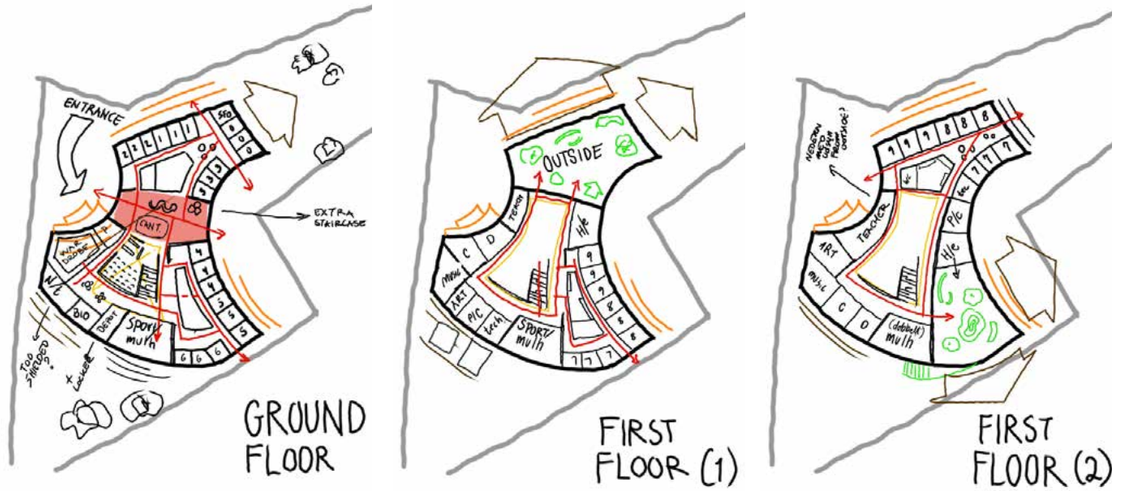


Ill. 45. Iteration 1.1 on site

[iteration 01.01]

The diagrams illustrate focal points from the observational analysis on page 35.

- The shape of the building on site
- The distribution of functions within the layout
- Flow and sightlines through the building
- View and orientation



Ill. 49. Plan sketches of Iteration 1.1 on site

The shape of Iteration 01.01 is inspired by the organic forms of Waldorf schools, resulting in a more playful expression. The arrival area is designed as a concave curve, welcoming students inside, while the curve on the south side integrates the park and green area. This also allows for greater extension on the north and east sides, which is optimal for classroom orientation. The layout emphasizes clear orientation and sightlines, while dividing the building into distinct sections.

The challenge with a compact shape stretching 80 - 100 meters without an open courtyard is that many functions must be placed along the façade to receive natural daylight, as few can be located in the center. This leads to large areas of wasted space in the core, and statistically, the shape results in long spans, which require heavy construction and reinforcement.

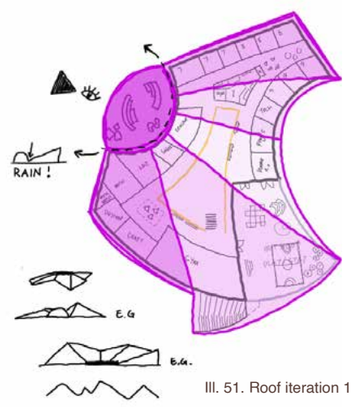
Two separate iterations were made for the first floor, illustrating varied placements of the terrace, facing north and south respectively.

Ill. 50. Sketched floor plan with focus areas. Ground floor and first floor.

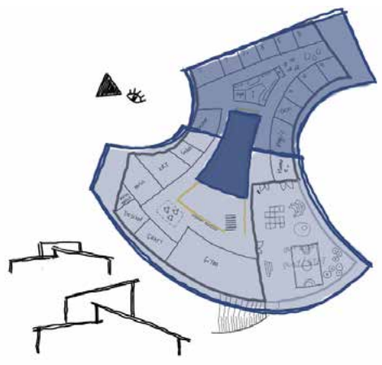
[roof exploration // 01.01]

Conceptual drawings of the roof includes:

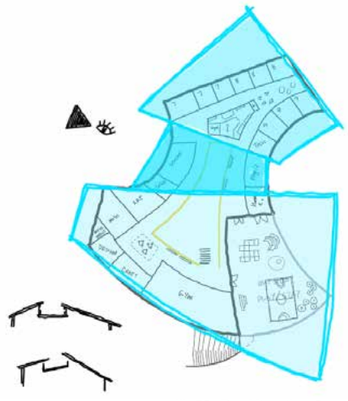
1. A roof inspired by the Waldorf School in Aalborg, creating a dynamic expression. Covered entrance with a dynamic roof expression on the main building.
2. Two main roof sections surrounding a central, elevated atrium that breaks through the core of the building.
3. Sectioning the building into classrooms, artium and shared rooms, creating a clear division of functions within the building. Allows for a covered terrace.



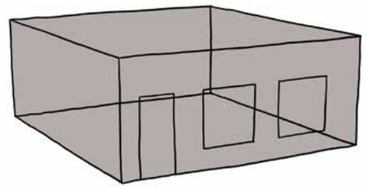
Ill. 51. Roof iteration 1



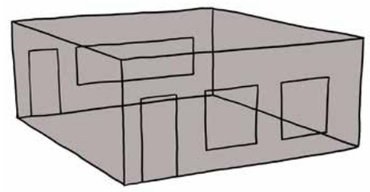
Ill. 52. Roof iteration 2



Ill. 53. Roof iteration 3



Ill. 54. Iteration 01. Window on one side

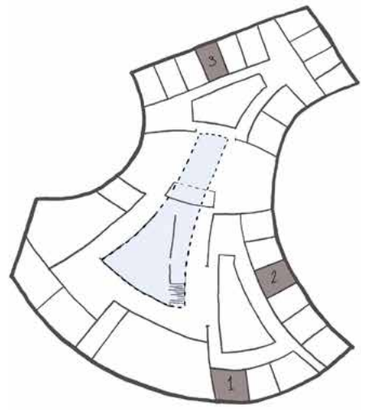


Ill. 55. Iteration 02. Windows on both sides

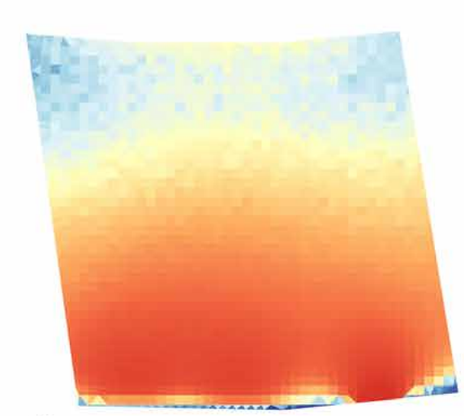
[daylight calculations // 01]

The following is a daylight analysis investigating the light distribution in the classrooms by looking at the daylight autonomy and the useful daylight illuminance. The aim is to have sufficient daylight in the classroom according to the industry guide and to have a better connection between inside and outside. According to the industry guide different methods can be used to ensure sufficient daylight. Because classrooms often have a simple geometry one can use the 10-pct method (the window area is equivalent to 10 pct of the floor area). In order to further ensure good daylight one can choose a minimum of 300 lux in 50 pct of the relevant area for half of the daylight hours (the relevant area is defined as the area of the classroom where the students and teacher sit the majority of the time), this method is also what is defined by the industry guide Standard + requirements. (Vorre et al, 2021)

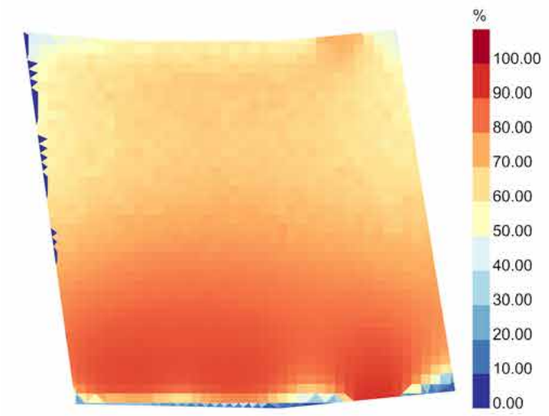
Three classrooms each having a different orientation are investigated. Room one is 7,7x8m, room two is 7x6m and room three is 8,8,x5m. The first iteration is an analysis of the three classrooms with only windows on the façade. The windows are 1500x1500mm and the door is 930 x 2040 mm. The second iteration has both windows on the façade and on the interior wall taking in light from the large skylight in the middle of the building (the building is two stories). The door on the interior wall is also 930 x 2040 mm and the window is 4200 x 1200 mm



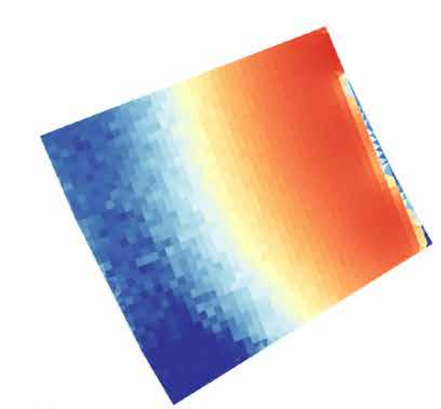
Ill. 56. Plandrawing marked with the three classrooms that are being calculated



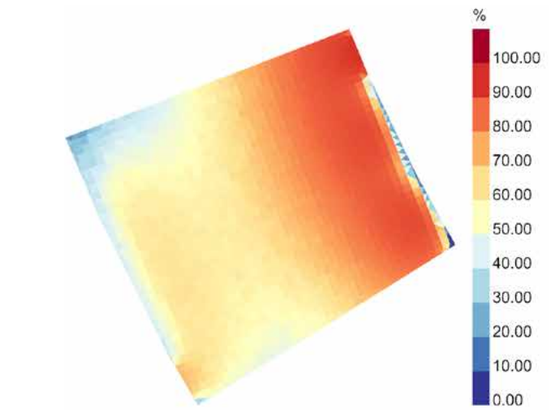
Ill. 58. Classroom 01. Iterartion 01.01, windows towards outside.



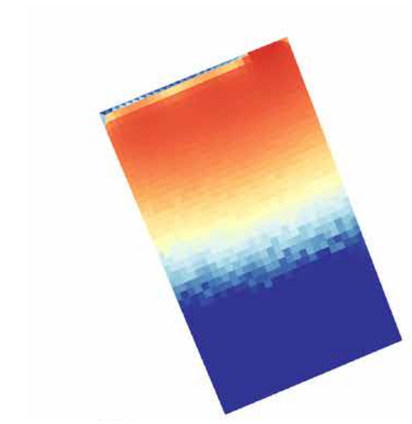
Ill. 59. Classroom 01. Iteration 01.02, windows on both sides.



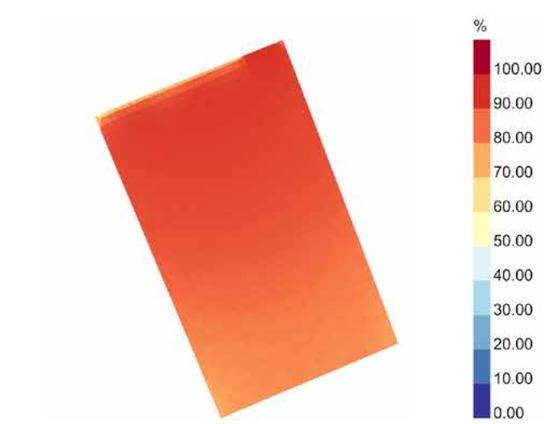
Ill. 61. Classroom 02. Iteration 01.01, windows towards outside.



Ill. 60. Classroom 02. Iteration 01.02, windows on both sides.



Ill. 57. Classroom 03. Iteration 01.01, windows towards outside.



Ill. 62. Classroom 03. Iteration 01.02, windows on both sides.

[daylight autonomy]

Daylight autonomy is the percentage of time during a year that a room reaches at least 300 lux from daylight alone (Cristiane slide, 2023). The three rooms being investigated range from 42m² to 60m². Room one is 60m², room two is 42m² and room three is 44m². In this iteration the window area for the three rooms are 4,1m² - which is not sufficient according to the 10 pct rule the industry guide first method of suggestions as a rule of thumb. According to the industry guide, standard +, the minimum level of daylight in the classroom needs to be 300 lux or more in 50 pct of the 'relevant area' for half of the daylight hours. The relevant area is the area where the students sit at their desk and where the teacher works during class. (Vorre et al, 2021) The industry guide will be introduced further in the following section.

Looking at the actual simulations the rooms do fulfill the requirements, but the second and third classroom will experience a very uneven light distribution inside. Furthermore the back of the classrooms will not have sufficient natural light, and for that reason there is another iteration investigating having windows on the interior wall too, using the light from the skylight.

Having windows on both sides creates a more even light distribution and it allows for more natural light. This dual-sided daylighting strategy not only increases the overall daylight but further reduces the contrast between the front and back area of the rooms, creating a more uniform and visually comfortable environment for students. This approach supports both visual comfort and energy efficiency, as it reduces the dependency on artificial lighting during school hours.

Sum up

This analysis shows that there will be sufficient daylight in the classrooms according to the industry guides guidelines, but some of the rooms will experience very uneven light distribution without windows on the interior wall. The windows on the interior wall will need to be frosted glass or have some other solution to not create panoptic classrooms. It is also important not to make the visual access to the corridor work as a disruptive element for the children and disrupt their focus. Even though the daylight is fulfilling the industry guide, having less than 10 pct window area is not sufficient when considering visual access from inside to outside.

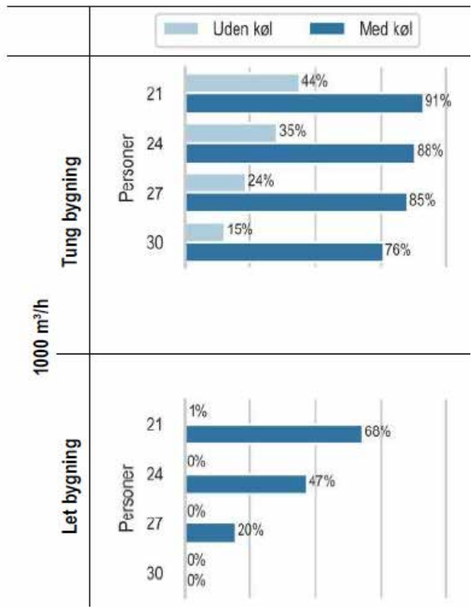


Table. 3. Diagrams from (Vorre et al, 2021)

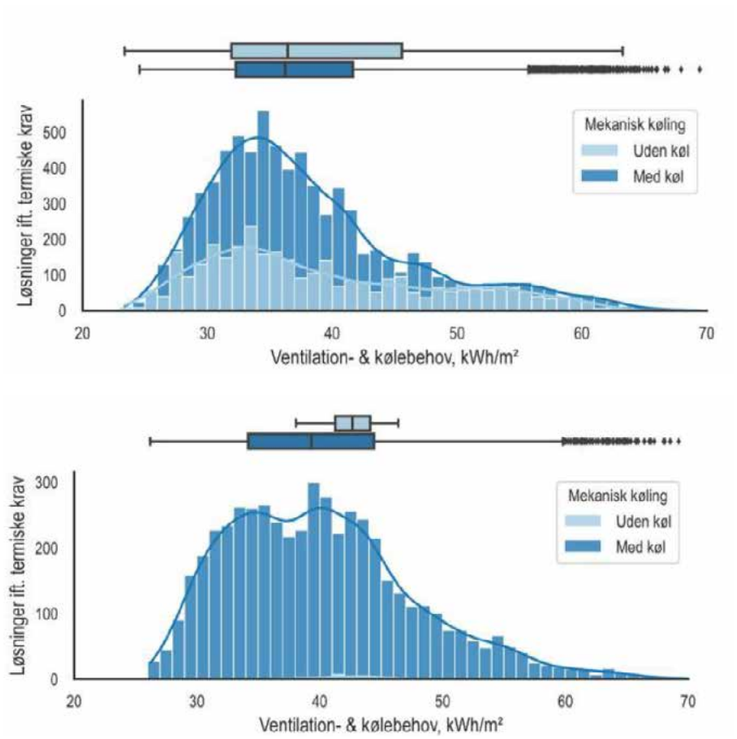


Table. 4. Diagram from (Vorre et al, 2021)

[indoor climate]

While pedagogy is essential to children's development, the indoor environment where they spend the majority of their time (primary years) can significantly enhance or impede their performance and creativity. The school's most important task is to provide the best conditions for learning, which is severely impacted by the indoor climate (Vorre et al, 2021). Indoor climate aspects, such as the thermal, atmospheric and visual climate, have a great influence on the energy consumption - alongside rising student count in the classrooms and sharpened indoor climate expectations - demanding bigger installations (Vorre et al, 2021). As both aspects are closely related, they will be considered early in the design process, to insure an optimal and sustainable building design.

A healthy indoor climate can help with fast task resolution, more creativity, less sick leave, conflicts and frustrations. Studies show that the indoor climate can affect performance and learning up to 10% - which is the equivalent to a year in the danish public school. (Vorre et al, 2021) The industry guide for indoor climate in schools serves as a foundation for this investigation, as referred to from DGNB. The following section will explore the impact of indoor climate, alongside the four key aspects and their significance.

Heavy vs light building

A heavy building was chosen, consisting mainly of concrete, supported by wood elements and suspended ceilings in the classrooms. Concrete was chosen because of its high thermal mass, acting as a thermal buffer during the day, releasing the heat throughout the night (Vorre et al, 2021). Additionally, concrete has good acoustic qualities, minimizing noise between spaces.

Table 4 illustrates the number of simulations with solutions that apply with the regulations. It states a big difference in the yearly energy consumption, ranging from 21 to 71 kwh/m^2, for heavy and light buildings/constructions. It is worth noticing the number of solutions without the implementation of cooling. Around 45% of the simulations apply with the indoor climate demands for the heavy building at an airflow rate of 1000m^3/h, while solutions are next to non-existence in the light construction. Implementation of cooling enhances the solutions to almost 90% and 60% for heavy and light construction, respectively.

Heat load

According to the industry guidelines it is a challenging task to achieve a good thermal indoor climate due to the high people load (graph 3). Another significant factor is solar gain, which varies depending on shading, type of glazing, and window size (Vorre et al, 2021).To minimize the internal heat load, it often requires a combination of both passive and active strategies. The building's thermal mass helps stabilize room temperature, while the mechanical system ensures consistent temperatures.

Therefore, reducing the number of students is not only beneficial from a pedagogical point of view, but also has a positive impact on the indoor climate, automatically reducing the heat load from 28 students + two teachers, to 18 students + two teachers. This is supported by table, illustrating a reduction of possible solutions, without cooling for a heavy construction, by approximately 66%

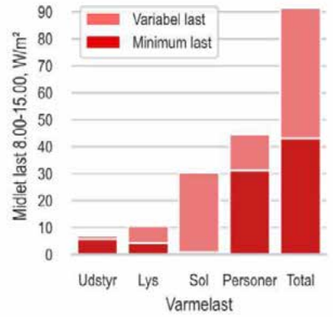
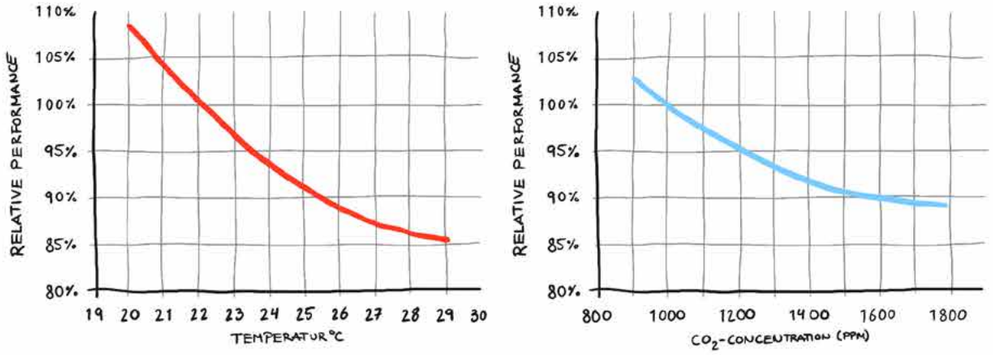


Table. 5. Diagram from (Vorre et al, 2021)



Ill. 63. Drawing of graph based on (Vorre et al, 2021)

[the four indoor climate aspects]

[thermal indoor climate]

Ill. 64. Thermal indoor climate icon

Thermal indoor climate essentially addresses how cold or warm a room is. It has a large influence on people's comfort and performance abilities. Parameters which influence the thermal indoor climate are: (1) air temperature, (2) radiation temperature and (3) air velocity/ draught. The operative temperature - the perceived temperature - is expressed by air- and radiation temperature, and this is what is referred to in norms and standards. Clothing and activity levels also play a role whether you are in thermal comfort. (Vorre et al, 2021)

There is a correlation between temperature and relative performance as shown in illustration 63. For a 100% relative performance the optimal temperature is 22°C while it decreases with higher temperatures. It is evidence that children's performance increases to 105% when the temperature drops to 20,7°C. While children generally thrive in colder temperatures most adults would consider it too cold. (Vorre et al, 2021)
Furthermore, draught is a factor when considering thermal comfort and it occurs when parts of the body cool down as a result of air movement. The experience of draught deteriorates with cooler temperatures. (Vorre et al, 2021)

[atmospheric indoor climate]

The atmospheric indoor climate is the air quality and this is dependent on oxygen, moisture, odors and contaminants from people, inventory/equipment and building materials (the industry guide focuses on contamination from people and user behavior). In order to ensure good air quality it is necessary with air change (dilution and exhaust ventilation). (Vorre et al, 2021)
Similarly with thermal indoor climate there is a correlation between air quality and relative performance. To ensure a relative performance of 100% the CO2-concentration shouldn't be higher than 1000ppm, likewise the relative performance decreases with a higher CO2-concentration. According to the industry guide the CO2-concentration shouldn't exceed 1000ppm (at outdoor level of 400ppm) (Vorre et al, 2021)

Ill. 65. Atmospheric indoor climate

[visual indoor climate]

Visual indoor climate deals with daylight quantity and distribution, visibility to surroundings and electric lighting. Some of the most valued aspects of indoor climate are good daylight conditions and unobstructed view - especially view to green areas because it appears as a stress reliever. Daylight enhances several physical and biological phenomena, it helps the body to act sustainably during the day. In order to have sufficient daylight and view it necessary to investigate window size, placement, type, etc. and while larger windows will accommodate daylight and view it can also affect the thermal indoor climate negatively by overheating. Solar shading is often used but these can block the view and depending on the visibility class for the solar shading. (Vorre et al, 2021) Because of the varying daylight amount, electric lighting is important to ensure sufficient light. The electrical lighting should be multi-functional and dynamic to facilitate varying activities. According to the industry guide, to accommodate 'Standard +' requirements (more efficient than the 'Standard' requirements) the electrical lighting should be >_500 lux. (Vorre et al, 2021)

Ill. 66. Visual indoor climate

[acoustic indoor climate]

The acoustic indoor climate affects performance, sleep and stress levels, hence why it is important to create good acoustic conditions for both students and teachers. It's about lowering noise inside the classroom and from the surroundings, while maintaining clear speech comprehensibility within the room. To ensure these conditions it is relevant to implement sound absorbing elements. (Vorre et al, 2021)

Ill. 67. Acoustic indoor climate

[sum up]

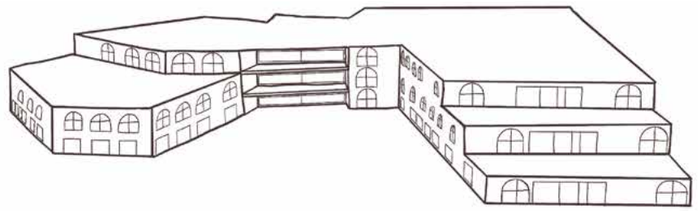
The indoor climate in schools plays a vital role in students' learning, well-being, and overall performance. A well-balanced indoor environment can enhance concentration, creativity, and task efficiency while reducing absenteeism, stress, and discomfort. The four key aspects; thermal, atmospheric, visual, and acoustic indoor climate, each contribute to creating optimal conditions for both students and teachers. By implementing evidence-based strategies and following industry guidelines, schools can foster healthier, more comfortable, and productive learning environments that support both academic success and overall well-being.

[energy considerations]

“There is a widespread belief that engineers design the heating, cooling, and lighting of buildings. The truth is that they only design the systems and equipment still needed after the architect designs the building to heat, cool, and light itself.”

(Lechner, 2015, p.3)

When designing new buildings it is important to consider energy efficient passive strategies. If these are not sufficient enough then active strategies can be implemented. When designing a school it is typical to use both passive and active strategies in order to accommodate the requirements from the industry guide and building regulations (Vorre et al, 2021). Some key aspects of the basic building design are heat retention, heat rejection and heat avoidance (Lechner, 2015). There are some general ideas to consider such as orientation, form (compactness), amount of insulation in the building envelope, window percentage, building materials, etc.



Ill. 68. Sketch of school building

A compact building has a low surface area to volume ratio (typically cubes) while more spread out shapes have a larger ratio. The lower the surface area to volume ratio is, the more energy efficient the building is. The design on illustration 64 is a combination of two overall rectangular shapes that are connected. In order to get a better understanding of the building design’s surface area to volume, the building’s compactness is calculated.

At 0,41 the building’s surface area to volume ratio indicates a higher level of compactness, but is still close to a moderate compactness. In addition to the benefits of a compact form, the choice of building materials also plays a crucial role in thermal performance, as previously mentioned. To help regulate indoor temperatures - and thus reduce the need for ventilation- the building primarily uses heavy materials such as brick and concrete. These materials contribute to better thermal mass and temperature stability.

In the window design for the building, the 10% rule has been applied to all classrooms. With classroom areas of approximately 60 m², each room includes around 6 m² of window area, never less, ensuring adequate daylight access. Furthermore the windows being used are energy-efficient windows with a low U-value (0,83) to reduce heat loss and lower the energy consumption (Outrup, n.d.).

The school being designed, as mentioned earlier, features a lower student count per classroom. This approach not only supports student well-being but also contributes to reduced energy consumption for cooling. Fewer students in each room lead to lower internal heat gains, which in turn decreases the required airflow rate. A reduced ventilation demand means less energy is needed for both ventilation and cooling systems.

Key figures kWh/m² yr

Renovation class 2

W.O. supplement	Supplement for special conditions	Total energy consumption
95,2	0,0	95,2
		42,8

Renovation class 1

W.O. supplement	Supplement for special conditions	Total energy consumption
71,5	0,0	71,5
		42,8

Energy concumption BR 2018

W.O. supplement	Supplement for special conditions	Total energy consumption
41,1	0,0	41,1
		42,8

Energy concumption Low energy

W.O. supplement	Supplement for special conditions	Total energy consumption
33,0	0,0	33,0
		42,8

Energy concumption Low energy

Heat	10,1
electricity for building operations	17,6
Over heating in rooms	0,7

Net demand

Room heating	8,2
Varm domestic water	6,1
Cooling	4,5

Selected electrical needs

Lighting	7,8
Room heating	0,0
Over heating in rooms	0,0
Heating of DHW	0,0
Fans	7,8
Pumps	0,0
Cooling	2,0
Total electricity concumption	31,7

Heat loss from installationsv

Room heating	0,0
Varm domestic water	0,9

Output from special sources

Solar heating	0,0
heat pump	0,0
Photovoltaic panels	0,0
Wind turbines	0,0

Ill. 69. Results from BE18

[BE18 results]

The building design has been entered into Be18, an energy calculation tool, to estimate its energy consumption and ensure compliance with the requirements of the building regulations.
The results (ill. 69) indicate that only minor adjustments are needed to meet the requirements set by the building regulations. These adjustments should prioritize passive strategies, and if further improvements are necessary, a small number of photovoltaic panels can be implemented to compensate for the building’s energy demand. While the results do show a slight tendency toward overheating, this is being further examined in BSim with a focus on classroom conditions. Therefore, it is not considered a significant issue in the overall energy consumption calculations.

[BSim]

Research indicates that the thermal indoor climate has a bigger influence on children's performance than previously anticipated (Vorre et al, 2021). To create a comfortable and productive environment for the children, two simulations were conducted in BSim for a critical classroom facing south, in order to explore two parameters:

- **Hours overheated throughout a school year**
- **The relation between a classroom at maximum and desired capacity, to explore the impact of the people load**

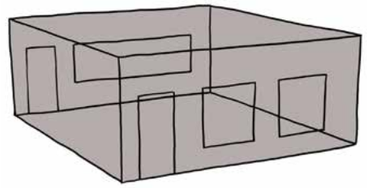
The assessments are based on the indoor climate class Standard+, which emphasizes children's performance levels and therefore requires lower temperature demands than those specified in the building regulations.

Children's optimal comfort temperature is slightly lower than for adults (Vorre et al, 2021). According to the industry guidelines for indoor climate in schools (Vorre et al, 2021), as mentioned earlier, children perform at 100% efficiency at 22°C. Their performance decreases by 10% at 25,5°C. Their performance efficiency can actually be increased to 105% when the temperature is lowered to 20,7°C.

Based on this information, we focus on the following temperature thresholds:

- **Hours below 21°C:** to assess potential for performance above 100%.
- **Temperatures above 22°C:** to know how many hours they perform 100%.
- **Temperatures above 25°C:** to measure hours, where they have a performance efficiency around 90%, as we aim to avoid performance falling below this level.
- **Temperatures above 26°C:** to monitor compliance with existing standards.

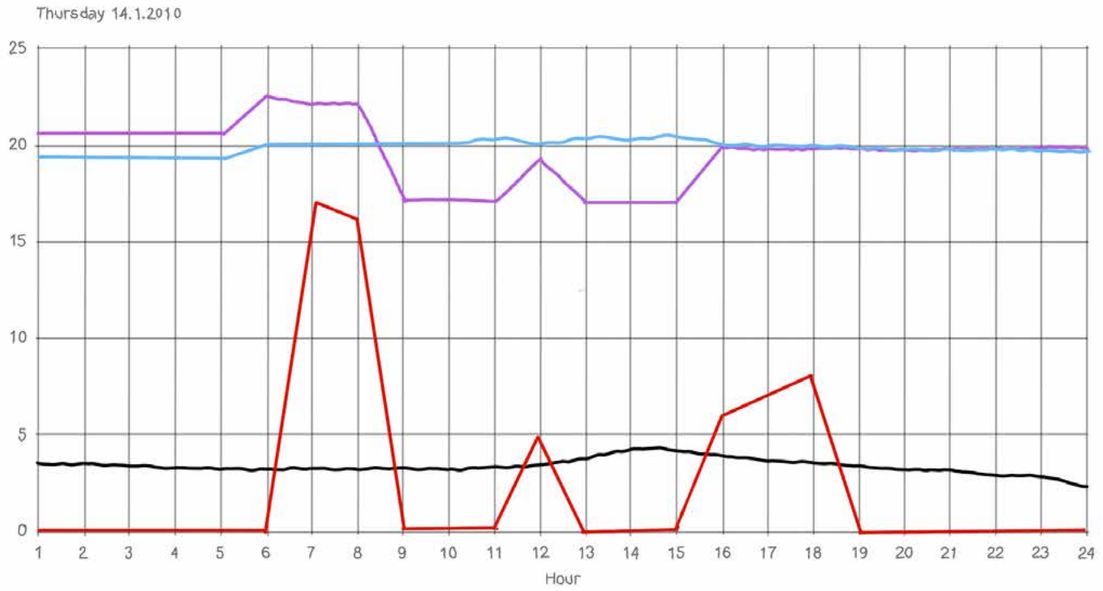
[BSim // inputs // iteration 01]



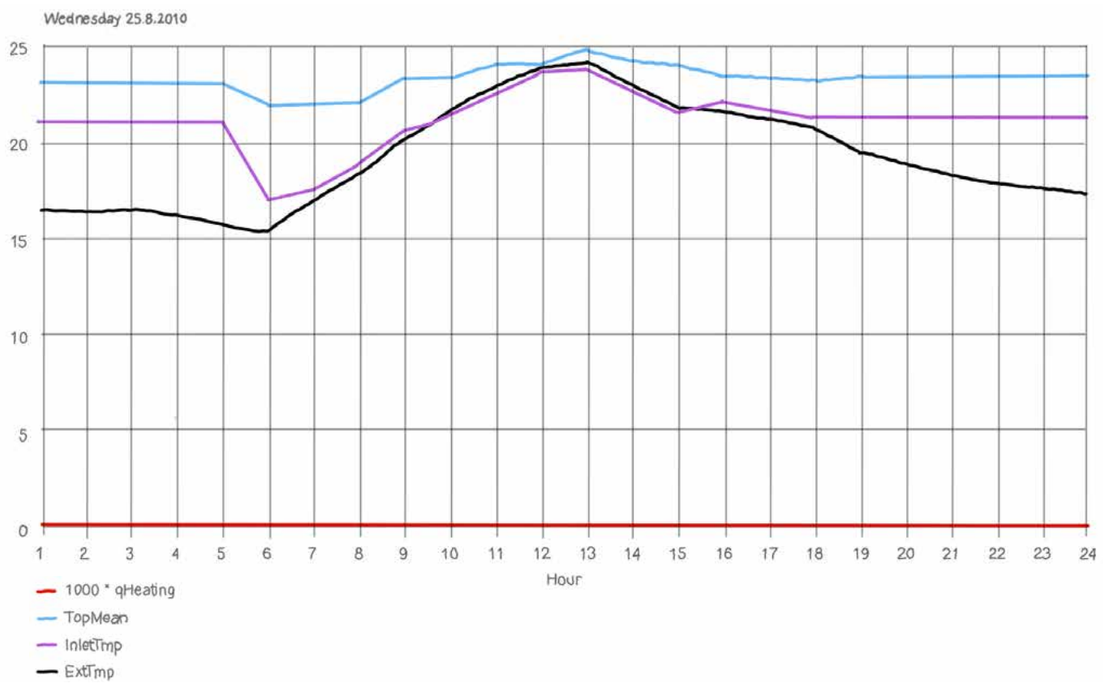
Ill. 70. illu text: Iteration 02 // Windows on both sides

Weatherfile:	Danmark_2013.dry		
Geometry:	Grossarea: 61,6m^2		
	Netarea: 55,9m^2		
Windows:	Framefactor:	0,85	
	Recess:	1 cm	
	Frame:	Alu/wood	
	Frame, U-value:	1,55 W/m^2	
Walls:	External:	0,5m Brick wall. U: 0,1W/m^2 K	
	Internal loadbearing:	0,075m Plywood. U: 1,4 W/m^2 K	
	Partition wall:	0,15m RC. U: 0,3 W/m^2 K	
Floors:	Floor slabs:	0,4m RC slabs. U: 2,4W/m^2	
Usertime:	All weeks excl. week 26 to 31. Ventilation starts in week 31. Heating is running from nov. to may.		
Peopleload:	Component:	Heat Gen.	100W/person
	Profile:	100% 9-15, 75% in hour 10, 14, 25% in hour 12	
	Time:	Monday - friday	
Equipment:	Component:	Part to air:	0,5
	Profile:	100% 9-15, 75% in hour 10, 14, 25% in hour 12	
	Time:	Monday to friday	
Lighting:	Component:	Gen. Lighting Level:	300 lux
	Time:	Monday to friday 7-18	
Infiltration:	Component:	Basic AirChange:	0,08h^{-1}
	Profile:	50% 1-24, 100% 8-16 weekday	
	Time:	50% weekend All year	
Heatning:	Component:	MaxPower:	100W/m2
	Profile:	Design Temp:	-12C
	Time:	TeMin	17C
		Normal use 6-18, otherwise Night Setback Nov to May	
Ventilation:	Component:	Supply and Return(*):	0,286 m^3/h
		Hax Heat Rec:	0,8
		Max Moist Rec:	0,6
		Max Power (Heating):	20 kW

Note: As standard the values are taken from the industry guidelines for indoor climate in Schools. If the value is marked with (*), it is from own calculations.



Ill. 71. BSim results from thursday 14.1.2010.Graph.



Ill. 72. BSim results from Wednesday 25.8.2010. Graph.

[results]

The Graphs (ill. 71 & 72) are results from a simulation of a critical south facing classroom and is conducted for a classroom of 20 people - 18 students and 2 teachers. They represent summer and winter situations, respectively, illustrating the months of January and august.

In the winter, when the outdoor temperatures (ExtTmp) are low, the mechanical system (IntelTmp) and heating (qHeating) are operating, securing an even operational temperature (TopMean) inside the classroom. The peaks on the graph illustrate activity, indicating recess, when the students are not present in the classroom. A correlation between the outside temperatures and inside heat gain is especially noticeable in the summer period.

The results are a good indicator of the relationship between people load and room temperature. The graph does not take into consideration when the students have other lectures, beyond the classroom, and recess is 1 hour long. These factors are potential sources of error, and would essentially lead to higher energy consumption used on heating.

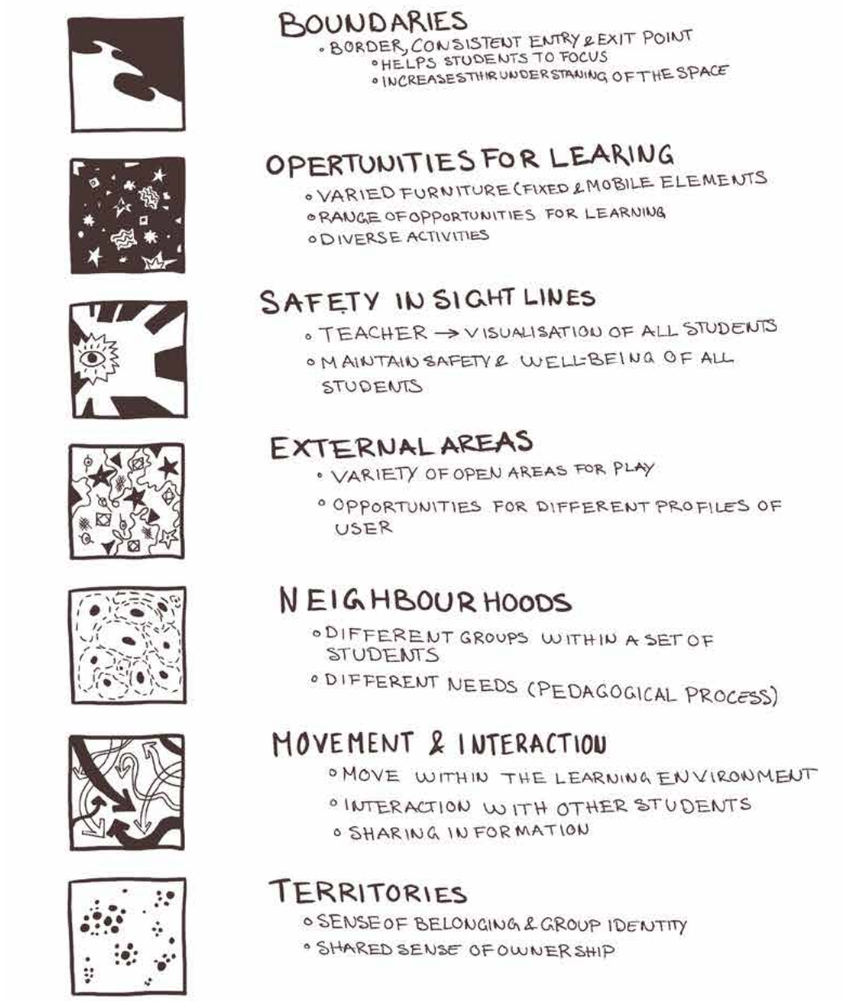
Table 6 illustrates the results for hours with overheating in the south-facing classrooms with 20 and 30 people, respectively.

Hours	20 people	30 people
Hours below 21°C:	6161	5478
Hours above 23°C:	457	731
Hours above 25°C:	21	33
Hours above 26°C:	3	9

Table. 6. Values for 20 and 30 people in a classroom, respectively

[design patterns]

As stated in the hypothesis, it is possible to develop a school that fosters a children-orientated and supportive learning environment by looking into research on learning environments in order to make informed choices. Doris C. K. Kowaltowsi, Pedro P. Goncalves and Benjamin Cleveland have written the paper “Better school architecture through design patterns”. The paper gathers evidence-based design information related to school buildings and creates different design patterns based on that information. The design patterns are in many cases not very specific which give opportunity for a variety of create solutions. Illustration 73 shows the design patterns that are selected to be worked with through the design.



Ill. 73. Drawings based on diagrams from (Kowaltowski et al, 2024)

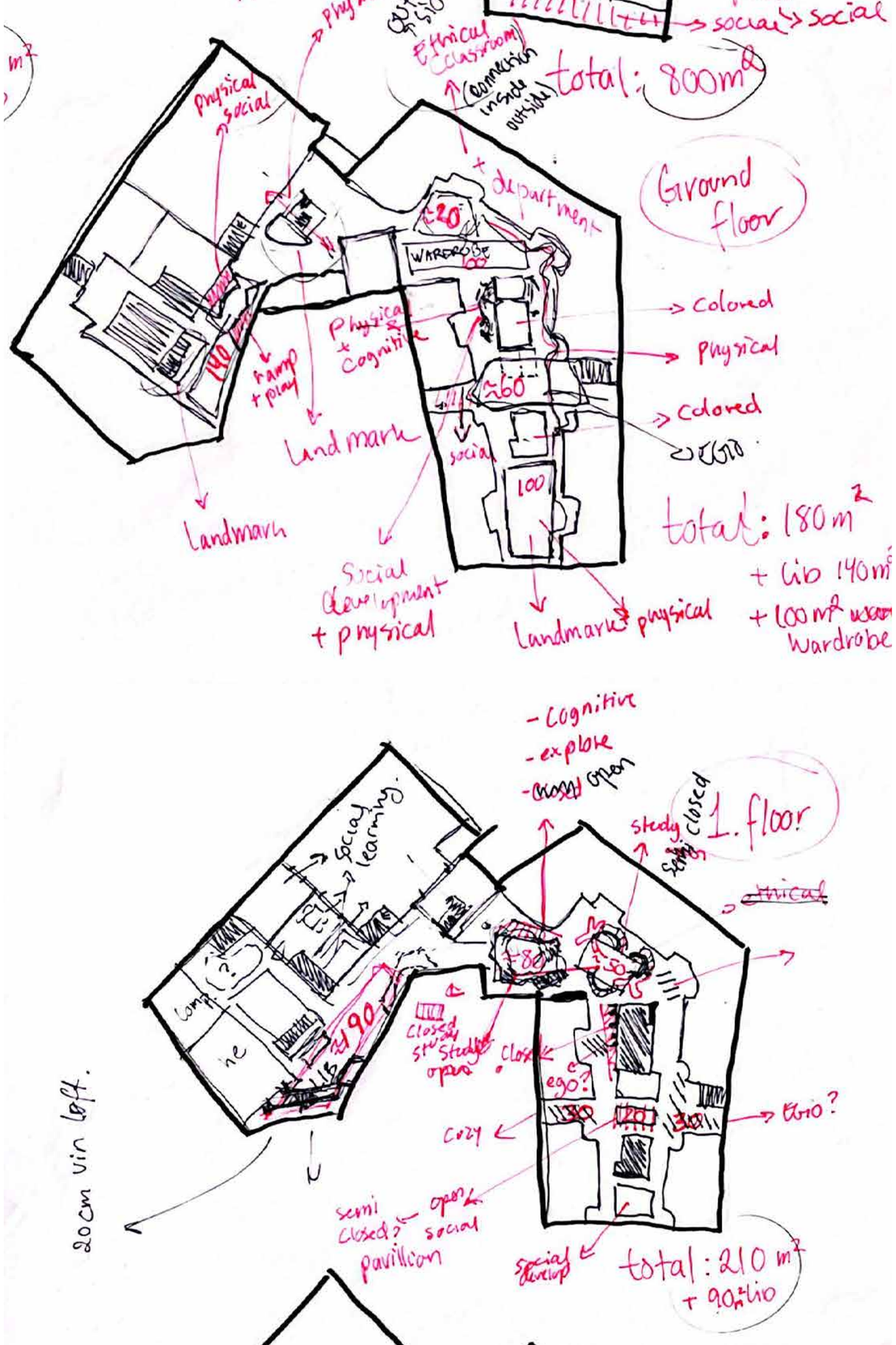
[detail of departments]

A key design consideration when designing a school is whether it should be organized into phase-based departments or kept mixed across classes. The exploratory report ‘Den afdelingsopdelte skole’ by the Danish Evaluation Institute (EVA, 2007) examines the considerations and experiences related to departmentalized school structures. However, the study does not offer conclusive evidence regarding the learning outcomes for students in such schools.

In many cases, the transition between departments have had a positive impact on students, both socially and academically (EVA, 2007). However, this is highly dependent on a safe and well-managed handover process, to avoid transitions risk disrupting the student’s learning process, especially for students with varying academic strength (EVA, 2007). Another potential drawback is the risk that departments may become isolated units. To minimize this, the design must encourage interaction between departments through shared spaces and overlapping functions distributed across different floors. This spacial strategy will ease transition by allowing students to become familiar with different parts of the school. Additionally, fixed classrooms and familiar surroundings are designed to offer stability and comfort.

Based on insights from the case studies and academic research, we have chosen to design a departmentally divided school, physically separating the school into three distinct educational phases: early primary, primary, and upper primary.

Children’s developmental differences become most apparent within their departmental spaces and classrooms, where they have the opportunity to influence their immediate surroundings and develop a sense of belonging. This can be enhanced through intentional design that acknowledges how different learning environments support developmental needs. It is therefore essential to understand the purpose of each phase, which will be presented on the next page supported by sketches illustrating their respective needs.

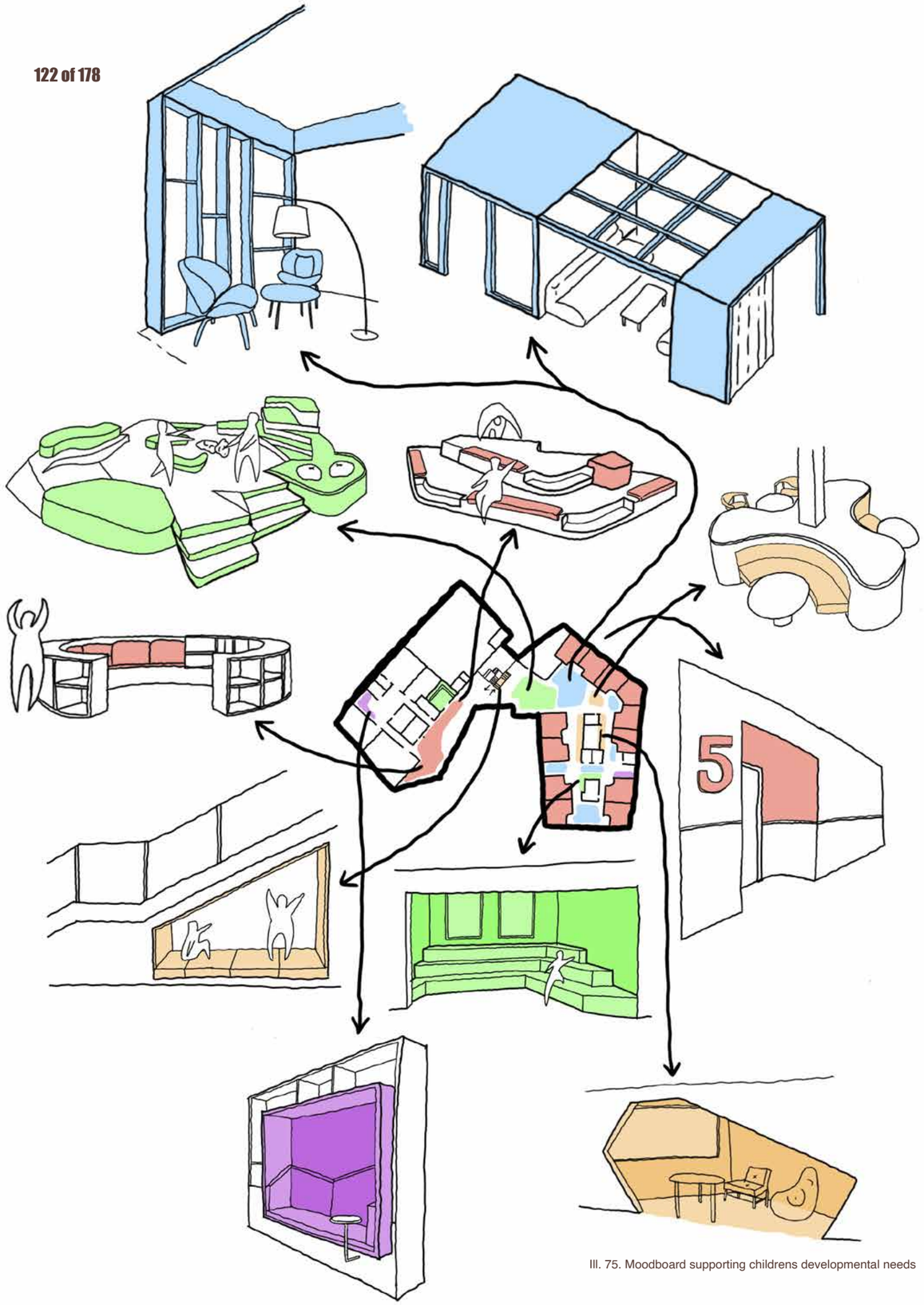


Ill. 74. Implementation of different learning environments. Sketch

[early primary]
Focuses on early literacy development and learning readiness. Students spend most of their time in the classroom or participate in whole-class activities in shared or outdoor areas. Learning is primarily play-based and supported by an exploratory teaching approach (EVA, 2007). Flexible classroom layouts are essential to accommodate various activities. At this stage, group work is less relevant, and instead, shared areas are designed as cozy, playful spaces with hideaways, quiet zones, and activity corners. A sense of security - both pedagogically and spatially - is essential.

[primary]
Serves as a bridge between early education and the academic demands of upper primary, combining elements of structured learning with continued exploration. Students begin to work more independently, moving between the classroom and learning spaces for group- or individual activities. A key focus is providing the students with differentiated instruction and supporting their individual learning processes.

[upper primary]
Emphasis on academic performance and final examinations. The lectures are structured more traditionally with focus on core academic subjects, neglecting creative subjects. Students tend to work more independently, and make frequent use of shared areas for individual work and group projects. Therefore, the spatial design must provide a balance between opportunities for collaboration and quiet, focused work environments.



Ill. 75. Moodboard supporting childrens developmental needs

[moodboard]

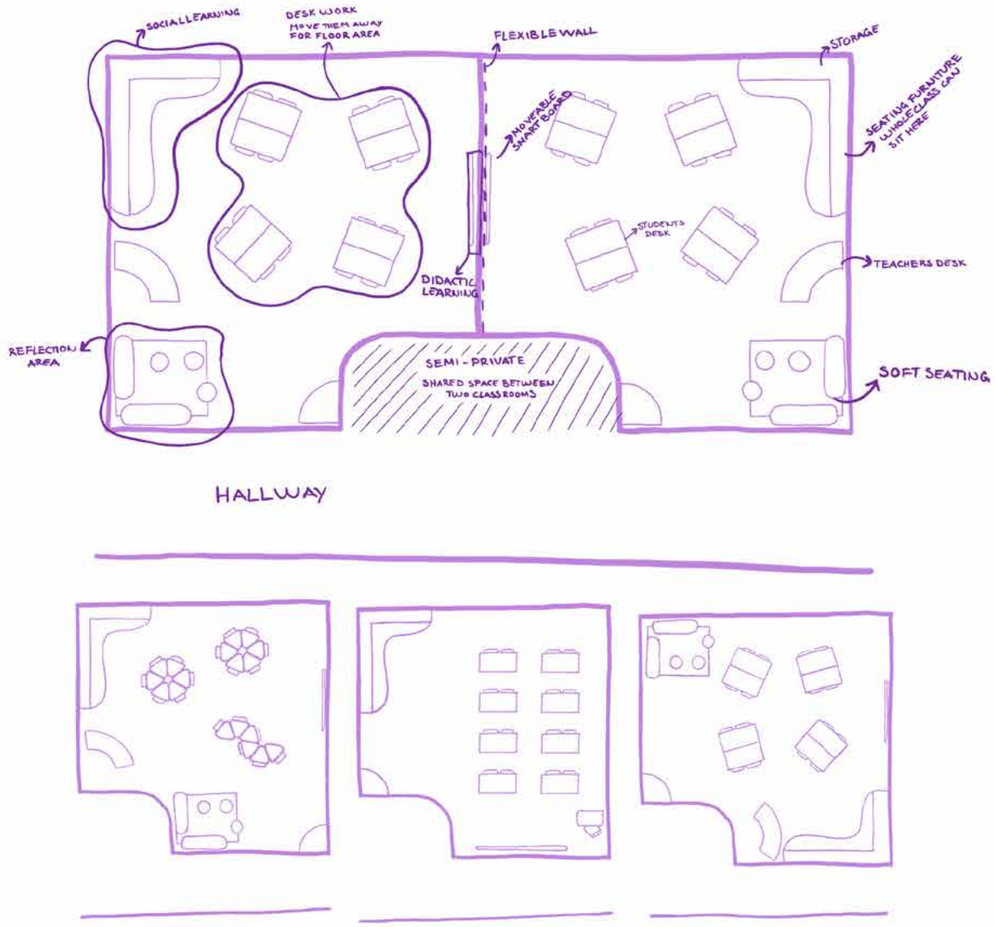
The moodboard on illustration 75, illustrates different approaches to learning environments in the primary phase, that support the children's developmental needs, as mentioned on page 56. These concepts are incorporated in the design.

The department consists of soft-seating, multipurpose furniture, nooks and space for hide and play. The implementations offer different settings, such as open spaces, semi closed lounge areas and closed group rooms - depending on the purpose. These elements help break up large open areas and create space within spaces, fostering interactive environments for the children to discover. Integrating furniture along the core of the departments creates dynamic flow along the corridors. Through the use of furniture, it is possible to create landmarks and differentiate between the three phases. Landmarks are essential, as the children learn how to navigate. This is implemented through color and core elements throughout the departments.

[4th grade - detail of classroom]

In this part of the report, we zoom in on the classroom design and distribution. The design is based on a 4th-grade classroom, with the aim of creating a flexible environment that encourages dynamic learning. We propose the creation of distinct zones within the classroom to foster various activities and learning styles (Rigolon et al, 2011). Inspired by research on the benefits of L-shaped layouts (Nair et al, 2005), the classroom zones are thoughtfully arranged to balance structure and freedom. These zones include areas for focused work, collaboration, and relaxation, realized through a combination of soft and hard seating solutions.

The renders on the following two pages are a visual represetation showcasing different combinations of materials in the classroom (ill. 77-79).



Ill. 76. Interior design of the classroom

Ill. 77. Scenario 01. Merged classroooms

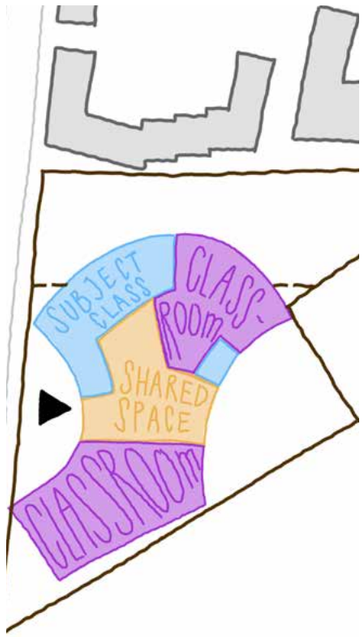
Scenario 01
The illustration explores having painted concrete on the interior walls, while using bricks on the exterior wall - representing the façade material on the inside. There is a strip of wood along the walls, adding warmth and breaking up the hard and cold materials.

Scenario 02
The second illustration has painted concrete on the exterior wall, painted foldable walls, and brick interior walls. This illustration also introduces a strip of wood.

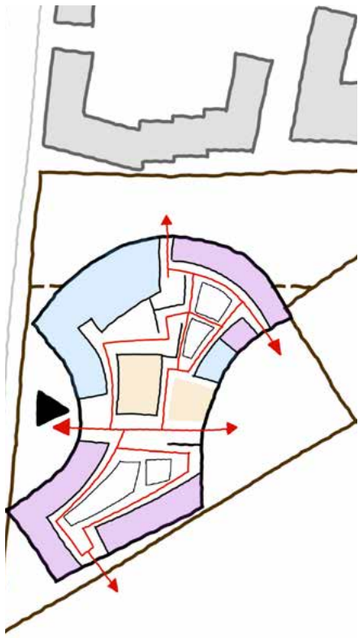
Scenario 03
The last iteration features brick on all walls except for the foldable wall. The strip of wood continues in this iteration, adding another layer to the room.

Ill. 78. Scenario 02. Brick interior, concrete exterior

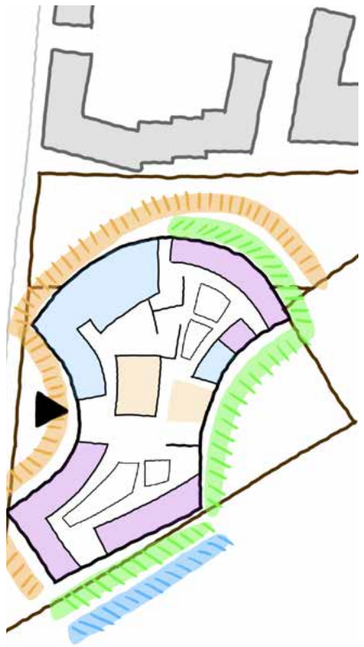
Ill. 79. Scenario 02. Brick walls with concrete foldable wall



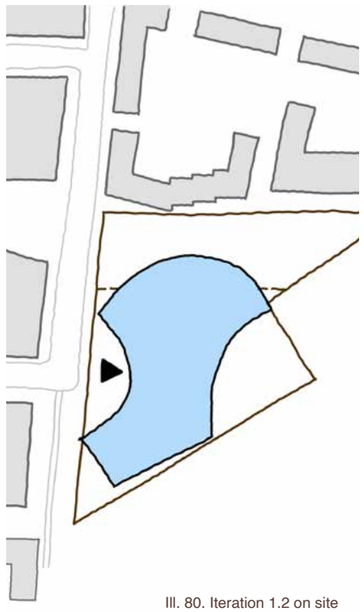
Ill. 81. Distribution. Iteration 1.2



Ill. 82. Flow. Iteration 1.2



Ill. 83. View. Iteration 1.2



Ill. 80. Iteration 1.2 on site

[iteration 01.02]

The diagrams illustrate focal points from the observational analysis on page 35.

- The shape of the building on site
- The distribution of functions within the layout
- Flow and sightlines through the building
- View and orientation

Since the development plan for Stigsborg is under revision, changes have occurred throughout the project. The fragmented courtyard buildings to the north were expanded, consequently reducing the size of the site. The area in between is planned to be transformed into a shared space and the new city square, which we aim to engage with.

Iteration 1.1 included several desired qualities, such as optimal form, orientation, and views, which we wanted to maintain. To adapt to the new conditions, the shape was flipped upside down and pushed down onto the site, resulting in additional constraints. A significant number of classrooms now faced south and towards the residential buildings. After multiple iterations, it was not possible to achieve sufficient north- and east-facing façades for the classrooms, compromising their quality. This ultimately led to a reconsideration of the overall design.

The new approach was to optimize the building structure, with a large façade area facing north and east and minimizing waste space in the core, while maintaining a compact building

Ill. 84. Iteration 1.2 on site

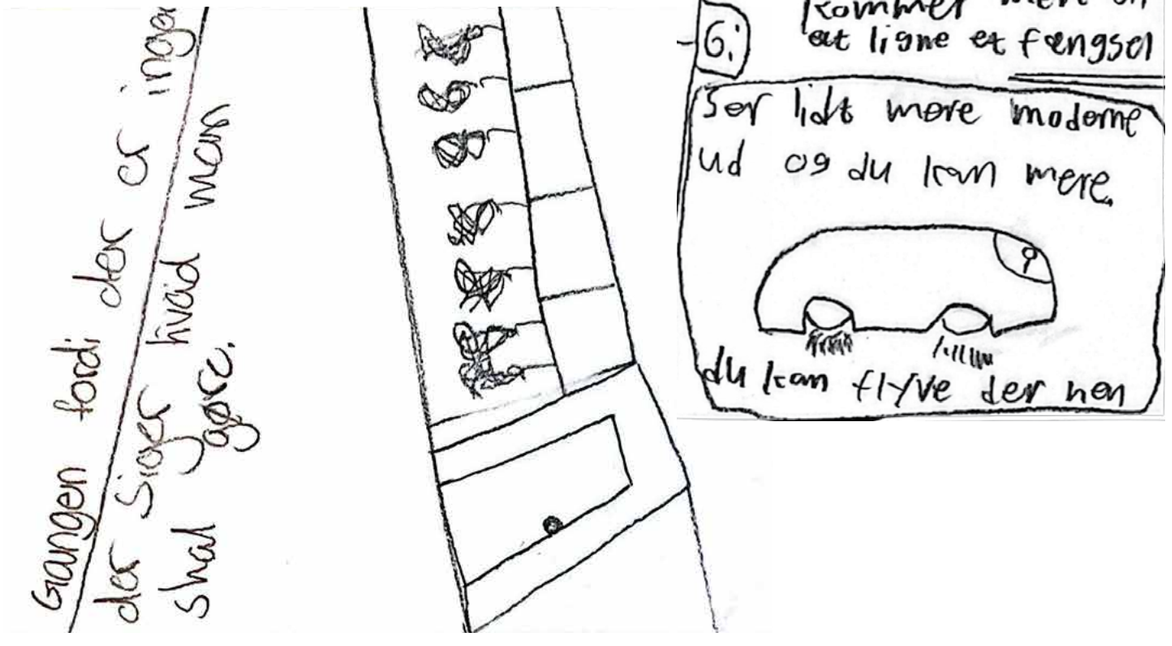
[workshop with 5.A // skipper clement school]

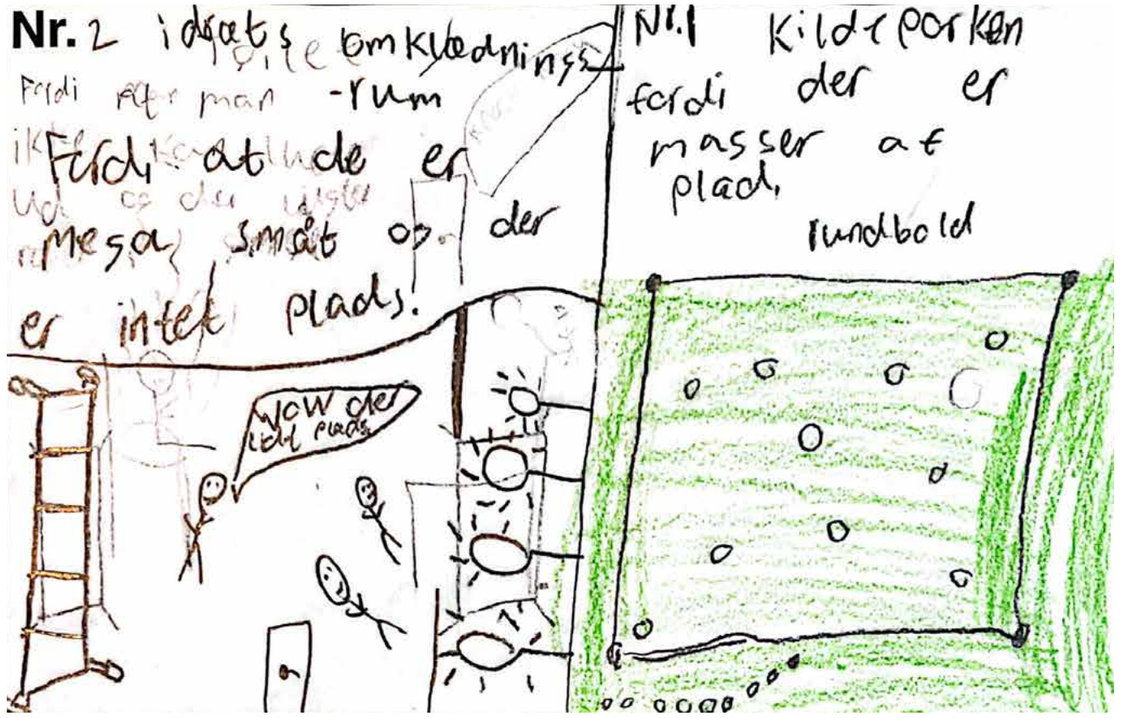
A workshop was conducted in collaboration with 5.A at Skipper Clements School in Aalborg. The purpose of the workshop was to gain an understanding of how students interact at school, what their needs are, and how they perceive the framework they have been placed in. Public or private school is where children spend 10 years of their lives, which is why it is important to understand how children develop and how they perceive and are influenced by the school environment.

The workshop consisted of six child-friendly questions, which were meant to make the student think critically about their experience. These answers were to be drawn or communicated through words. Through the drawing we identified some patterns and critical points that were not of much significance when seen from the outside. We incorporated this study in the development of our design.

Questions for the children

- What/ where is your favorite place at school, and why?
- Where do you least like to be at school, and why?
- Draw a map of your daily route on a school day
- What is your favorite memory from school, and why?
- What does your dream classroom look like?
- What do you think the school of the future will look like in 50 years?

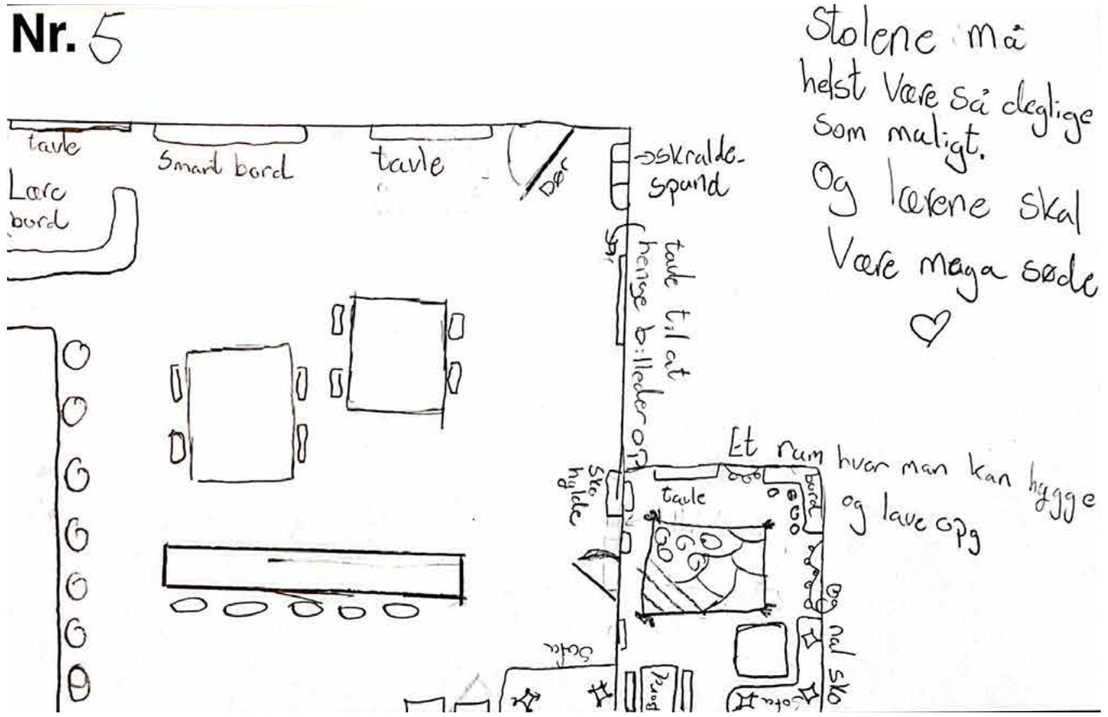




Ill. 85. Number five. “How will the future school look like?”. Drawing, boy 5.A.

Ill. 86. Drawings from 5.A at Skipper Clement School

Ill. 87. Drawings from 5.A at Skipper Clement School



Ill. 88. Drawings from 5.A at Skipper Clement School

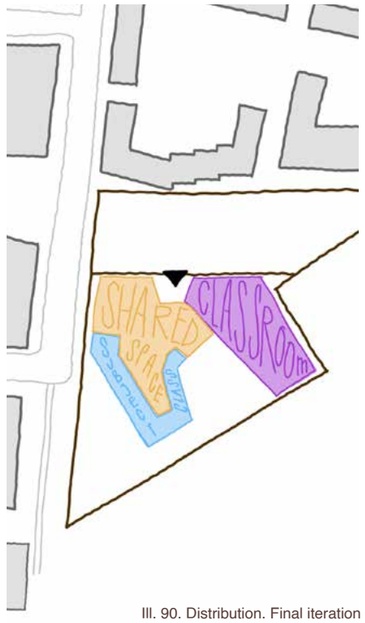
[sum up // workshop]

Focus areas from workshop

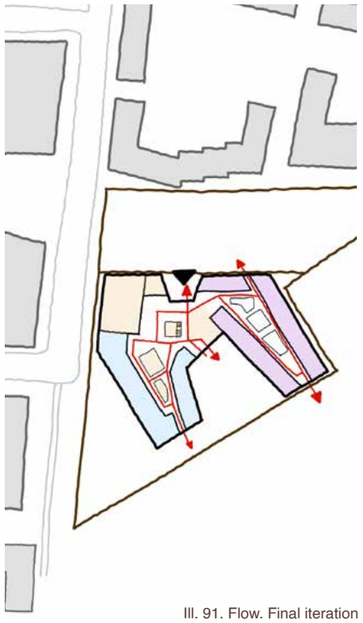
- **The bathroom facilities are important and not pleasant.**
- **There is a need for bigger locker rooms, with more space, closed lockers and more seating areas.**
- **They children enjoy being creative and active. They like to play and run around in their recess, and they enjoy sports as well as creative subjects, such as music and art.**
- **They requested areas in the classroom with cozy atmosphere, a pop of color and space for informal conversation.**
- **The hallways was a place with divided feelings. Some children enjoyed the cooridors, because it facilitates informal meetings, while others felt misplaced because of exposure and lack of stay.**

[final iteration]

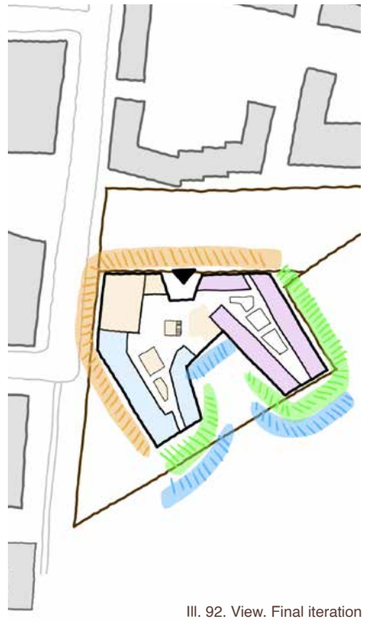
The following section presents the final design iteration explored. It investigates the urban area of the site, window and façade explorations, and roof exploration. Furthermore, the section calculates the airflow rate in order to select a central aggregate for each zone of the building.



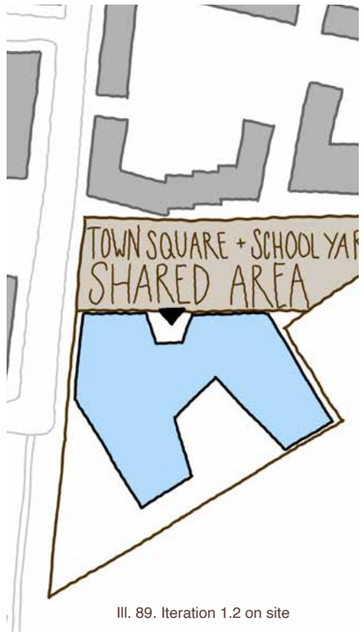
Ill. 90. Distribution. Final iteration



Ill. 91. Flow. Final iteration



Ill. 92. View. Final iteration



Ill. 89. Iteration 1.2 on site

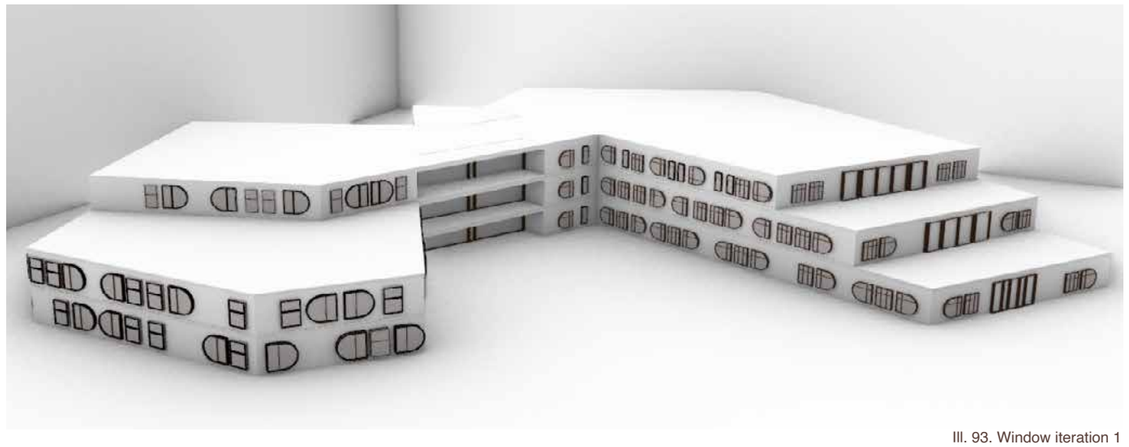
[final iteration]

The diagrams illustrate focal points from the observational analysis on page 35.

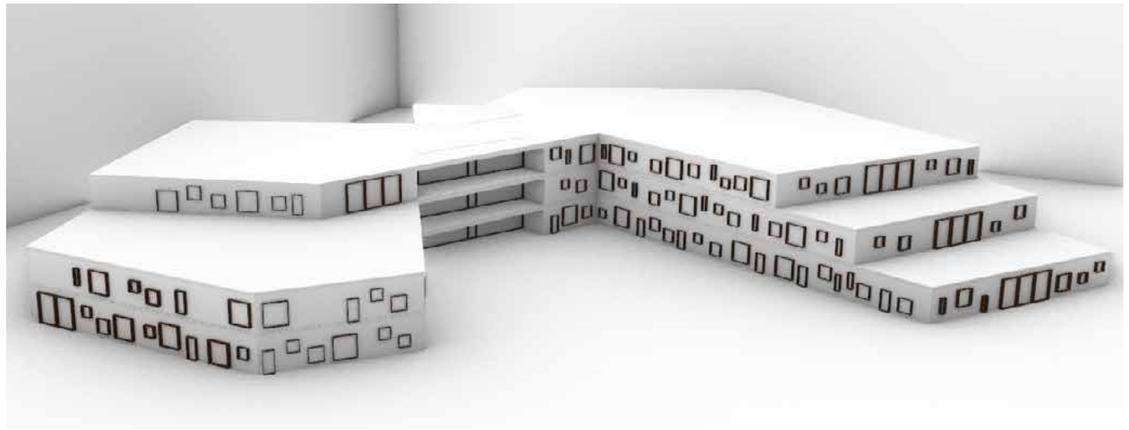
- The shape of the building on site.
- The distribution of functions within the layout
- Flow and sightlines through the building
- View and orientation

The updated site conditions on context are visible, with the implementation of the shared space and town square.

The final iteration has a more angular shape with straight lines creating two wings and a central connection between them, intentionally framing and inviting the adjacent fjord and park closer to the building, fostering a strong relationship between indoor and outdoor environments. This orientation maximizes natural light and views, enhancing the overall user experience. The illustrations highlight these key aspects, showcasing how the architectural form responds thoughtfully to the site context while supporting the functional needs of the school.



Ill. 93. Window iteration 1



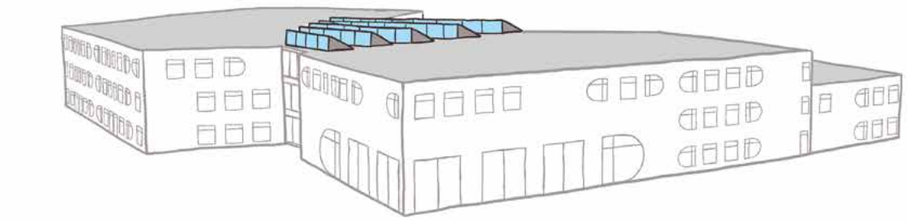
Ill. 94. Window iteration 2

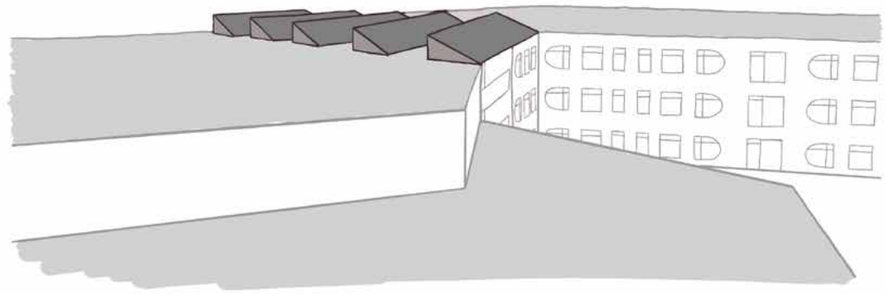
[façade exploration // window composition]

The following is a façade exploration focusing on two window explorations and how they influence the building's overall expression. The building needs to create a dynamic, but balanced, window expression.

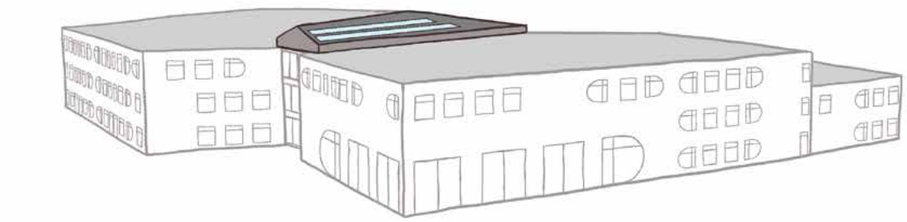
Iteration 01
The first iteration explores the use of both square and arched windows in combination. The idea is to use a traditional shape, like the arch, and reintroduce it in a different way. The arches are rotated 90 degrees and are used to illustrate the rooms on the interior by the way they are orientated.

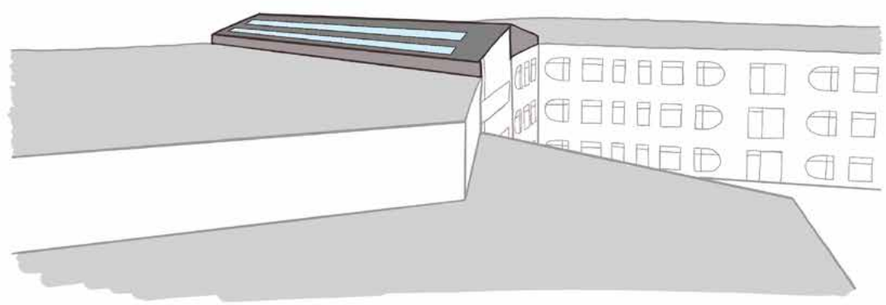
Iteration 02
The second iteration explores a playful façade which is not in order, nor does it consider the different rooms and the type of lighting they would get. The playful façade relates more to the idea of an active school with life.



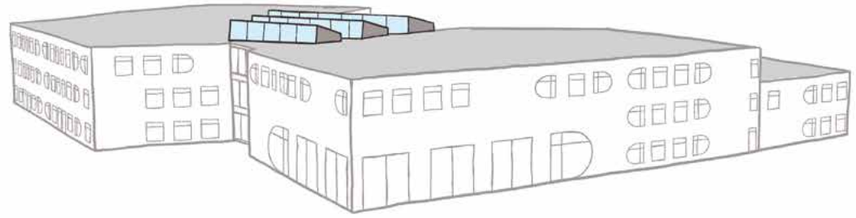


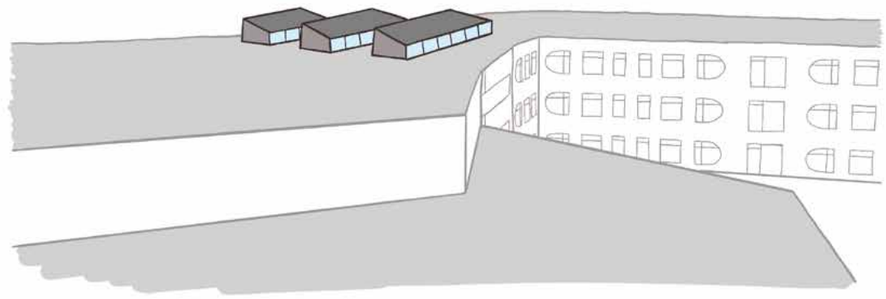
Ill. 95. Roof iteration 1





Ill. 96. Roof iteration 2





Ill. 97. Window iteration 3

[roof exploration]

The following is a roof exploration focusing on the middle part of the building. The atrium is located in this area, which is why it is preferred to have skylight windows. The building shape has a lot of character; therefore, the roof is chosen to be flat. However, in the middle of the building, it is desired to create a different type of expression. The three explorations investigate different executions of the roof. The northern and southern middle parts of the building are not parallel and have entirely different angles, making a structured roof difficult.

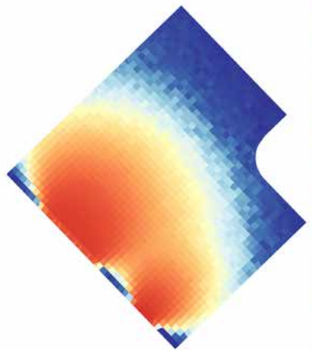
Ill. 98. Façade iteration 1. Red brick with thick stripe

Ill. 99. Façade iteration 2. Combination of wood and brick

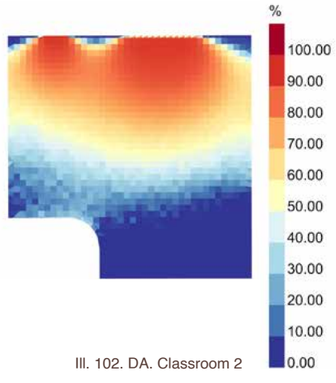
Ill. 100. Façade iteration 3. Brick façade , varying in color, with thin stripe

[façade exploration // material composition]

The following explores three different façade expressions. All three have bricks, but one uses red bricks with red mortar, while the other two use two different nuances of brown. The first exploration has a strong color, and the red mortar makes it seem very uniform. It also has a thick detail around the floor slab. As mentioned, the last uses brown brick, with a darker color on the 2nd floor. This detail matches the detail on the other buildings in the area. The second illustration showcases the façade without any details with the brick, while the third has thin vertical and horizontal details. This gives the building a few vertical lines, compared to the very horizontal building.

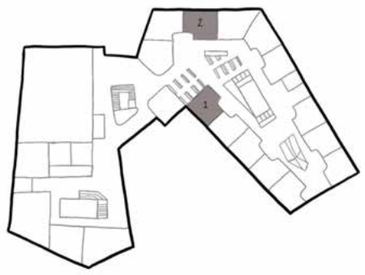


Ill. 101. DA. Classroom 1



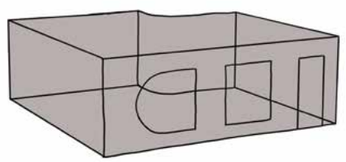
Ill. 102. DA. Classroom 2

[daylight calculations // 02]



Ill. 103. Overview of chosen classrooms

Since the classroom layout has changed following the previous daylight analysis, this updated analysis evaluates whether the new L-shaped design receives sufficient daylight and examines the uniformity of light distribution. In this analysis the classroom is 60m^2 and the windows do follow the 10 pct rule which means that the window area is 6m^2. Given that the back part of the classroom is more of a breakout area with soft seating and cozy environment as mentioned earlier, that part of the classroom is not a part of the relevant classroom area defined by the industry guide.
The simulation confirms that the L-shaped classroom fulfilled the requirements from the industry guide. Furthermore this shape has a more even daylight distribution within the relevant area making a more pleasant visual indoor environment.



Ill. 104. Illustration of classroom

[ventilation // air flow rate]

To ensure a school with a good atmospheric indoor climate the ventilation rates for the specific rooms needs to be calculated, and the results will furthermore help select a fitting central aggregate for the different parts of the building.

Air flow rate
As mentioned earlier this thesis uses the values given by the industry guide for indoor climate in schools. The industry guide only addresses the necessary ventilation rate per person in classrooms and group rooms, which is why DS/EN 16798 is used in other parts of the building. Furthermore the industry guide does not address the emission from the building, so the values used in the calculations are from DS/EN.
Depending on the accepted CO2 concentration in the study areas, the ventilation rate is different. As previously mentioned the CO2 concentration should not exceed 1000 ppm and the graph from “The four indoor climate aspects” (ill. 63) indicates that having a CO2 concentration at 900 ppm increases the students’ performance further. This is why the project group has chosen to work with a ventilation rate (11,3 L/s per person) that ensures an indoor CO2 concentration that does not exceed 900 ppm (Vorre et al, 2021). This ventilation rate is 1,3 L/s per person higher than what the standard values in DS/EN for a category one building (DS/EN 16798). Both DS/EN and the industry guide only use ventilation rates for an activity of 1,2 MET (2,0 for a child), which is the activity level of a person working at a desk. The school does have rooms with a higher activity level which needs to be taken into account, appendix 5 shows the formula used for those rooms.

The method used to calculate the total ventilation rate in each room is based on perceived air quality (method one) from DS/EN. (appendix 5)
The following table is a simplified version, the fully extended version is in appendix 5.

Categories	Area [m^2]	People [max]	Max. airflow rate [m^3/h]	Air change [h^1]
Classrooms				
Classroom // 0. grade	60	17	907,6	5,4
Classroom // 1. grade	60	17	907,6	5,4
Classroom // 2. grade	60	17	907,6	5,4
Classroom // 3. grade	60	17	907,6	5,4
Classroom // 4. grade	60	20	1029,6	6,1
Classroom // 5. grade	60	20	1029,6	6,1

Table. 7. Table for total ventilation rate

Ill. 105. Building divided into zones

[central aggregate]

The air flow rates are used to dimension the size of the central aggregate. The design is divided into ventilation zones in order to have a few smaller aggregates instead of one large, and to minimize the lengths of the pipes.
Illustration 105 shows the ventilation zones and table 7 shows the total air volume for each zone. Based on the different air volumes for each zone an aggregate will be selected by using Systemair (a program that shows different options for an aggregate based on the given information).

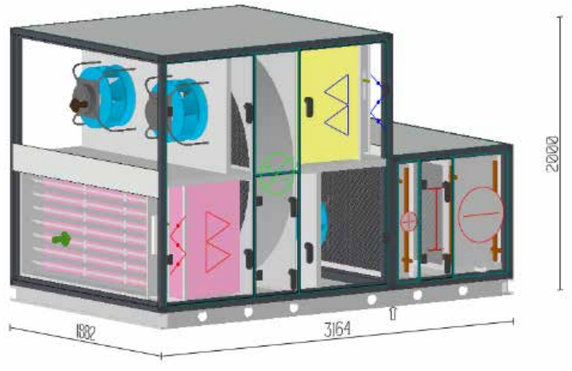
Table 8 shows the total air volume for maximum capacity in each zone, which means the maximum number of people in each room at the same time. This is not something that is very likely to happen normally, which is why the air volume for normal capacity is calculated to show the total air volume in each zone for an everyday scenario (in the scenario all the rooms are also occupied at the same time). Based on the total air volume for both normal and maximum capacity the following aggregate is selected for each zone. This aggregate is a size 18 and can deliver both the smaller amounts of air and the larger once.

The chosen aggregate has a rotary heat exchanger to save energy by using the heat from the exhausted air to transfer heat to the incoming cold air. Furthermore the aggregate has both a heating and cooling coil. The heating coil is used primarily in the winter when the heat recovery (rotary heat exchanger) is not sufficient. The cooling coil is for the summer time, using mechanical cooling to reduce the supply air temperature.

Zone	Total air volume at normal. capacity [m^3/s]
Zone 1 (ground floor - east)	3,59
Zone 2 (first floor - east)	3,08
Zone 3 (second floor - east)	4,02
Zone 4 (ground floor - west)	3,90
Zone 5 (first floor - west)	1,58

Zone	Total air volume at max. capacity [m^3/s]
Zone 1 (ground floor - east)	4,14
Zone 2 (first floor - east)	3,55
Zone 3 (second floor - east)	4,61
Zone 4 (ground floor - west)	4,72
Zone 5 (first floor - west)	2,08

Table. 8. Total air flow rate. (Top) Normal capacity. (Bottom) Max. capacity.



Ill. 106. Chosen central aggregate

Ill. 107. Urban concept sketch

Ill. 108. Urban sketch 01

[urban]

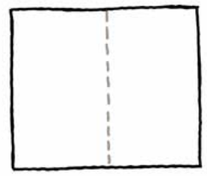
When considering the surroundings there are three main meetings. Firstly there is the meeting between the school district and the city. It is important to not only consider the school as its own unit but to also consider it as a part of the city and therefore giving back to the city. This meeting between the city and the school can also contribute to the students' ethical development. The students ethical development is about their behaviour and disposition towards other people and the environment. It is outside of the home in school for example that children start developing their own independent definition of right and wrong or what should or should not be done. (Rigolon et al, 2011) Having a town square and school yard combined will expose the children to people other than themselves - learning to respect human diversity- and this type of place can convey value. The idea of 'us' and 'them' will be minimized because they get exposed to other people and have to coexist. It will also teach the children a sense of responsibility because a shared space needs to be well kept and maintained (Rigolon et al, 2011).

The second meeting is the meeting between the school district and the harbour. It can be dangerous to get too close to the harbor when working with children and as result of this the planned path between the park and the harbor is keeped as a boundary and this could further be supported by placing trees along the path and keeping the play areas the youngest closer to the building. Furthermore the harbor is not one sided, the harbor combines Aalborg to Nørresundby and Stigsborg so the out area should relate not only to the rest of the harbor in Nørresundby and Stigsborg but also the harbor in Aalborg.

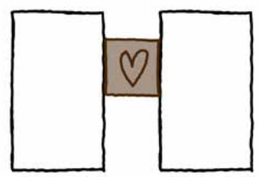
The last meeting with the surroundings is the park. The school district is both meeting the park but the park is also a part of the school district's outdoor areas. Like the encounter with the city, the park also holds the potential to support children's ethical development. The park can be a possibility for the children to learn about natural elements and phenomena (Rigolon et al, 2011). This can be executed by implementing ponds, creating natural ecosystems, planting fruit trees, berry bushes and/or herpes, this way children have a frequent encounter with plants and animals.

[presentation]

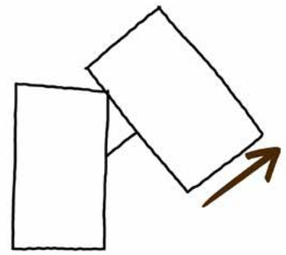
[concept diagrams]



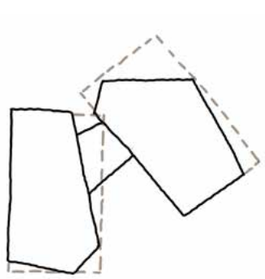
Compact building volume split in two



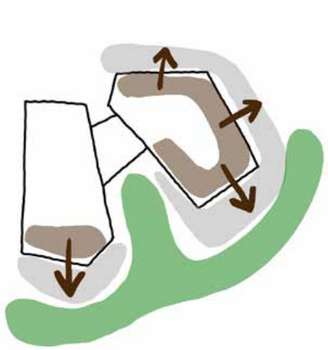
The heart of the building connects the two building sections



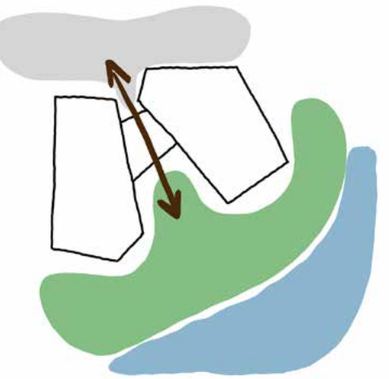
The department is rotated, inviting the park and fjord close



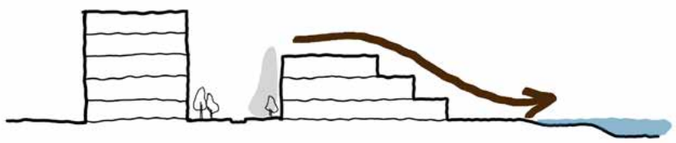
The building corners are cut to create a dynamic flow and expression



Extend learning into the outdoors, creating a link between inside and outside



The building connects the nature and urban area with the city square



The building scales down towards the open landscape and fjord, while shielding for the high residential buildings

[masterplan 1:500]

Ill. 109. Ground floor atrium. Render

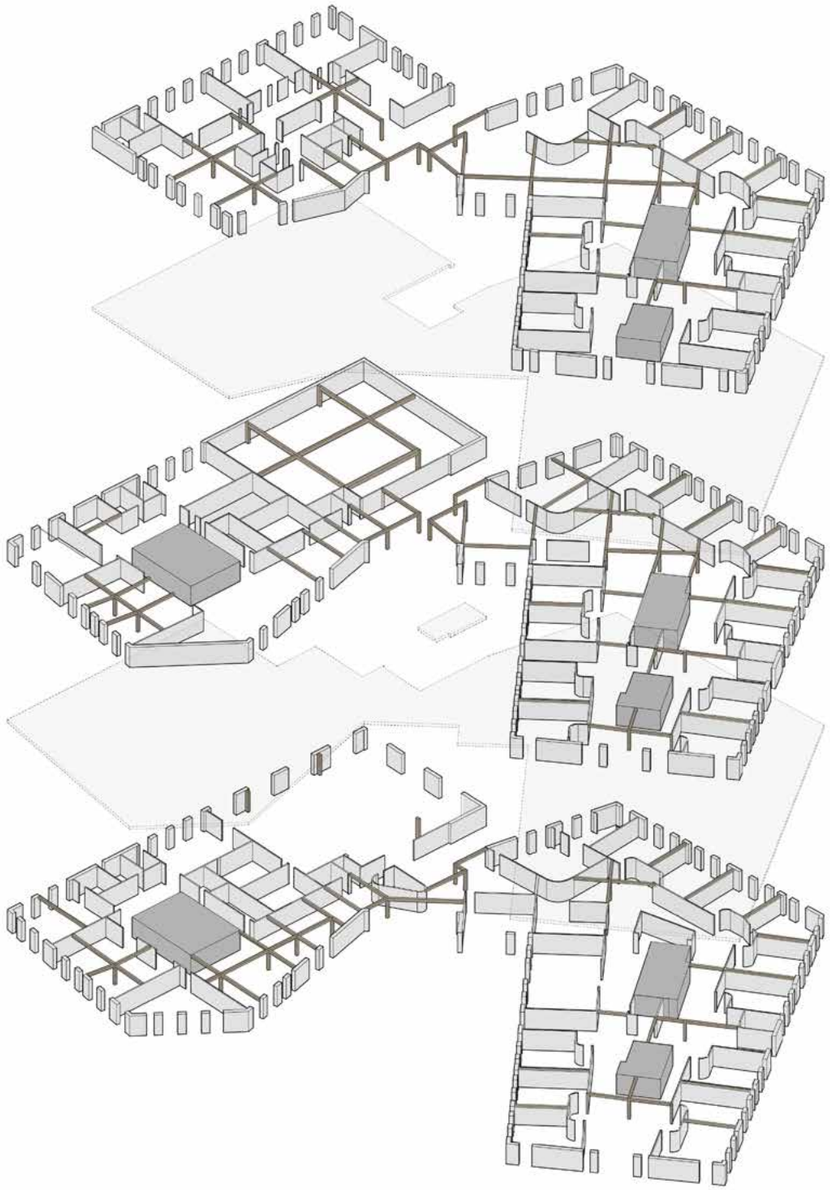
Principal 11,5m²
Grade 0 58m²
Grade 0 58m²
Grade 0 58m²
Special needs class 51m²
Secretary 27,8m²
Teacher lounge 80m²
Sports hall 470m²
Depot 22m²
Grade 1 58m²
Grade 1 58m²
Toilet 18,7m²
Tech. room 37,5m²
Exit 15m²
Wardrobe 76m²
SFO 63m²
Canteen 19m²
Grade 3 58m²
Grade 3 58m²
Group room 13,8m²
Lounge 13,8m²
Grade 1 58m²
Toilet 12m²
Locker room 47m²
Locker room 47m²
Toilet 31,5m²
Grade 2 58m²
Music 88m²
Utility room 12m²
Toilet & HC 24m²
Group room 58m²
Grade 3 58m²
Grade 2 58m²
Music depot 10m²
Exit 15m²
N/T depot 16m²
Tech. room 37,5m²
Utility room 37,5m²
Grade 2 58m²
Nature & Technology 83m²
Crafts 121m²
Design 88m²

[ground floor 1:250]

Grade 4
58m²
Grade 4
58m²
Grade 4
58m²
Group room
51m²
Grade 5
58m²
Group room
58m²
Exit
15m²
Toilet
13,7m²
Tech. room
37,5m²
Lounge
13,8m²
Group room
13,8m²
Grade 6
58m²
Special needs class
58m²
Toilet
31,5m²
Grade 6
58m²
Grade 6
58m²
Wardrobe
39m²
Grade 5
58m²
Grade 5
58m²
Teacher's office
119m²
Sound/light
22m²
Toilet
12m²
Social learning
47m²
Art
88m²
Group room
59m²
Toilet & HC
24m²
Art depot
10m²
Exit
15m²
Tech. room
37,5m²
Utility room
37,5m²
Computer room
85m²
Home economics
141m²

[first floor 1:250]

[second floor 1:250]

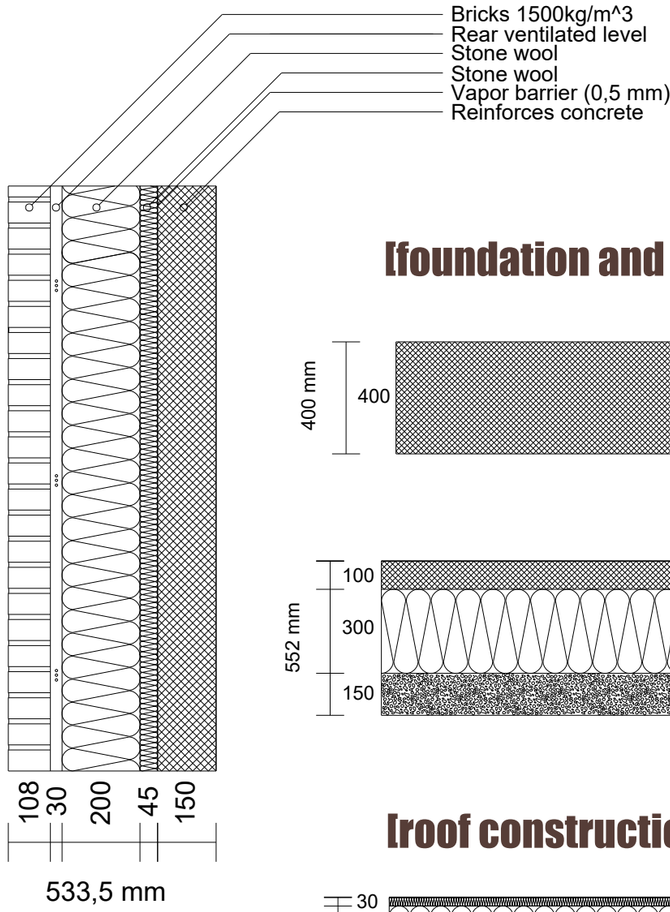


[structural system]

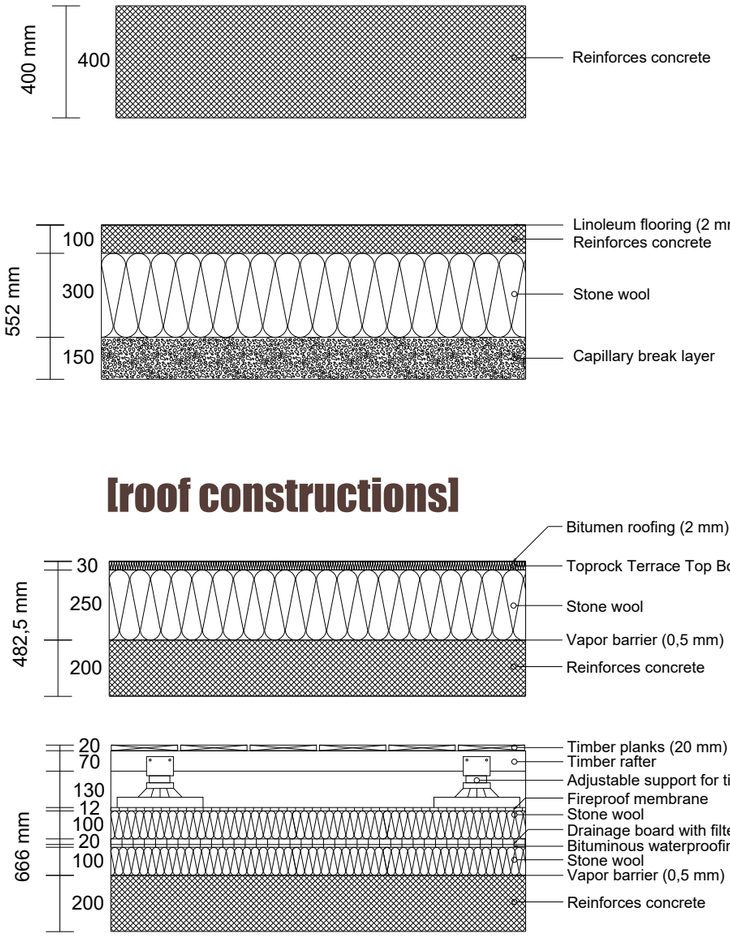
The building’s structural system consists of a load-bearning concrete façade with an attached brick cladding. The interior walls are made of 15 cm thick reinforced concrete elements, providing 120-minute fire resistance. Cross-Laminated Timber (CLT) is introduced to support the long spans across the common areas. Concrete cores are implemented to breack up large spaces, minimize the use of free-standing colums and reduce the size of the beams.

Ill. 110. Isometric drawing of the structural system

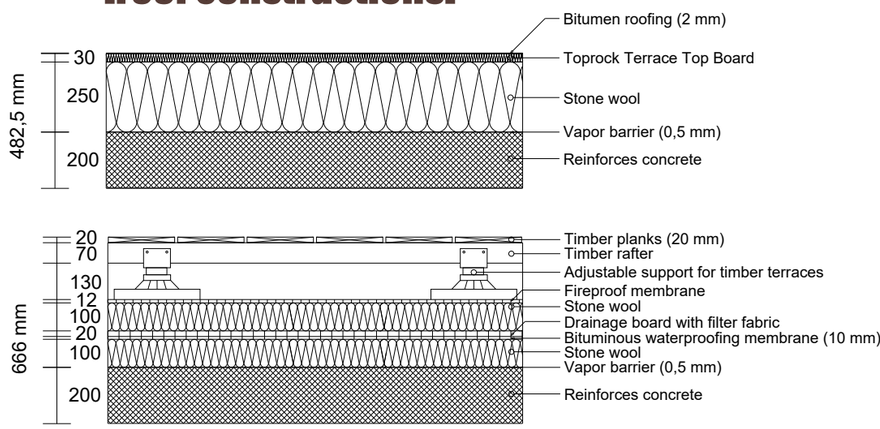
[exterior wall]



[foundation and floor slab]



[roof constructions]



Ill. 111. Construction details

[energy consumption // be18]

The energy performance of the final design proposal has been calculated to ensure it meets the standards set by the building regulations. The use of passive strategies has significantly improved the possible energy performance of the building. Some of the passive strategies that have been used are: low thermal transmittance on the building envelope, energy efficient windows, a compact building envelope, 10 pct rule for windows in all classrooms, few rooms facing south and the ones that do are not rooms with long stay. Furthermore, the fact that there are fewer students in each room lowers the necessary air change rate which minimizes the energy use on ventilation and cooling. It is reflected by the results that the design fulfills the standards without any active means. As mentioned earlier the value showing slight overheating is accounted for by the BSim simulations, thus, it is not considered a significant factor in the building's overall energy use.

Key figures kWh/m² yr

Renovation class 2

W.O. supplement	Supplement for special conditions	Total energy consumption
95,2	0,0	95,2 39,7

Renovation class 1

W.O. supplement	Supplement for special conditions	Total energy consumption
71,5	0,0	71,5 39,7

Energy concumption BR 2018

W.O. supplement	Supplement for special conditions	Total energy consumption
41,1	0,0	41,1 39,7

Energy concumption Low energy

W.O. supplement	Supplement for special conditions	Total energy consumption
33,0	0,0	33,0 39,7

Energy concumption Low energy

Heat	12,9
electricity for building operations	15,0
Over heating in rooms	0,4

Net demand

Room heating	11,0
Varm domestic water	6,0
Cooling	2,8

Selected electrical needs

Lighting	6,8
Room heating	0,0
Over heating in rooms	0,0
Heating of DHW	0,0
Fans	6,9
Pumps	0,0
Cooling	1,2
Total electricity concumption	27,3

Heat loss from installationsv

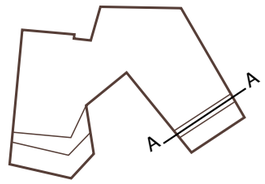
Room heating	0,0
Varm domestic water	0,8

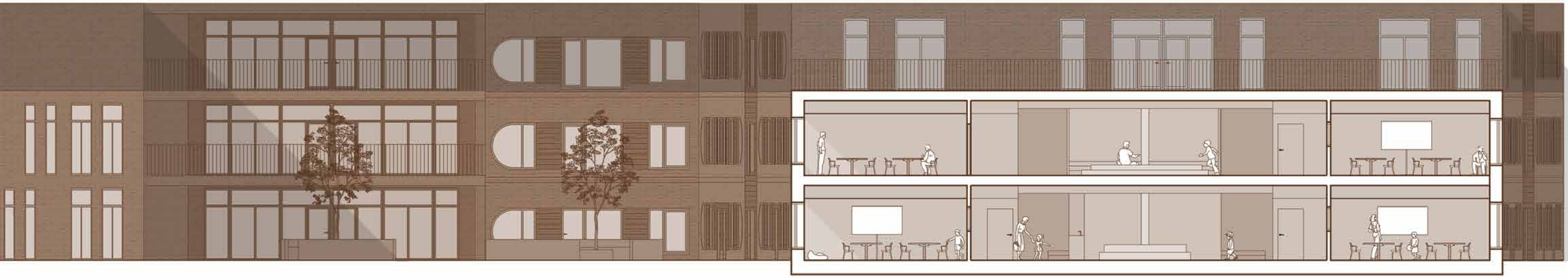
Output from special sources

Solar heating	0,0
heat pump	0,0
Photovoltaic panels	0,0
Wind turbines	0,0

Ill. 112. Final Be18 results

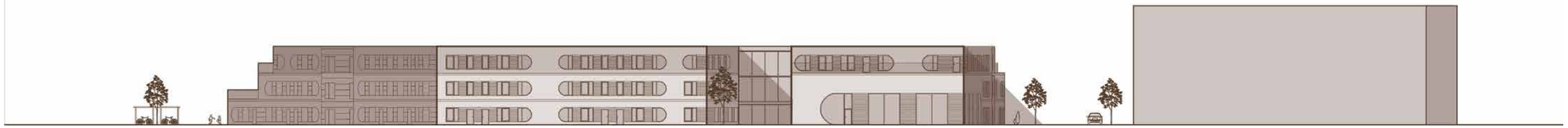
[section AA 1:150]



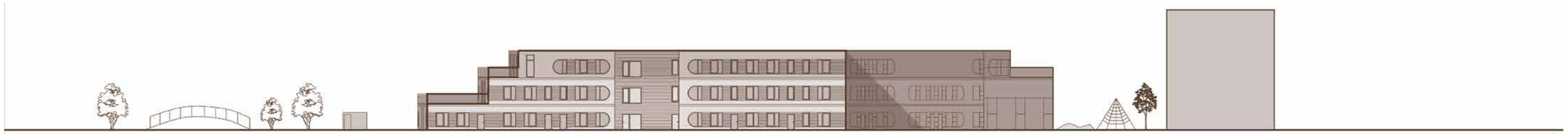


0 1 5 10

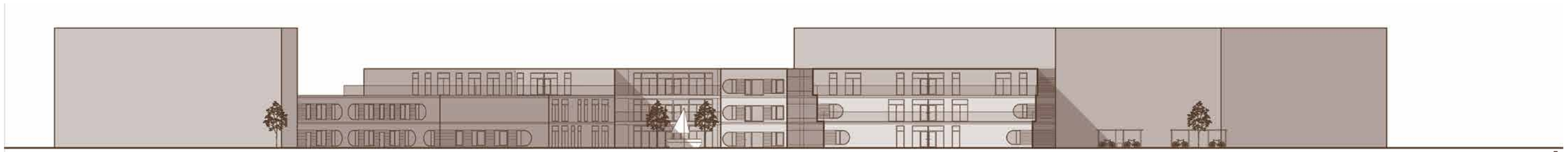
[elevation 1:500]



north



east



south

west

0 5 10 15 20 25

[epilogue]

[conclusion]

Although part one and two are summarized separately in relation to the revised hypotheses, this section will provide an overarching conclusion of the thesis. The initial hypothesis was developed based on a motivation and curiosity regarding institutional architecture, and how two institutions, such as schools and prisons, are perceived differently yet still have many similarities. The theoretical and historical chapter concludes that the two institutions do have a shared historical origin and some of the same themes apply in both cases - institutionalization, normalization, power dynamics - resulting in structural and operational similarities. Several core structural and operational similarities can be identified (these are already listed in the first revised hypothesis summary): (1) Purpose; both institutions are meant to prepare individuals for integration into society through habilitation and rehabilitation; (2) Control and rules: each operates under authority figures and systems that maintain order; (3) Surveillance: physical layouts and monitoring practices are used to guide behavior and uphold discipline; and lastly; (4) Disciplinary measures: non-compliance is met with corrective responses.

The revised hypothesis has a broad focus on architectural elements within the two institutions which shape the individual's experience. The observational analysis revealed significant structural and psychological parallels. These stem from the shared historical and institutional foundation. The aspects extracted from the analyses reveal that the institutional framework shares a common blueprint - one that affects the experience of space, authority, and autonomy. Even though they share a common blueprint, the thesis does not conclude that schools and prisons are the same. Nor does it assert that aspects such as surveillance, spatial distribution, and control are inherently negative simply because they are also found in prison architecture. This hypothesis led to a second and final revision to incorporate the design of a new school in Stigsborg, Aalborg. The translation from research to architecture involved making tangible theoretical ideas and turning them into design criteria that help create guidelines for the design.

The design of the new Stigsborg School is a result of the work conducted throughout the thesis. As mentioned previously, the design is not absolute, but it is a reflection of not only all the research conducted, but also the specific project with its particular conditions. Some design parameters are overarching insights into institutional architecture, while others relate to the unique conditions of the specific site in Stigsborg. The school area is large, making it difficult to detail every aspect; though the design is complete, some parts are investigated further than others. The overarching concept for the final design is the fusion between traditional and modern ways of designing schools, while keeping the central focus on the children.
The design is deeply rooted in a child-centered pedagogical approach. It is based on the understanding that architecture can significantly influence behavior, mood, and learning outcomes. The final design proposal reflects the established design criteria in its execution.

The new school engages with its surroundings by opening toward the fjord and the park, while establishing a shared space where it connects with the city. In the meeting between the natural environment and the building, there are some areas, such as the pond, with opportunities for hands-on learning. Furthermore, the school relates to the surrounding buildings by using similar bricks with details resembling those on the site.

The building is divided into three main departments, allowing for specific interiors that support the different developmental stages. There are shared spaces that afford informal meetings and interactions. Flow and sightlines are carefully integrated throughout the corridors, providing clear visual connections within the building. At the same time, small nooks and crannies are incorporated to spark children's curiosity and encourage moments of exploration and discovery.

Given the smaller number of individuals in each class supporting the connection between each student and their teacher, the effect of fewer students requires less energy consumption. The internal heat gains within the classroom are low, resulting in a lower ventilation rate. The lowered temperatures within the classroom have a positive impact on the students' overall performance.
Ultimately, this thesis illustrates that by combining a deep understanding of institutional history with contemporary pedagogical insights, architectural design can create school environments that meaningfully enhance children's cognitive development, social interaction, and emotional well-being.

[reflection]

Dare to Ask
In this master's thesis, we dared to start with the question and figure out the answer as we went along. We critically examined existing norms within school architecture and challenged them in a modern context by merging the traditional approach with the contemporary. In the end, the result may not be fully innovative in its physical expression and it may resemble a modern school building, but the underlying research, considerations, and values carry great significance for both the users and us as architects.
There is a need for a paradigm shift in the construction industry. We too often see buildings - and school buildings in particular - that rely on habitual thinking and aesthetic preferences. When architecture is not grounded in knowledge and research, there is a risk of creating physical environments that do not support development, well-being, and learning.
We chose to remove the economic aspect in order to achieve design freedom and to investigate what was necessary rather than what was possible. By asking questions first, we opened new perspectives that broke with linear thinking.

Paradigm Shift
Due to the project's approach, with a focus on research, the design process was secondary, to be seen as a byproduct. Still, it required an extensive design process. This attracted attention and raised questions about the approach to planning and the construction industry. The construction industry is often characterized by short design processes and tight budgets, leaving little room for user involvement and in-depth research. We chose to challenge this by letting knowledge be the starting point of the design. It is not about reinventing the wheel - sometimes it is about looking back at history and learning from it.

From Research to Space
One question we asked ourselves was: how do you translate knowledge from research and theory into architecture? Good architecture does not start with form - it starts with understanding. Our design decisions were drawn from informed research, interviews, and user involvement.
The project is a reflection on the architect's role as a critical co-creator in society. We live in a time where there are high demands on a building's functionality, flexibility, compactness, and sustainability. Therefore, the question is not 'how do we design a school for today,' but 'how do we ensure the school remains relevant tomorrow?'

Design Process
Due to the short design process, we were forced to make quick decisions. Different elements were worked on somewhat in isolation, which created challenges when assembling the various building parts, regarding which expressions fit together and which elements complemented each other. For a building of this size, it is important to limit oneself so it does not become overwhelming and result in noisy architecture. If we had had more time, we would have focused more on interior design and layout as well as the division between departments.

Regarding the structural aspect, we chose a dynamic form that interacted with the landscape and had its own formal expression, supporting play and a learning-rich environment. The system was not based on a rigid grid, which proved challenging in the long run due to columns being placed seemingly ‘randomly’ on the floor plan and some beams resting on columns at an angle. This was resolved through the use of concrete cores and load-bearing walls.

Design of the Building
It is important to understand that the school’s architectural expression and spatial organization have been developed through a series of conscious choices - both in didactic methods and the site context. It has been informed by the principles and pedagogical values we have chosen to work with specifically for this project.

From a practical perspective, this represents a substantial undertaking, making it difficult to explore every aspect of the building in detail. Although we have conceived and designed an entire school of approximately 10,000 m², we have focused specifically on certain areas, choosing to elaborate on the middle school in greater detail. Consequently, this should be regarded not as the conclusion of the process, but rather the completion of the initial phase of research, with further iterations of the design anticipated. Moving forward, we intend to conduct a more in-depth exploration of the individual rooms and the needs of the children, investigating how more specialized spaces with tailored functions can be developed, and how greater freedom and ownership can be afforded to the children within the environments they inhabit.

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[illustration list]

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[appendix]

appendix 01 - horsens state prison
appendix 02 - DGNB
appendix 03 - casestudies (interview with skipper clement and nordstjerne school)
appendix 04 - room program
appendix 05 - ventilation and air flow rate
appendix 06 - Be18
appendix 07 - definition of class sizes // recommendations
appendix 08 - cut-out from design process

AALBORG UNIVERSITET

THESIS TITLE PAGE

This form must be submitted for all theses written in programs under the Study Board of Architecture and Design, and it should be placed at the beginning of the appendix section of the assignment.

A printed copy of the form must be submitted along with the printed copy of the thesis.

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(All fields must be filled out)

Program: **Architecture** ☒ **Industrial Design** ☐ **Urban Design** ☐
This thesis was written by (full name):
Aja Khalid Hussein
Alane Chayainne Omwanor
Title of the thesis: Breaking the Framework: A Research-Based Inquiry into Institutional Architecture in Schools and Prisons
Supervisor´s name: Zakaria Djebbara
Submission date/year: 02. june 2025
Is the project confidential? **Yes** ☐ **No** ☒
External collaboration* **Yes** ☐ **No** ☒
External collaboration partner (name of company/organization):
Contact at external collaboration partner (title, name og email):

What is an external collaboration? Read more here.

appendix 01 - horsens state prison

Appendix 01 consist of the following:
01.01Interview with Anders Sørensen, Museum Inspector
01.02 Notes from guided tour with Janne, prison guard
01.03 Mail of confirmation for use of floorplans
01.04 Floorplan of Horsens State Prison

01.01 interview with Anders Sørensen, museum inspector

The interview with Anders Sørensen took place at Horsens State Prison on 19.02.2025. The following are notes extracted from the interview. Translated from Danish.

- Westward expansion --> courtyard area (east and west side).
- In 1854, the west wing was completed.
- Prison walks were done in a circle with a guard – no space for ball games as people might imagine

- **The major social reform of 1933** (passed as part of the Kanslergade Agreement - considered the most significant political-economic deal of the 1930s).
- In 1933, a new civil criminal code was enacted - cells were constructed on the 4th floor.Previously, the cells were central - back-to-back in the middle with hallways on both sides.
- Renovation in 1875.
- Meals were served in cabinets - not meant to be social.
- In Viborg (old prison), there were dormitories. Different layout – more communal eating and interaction.
- New assumption: inmates should be more isolated - only contact with their cellmates. The idea was they shouldn't socialize.

Types of prisoners:

- **Correctional prisoners:** First-time offenders, usually for minor crimes. Aimed to be rehabilitated through discipline and work. Had larger cells due to constant isolation (23 hours a day).
- Vridsløselille had windows because of the isolation.

- **Penal labor prisoners:** Repeat offenders, often for serious crimes. Sentenced to hard labor under harsh conditions. Punishment was meant to be both penal and deterrent. Physical and meaningless labor.

Criminology
Belief that dimensions of the skull and facial features (distance between eyes, mouth, forehead, etc.) could predict criminality.

Criminal Law in the 1900s - (passed in 1930)
Stricter requirements for officers – previously, they were just boys handed keys – the only difference between inmates and guards was "those who had the keys."

Ferdinand Anthon Mazanti (*) – Prison director – criminal ring.
In the 1980s, most officers including the director were replaced after a scandal.

No one knew the procedures early on – it was incidents like this that revealed how to handle inmates and prison operations.

Biggest change: Criminal Code of 1933 - still in use today, though much of it has been relaxed (e.g., concerning pornography).
- Penal prisoners (term from German) - hybrid between English and Dutch systems.
- Each advocated different methods (self-reflection, open workrooms).
- This ended with the new law - prisons were to be standardized.

Cells were moved to the sides with panoptic corridors - changed the entire understanding of prisons.
- About 90% of inmates had some kind of disorder (from ADHD to mental illness).
- Panoptic corridors phased out from around 1950.
- Problem with many cells (24): inmates with different needs trigger each other. To avoid unrest, prisons were closed off more.
- Technology developed, too.

Enner Mark learned the lesson: units were segmented - the idea was to function almost like 4 individual prisons.
- 2 floors, 4 cell wings on the ground floor, 4 on the first floor. Cell wings with 6 cells. Smart because you could shut them off.
- You can house them under one roof but still lock off sections - flexibility is the biggest benefit, especially regarding gang conflicts.

Resocialization - part of it is saving money for leave or Christmas vacation, etc. But not possible due to lack of staff. Compromises are made on elements that reduce the chance of reoffending.Especially problematic due to lack of prison officers.

Impact on local society and the surrounding community:

Horsens became a "prison town."
- The western part of the city was burdened. When that area was built, it was a working-class neighborhood – historically underprivileged.
- The prison didn't cause the problems, but didn't help either.
- As the prison was located there, more families and vulnerable people moved into the area.

Why place the prison in Horsens?
- Horsens is a kind of hub – there were also annexes (other small locations for prisoners or administrative functions).
- State Prison of East Jutland (previous name).
- Storstrøm Prison replaced Vridsløselille.

Forms of punishment and discipline:

Horsens is seen as Denmark's "modern prison" (alongside Vridsløselille).
- Self-isolation.
- Rise and shine: 5 AM to 8 PM. Get up early to go to work, back in the evening.
- In the past, theft was common --> Why steal? No money --> Why no money? No work.
- --> Hence, inmates had to work in prison (also part of resocialization).
- Inmates were forced to go to church on Sundays.

Discipline was taught through:
- Isolation
- Bread and water for 3 weeks
- Whipping / flogging

Education:
- Prisoners could go to school in prison - complete grades 7, 8, 9.
- If they behaved and worked hard, they could move up ranks.
- --> Depending on level, they could get nicer uniforms.
- --> Usually, they had to have the same hairstyle (no personal identity). But if they did well, they could get bangs (a different hairstyle), etc.
- Mindset: If you work and behave, you'll do well. If you lie around and are lazy - that's a no-go.

In Denmark, one can be placed in isolation for 28 days.That's more than most places – usually 15 days. Denmark has been heavily criticized for this.
The harshest punishment apart from that is a fine and (something else unclear).

1940s:
- Nurses arrived - before that, only a doctor in the medical unit.
- From 1951, psychopath detention in Horsens (1955 - 1968 it was the only psychopath prison in Denmark).
- Electroshock therapy was used - little understanding of how it worked.

During the blackout (introduced April 9, 1940) and the occupation - crime rose. Until August 29, 1943, Danish courts sentenced criminals - under Danish law. After that, the German War Court took over.

1990s gang wars - many gang members were imprisoned. (Janne's story about Bandidos and Hells Angels being imprisoned together.)

- **Structure:**
  Vridsløselille in Copenhagen --> the blueprint for the central wing in Horsens.
- New prison principle: Sectioning and self-management (communal kitchens) in individual sections.
- Inspired by the Netherlands and England.

01.02 guided tour with Janne, prison guard

The guided tour took place at Horsens State Prison on19.02.2025. The following script are notes from the tour.

Closed prisons:
- Perimeter wall - wall all around the prison
- One typically ends up in a closed prison if the sentence is more than 5 years.

Open prisons:
- The aim is to resocialize the inmates.
- South side: (The entrance with the office and surveillance, where the warden used to sit) was off-limits to prisoners – considered de-civilized – they were not allowed to stay there.
- Work in prison: It's smart because you make new connections and already have an income when released (contributes to reducing crime).

Types of prisons:
Open prisons, closed prisons, remand centers.

Enner Mark:
- At the time of opening - it was the most secure prison in Northern Europe. Recidivism: ~80% in 2002, 50–60% in 2016 (in closed prisons).
- 3.2 km long perimeter wall.
- 6 "housing units"/Clusters, 48 cells per unit.
- There's a lot of distance between everything (not necessarily a good thing).
- Long distance + high security between places.
- Surveillance might go too far – more security and cameras, but if inmates physically assault staff or fight, the cameras won't stop or intervene.
-

Horsens State Prison:
- Horsens State Prison was taken into use in 1853.
- Had space for 180 inmates.
- North side: Where prisoners moved around. There was a grocery store, library, outdoor walks, etc.
- The prisoner was followed everywhere by a guard.
- In Danish prisons, inmates must work.
- Comment from prison guard in regards to the manual big key they still use: "If it works, don't change it" – e.g., large keys. The system hasn't been changed because it works.

Officers:
- Severe staffing shortages. If there aren't enough guards, inmates are simply locked in for longer hours.
- Physical and mental strain on guards: After assaults or incidents, they receive debriefings, defusing sessions, psychologist support, etc., to help them cope. Many suffer from PTSD.
- Guards were not allowed to patrol alone at night – always two together.
- The new prison has chip access, fingerprint scanners, etc. (Ruko keys).

01.03 mail of confirmation for use of floorplans

AS

Anders Stokholm Sørensen<asso@horsens.dk>

Til: Aja Khalid Hussein

Cc: Alane Chayainne Omwanor

Tir 25-02-2025 08:52

Hej,

Det er dejligt at høre, I fik noget ud af besøget. Det må have været en lang dag med turen forbi Randers Statsskole og efterfølgende besøget her.

Plantegningerne kommer fra vores eget kortskab, hvorfor I bare skal kreditere os, dvs. Fængselsmuseet.

De er offentlige tilgængelige i den forstand, at man ikke skal ansøge om at få tilladelse til at tilgå dem. Det er blot ved henvendelse, som I gjorde.

Håber, det giver mening.

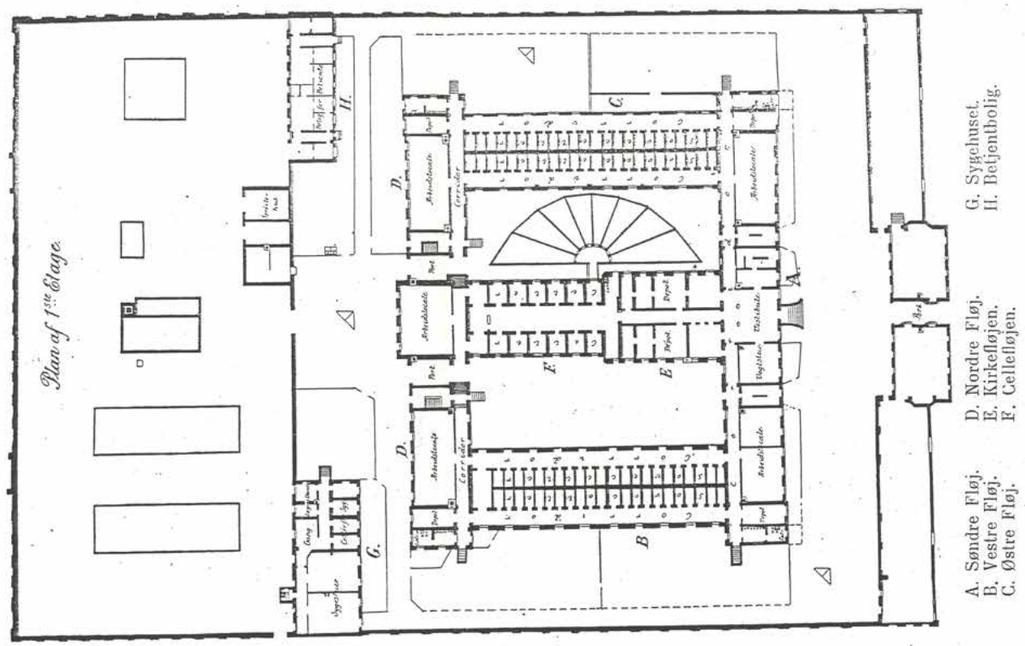
Med venlig hilsen

Anders Stokholm Sørensen
Museumsinspektør

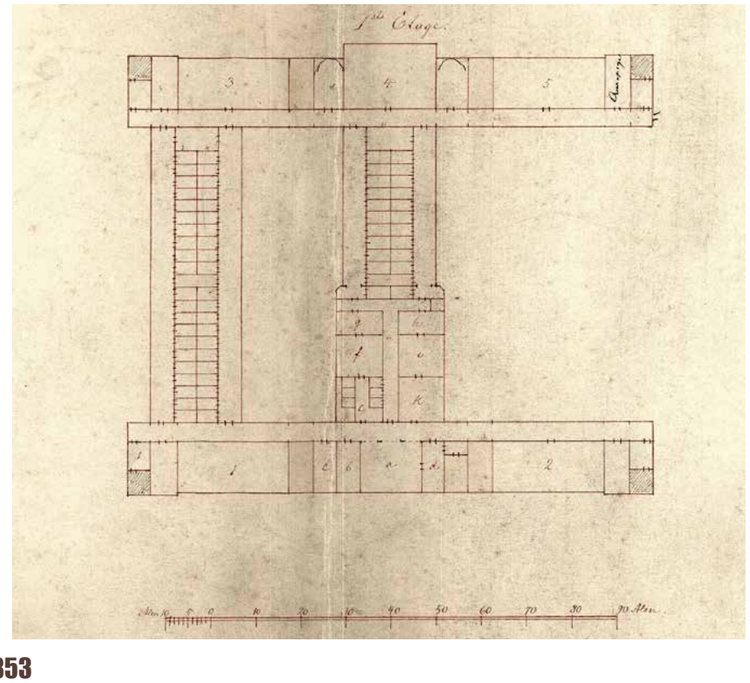
Mail: asso@horsens.dk
Telefon direkte: 23310433

Horsens Kommune

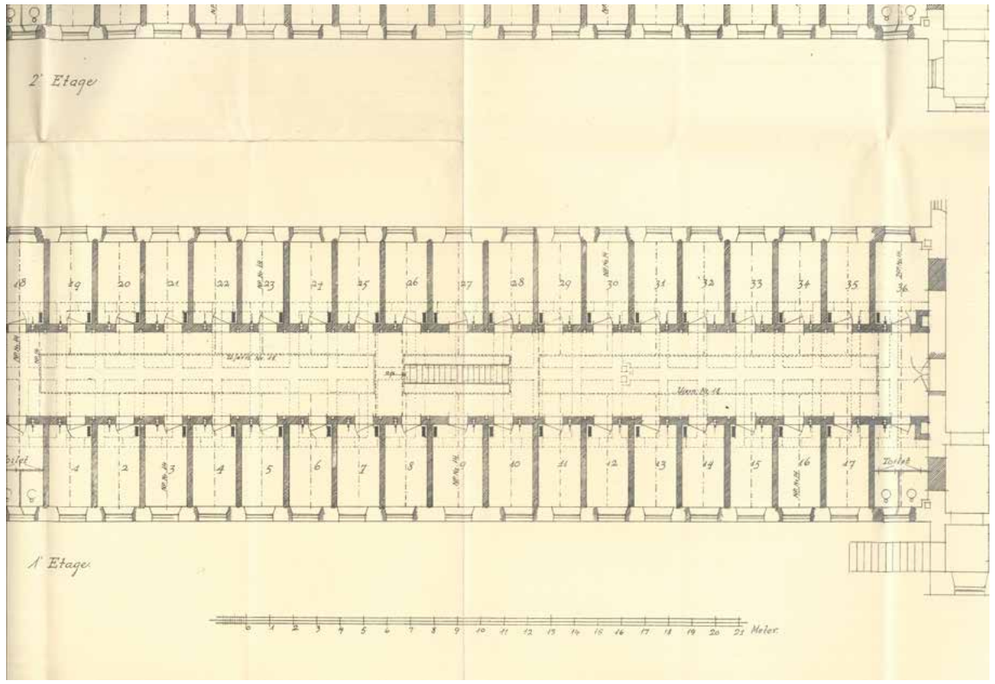
01.04 floorplans for Horsens State Prison



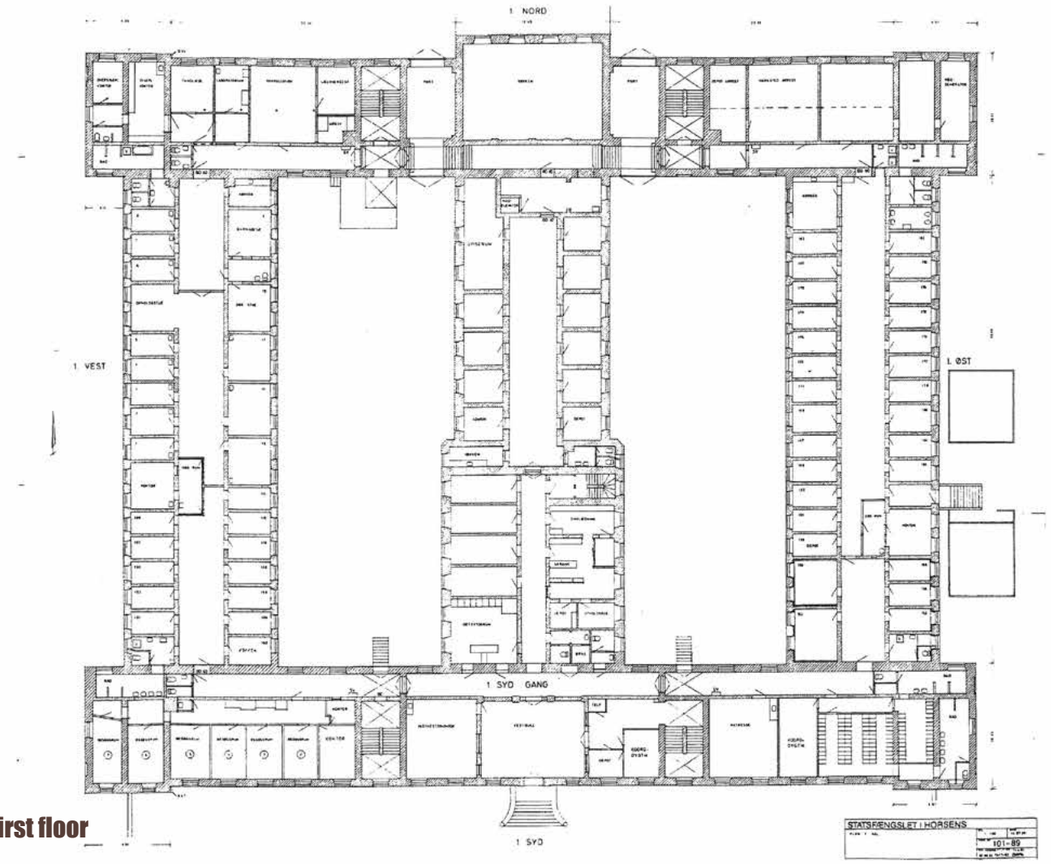
First floor - 1854



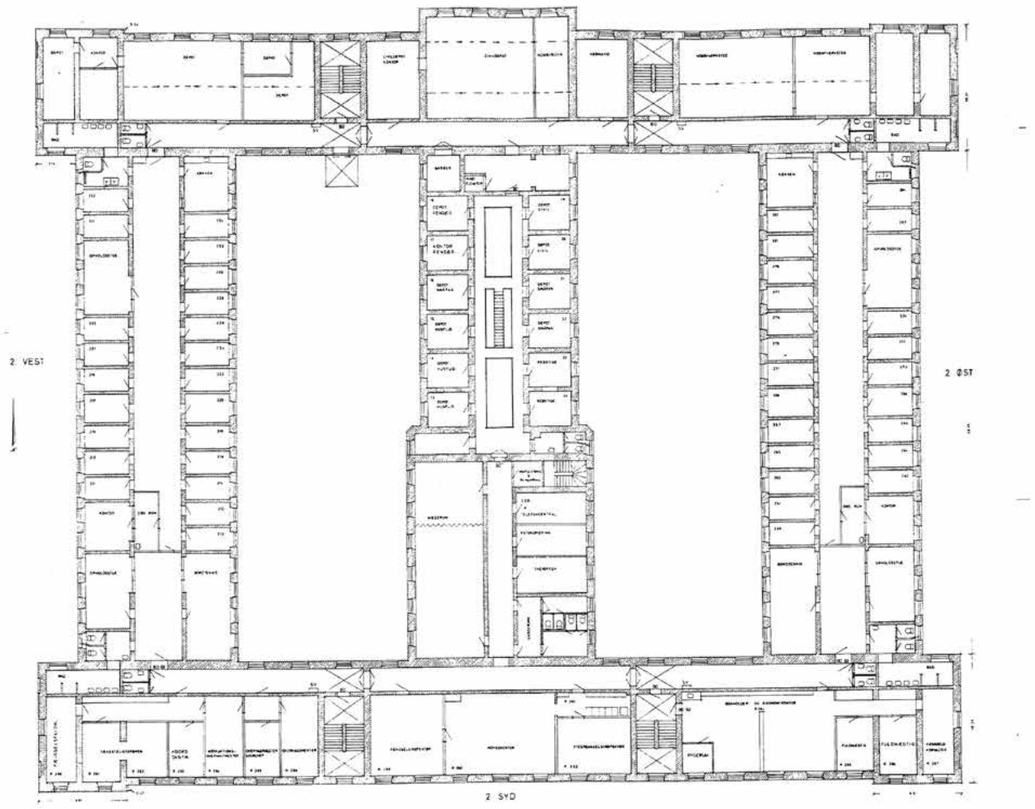
Floorplan from 1853



Floorplan after first renovation 1875



First floor



Second floor

appendix 02 - DGNB

The following section consists of discriptions from DGNB (Rådet for bæredygtig byggeri). Own translation.

2. Differentiated Use

This sub-criterion focuses on making the design of the building and landscape as flexible as possible in terms of use and creating the greatest potential for conversion to ensure the longest possible lifespan of the building.

Indicator 2.1 Extended Use in the Building and Outdoor Areas

The aim of this indicator is to create added value by combining necessary functions with socially value-creating initiatives through dual programming or extended use.

Extended use in the building: Defined by one or more functions in the building being available outside of primary usage hours, thus creating extended use of the specific function. Examples include the possibility for external parties to rent conference or meeting rooms, party venues, etc., or for a function such as a cafeteria to be open outside of working hours as a restaurant available to the local area. It may also involve the possibility to borrow/rent sports facilities on weekends, holidays, etc.

Extended use in the outdoor area: Defined by an outdoor area having two or more functions simultaneously or at different times of day, week, or month. The area may have a larger landscape character, e.g., a stormwater management system (LAR) combined with nature and recreational elements, or with sports and playground functions. To be eligible for points as extended outdoor use, the two or more functions must be used continuously throughout the day, week, or months – it is not sufficient if one of the functions is only relevant a few times per year.

Indicator 2.2 Adaptability of the Building

The building has a high degree of adaptability: Evaluations are based on the primary areas of the building, i.e., hallways, storage, restrooms, basement, etc., are not included. It must be documented that 80% of the primary areas meet the following:

- Multifunctionality, i.e., spaces where different activities can take place either simultaneously or at different times. Documented via floor plans with zoning scenarios. Perspective: different activities / simultaneity.
- Flexibility of existing rooms, i.e., the rooms can be used for various functions. Documented via furnishing scenarios. Perspective: reconfiguration / over time.
- Flexibility in terms of layout changes through remodeling (adding, moving, removing walls), which leads to changed use and function. Documented via different layout scenarios. To validate the division of a building into smaller units, the technical systems' design must allow for this (e.g., underfloor heating, ventilation). If a building is divided, additional sanitary units may be needed and must either already exist or be possible to install. For larger units to be divided, documentation must show compliance with fire and acoustic requirements for floor and interior wall construction. For merging smaller units into larger ones, the technical system must also support this, including shared control for heating and ventilation. Techni-

cal descriptions and drawings must be included. Perspective: remodeling / future-proofing.

3. Reflection and Activity

The purpose of this sub-criterion is to ensure the building is viable with a focus on meeting the needs of various user groups, including the need for personal spaces to withdraw. In addition to enabling spaces for reflection and retreat, this criterion also addresses major societal challenges such as loneliness. Human nature and the need for social interaction and community are supported differently depending on the building typology. The goal is to create an environment where users experience high levels of comfort, well-being, and satisfaction. This is achieved by integrating elements in physical design, support for social activities, and emphasis on the experience of nature, all contributing to a positive atmosphere and high quality of life.

Indicator 3.1 Human Needs – The Personal Space

This indicator emphasizes individual needs by providing options to retreat from the community. Relevant for user groups both in workspaces and residences. It demands spatial quality and spaces for recreation/privacy/rest. Green and recreational areas and rest areas must not be over-programmed to avoid compromising their original function. Themes include nature, healing gardens, sensory experiences, and biodiversity. Differentiation is made between small outdoor spaces and large areas regarding feasibility. Individual zones and/or rooms are incorporated early in the project. This is documented in drawings and functional descriptions.

- *Niche:* A small seating area, e.g., integrated seating in a corridor.
- *Zone:* A larger area in an open space.
- *Landscape:* Outdoor areas include both green, recreational spaces and-paved, urban spaces.

Room types and characteristics:

- *Quiet/rest rooms:* Enclosed spaces designed for rest and reflection, ideally placed along a façade, away from high-traffic zones. Designed with soft materials, muted colors, low reverberation time, and materials discouraging social interaction. Can also be niches or alcoves without through traffic.
- *Quiet/rest zone/lounge:* Similar characteristics to quiet rooms but in a larger area for multiple users at once.
- *Phone/conversation rooms:* Acoustically optimized for short reverberation time and soundproof for confidential conversations. Can be combined with rest rooms to optimize use. Must be bookable.
- *Meeting rooms:* Equipped for various meeting types (e.g., whiteboards, projectors). Should be shieldable from outside view and allow for at least two furniture configurations. Shared facilities for multiple rooms must be accessible without disrupting others.
- *Touch-down workstations:* Temporary workstations equipped with screens, keyboards, storage, etc.
- Building's outdoor areas for nature, recreation, reflection, and sensory experiences must be shielded from noise and disturbances.
- Points are awarded for outdoor areas that meet these criteria and include special nature experiences (e.g., sensory gardens, artistic water elements).

Outdoor space scale differentiation:

- *Large outdoor area:* At least 20% of the area must be allocated for nature, recreation, reflection, and sensory experiences, accessible to users and the public outside building hours.
- *Small outdoor area:* At least 20% allocated to planted quiet areas, possibly semi-private or public.
- Microclimate studies must be conducted during design (wind, sun, precipitation, noise) to optimize comfort and protect against unpleasant sensory impacts. These must be used in the final design.

Indicator 3.2 Human Needs – The Shared Space

Focuses on how the building and outdoor areas can contribute to shared functions and spaces encouraging social interaction and community. Communities can be formal/informal, co-located/shared-resource based, symbolic or concrete, and at different scales (neighbors, residential area, city).

Common functions should be integrated to facilitate social interaction, both for users of the building and, if possible, for local residents. Outdoor social spaces must be inclusive and cater to diverse age and user groups. It is also important to consider how these functions extend the use of building and outdoor areas throughout the day to avoid underuse.

Projects are evaluated on whether relevant functions have been considered based on user needs and building context. Existing facilities within 100m (urban) or 500m (rural) can earn points if documented as relevant and accessible, referencing a local social services study.

4. Relationship Between Building and Surroundings

Whether renovating or building new, it's essential to consider how the building integrates with its context—from its footprint to edge zones and outdoor spaces. This sub-criterion emphasizes the building's contribution to formal and informal social meeting places and its interaction with the surrounding area and landscape. Including various user groups through different meeting, resting, and activity options in the outdoor space fosters interpersonal relationships and helps build strong communities.

Indicator 4.1 The Edge Zone

For all building types, how the building meets the outdoor space is critical. This indicator focuses on the edge zone and the activation of ground floors, particularly the relationship between the building and outdoor areas with private, semi-public, and public spaces.

Key points:

- *Social programming of edge zones:* Zoning for private/semi-public/public use and activation of the ground floor.
- *Transition zones:* Enhance sensory experience and create active in-between spaces.
- *Privacy gradation:* Earn points by establishing graduated transitions between private, semi-private, and public areas (e.g., front gardens, level changes, stairs, planting).
- *Microclimate optimization:* Earn points for protected entrances, covered outdoor areas, recessed façades, or overhangs.

Indicator 4.2 Contact Between Indoors and Outdoors
This indicator highlights the importance of visual and physical contact with nature outdoors. Research shows that human mental health and well-being are positively affected by views of greenery, water, or wide vistas (Roger Ulrich, 1984). The human need to be in contact with nature, thereby achieving well-being and better quality of life, is therefore emphasized. Particularly in an urban context, urban nature also contributes to increased awareness that we must reconnect with nature in order to take better care of it.

Furthermore, this indicator focuses on the physical connection between indoors and outdoors and on people's well-being by having direct access to outdoor living areas from the building. At the same time, direct exit from the building allows us to expand our usable areas during the summer months and can create opportunities for more efficient indoor spaces. The focus here is therefore on the relationship with and access to outdoor areas. This can take many forms and be based on different needs.

- *Definition of View:* Direct view must be a horizontal view of nature, green outdoor areas, wide views, sky, or water. The evaluation section specifies the proportion of various rooms that must have a view in order to achieve points, depending on the building's use.
- *Nature:* Defined as the overarching concept for original natural areas of various kinds, depending on location.
- *Green outdoor areas:* Defined by vegetation on the ground, roofs, or façades. The green outdoor areas must be established at the time of certification.
- *Wide view:* Defined as being able to see >50 meters across city and/or landscape.
- *Sky:* Defined as being able to see the sky through the nearest window.
- *Water:* Defined as a view of the sea, lakes, streams, or other artistically and scenically designed water elements.
- *Alternative Compliance:* Indoor planting is defined as integrated planting. This can include larger trees, established planter boxes, or plant walls. If indoor planting is implemented, a maintenance and care plan must be prepared and delivered in order to use it as an alternative means of compliance.
- *Outdoor Living Areas:* Outdoor living areas are defined as, for example, façade-integrated seating areas, atriums, terraces, balconies, rooftop terraces, courtyards, and similar spaces for individual or communal use.
- *Common Areas Within the Building:* Points can only be earned if these rooms are within the building.
- *Shoe-Free Zones in Institutions or Schools:* A shoe-free zone can have a positive effect on indoor climate, with reduced cleaning and wear as well as lower noise levels. This can be especially relevant for schools from grades 0–9, where students typically have fixed classrooms and a few subject-specific rooms. To support a shoe-free zone, space for storage of both indoor and outdoor footwear must be considered.

appendix 03 - casestudies

Appendix 03 consists of two interviews - 03.01 Skipper Clement School in Aalborg and 03.02 Nordstjerne School in Frederikshavn.

03.01 interview with skipper clement school

Project Group: How do you work with your core values? Particularly regarding creativity, responsibility and consequences, mutual respect, and students' independence?

Peter: So, that's why you simply… Well, that short hour during our introductory evening about the school's daily life - it's actually about our values. And I hope that when we go for a walk in a moment, you'll see mutual respect. For example, you might meet children who greet you. If I didn't meet you at the door, many of our guests still say, "Wow - from the entrance to the office, three students asked if they could help me." That's what we hope people experience.
I set the tone every morning by standing out here from about 7:30 to 7:50, greeting all the children and adults with a "good morning" and hopefully a little comment too.
Like, "Oh, you've got a new jacket," or "Oh, you're using crutches - what happened?" Things like that. We try to signal from the adults' side as well that we see people, we look them in the eyes and say, "I was actually looking forward to you coming." It might be that we need to have a serious conversation at 10:00 because you copied something from the internet, but at least we started the day with a smile and a good morning.
I also want to be known not just as the one who scolds. I don't scold that often, luckily - but it's part of my job to be the "grumpy guy" sometimes. Still, I want to be more than that. Mutual respect includes holding the door open for each other and respecting differences. You'll also see that we have four people in flex jobs, and many of our students come from resource-strong families. I think it's good for them to also meet people who aren't as resourceful but who still play a role in daily school life. We have a guy named Martin who shelves books in the library. He can't lift anything heavier than a liter of milk. He stutters so much that it takes him 15 minutes to tell a joke. But it's good for the children to meet Martin - not just teachers with high expertise and fast speech. So we try to reflect diversity as best we can, knowing we're a private school and don't always reach all social classes - but still, we strive for diversity.
(...)

Project Group: And what about students' independence?

Peter: Yes, and responsibility. That's something we emphasize a lot. For example, students always have homework from day one. We don't post homework online. Even in early grades, students learn they're responsible for finding a system to write down their homework. It might sound basic, but that's one of the first places we teach responsibility. If a child says, "My mom didn't give me my math book," well, it's not your mom's job to pack your bag - even though we have plenty of "curling kids."
(...)

Peter: So responsibility really permeates everything we do. And it's also where we have our most serious conversations - when someone fails to take responsibility for the shared learning environment. If they're disruptive, passive, or outright destructive during lessons, then we sometimes have to have serious talks.
You've probably noticed that one of our values is consequence. But it's about learning that everything you do has consequences. If someone is systematically destructive toward the other 23 in the class, the consequence might be that they need to look for a different school.
That might sound very elitist - but it's not that bad. We have 850 students, and in the nearly 11 years I've been here, we've expelled 14. So it's not something we do lightly. But at the same time, it's not just words on a piece of paper - it's something we're prepared to enforce. And just knowing that can make conversations shorter and clearer.
(...)

Project Group: What other kinds of consequences do you give to students?

Peter: Well, typically, as long as students follow social and common rules, they enjoy a great deal of freedom. Our 10th graders, for example, can come and go as they please - they just need to be in class when lessons start. If they'd rather eat cheese puffs at Kennedy [a shop/café] than the liver pâté sandwich their mom made, they can - as long as they're in their seats for class.
That principle applies widely. For example, small music groups sometimes want to form bands - they're allowed to use the music room during breaks, as long as they treat the instruments well. But if it looks like Hiroshima 1945 when the teacher returns, the privilege is revoked.
In winter, older students can use the gym during breaks - but only as long as they don't leave trash on the floor. If they do, the privilege is gone. As long as you follow the rules, you're allowed a lot. But students also experience the consequences when they break agreements.
Yes, sometimes it turns into collective punishment. Maybe 15 out of 18 students followed the rules, and 3 didn't - but that's where responsibility comes in. If Brian leaves his sandwich wrapper behind, and it stays there, we might not be allowed to play next Monday.

Project Group: So it's about community?

Peter: Yes, we try to cultivate that - and that brings us back to mutual respect. The six values really go hand-in-hand.
(...)

Project Group: Are there specific pedagogical approaches you use to support these values?

Peter: Well, since our values are timeless, we try to build on tradition - not because we're stuck in the past, but because we find value in it. If someone's angry with us, they might say we're old-fashioned.
I hope not too many people are angry - but yes, we're a bit old-fashioned. For example, students don't bring their own devices until 7th grade. Until then, they write with paper and pencil and read actual books - lots and lots of physical books. Of course, we also have digital platforms and tools.
(...)

Peter: But we also rely on evidence. We've seen that it works. It creates calm.

Students with autism or ADHD really need clear structure - and we've clearly seen that so do average kids. Most children want to know what's expected of them and what they can expect in return - whether in handball or English class.
(...)

Project Group: Are classrooms set up so students stay put and teachers rotate?

Peter: Yes. That's how we do it. It's an interesting question, because our two departments differ slightly. In the Danish department, the same teacher often stays with a class from grades 1 to 6, then new groups and teachers are assigned from 7 to 9.
In the international department, it's more like the British system. For example, Sara always teaches Stage Two - like 1st grade. Each year in August, she gets a new class, and by June she moves them up to Stage Three and gets a new group.
And you might be interested in this: The classrooms in the international department are designed by individual teachers. In the Danish department, they're more often shared spaces designed by teaching teams.
It's very British in style - like in Scotland, where the door doesn't say "4B" but "Miss Brown." It's her room - welcome to her kingdom.
(...)

Project Group: Do teachers actively change the setup of desks and chairs depending on the lesson?
Peter: Far too little. We're very traditional there. We've had furniture vendors and school designers visit and show setups - like one classroom with 24 different types of seating: bean bags, stools, office chairs, etc.
When I brought that idea to the teachers' lounge, I was quickly shot down. They just can't picture it.

Project Group: But shouldn't the setup be about what works for the students?

Peter: Yes, but teachers know what works for students.

Project Group: But how can you know what works if you don't try it?

Peter: Good point! But remember, we're also a business. A large segment of our parents expects the school to look like the one they attended. That's the price of being a private school.
I'm not saying we pander to parents - but many do ask why our teachers are paid the same as those in a public school like Sønderbro, even though "they deal with all kinds of kids."
I believe them - my daughter worked there. And they deal with all kinds of cases. But our teachers face a different kind of pressure - they're under constant scrutiny from parents. If we become too experimental, we get immediate feedback. Worst case: they'll pull their child out.
That doesn't mean we don't experiment. I always say - there's a reason we have windows in our school: to keep an eye on what others are doing. And we are about to decide on a 150-million-kroner building project tonight, hopefully.
(...)

Project Group: Given your more traditional classrooms, when students need to do group work, do they go to other spaces?

Peter: No - we lack those kinds of group rooms. That's one of the reasons we're planning this expansion.
When people ask what our challenge is, I say: space, inside and out. Outside, we spread students across different areas. For example, the youngest have a schoolyard, the middle grades go to Kildeparken, and the oldest go across Øster Allé to a lawn by the old post office.
Inside, we really lack group rooms.
(...)

Project Group: Can you see a difference in the classroom setup between the youngest grades and, say, 7th grade?

Peter: Between kindergarten and 7th - yes. But between 3rd and 7th, not so much. Students do get lockers eventually, as they start to have more books. Our school covers a huge district - from Hobro to Frederikshavn and Nibe to Hals. To avoid hauling heavy bags on trains every day, we provide storage.
(...)

Project Group: How's the teacher-student relationship outside class - during breaks and such?

Peter: Close.

Project Group: Do teachers sit with students?

Peter: Some do yard duty - especially when we're off school grounds. We need to be visible and respectful in public parks, make sure kids don't damage plants or misbehave. But yes, we also have a staff room where adults can have a break and adult conversations - we're far from having a fully integrated shared space.
(...)

Project Group: How long are breaks?

Peter: The school day starts at 8:10. After two lessons, there's a 15-minute break from 9:40 to 9:55. A module is two 45-minute lessons. At 11:25, the class eats lunch with a teacher (up through 7th grade) for 15 minutes - sometimes they watch Ultra News, hear a story, or share a joke while eating.
Then there's a 30-minute recess after lunch - so three-quarters of an hour in all.
(...)

Peter: And sometimes you have to be creative. I used to teach math in lower grades. I made a deal with my class: if everyone finished their tasks, the math teacher would stand on his hands and sing a song.
It was awful for Søren, who didn't do his homework, because he couldn't join in - and 23 kids were watching him. But guess what? Søren did his homework next time. I didn't need to scold him. It's great to walk into a room and start with a smile, not "Who didn't do their homework today?" That's such a negative way to start.
(...)

Peter: And then you really get to build a strong culture.
Yeah, I know it sounds harsh and old-fashioned, but that's what I mean. They also discipline each other. Like, when we get 24 new students in - we go from having two sixth-grade classes to having three seventh-grade classes - so

24 new students join. What we do is, we take one sixth-grade class with 24 kids and divide them into three. So, eight go to 7A, eight to 7B, and eight to 7C. Then we do the same with the second sixth-grade class, and the 24 new students from outside are also divided into three.
So suddenly, we have three classes of 24 students each. And in each of those classes, there are eight students from the original 6A, eight from 6B, and eight newcomers from outside the school. That happens every year. And, of course, some of the new students will push the rules a bit - or even test them outright. The best example was a student who, systematically, could use the f-word in every sentence during the first 14 days… until three of his classmates said, "That's enough."
(...)

Peter: If you make the culture strong enough, then as an adult, you really don't need to spend that much energy on it. Students mirror the behavior they see in others. So if, during their first month here, the new students see the older "Skipper" students asking guests, "Can I help you with something?" - then they start doing the same.

(...)
Peter: Life doesn't require us to be perfect. We just have to do our best. If you can find a place somewhere in between, you can actually thrive at Skipperen - even if you're not academically high-achieving.
We have differentiated teaching levels from 7th to 10th grade. We make an extra effort to support those who are struggling academically. So, when 8th grade has math, all of 8A, 8B, and 8C have it at the same time. And then there's a fourth room called 8D, where the 12 students who find math difficult go - so they get more learning time.
It's a fantastic safety net for those who struggle to keep up.
Some students come in thinking, "Maybe this D group is a bit tough." But once they're there, they're like, "This isn't bad at all." In fact, sometimes we have to expand the group - instead of 12, we let 14 students go there, because more want to.
But it must not get too big either, because then it just becomes a regular class.
(...)

Peter: And it's the same in English, German, and math. Just because you struggle in math doesn't mean you also struggle in the other subjects. You might be in your regular class for English and German - and the other way around: you might be super sharp in math, but find German impossible, so you're in the support group for German.

03.02 interview with norstjerne school

The following interview was conducted at Nordstjerne School in Frederikshavn on 11.04.2025.

(…)
Project Group: Regarding the small nooks and group rooms - do all departments use them equally, or is it more specific departments that make more use of them? And are they an active part of the teaching?

Lise: Yes, it is an active part of teaching that you have the option to go out. In some classes more than others. It completely depends on how the class is. Some classes, you can just say: “Here’s the task - go ahead.” “Yes, let’s do it!” Some classes need to know: “We all sit in our chairs at our desks, you don’t get up unless you’re told, and this is the kind of teaching we’re doing now.” That’s much more structured. And again, it depends on the class.
You probably also know this from your own school days, right? In some classes, anything was possible without issues, and in others, it would all fall apart even before you got started. If you said “go out and sit wherever,” five students would be playing table tennis and others making paper airplanes. That’s how it is - it varies from group to group.

Project Group: Okay, yes. So it’s not that the upper grades use it more than the middle ones?

Lise: No, it’s just used in different ways.

Project Group: We’ve already touched on this, but what do you think works well in terms of the overall layout and room distribution in the building?

Lise: I think it works well with the shared spaces. I also think it works well that - though you haven’t seen it - you should check it out when you leave: the playground is spread across a large area, so kids don’t necessarily play across age groups. That’s good too, because, for example, if 7th graders play soccer against 2nd graders - it doesn’t usually go well, because they’re physically stronger and play differently. So it’s good that it’s divided. Sometimes the older kids miss playing on the little kids’ playground, but that’s something you can do for a specific class hour and say: “If you want to go there, let’s go - it’s sunny today,” right?
(…)

Project Group: Do you see any challenges or consequences with having the school divided into different departments? Does it create a kind of separation?

Lise: Yes, you do become a bit cut off from each other and from a shared sense of community. We have a large special needs department, and it’s very clearly separated - the special needs department is over there, the general education is over here, and we don’t mix. There can be many reasons for that. But if we want to have more integration between students from the special and general departments, then the issue is that they don’t get exposed to what a typical school environment is like.
And I don’t think that’s ideal. I also think it’s good for students in general education to see that some kids are different, have different needs—that we’re

all here together.
So yes, there are clearly pros and cons. You could also imagine older students taking more responsibility for younger ones if they were located closer together. Sometimes older students can separate younger ones who are fighting and say: “Hey, what are you doing?” They could be good role models or help in stressful situations, just like a teacher. If they’re used to it. Because it has to be done properly, of course.
(…)

Project Group: I’m also curious because we spoke to someone working on something here, and they mentioned that the school started with 1,100 students and now has around 700 - 750. I assume there were more classes before - what about the classrooms? Are there more empty rooms now, or how does it work?

Lise: Yes, there are more empty classrooms now. And they’re not always used optimally. I think we have several rooms with a lot of junk. We probably need to tidy up a bit. That’s what happens when you suddenly get more space - you start to spread out. You know, like when you move into a bigger apartment and wonder how you ever managed in the smaller one. So yes, there’s definitely potential for improvement - tidying up a bit.
There are tables and chairs we don’t know what to do with, screens that can be rolled in for alternative teaching activities - all sorts of things. So if you ask whether we have enough space, people will say “no, we use all of it,” but that’s only because we have it.

Project Group: We’re also curious about how teachers interact with students during breaks. Do teachers go to the staff room for lunch, or are they with the students?

Lise: Both, actually. There’s always someone on playground duty - what you might call an “old-school yard duty.” Teachers and SFO (after-school care) staff share that responsibility. In the lower and middle grades, we have adult-led activities. So if a child wants to join a game of football or tag, they can sign up, and there’s an adult leading the activity. That can be comforting for some kids. There’s also just free play, and there are other adults around if needed.
In the lower grades, we have a “coffee room” for staff, and like here, it has big windows facing the playground, so we can often see what’s going on from inside. That’s really nice. In the middle grades, teachers often stay in a prep room if they don’t have duty. And it’s usually possible to get hold of an adult there. It’s the same in the upper grades.

Project Group: So it’s organized within each department to ensure there’s always a teacher around?

Lise: Yes, there should always be someone available if a conflict arises. We do have a large staff room too, but for those in the lower grades, it’s located upstairs next to the library. And if you’re working down here in the lower grades and have a 10-minute break, it feels like a long walk to get up there. So we’re not together as much as we could be, and I do think that’s a disadvantage. You end up mostly with your close colleagues, which is lovely, but you might not get much input from others.
(…)

Project Group: Regarding teaching, both in terms of classes and collaboration - do teachers work together across classes? Like cross-disciplinary or

cross-classroom teaching?

Lise: They do that a lot, and it's great because then you're two or three people planning and teaching together. So if you're doing something you find difficult, someone else can help. That's always how it is - some find certain things harder than others. Then some students can get more attention, while others are more independent. So yes, that happens a lot. There's also something about planning together - you prepare this part, I'll prepare that part, and then everything's covered.
Right now, we have a really great math project going on across the three 1st grade classes. One teacher got extra hours to run it, and she has a co-teacher helping her plan. During the lessons, all three teachers are involved. It's full of different math games. We also have something called "Math for Fun" in the SFO that kids can join voluntarily. A teacher and a pedagogue plan it together. So we do a lot of collaborative work.
I don't like the idea of being a "private practitioner" - me planning my teaching, you planning yours, and we never connect. We really emphasize teamwork, especially if we have a class that's causing issues. Then the whole team must agree on how to strengthen the teaching, identify student profiles, design the instruction together. Because if I teach one way and you do the complete opposite, it doesn't work. You need shared strategies for it to succeed.
(…)

Project Group: Okay. Are there also times when classes are merged?
Lise: Yes, that happens too. It depends. For example, if we want to do something cool in science together but the schedules don't align, it gets tricky. Maybe we can swap a lesson once or have a special day. But next year, some teachers have specifically asked for parallel scheduling - like always having math at the same time. Then you can easily merge classes, say, three classes with four teachers rotating between workshop stations. That's a much more effective way to use resources than everyone prepping alone. That just leads to double work in less time.
(…)

Project Group: How does it work with students and adults from the local community?

Lise: What do you mean?

Project Group: For example, the retirees who come in - is that during school hours?

Lise: Yes, they come during school hours - like during a Danish class on Tuesday, they'll take a few kids aside to read with them, help them with reading skills. Some come to help with math in 6th grade: "Let me show you how to do that." They're an extra pair of hands in a busy day, and it's really great. Many of the kids, especially the younger ones, love it. We also have a new school program where students attend three days a week here and spend two days at EUC Nord (a vocational education center), working in carpentry, auto repair, or gastronomy. So they get academic and hands-on vocational learning. It's a new initiative from the government. Now we're starting to collaborate with more companies because we have many students needing internships.
We also collaborate a lot with the local language center. In Frederikshavn Municipality, when new families arrive, the kids go to the language center for three months to learn basic Danish. Then they move into regular school. For some, that works well; for others, it's tough. So we work closely with the language center to provide ongoing support. There's a lot going on in that area.

04 room program

The extented room program as refered to on page 101 in the report. The net area is around 5,700m², while the gross areas hits approximately 10,000m². The result deviates significantly due to the circulation (hallway) area. Likewise, the area for ad-hoc group rooms of various sizes in the common areas have been included, but not to full extend in the room program.

Room program						
Category	*Notes*	*People (max)*	*People (mean)*	*m2*	*Number of rooms*	*Total m2*
Class rooms						
Classroom // 0. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 1. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 2. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 3. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	17	15	60	3	180
Classroom // 4. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	20	18	60	3	180
Classroom // 5. grade	Their classroom should have more than one type of learning environment (board-based instruction, social learning and a reflection corner).	20	18	60	3	180
Classroom // 6. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 7. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 8. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Classroom // 9. grade	Their classroom should have more than one type of learning environment (collaboration zones/social learning, a reflection corner and flexible areas to encourage autonomy).	20	18	60	3	180
Special needs classroom	One for each department (Early primary, Upper primary and Lower secondary).	15	10	60	3	180
Level-based class	This is for lower secondary students. If students in 7th, 8th, or 9th grade are behind in a subject, they receive level-based teaching.	15	10	50	1	50
Other study rooms						
Art (1. - 6. grade)	With storage room. The storage room door should be 1 meter wide. Room need cabinets and drawers.	20	17	90	1	90
Music (1. - 6. grade)	With storage room - around 12m2.	20	17	83	1	83
Nature & Technology (1. - 6. grade)	Movable tables, kitchenettes, IT workstations, cabinets, and drawers.	20	17	80	1	80
Crafts (3. - 6. grade)	Craft and Design are two separate rooms, one for crafts and one for design.	20	17	120	1	120
Design (3. - 6. grade)	Craft and Design are two separate rooms, one for crafts and one for design.	20	17	88	1	88
Home economics (5. - 6. grade	Large enough for both theoretical and practical learning, with a storage room, cabinets, and drawers.	20	17	140	1	140
Biology (7. - 9. grade)	There needs to be room for a demonstration table, lab tables, smartboard, cabinets and drawers, etc. The storage room door should be 1 meter wide	20	17	86	1	86
Physics & Chemistry (7. - 9. grade)	drawers, smartboards, etc.	20	17	86	1	86
Makerspace	New learning environment - combination of machines and materials	20	17	90	1	90
Computer room	Computer for each student.	20	17	80	1	80
Physical education (P.E.)	Size 42x22m (half size*).The dimensions of this room need to accommodate various sports (e.g., badminton) and should have a height of 7–8 meters. Preferably, the room should receive light from the north. The room needs equipment room, the equipment room opening should be 2.5 meters wide, with a door height of 2.5 meters.	40	35	470	1	470
Locker rooms	The space should include different zones (shoe area, barefoot area, wet area) and be accessible for people with disabilities. One shower pr 4-6 people. Seperate show for teachers.	20	15	45	2	90
Library	Consists of more than one room (on two floors) and it should contain workspaces, books, films, etc.	45	20	80	2	160
Study areas	Different types of group areas/rooms, located in open spaces near the classrooms and some further away more isolated. The types vary depending on which grades they are intended for.	5	3	25	10	250
Teachers and administration						
Teachers lounge	Shared among all employees at the school. Soft furnishings, lunch area, kitchenette, coffee station, storage, etc.	40	25	80	1	80
Teachers office	Shared office and desks for class preparation. There should also be space for a few meeting rooms. The area should be located near both the early primary and upper primary sections to ensure close proximity—since the youngest students need adult support more frequently.	8	4	20	1	20
Principal office	Private enclosed office, large enough to include a meeting area.	4	1	10	1	10
Secretary	Should be located near the entrance and near the principals office.	4	4	15	1	15
IT	Should be located near the teachers office and the secretary.	1	1	7	1	7
School nurse (and school psychologist)	Their office is not in constant use. It should be located in a more private and discreet area to ensure student confidentiality.	4	1	10	1	10
Other functions						
Canteen area	An area for the studens and staff to buy food, and a small area where one can sit (most of the students normally eat in their own department).	30	20	80	1	80
Canteen kitchen	Kitchen and counter.	3	2	20	1	20
Wardrobe	There needs to be a wardrobe for each student located near their department, and wardrobes for the employees near their office/lounge area.	1	1	0,4	540	216
Kitchennettes	In every department + Teachers lounge	8	4	5	4	20
Ad-hoc	Ad-hoc areas are flexible spaces that vary depending on the department they are intended for. These could include motorically challenging play areas for early primary students, sofa areas for conversation for lower secondary students, varied seating arrangements, or exhibition spaces to showcase student work from, for example, creative subjects.	5	4	10	10	100
Printer room & supply storage	There should be a printer area in each department.	3	1	8	4	32
After school care (SFO) area	The after-school care area is for students in the early primary and should therefore be located near their department, with easy access to the outdoor areas. There needs to be a specific room, but most on the play areas, etc. are shared with the early primary department. 4-5m2 pr. student.	221	170	680	1	680
After school care (SFO) room		25	18	60	1	60
Toilets	One pr 15 students. (0. - 3. grade, 13 toilets), (4. - 6. grade, 11 toilets) and (7. - 9. grade, 11 toilets). Private toilets for the employees (4 toilets)	1	1	1,5	59	88
Accessible toilet	One or two pr. floor.	2	1	5	4	20
Cleaning storage	One on each floor.	2	1	8	3	24
Janitor storage	One on the ground floor	2	1	15	1	15
Technical room	There needs to be distributed technical rooms to shorten ducts and create smaller technical rooms.			50	5	250
Fire escape	They need to be distributed throughout the building to ensure short distances and easy access for people.			15	3	45
Total						**5735**

05 ventilation and air flow rate

Air flow																
Atmospheric indoor climate	Room description				Standard values from Danish Industry guidelines (specifically for schools)		Value from DS/EN 16798 [1]				Calculation method for: Perceived air quality, based on European/danish standard (DS/EN) Values from DS/EN 16798					
Category	Area [m2]	Volume [m3]	People [max. cap.]	Activity [met]	CO2 emi. pr pers [l/h] [2]	Ventilation airflow rates, pr. person [l/s] [3]	Ventilation airflow rate for emissions from building [l/s m^2]	Ventilation airflow rate for emissions from building [l/s]	Ventilation airflow rates, total [l/s] [4]	Ventilation airflow rates, total [m^3/h] [5]	Ventilation airflow rates, pr. person [l/s] [6]	Ventilation airflow rate for emissions from building [l/s m^2] [7]	Ventilation airflow rates, total [l/s]	Ventilation airflow rates, total [m^3/h] [8]	Max. airflow rate [m^3/h]	Air change [h^-1]
Class rooms																
Classroom // 0. grade	60	168	15	1,2	20,4	11,3	1	60	229,5	826,2	10	1	210	756	826,2	4,9
Classroom // 1. grade	60	168	15	1,2	20,4	11,3	1	60	229,5	826,2	10	1	210	756	826,2	4,9
Classroom // 2. grade	60	168	15	1,2	20,4	11,3	1	60	229,5	826,2	10	1	210	756	826,2	4,9
Classroom // 3. grade	60	168	15	1,2	20,4	11,3	1	60	229,5	826,2	10	1	210	756	826,2	4,9
Classroom // 4. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Classroom // 5. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Classroom // 6. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Classroom // 7. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Classroom // 8. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Classroom // 9. grade	60	168	18	1,2	20,4	11,3	1	60	263,4	948,2	10	1	240	864	948,2	5,6
Special needs classroom	60	168	10	1,2	20,4	11,3	1	60	173	622,8	10	1	160	576	622,8	3,7
Level-based class	50	140	10	1,2	20,4	11,3	1	50	163	586,8	10	1	150,0	540,0	586,8	4,2
Other study rooms																
Art (1. - 6. grade)	90	252	17	1,2	20,4	11,3	1	90	282,1	1015,56	10	1	260	936	1015,56	4,0
Music (1. - 6. grade)	83	233,6	17	1,5	25,3	14,0	1	83,4	322,1	1159,6		1			1159,6	5,0
Nature & Technology (1. - 6. grade)	80	224	17	1,2	20,4	11,3	1	80	272,1	979,56	10	1	250	900	979,56	4,4
Crafts (3. - 6. grade)	120	336,0	17	2	33,7	18,7	1	120	438,24	1577,664		1			1577,664	4,7
Design (3. - 6. grade)	88	246,4	17	1,2	20,4	11,3	1	88	280,1	1008,36	10	1	258	928,8	1008,36	4,1
Home economics (5. - 6. grade	140	392	17	2	33,7	18,7	1	140	458,24	1649,664		1			1649,664	4,2
Biology (7. - 9. grade)	86	240	17	1,2	20,4	11,3	1	85,7	277,8	1000,1	10	1	255,7	920,6	1000,1	4,2
Physics & Chemistry (7. - 9. grade)	86	240	17	1,2	20,4	11,3	1	85,7	277,8	1000,1	10	1	255,7	920,6	1000,1	4,2
Makerspace	90	252	17	1,2	20,4	11,3	1	90	282,1	1015,56	10	1	260	936	1015,56	4,0
Computer room	80	224	17	1,2	20,4	11,3	1	80	272,1	979,56	10	1	250	900	979,56	4,4
Physical education (P.E.)	470	3525	35	3,5	59,0	32,8	1	470	1616,6	5819,76		1			5819,8	1,7
Locker rooms												1				
Library	80	224	20	1,2	20,4	11,3	1	80	306	1101,6	10	1	280	1008	1101,6	4,9
Study areas	10	28	3	1,2	20,4	11,3	1	10	30	108	10	1	40	144	144	5,1
Teachers and administration																

Teachers lounge	80	224	25	1,2							10	1	330	1188	1188	5,3
Teachers office	20	56	4	1,2							10	1	60	216	216	3,9
Principal office	10	28	1	1,2							10	1	20	72	72	2,6
Secretary	15	42	4	1,2							10	1	55	198	198	4,7
IT	7	19,6	1	1,2							10	1	17	61,2	61,2	3,1
School nurse (and school psychologist)	10	28	1	1,2							10	1	20	72	72	2,6
Other functions																
Canteen area	80	224	20	1,2							10	1	280	1008	1008	4,5
Canteen kitchen																
Wardrobe																
Kitchennettes	5	14	4	1,2							10	1	45	162	162	11,6
Ad-hoc	10	28	4	1,2							10	1	50	180	180	6,4
Printer room & supply storage	8	22,4	1	1,2							10	1	18	64,8	64,8	2,9
After school care (SFO) area	680	1904	170													
After school care (SFO) room	60	168	18	1,2	20,4	11,3	1	60	263,4	948,24	10	1	240	864	948,24	5,6
Toilets																
Accessible toilet																
Cleaning storage																
Janitor storage																
Technical room																
Fire escape																

06 Be18 calculations

On the following page, the Be18 calculations are presented. Be18 from the desing process is to be found on page 113 and below.

06.01 Be18 calculation - design process

Key figures kWh/m² yr

Renovation class 2

W.O. supplement	Supplement for special conditions	Total energy consumption
95,2	0,0	95,2
		42,8

Renovation class 1

W.O. supplement	Supplement for special conditions	Total energy consumption
71,5	0,0	71,5
		42,8

Energy concumption BR 2018

W.O. supplement	Supplement for special conditions	Total energy consumption
41,1	0,0	41,1
		42,8

Energy concumption Low energy

W.O. supplement	Supplement for special conditions	Total energy consumption
33,0	0,0	33,0
		42,8

Energy concumption Low energy

Heat	10,1
electricity for building operations	17,6
Over heating in rooms	0,7

Net demand

Room heating	8,2
Varm domestic water	6,1
Cooling	4,5

Selected electrical needs

Lighting	7,8
Room heating	0,0
Over heating in rooms	0,0
Heating of DHW	0,0
Fans	7,8
Pumps	0,0
Cooling	2,0
Total electricity concumption	31,7

Heat loss from installationsv

Room heating	0,0
Varm domestic water	0,9

Output from special sources

Solar heating	0,0
heat pump	0,0
Photovoltaic panels	0,0
Wind turbines	0,0

06.02 Be18 calculation - final results

The energy performance of the final design proposal has been calculated to ensure it meets the standards set by the building regulations. The use of passive strategies has significantly improved the possible energy performance of the building. Some of the passive strategies that have been used are: low thermal transmittance on the building envelope, energy efficient windows, a compact building envelope, 10 pct rule for windows in all classrooms, few rooms facing south and the ones that do are not rooms with long stay. Furthermore, the fact that there are fewer students in each room lowers the necessary air change rate which minimizes the energy use on ventilation and cooling. It is reflected by the results that the design fulfills the standards without any active means. As mentioned earlier the value showing slight overheating is accounted for by the BSim simulations, thus, it is not considered a significant factor in the building's overall energy use.

Key figures kWh/m² yr

Renovation class 2

W.O. supplement	Supplement for special conditions	Total energy consumption
95,2	0,0	95,2
		39,7

Renovation class 1

W.O. supplement	Supplement for special conditions	Total energy consumption
71,5	0,0	71,5
		39,7

Energy concumption BR 2018

W.O. supplement	Supplement for special conditions	Total energy consumption
41,1	0,0	41,1
		39,7

Energy concumption Low energy

W.O. supplement	Supplement for special conditions	Total energy consumption
33,0	0,0	33,0
		39,7

Energy concumption Low energy

Heat	12,9
electricity for building operations	15,0
Over heating in rooms	0,4

Net demand

Room heating	11,0
Varm domestic water	6,0
Cooling	2,8

Selected electrical needs

Lighting	6,8
Room heating	0,0
Over heating in rooms	0,0
Heating of DHW	0,0
Fans	6,9
Pumps	0,0
Cooling	1,2
Total electricity concumption	27,3

Heat loss from installationsv

Room heating	0,0
Varm domestic water	0,8

Output from special sources

Solar heating	0,0
heat pump	0,0
Photovoltaic panels	0,0
Wind turbines	0,0

07 definition of class sizes // recommendations

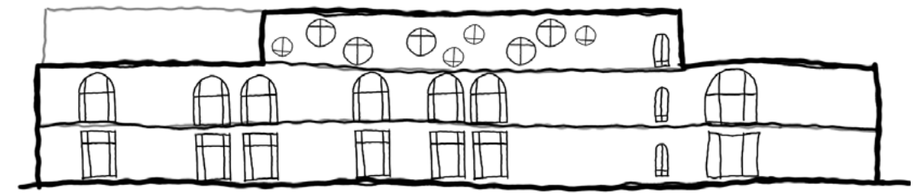
The definition of class sizes is based on information from the industry working environment community for Public School and Gymnasium. Their estimation on room sized is based on 28 student. In order to accommodate the new Stigsborg Schools need, calculations were made based on m² per student. In the following section there will be provided some usefull key parameters.

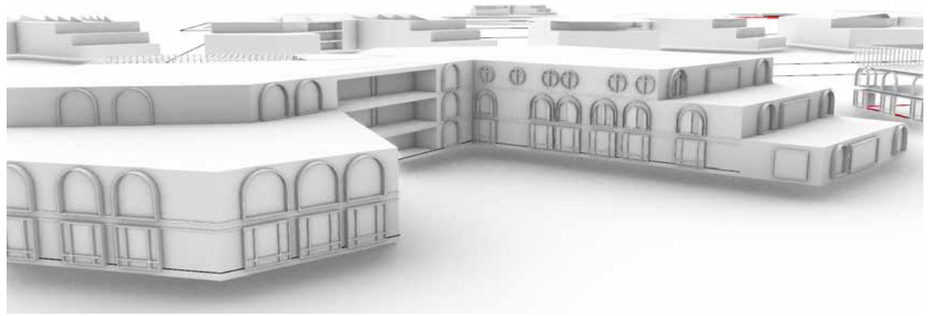
Room program

Category	*Notes from the industry guide*	*Industry Working Environment Community [m2]*	*Stigsborg School [m^2]*
Art	Access: delivery access and easy waste handling Room design: Should be large and bright Emergency exit: must have two exits No doorsteps Lighting: Critical - prioritize natural light, general light, task light and blackout Storage: Sufficient storage spece. Depot door must be 1m wide w.o. steps	*not specified	88
Biologi	Teaching: Should occur in large, bright rooms suited to investigative and experimental learning Space: Must include demonstration table, lab benches, sufficient cabinets A space of min. 120m^2 w. adjacent classrooms, group rooms and storage meets requirement Air volume: min. 12m^3 per person Storage: door width min. 1m	120	86.5
Physic & Chemistry	Space needs to: Demo table, lab benches for full class, long-term experiments, storage, interactive boards, IT equipment Recommended space: 100-120m^2 Doors: min. 77cm clear width	100-120	84.5
Crafts & Design	Size: min. 250 for 24 students, no enclosed rooms under 40m^2 Three primary zones	250	204
Physical Education (P.E.)	Dimensions based on minimum playing are standards Ceiling height: Badminton: 8m & Other sports: 7m Daylight: north-facing light Doors: 2,5m wide	*not specified	470
Home Economics	Room setup: Spacious enough for both theoretical and practical work. Room should appear clean bright and well-kept Size: for 16 students: 120-120m^2 Multiple sinks Daylight: good daylight, and artificial lighting quility is critical	120-140	141
Makerspace	New learning spaces combining traditional crafts with digital fabrication	*not specified	88
Music	Room setup: Supports practice, creation, and music understanding Size: 90-100m^2 1-2 side rooms: approx. 12m^2	90-100	88
Nature & Technology	Area: 1) dedicated classroom for grades 1-6, 2) workshop space within science area, 3) use of traditional subject classrooms & 4) regular class (home) room w. mobile kits	*not specified	83
Library	Should include multiple rooms, preferably centralized in the school. Proximity to other subject rooms improves utilization	*not specified	340

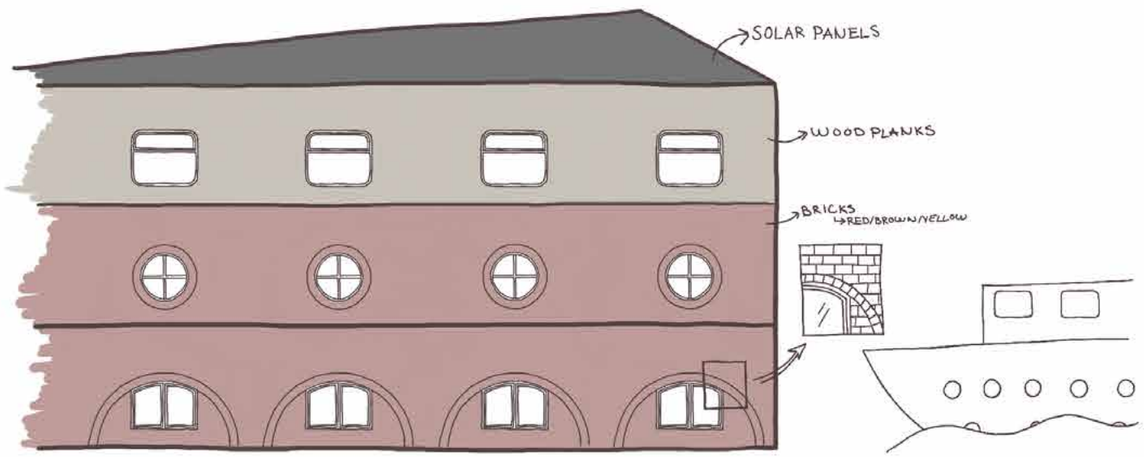
08 cut-out from design process

08.01 window iterations

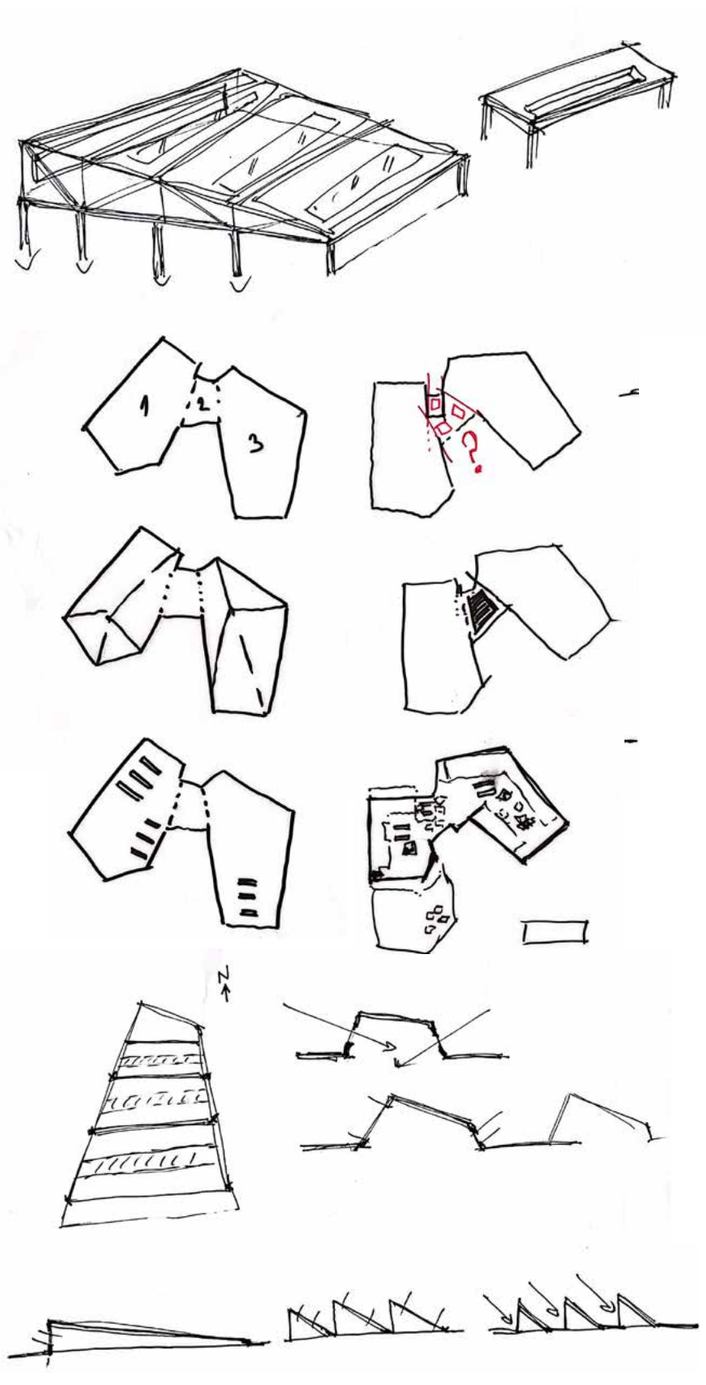




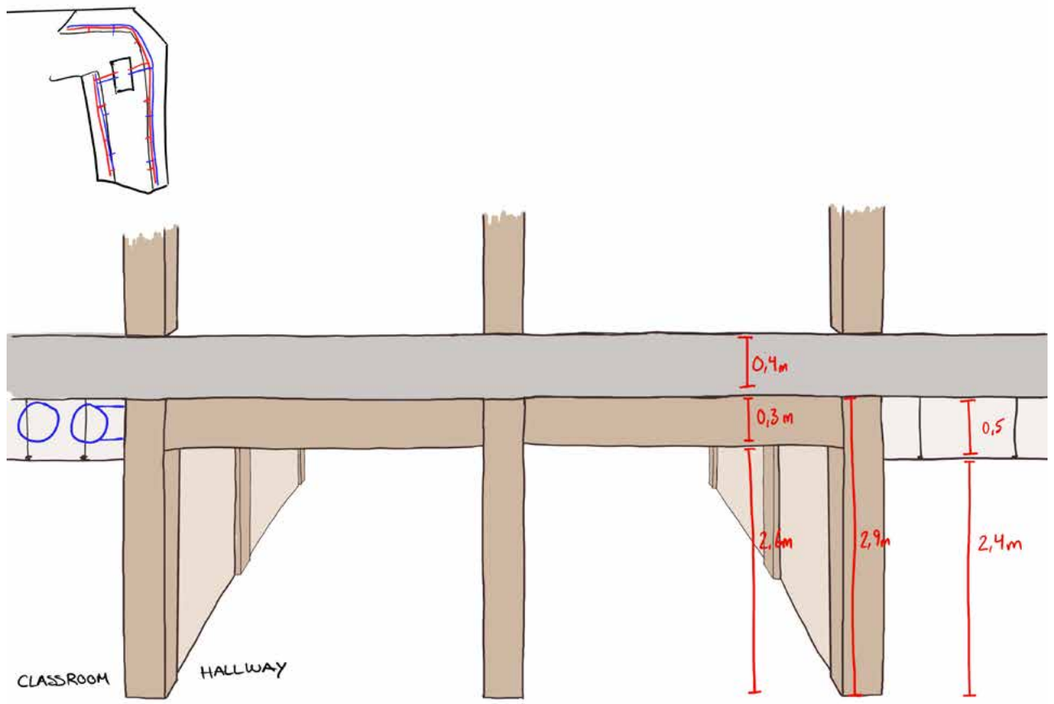
08.02 façade iteration



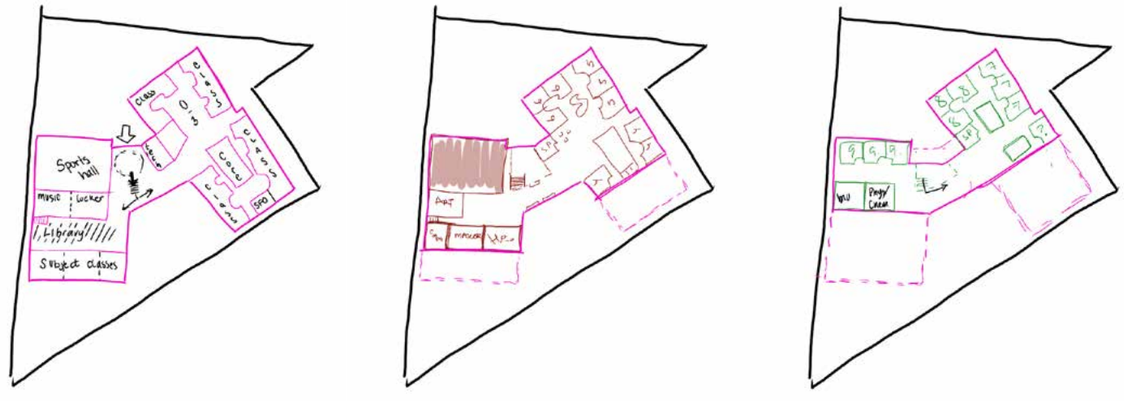
08.03 roof iterations

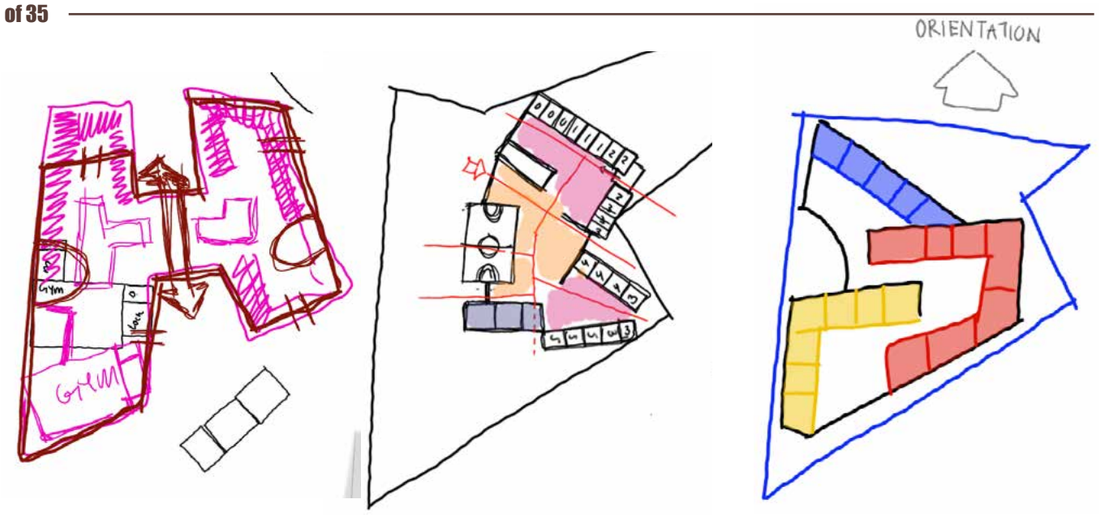


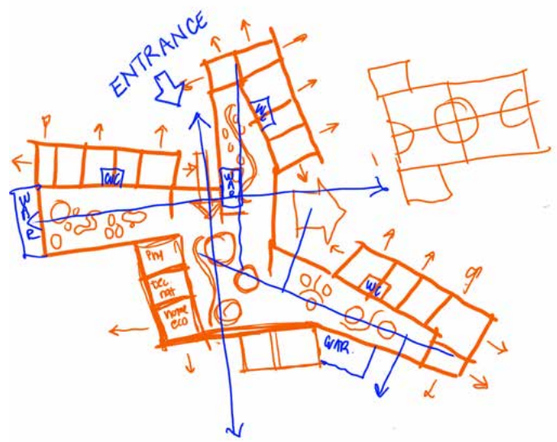
08.04 beams and columns // ventilation ducts

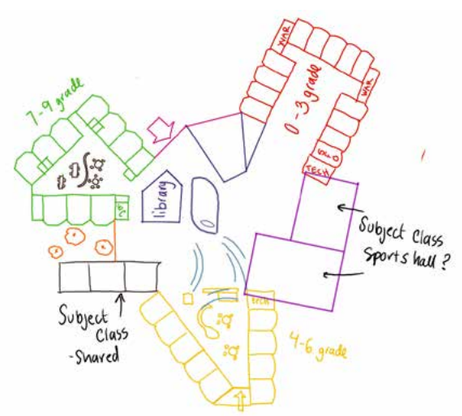


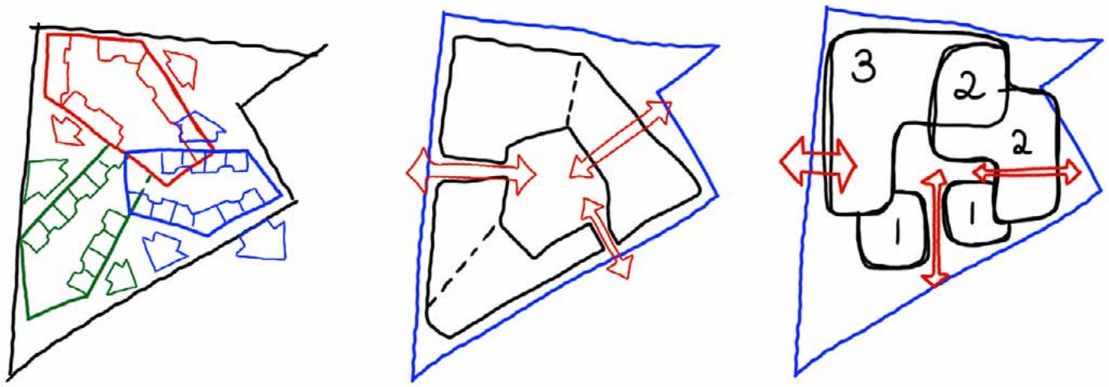
08.05 plan iterations

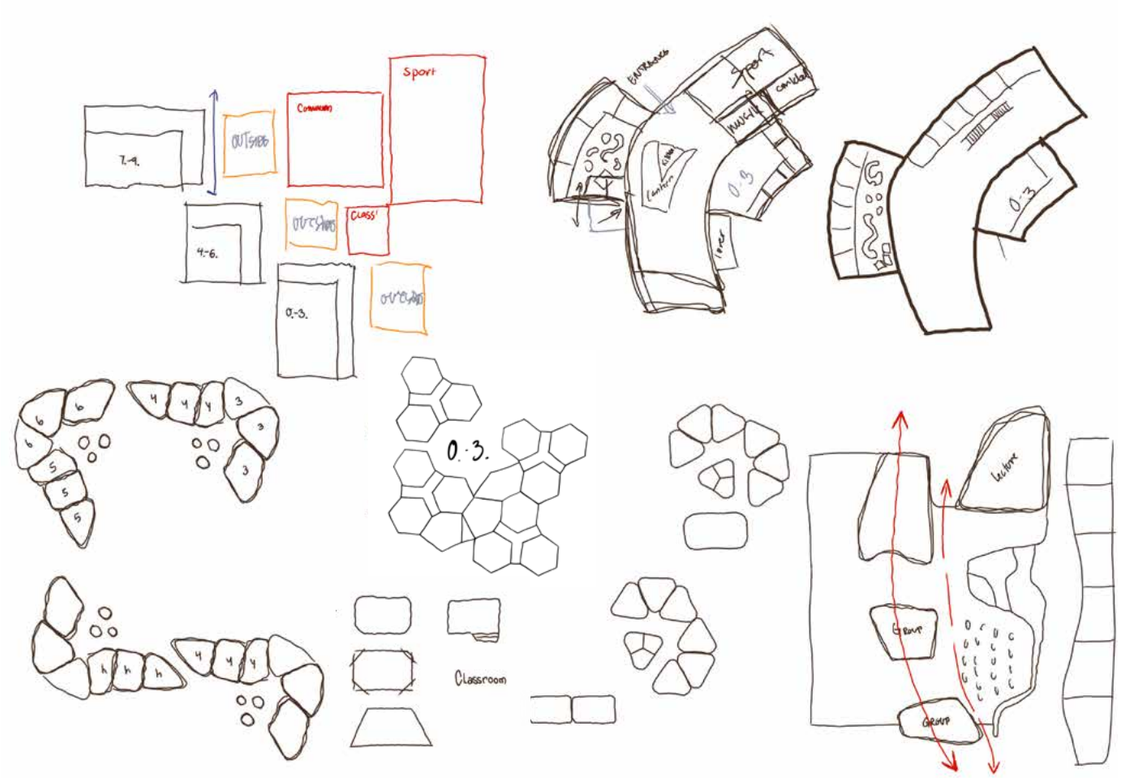
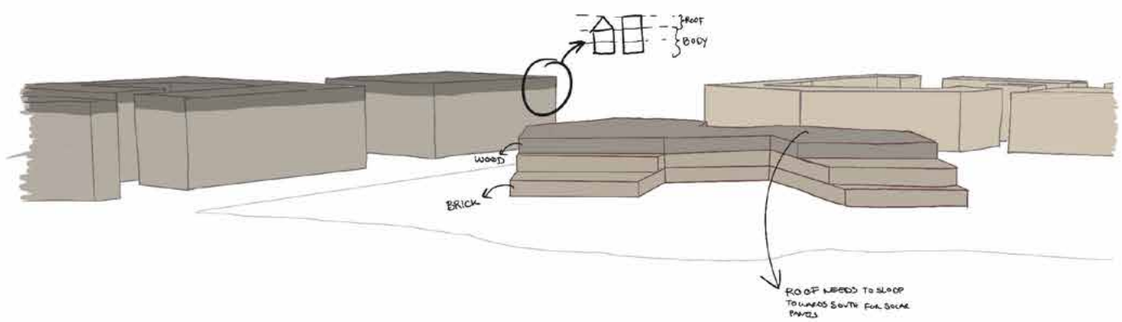












08.06 building in context