

Focused in school

An accessible school building for students with neurodevelopmental disorders and concentration difficulties.

A master thesis in Healthcare Architecture
by Susanna Arsaellsson

Chalmers School of Architecture
Supervisor: Lin Tan
Examiner: Cristiana Caira



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“An accessible school building for students with neurodevelopmental disorders and concentration difficulties.”

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A master thesis in Healthcare Architecture
Master's program in Architecture and Urban Design

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Growing up with a family member within the autism spectrum the questions of accessibility and inclusion have always been present. Given the opportunity to form my own architectural project I saw the opportunity to combine my interest in interdisciplinary projects where complex architectural questions meet the knowledge of user groups and practices, with my personal experiences and knowledge of the specific user group. The result is an investigation of how architecture can be used to create accessible learning environments in the form of a school building.

ABSTRACT

Children with neurodevelopmental disorders and concentration difficulties often experience difficulties in school, resulting in lower grades and longer periods of absence. In Sweden education must be accessible for all regardless of one's preconditions and it must not discriminate based on ability. Many schools fail to provide the support and accessibility needed for this group of children and as a result they are more likely to experience stress, mental illness, bullying and harassment during their education.

To raise awareness and facilitate the situation for this group, this thesis will investigate how factors in the physical learning environment affect students with neurodevelopmental disorders and concentration difficulties. Through the design of a school building the thesis aims to answer the question of how architecture can be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties.

To understand the relation between students' experiences of their physical environment and its design, observations, interviews and literature studies have been conducted. To translate theory into practice, workshops, model making and sketching have been used.

The thesis results in a design proposal for an elementary school in Torslanda, Gothenburg. The design focuses on creating accessible learning environments, where the specific factors in the physical learning environment affecting children with neurodevelopmental disorders and concentration difficulties have been investigated.

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““ Varje elev har rätt att
i skolan få utvecklas,
känna växandets glädje och
få erfara den tillfredsställelse
som det ger att göra framsteg
och övervinna svårigheter. ””

*Läroplan för grundskolan,
förskoleklassen och fritidshemmet 2011.
(Skolverket, 2019).*

1. INTRODUCTION

This master thesis explores accessibility in school architecture. It is written in the Healthcare Architecture direction and is intended as an inspiration for architects and stakeholders to create environments adapted for those who do not always follow the norm.

The thesis is divided into nine chapters where the design process and the final proposal are intertwined with theoretical reasoning and explanations.

1.1. PROJECT BACKGROUND

The Swedish education act states that education must be provided for all children, regardless of preconditions or disabilities and the elementary school should be the primary alternative for education (SFS 2010:800). The legislation sets a standard for all learning environments to be accessible in order to provide an equal education for all.

Despite this, many schools fail to comply with the rules stated in the legislation (Skolverket, 2016). For students with neurodevelopmental disorders the situation can be described as particularly difficult and the group experience high levels of absence, lower results in school and is highly representative in categories of bullying, harassment and mental illness as a result of their learning environment (Attention, 2017). Not only does the lack of accessibility in the learning environments influence the education. It can also impact the students' health and opportunities to obtain work in the future.

Research suggests specific environmental factors to be of importance for designing learning environments for children with neurodevelopmental disorders and concentration difficulties. Yet Swedish guidelines for accessibility lack directions on how this research could be used, leading to a situation where architects and stakeholders fail to implement the knowledge.

1.1.1. PURPOSE

The purpose of this thesis is to raise awareness of how different environmental factors in the physical learning environment can affect the accessibility for students with neurodevelopmental disorders and concentration difficulties.

1.1.2. AIM

The aim of this thesis is to raise the question of accessibility within school buildings by investigating how factors in the physical learning environment affect students with neurodevelopmental disorders and concentration difficulties.

Through the design of a school building the thesis aims to explore how architecture can be used to create accessible learning environments.

1.1.3. RESEARCH QUESTION

How can architecture be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties?

Keywords: Accessibility, Learning environment, School building, Neurodevelopmental disorders, Concentration difficulties.

1.2. DELIMITATIONS

The delimitations of this thesis are the physical learning environments within a school building for students at year F-6. Although a learning environment preferably is seen as a coherent environment, the thesis will only propose a rough idea of the outdoor environments and not a thorough investigation related to the thesis question.

1.2.1. PRECONDITIONS OF THE DESIGN PROPOSAL

The design proposal is based on an ongoing project in Torslanda, where the municipality of Gothenburg is planning an elementary school with an integrated school for children with special needs. The proposal is based on the preconditions of the municipality and the altered detailed development plan II-3301; although it had not come into force at the start of this thesis. In order to fit the thesis into the timeline, the thesis will only focus on the elementary school and the proposal will therefore only regard approximately 550 students, instead of the originally 570 intended by the municipality.

1.2.2. USER GROUP

The primary user group of this thesis is children with neurodevelopmental disorders and concentration difficulties educated in an elementary school environment.

Many factors can affect the possibilities for children with neurodevelopmental disorders and concentration difficulties to succeed in school. Pedagogical

aspects, personal background and expectations are all important factors for children who experience difficulties in their learning environment. This thesis will investigate how specific environmental factors in the physical learning environment can be designed to make it more accessible.

1.2.3. PEDAGOGICAL PRACTICES

This thesis will not be based on a specific pedagogical practice. Instead the curriculum for the elementary school will be the guidance of what to learn and how.

The thesis will be based on the assumption that a school building needs to support the learning of the different skills and knowledge stated in the curriculum. Additionally a school building needs to be accessible in order to provide equal conditions for all students.

An accessible learning environment is in this thesis defined as a learning environment that, regardless of preconditions, allows students to access not only the physical environment, but also the social and pedagogical environment. (The different types of learning environments are defined and described in chapter 6.)

CURRICULUM

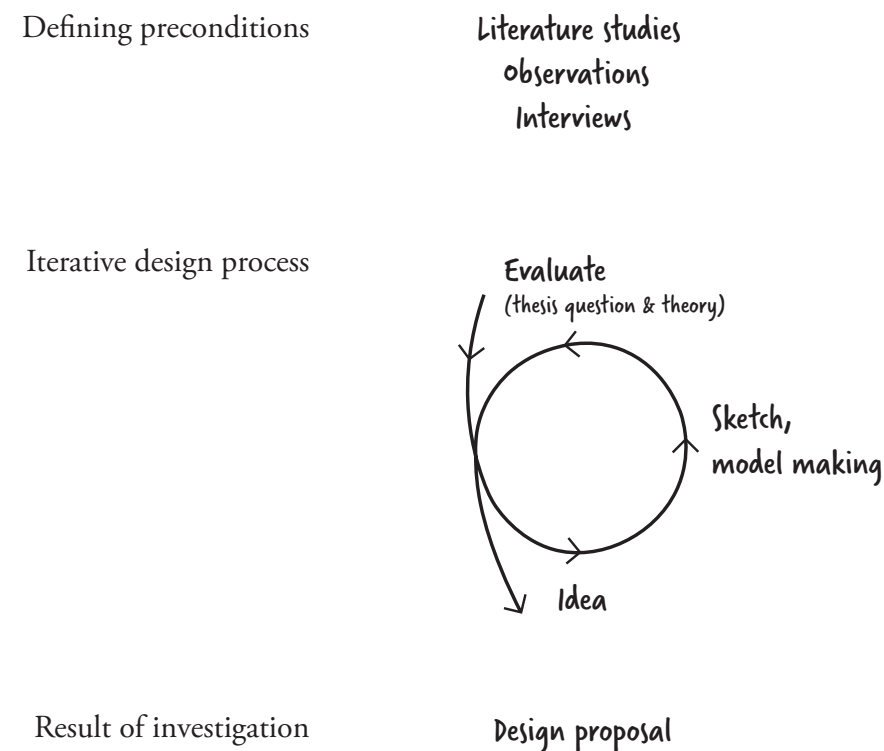
+

ACCESSIBILITY

=

SCHOOL BUILDING

"How can architecture be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties?"



1.3. RESEARCH FOR DESIGN

To understand what factors in a physical environment affect students with neurodevelopmental disorders and concentration difficulties, interdisciplinary literature on learning environments, architecture and the different diagnoses have been studied.

To understand the characteristics of a learning environment observations during study visits and interviews with a teacher and a practicing architect, working with school buildings, have been conducted. The purpose of these investigations was to understand how students and teachers use their environment. What types of activities take place in a school building and what type of spaces are required to fulfill these activities?

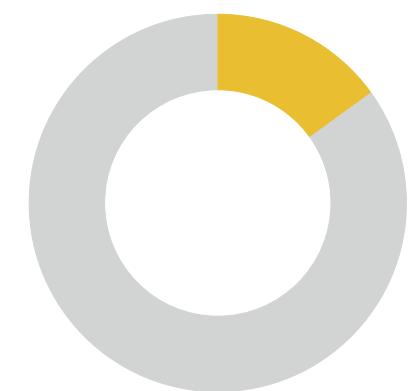
The observations took place during two days at Röseldsskolan, an elementary school for the years F-9 in the municipality of Lerum. The observation followed a team of students and teachers in the year F-3, one day focusing on the formal learning environments and one day focusing on the informal learning environments. The observation was conducted based on a questionnaire of environmental factors affecting the user group specified in this thesis.

1.3.1. DESIGN PROCESS

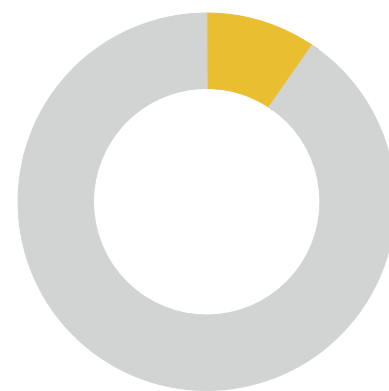
To translate the theory into an architectural design, an iterative process has been used, starting with defining the preconditions of the project. Sketching and model making has been used as the primary design tools throughout the whole process, where new design ideas have been tested and evaluated in an iterative process.



(Attention, 2017)



Approximately 15 % of Swedish children have a disability (Tufvesson, 2007; Barnombudsmannen, 2016).



Approximately 8 % of students in Swedish schools have a neurodevelopmental disorder (Attention, 2020).

2. HEALTHCARE ARCHITECTURE

Disabilities can be defined as limitations in relation to the surrounding environment (Socialstyrelsen, 2007) and according to Barnombudsmannen, approximately 15 % of all children in Sweden has a disability (Barnombudsmannen, 2016).

Swedish legislation clearly states that the limitations a disability can entail must not prevent the individual to participate in society (SFS 2008:567). Yet research shows an over-representation amongst children with disabilities in several areas of life, where their disability makes them extra vulnerable (Barnombudsmannen, 2016).

The school environment is an environment where many children with disabilities experience exclusion, harassment and discrimination based on their ability (Attention, 2017; Skolverket, 2016). One group that is especially vulnerable in the school environment is children with neurodevelopmental disorders. Specialpedagogiska skolmyndigheten states that children with neurodevelopmental disorders are at higher risk of experience stress, mental illness and bad health as a result of their learning environment (Specialpedagogiska skolmyndigheten, 2019).

2.1. USER GROUP

The primary user group of this thesis is students with neurodevelopmental disorders and concentration difficulties.

2.1.1. NEURODEVELOPMENTAL DISORDERS, NDD

Neurodevelopmental disorders include various diagnoses that affect the brain function and the nervous system (Barnombudsmannen, 2016; Specialpedagogiska skolmyndigheten, 2019). There are no clear statistics of how common neurodevelopmental disorders are amongst children within the Swedish school system, but approximately 8 % of schoolchildren have a diagnosis within the spectra (Attention, 2020).

Neurodevelopmental disorders affects how the brain process information which can cause information and sensory input to be interpreted differently (Barnombudsmannen, 2016; Specialpedagogiska skolmyndigheten, 2019). What effect this can have on children can vary, but difficulties with interaction, impulse control, attention, activity level, memory and learning are in general common (Attention, 2020). Diagnoses typically in the range of neurodevelopmental disorders are autism spectrum disorder, ADHD and Tourettes syndrome (Barnombudsmannen, 2016; Specialpedagogiska skolmyndigheten, 2019).

2.1.2. CONCENTRATION DIFFICULTIES

Concentration can be defined as the ability to direct and maintain the perception in order to finish a specific task while sorting out irrelevant sensory input (Kadesjö, 2008). A student with concentration difficulties have trouble sorting out relevant sensory input and can therefore become overwhelmed by impressions.

Concentration difficulties are typically categorized in primary and secondary concentration difficulties. Primary concentration difficulties are caused by biological factors and cause a child to become easily distracted by sensory input from the surrounding. Secondary concentration difficulties are situational based and are caused by temporary factors either in a child's home environment or in specific situations that can cause difficulties. Since secondary concentration difficulties are caused by external factors, the difficulties can end when the problem that causes the difficulty is solved.



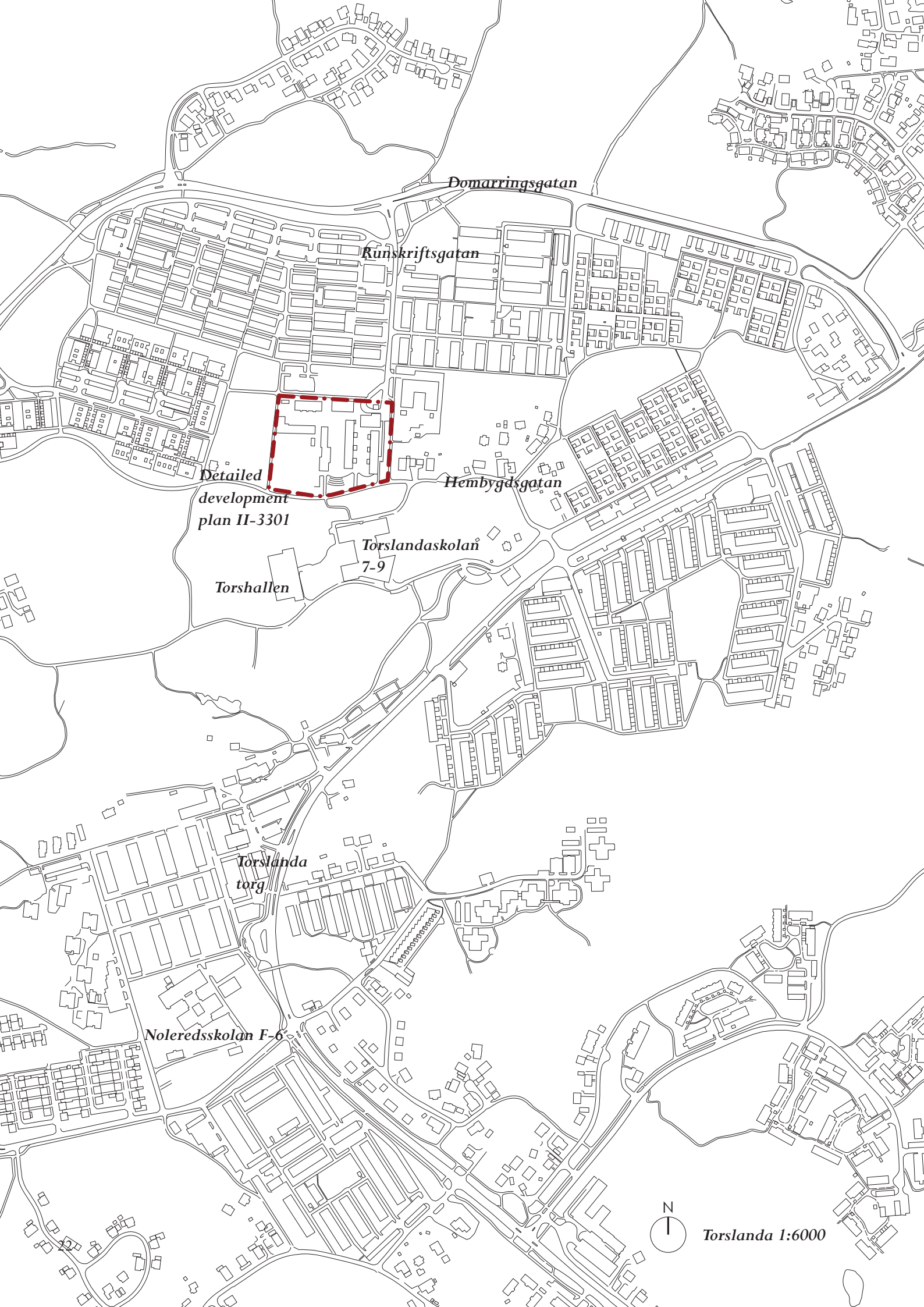
3. TORSLANDA

As a base for the investigation on accessible school buildings, this thesis will use a site located in Torslanda, a peripherally placed district in the northwest part of Gothenburg.

Torslanda has a large scale characteristic with several industrial areas, mixed with quiet residential neighborhoods and areas of nature along the seaside, and holds the only connection to the northern archipelago.

Torslanda was historically a rural area, but started expanding during 1960 when large industries were established in the area (Göteborgs stad, 2008). Torslanda still provides a large share of workplaces for the citizens of Gothenburg with large scale industries such as Volvo Torslanda, the Port of Gothenburg and refineries.

School admissions in the municipality of Gothenburg are administrated by a principle of proximity, which means the right to a school placement within 2-4 km distance from the home, making Torslanda the primary admission area for the new school building (Göteborgs stad, u.å.).



3.1. THE NEIGHBORHOOD

The site is located in a quiet, middle-class, residential area mainly with small scale row houses and villas. The neighborhood is traffic segregated and the many pedestrian roads offer good opportunities for children to walk or bicycle to school by themselves

The site already has a school building for students’ year F-5, but the municipality is currently planning for a new, larger, school building for the years of F-6.

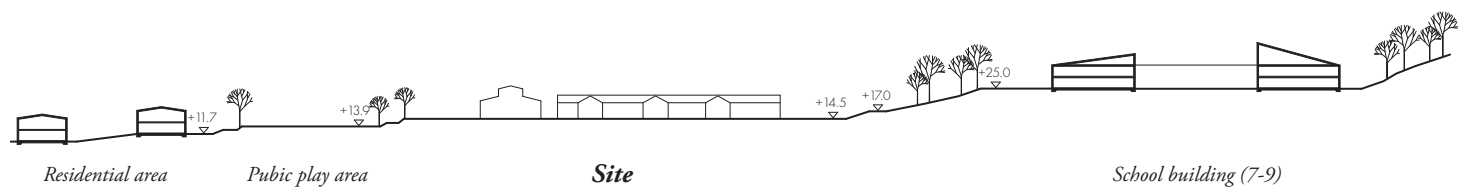
On the south side of the site, on a hill, a second school is located for the years 7-9. Paths in the sloping landscape facilitate the connections between the schools and on the southwest part of the hill a forest landscape is spreading.

3.1.1. DETAILED DEVELOPMENT PLAN II-3301

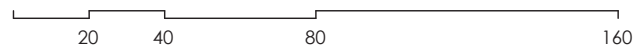
The municipality of Gothenburg is in the process of altering the detailed development plan for the site. The new regulation proposes a school building of three floors on the east part of the site and the municipality is planning a new elementary school for the years F-6, instead of today’s F-5 (Göteborgs stad, 2019).



N
Site 1:4000



Section A-A 1:2000



1. Preschool on the east side of the site



2. Villas on the east side of the site



3. Torslandaskolan 7-9



4. Nya Torshallen



5. Apartment buildings on the northeast side of the site; built in the 1960s



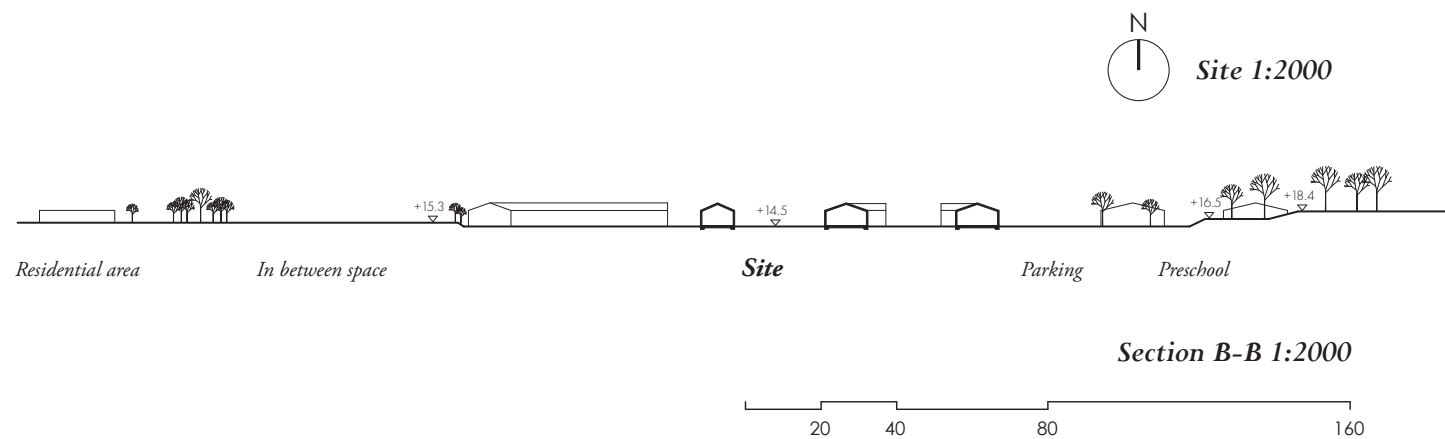
6. Row houses on the north side of the site; built in the 1970s



6. Row houses on the north side of the site; built in the 1970s



7. Row houses on the west side of the site; built in the 1970s



1. Existing school - Torslandaskolan F-5



2. Existing school - Torslandaskolan F-5



2. Existing school - Torslandaskolan F-5



3. Outdoor seating



4. Preschool on the site



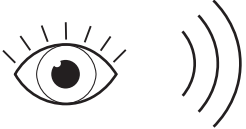


5. West side of site



6. North side of site



7. South side of site

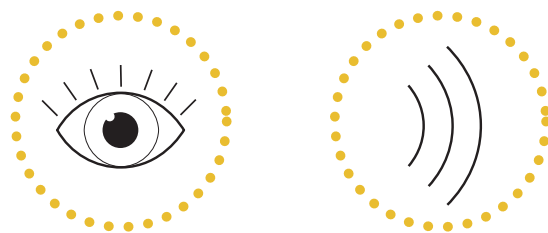
			
SITE	<ul style="list-style-type: none"> - Orient the building with views towards the built environment - Orient the building concerning outdoor environments to decrease disturbing noise and views - Orient the building concerning cardinal directions to avoid direct sunlight in learning environments 	<ul style="list-style-type: none"> - Place volume according to flows to facilitate wayfinding - Provide easy overview to facilitate wayfinding - Use a clear architecture language and readable volumes to facilitate wayfinding 	<ul style="list-style-type: none"> - Provide different outdoor environments
BUILDING	<ul style="list-style-type: none"> - Limit sensory input in learning environments - Consider views towards surroundings with noise and movements to minimize sensory input (schoolyards, roads etc) - No windows between rooms or in multiple walls - Minimize the number of doors in rooms for learning - Minimize noise in learning environments 	<ul style="list-style-type: none"> - Provide smaller units - Use multiple entrances and alternative flows to minimize crowding - Provide an easy overview and short distances between learning environments to facilitate the wayfinding - No passages through learning environments - Provide enough square meters to minimize crowding (especially in spaces with large flows of people) 	<ul style="list-style-type: none"> - Provide different rooms for different activities - Provide spaces for retreat - Provide small rooms for one-on-one teaching - Arrange the spaces so all children can participate in the social learning environment (no exclusion)
INTERIOR DETAILS	<ul style="list-style-type: none"> - Use enclosed storage space - Use calm colors in learning environments - Use contrasting materials and colors in learning environments 	<ul style="list-style-type: none"> - Use colors to mark important flows and entrances to facilitate wayfinding - Let the interior reflect on the use of a space to make the building readable for the user 	<ul style="list-style-type: none"> - Provide personalized seating

A matrix of environmental factors affecting students with neurodevelopmental disorders and concentration difficulties and how they can be addressed on which architectural scale.

4. ENVIRONMENTAL FACTORS

Living with a disability is a unique experience for every child and to what extent a disability poses an obstacle in life can vary. Several factors in a learning environment can be a hinder and negatively affect the learning outcome for children with neurodevelopmental disorders and concentration difficulties. The factors are not in themselves specific for the user group. They are rather aspects that can be an obstacle for everyone. However the difficulties can be amplified for students with disabilities, due to an extra vulnerability caused by the disability.

The environmental factors are in this thesis categorized as perception, flows and defined spaces and can be implemented on all scales; from urban planning to interior details. Given the delimitations of this thesis the scales investigated will be site, building and to some extent interior details.



VISUAL AND AUDITORY SENSORY INPUT

Limited sensory input

Views towards the built environment

No views towards schoolyards or environments
with many movements (corridors, roads etc.)

No direct sunlight

Enclosed storage space

Few doors and no windows in multiple walls

Calm colors

Use contrasts in materials and colors

No background noise

Regard the orientation of sensitive learning
environments and limit the number of windows
toward noisy areas (corridors, schoolyard etc.)

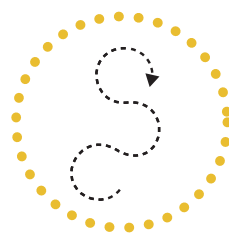
*(Tufvesson, 2007; Tufvesson & Tufvesson,
2009; Specialpedagogiska skolmyndigheten,
2018; Malmgren & Valsö, 2019)*

4.1. PERCEPTION

Perception is the understanding of the surrounding environment through sensory input (Kadesjö, 2008; Tufvesson & Tufvesson, 2009). The ability to process sensory input is an automated process where every input is processed and the unnecessary information is sorted out. How children with neurodevelopmental disorders and concentration difficulties perceive sensory input can vary and difficulties with the perceptive ability are common. The ability to sort out unnecessary information can be limited; leading to an overwhelming amount of sensory input the individual must react to. The constant interruptions make it difficult to stay concentrated and can be draining to the brain.

The ability to understand and interpret sensory input can also be limited, which can affect the understanding of spatiality, leading to different interpretations of space.

School environments have high levels of sensory input (Kadesjö, 2008). Both in the environment itself, but also in the flow of information learning entail. For children with difficulties to perceive, sort out and interpret sensory input, the school environment can be particularly difficult to handle and can negatively affect the child's ability to learn. In the school environment visual and auditory perception can be particularly difficult to handle. By a limitation of the sensory input, a learning environment can become more accessible (Tufvesson & Tufvesson, 2009).



FLOWS

- Easy overview and short distances
- Clear architecture (readable building design, clear placement of entrances etc)
- Smaller units
- Multiple flows and multiple entrances
- No crowding

(Tufvesson, 2007; Tufvesson & Tufvesson, 2009; Specialpedagogiska skolmyndigheten, 2018; Malmgren & Valsö, 2019; de Laval, 2017)

4.2. FLOWS

Through sensory input the surrounding is registered and an understanding of the spatial qualities, distances and relations between elements can be made (Kadesjö, 2008). If the brain struggles to process the sensory input to an apprehensible coherence it can be difficult to understand how the space is organized, making it more difficult to orientate within it.

To facilitate for children with a disability affecting the perceptive ability, it is important to find an organization of space that is easy to read, preferably with short distances, making movements between learning environments less stressful and energy-consuming (Malmgren & Valsö, 2019).

Not only must a school building be easy to orientate in. It also has a large flow of people using the space during the day, which can cause crowding. Crowding can be defined as the density of people in a specific environment (de Laval, 2017). Students with neurodevelopmental disorders and concentration difficulties are more sensitive to the effects of crowding and can experience more difficulties in large environments with a high number of social encounters (de Laval, Frelin & Grannäs, 2019). A large shared entrance is for example more difficult to handle than multiple separate entrances.



DEFINED SPACES

Different rooms for different activities

Clear use of space

Participation in the social learning environment

Personalized seating

Small rooms for one-on-one teaching

Spaces for retreat

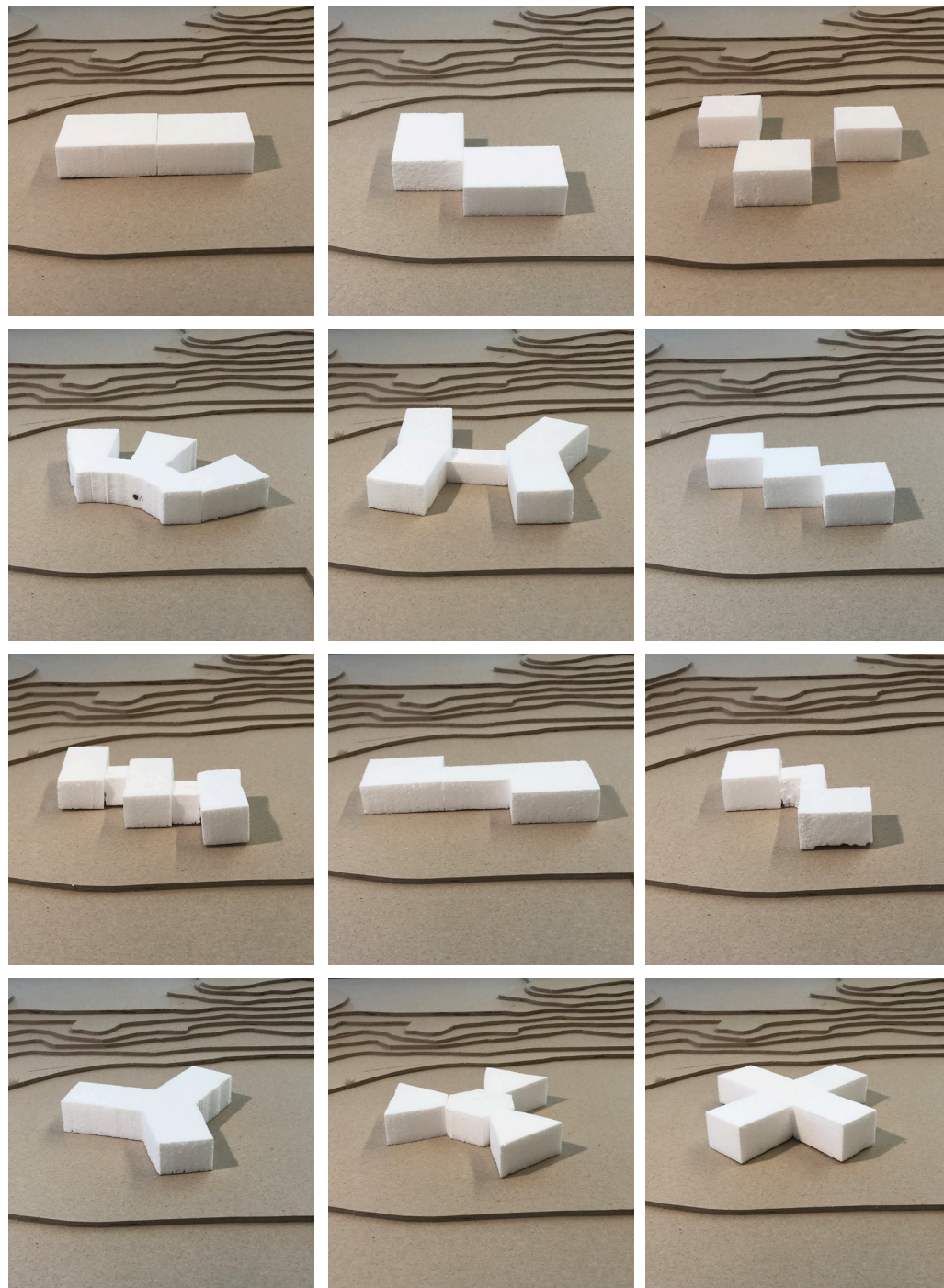
*(Tufvesson, 2007; Tufvesson & Tufvesson, 2009;
Specialpedagogiska skolmyndigheten, 2018)*

4.3. DEFINED SPACES

A learning environment that provides a various range of spaces for different types of activities increases the possibility to find a suitable environment for the needs of the students which enhances the possibility to participate in the learning (Tufvesson & Tufvesson, 2009; Specialpedagogiska skolmyndigheten, 2018). A various range of spaces also facilitate for teachers to divide students into suitable constellations for a specific activity (de Laval, 2017). Spaces designed for a specific purpose are also considered easier to handle for children with neurodevelopmental disorders and concentration difficulties (Tufvesson, 2007). Understanding how a space is supposed to be used can provide a sense of safety (Specialpedagogiska skolmyndigheten, 2018).

Small rooms, for example group rooms, are considered easier to handle for children with neurodevelopmental disorders, as well as one-on-one teaching (Tufvesson, 2007). All children need to be able to participate in the social context of the learning environment and even if a secluded room is easier to handle, the aspects of participation and inclusion must be taken into consideration.

It is important for students with neurodevelopmental disorders and concentration difficulties to feel safe in their environment (Tufvesson & Tufvesson, 2009). A learning environment can contain different numbers of environmental factors that can be difficult to handle for the user group. The more factors an environment contain, the harder the environment is to handle. By providing a safe space in the environment, for example a retreat or a personalized placement in the learning environment, the toleration for the environmental factors will increase.



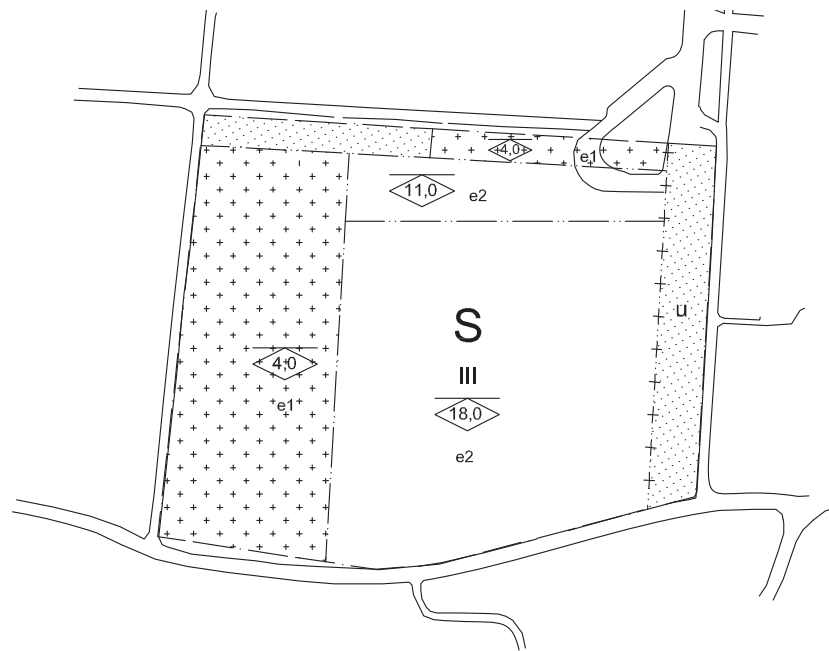
A selection of sketch models from a model workshop to understand the preconditions of the site and the specific needs of the user group.

5. DESIGN PROCESS

A school building is a complex typology with many aspects to take into consideration during the design process. Site conditions, program, flows, user groups, sustainability, accessibility and esthetics are just a few.

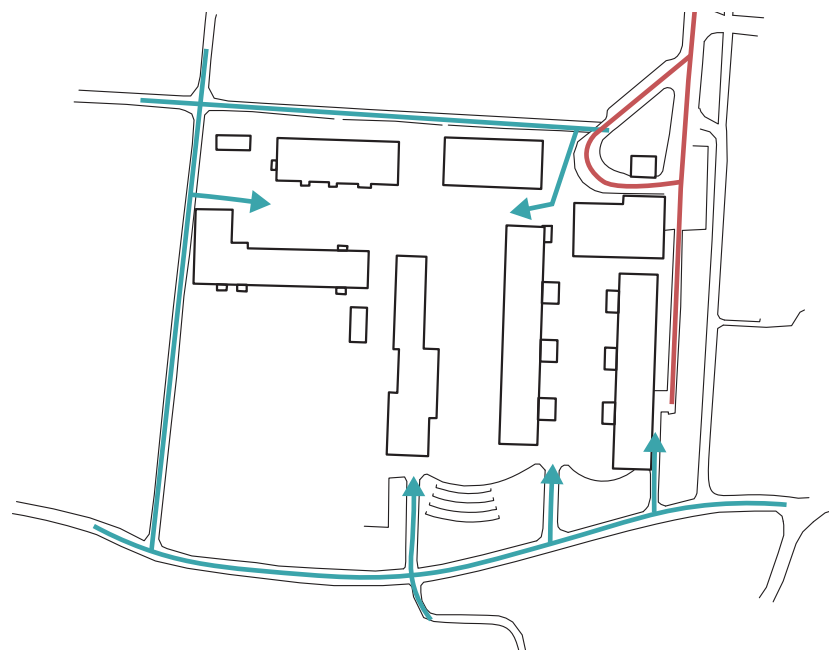
Different shapes and volumes have been tested and evaluated during the process, with two main perspectives in mind. The first perspective is the specific site conditions on the site in Torslanda and the second perspective is the specific needs of the user group.

The specific site conditions and how they relate to the needs of the user group, both inside and outside of the school building must be understood and taken into consideration to make the design accessible.



*S = school building
u = not buildable*

Detailed development plan II-3301as proposed from the municipality of Gothenburg (Göteborgs stad, 2019). (Graphics altered by author.)



*Road (cars)
Pedestrian road*

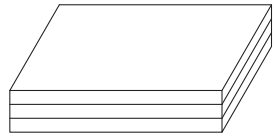
Roads and pedestrian roads to the site.

5.1. SITE ANALYSIS

The proposal is based on the detailed development plan II-3301, which states the possibility to build a three-floor school building, with a maximum building height of 18 meters.

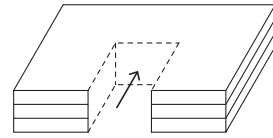
The site has one primary road to the site. It is located on the east side of the site and will determine the placements of delivery and parking on the site. The west part of the site has less buildable area according to the detailed development plan and will therefore be used for the schoolyard. A smaller area in the northwest corner of the site is not buildable due to an existing tree avenue.

The site has three primary entrances; one by car and two pedestrian roads leading into the site. Since the neighborhood is mainly traffic separated, the proposal will not propose a hierarchy between the entrances and the school building will be easy to access from all directions.



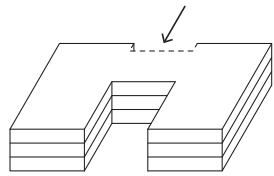
1.

Three floors according to the detailed development plan. This gives a spacious schoolyard for the many children attending the school.



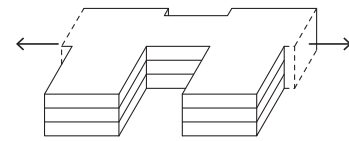
2.

A cut in the volume creates more facade area and allows for a division between shared learning environments and units, where passages through the units are avoided.



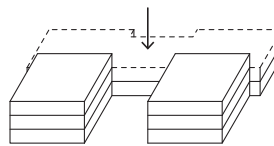
3.

A second cut marks out the main entrance to facilitate the wayfinding.



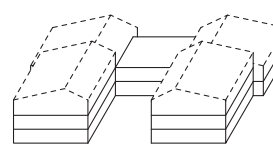
4.

The volume is pulled out to make a distinction between the different learning environments, making the volume more readable from the outside.



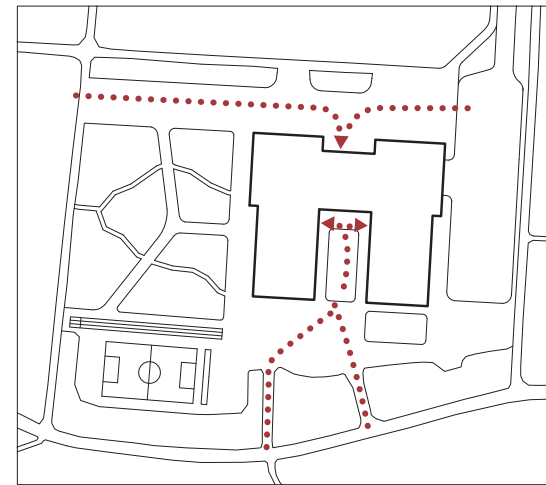
5.

The volume height is adapted to the surrounding landscape and nearby buildings.



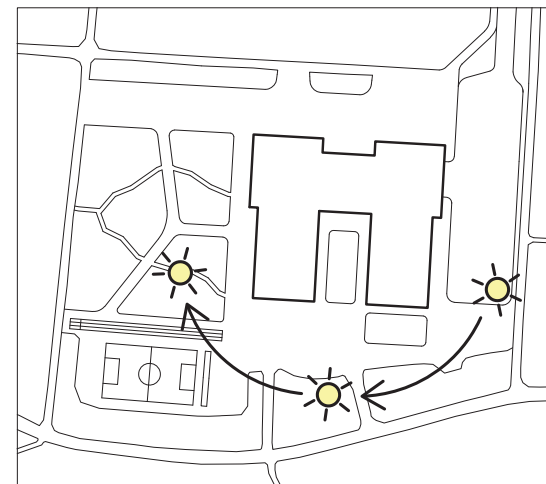
6.

Pitched roofs add height to the volume, reducing the horizontal expression the large program gives the volume.



5.1.1. FLOWS AND ENTRANCES

The volume is oriented according to the flows on the site to provide easy access and wayfinding for the students. The multiple entrances decrease the crowding of students and provide an alternative where the students can access the units directly or engage in the many social encounters of the main entrance.



5.1.2. DAYLIGHT AND ORIENTATION

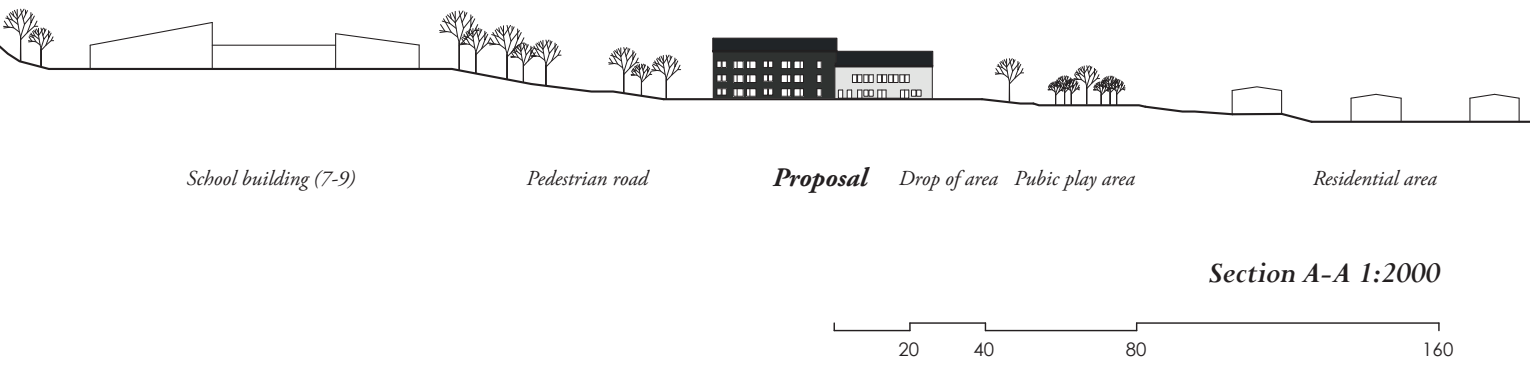
Direct sunlight, with heat and glare, can be problematic for students with neurodevelopmental disorders and concentration difficulties. Without compromising with daylight, the volume is orientated with its main learning environments in an east-west direction.



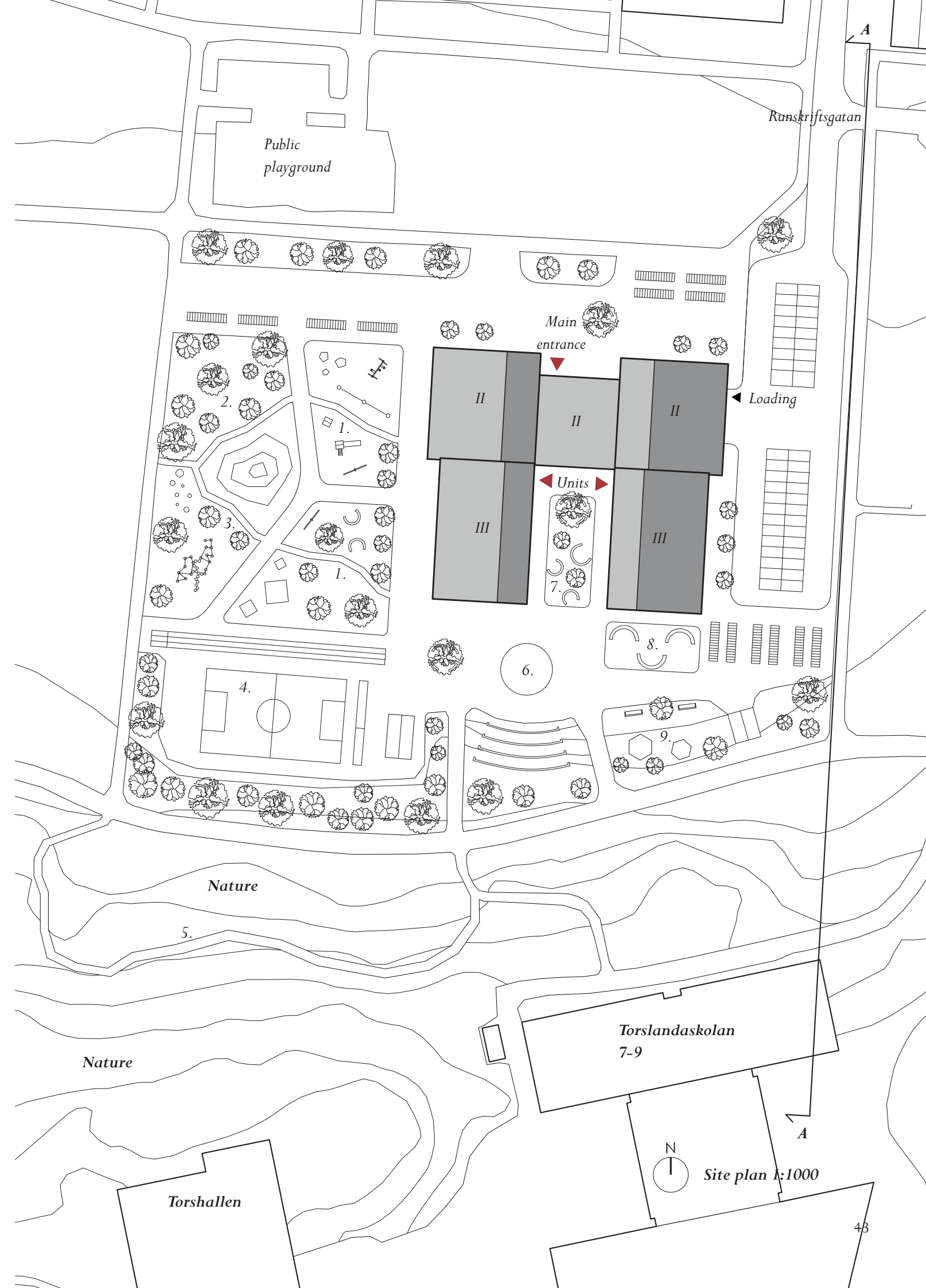
5.1.3. NOISE AND SCHOOLYARD

To limit views and noise from the schoolyard the most active parts of the outdoor environment are placed in the southwest corner of the site. The placement of the volume also limits the noise from a nearby playground.

The shape of the volume allows the most concentration sensitive learning environments to be placed towards a smaller, calmer part of the schoolyard.



1. Area with playground equipments
2. Area for playing in nature
3. Area for motoric play
4. Active area for movement and sport
5. Path in the nature
6. Outdoor stage with gallery seating
7. Calm area with trees and benches
8. Outdoor learning environment for gardening
9. Outdoor learning environment for workshops and creativity

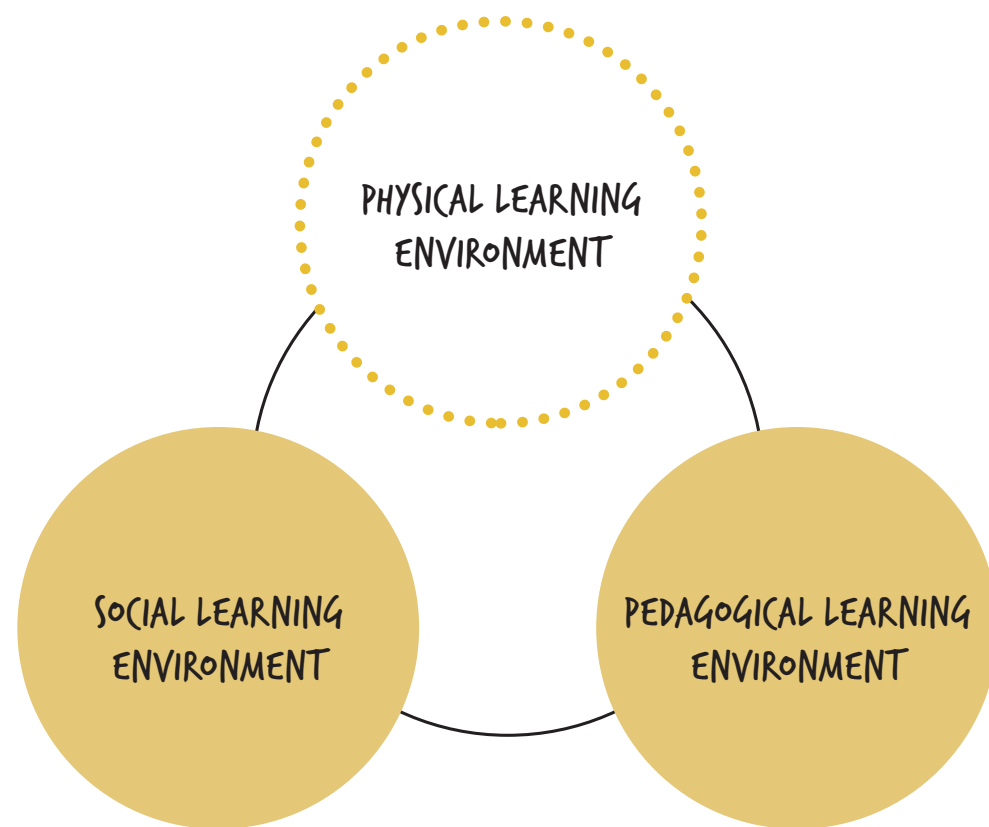


“ Det allra viktigaste är att tänka:
vad är skolans uppdrag?
Och det är inhämtning av kunskap.
Inhämtning av kunskap och
att skapa demokratiska
individer inför framtiden. ”

*Madeleine Nordenknekt
(Architect at Liljewall Architects, 2020).*

6. LEARNING

Learning is often associated with school buildings and educational systems, but is rather something present regardless of the situation or the intent (Säljö, 2015). A distinction can be made between informal learning, which happens automatically while engaging in other primary activities, and formal learning, where a specific knowledge that is to be learned is well defined (Björklid, 2005). Even though the primary function of a school is to provide children with specific knowledge defined by a curriculum, both formal and informal learning takes place within a school building.



A learning environment consists of three types of environments; a pedagogical, a social and a physical environment.

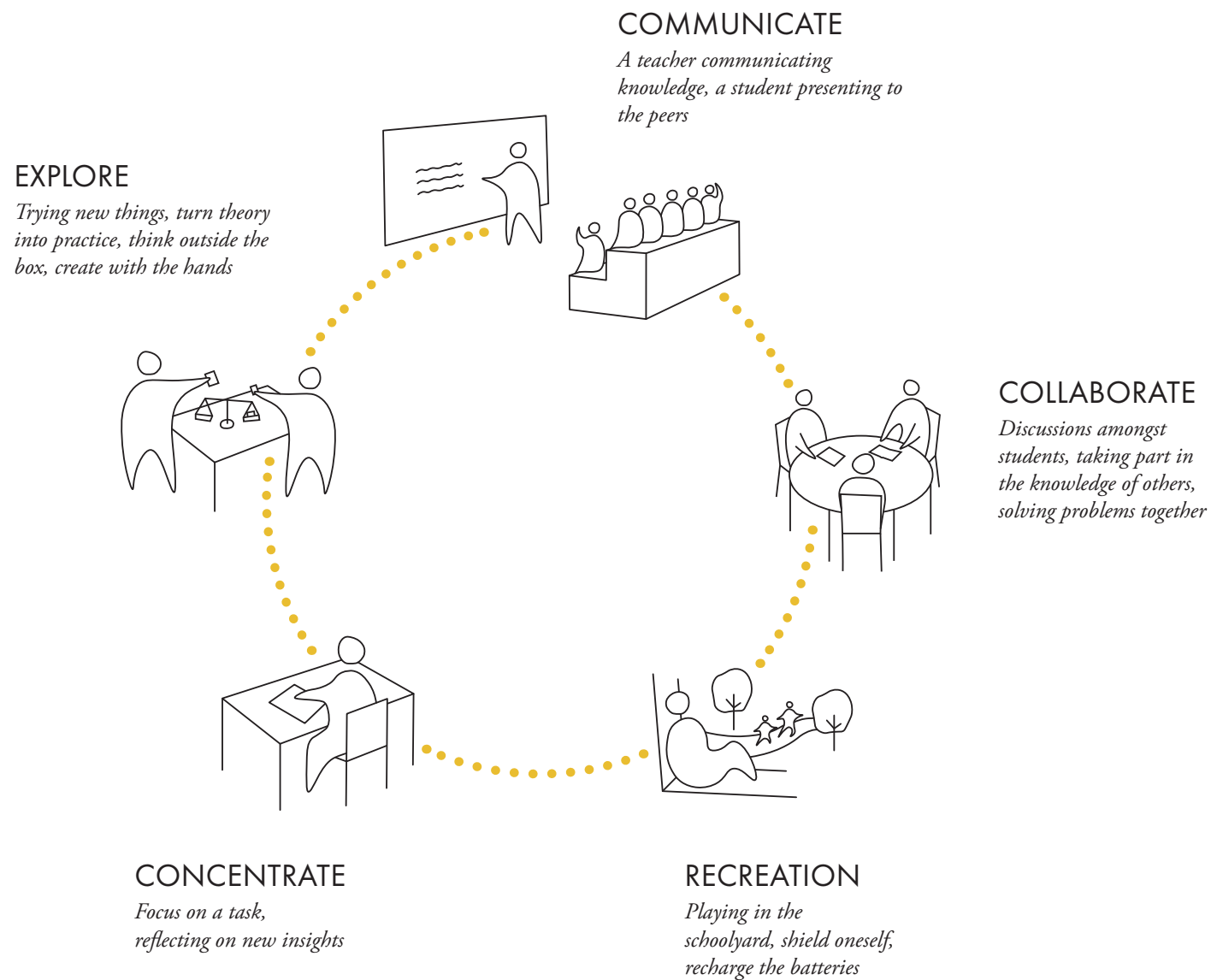
6.1. LEARNING ENVIRONMENTS

A learning environment consists of three types of environments; a pedagogical, a social and a physical environment (Malmgren & Valsö, 2019). Depending on how the physical learning environment is organized, it can either support or hinder the social and pedagogical activity that takes place within the environment (Malmgren & Valsö, 2019; Lippman, 2010). According to the study Clever Classrooms, 16 % of the learning results in schools can be described by factors in the physical environment (Barrett, Zhang, Davies & Barrett, 2015).

Since education is primarily organized around formal learning, the curriculum sets the framework for the pedagogical environment and in extension also the physical environment (Björklid, 2005). By understanding how the curriculum defines what must be learned and how, the spatial qualities in the physical environment can be adapted to better suit the learning.

6.1.1. ACCESSIBLE LEARNING ENVIRONMENTS

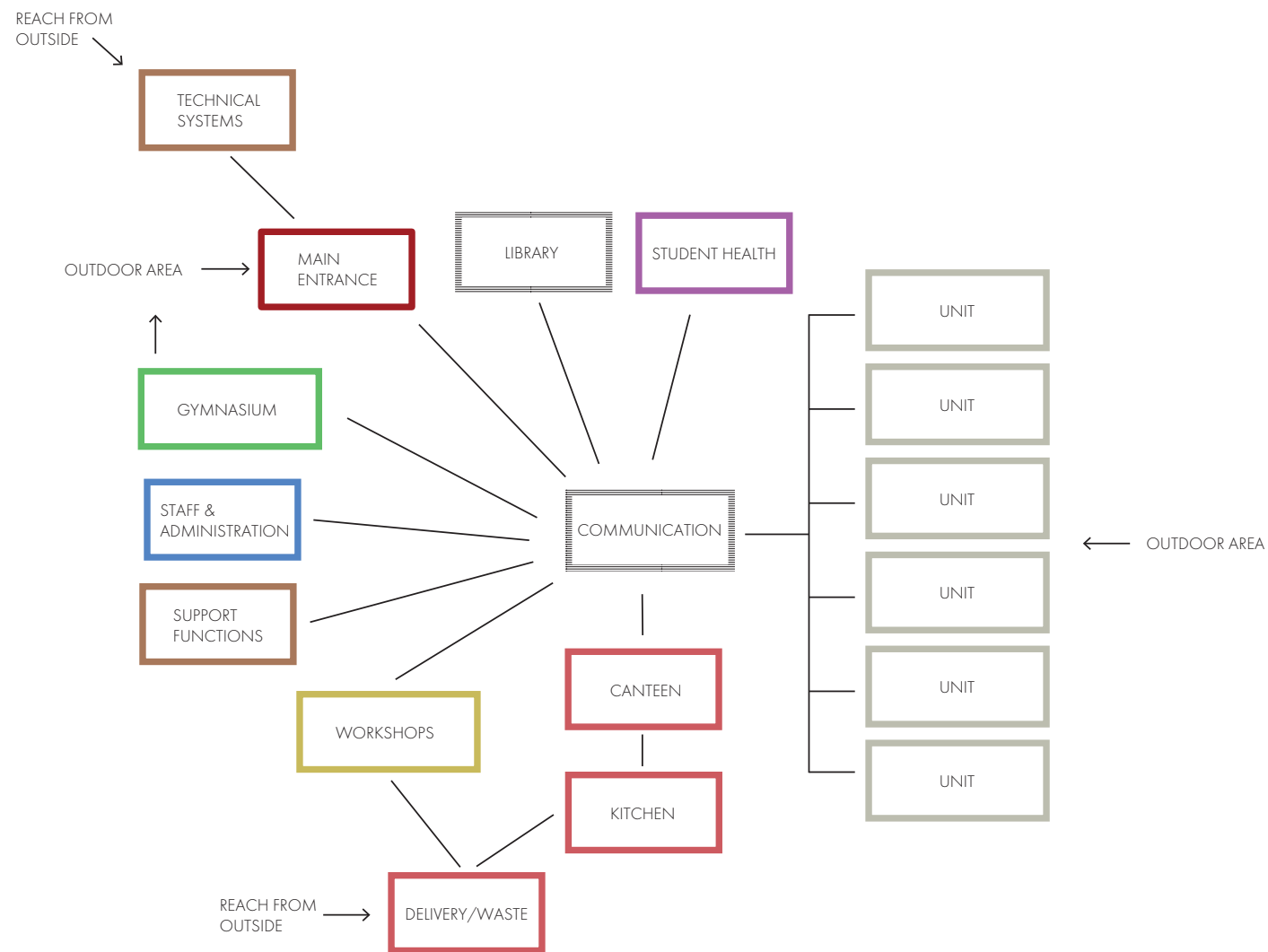
Not only does the physical environment affect the learning outcome, but it also communicates to the users through its design. Environments that lack in accessibility communicate to students with disabilities that they are not welcome to take part in the activities (Björklid, 2005). Accessible environments, conversely communicate the importance of education for all students, despite their difficulties.



Categorization of activities that can take place during a school day.

7. PROGRAM AND FLOWS

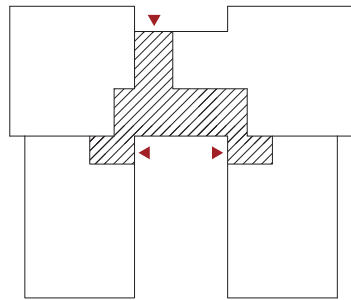
Several types of activities take place during the school day. Some activities demand calm environments for rest and concentration. Some demand spacious environments for movement and play. Some spaces allow for lively discussions and some invite to create. A school building has many usages and must be able to provide spaces suitable for all types of activities and user needs.



A diagrammatic scheme over the spatial configurations of the building to understand the relation between the different parts of the program.

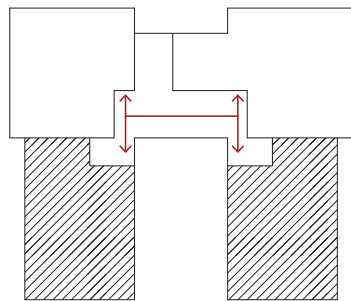
7.1. SPATIAL CONFIGURATIONS

The primary learning environments will be clustered into six units for the years F-3 and 4-6. This solution creates smaller units within the large school building, providing a safe and familiar environment for learning. The units will have separate entrances to facilitate for the children who experience difficulties with crowding and many social encounters. All shared learning environments will be centrally placed in the building and reached from a central communication to avoid disturbing and noisy passages through any of the learning environments.



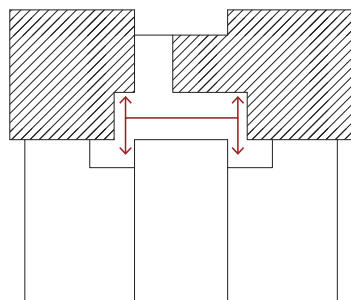
7.1.1. ENTRANCES AND COMMUNICATION

Multiple entrances divide the flows of people in the building, decreasing the crowding and facilitating for students with neurodevelopmental disorders and concentration difficulties.



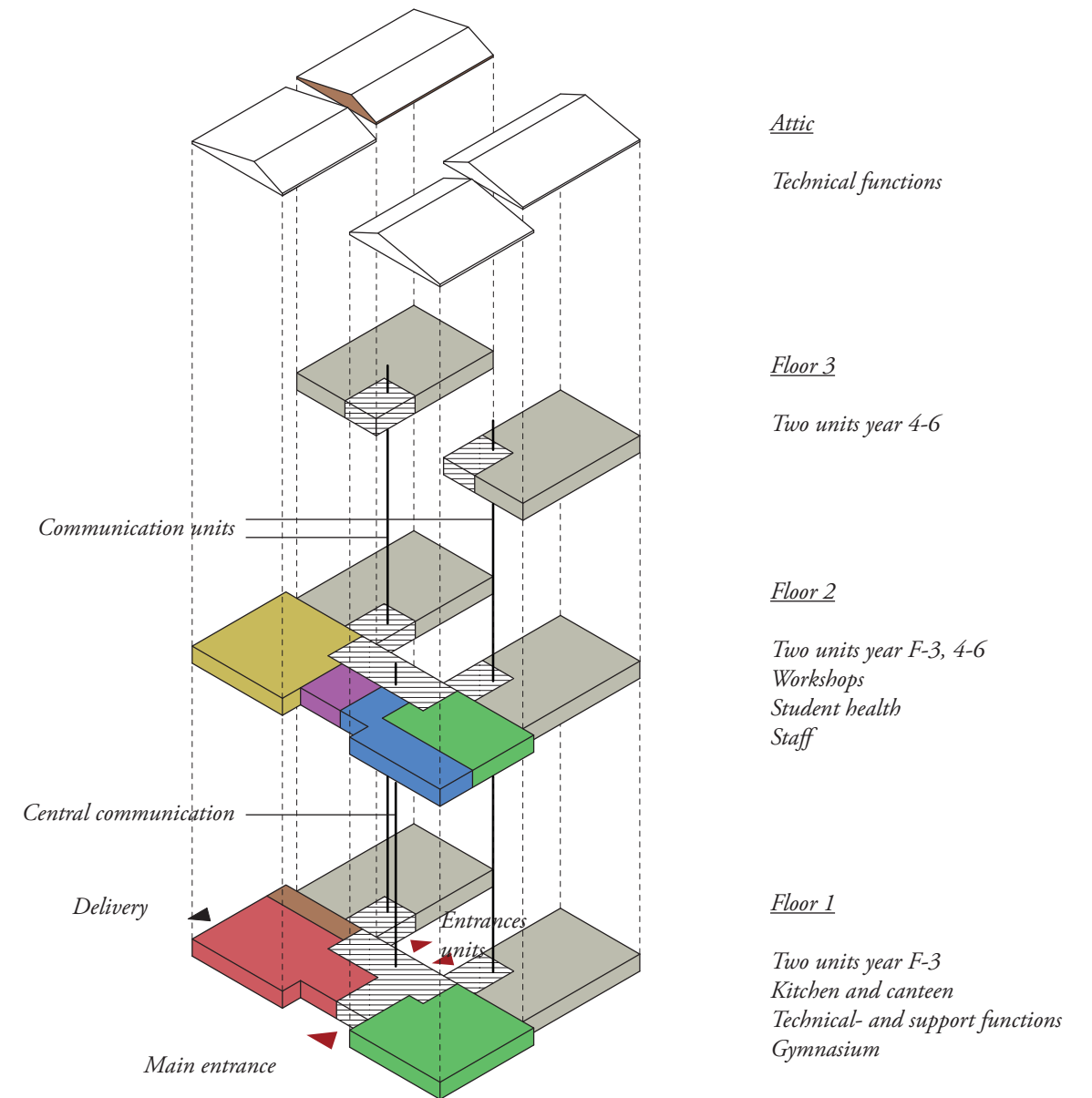
7.1.2. UNITS

The learning environments are clustered as units and placed to avoid passages thorough the learning environments to decrease the noise and social density in spaces for learning.



7.1.3.SHARED LEARNING ENVIRONMENTS

The shared learning environments have a central placement in the building to minimize the distances between environments for learning.



Technical- and support functions	436 sqm	Units	3450 sqm
Kitchen and canteen	505 sqm	Workshops	563 sqm
Entrances, communication, library	916 sqm	Student health	84,5 sqm
Gymnasium	550 sqm	Staff	304 sqm



8. DESIGN PROPOSAL

“How can architecture be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties?”

Theory regarding environmental factors influence on students with neurodevelopmental disorders and concentration difficulties can provide general guidance on how to create accessible learning environments. Although it is the interpretation and application into a spatial organization that will determine the accessibility of space.

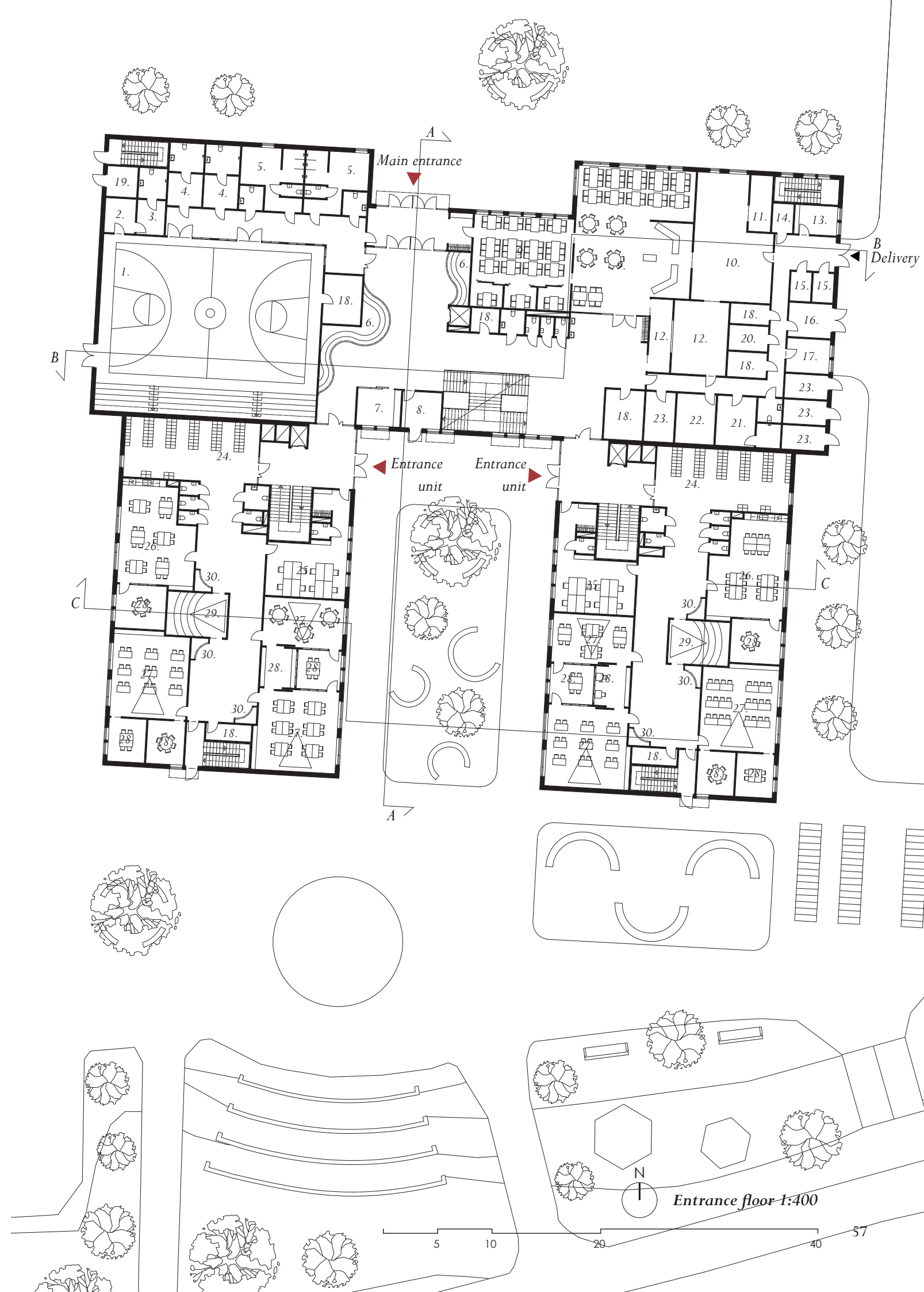
How can *limitation of sensory input* be translated into a spatial experience and how can *easy wayfinding* apply to a spatial organization?

Designing for accessibility can have various architectural solutions and even though there are general theoretical principles to guide, all humans have their characteristics and difficulties that will affect their experience of an environment. To fulfill the thesis initial statement of creating accessible learning environments, a translation of theory into spatiality must be made to add a layer of accessibility to the architecture of school buildings.



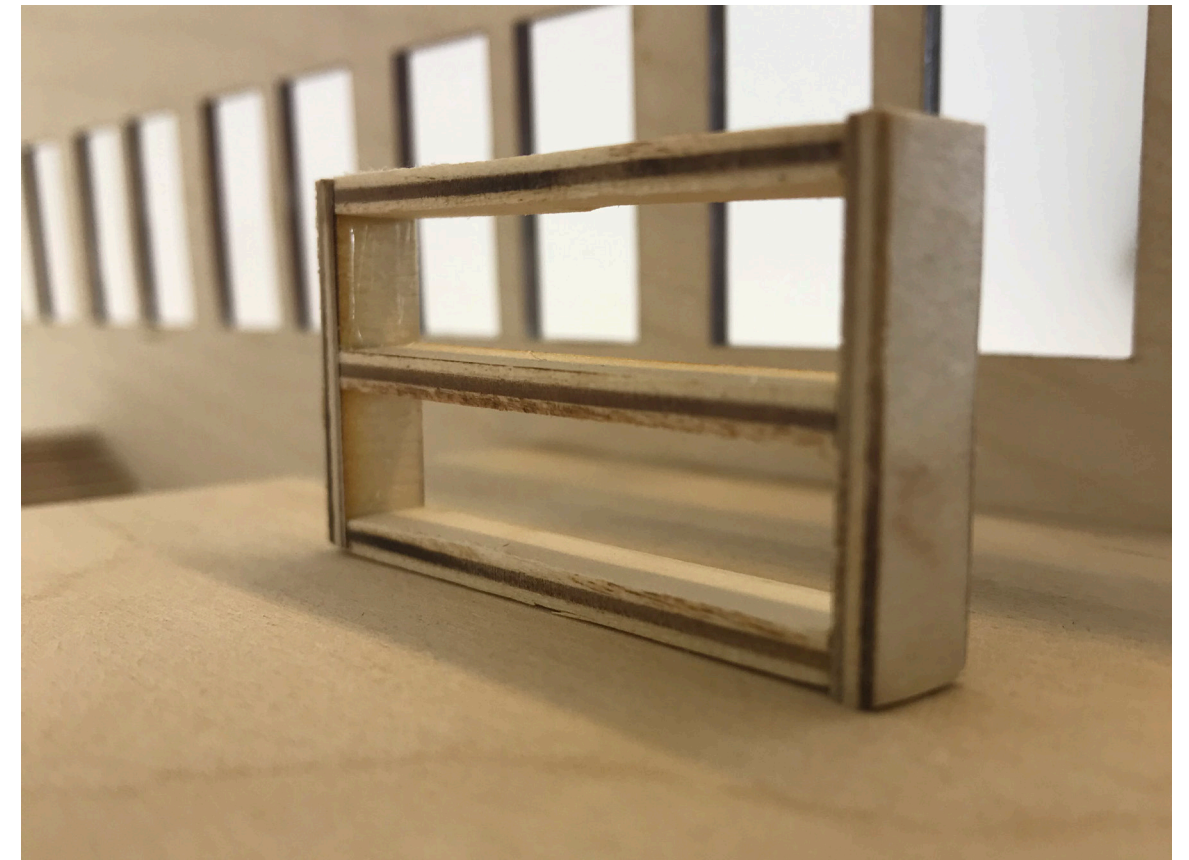
Places for retreat in the large main entrance. The curved walls reduce acoustics, providing less noise in a large environment with a high flow of people.

- | | | | |
|-----------------------------|------------------------|---------------------------|------------------|
| 1. Gymnasium | 9. Canteen | 18. Storage | 24. Cloakroom |
| 2. Gymnasium expedition | 10. Kitchen | 19. Storage outdoor | 25. Office staff |
| 3. Changing room staff | 11. Preparation | 20. Cleaning kitchen | 26. Atelier |
| 4. Changing room individual | 12. Dish | 21. Changing room kitchen | 27. Classroom |
| 5. Changing room | 13. Expedition kitchen | 22. Cleaning | 28. Group room |
| 6. Gallery seating/retreat | 14. Freezer | 23. Technical | 29. Theatre |
| 7. Expedition | 15. Fridge | | 30. Retreat |
| 8. Janitor | 16. Waste | | |
| | 17. Pantry | | |





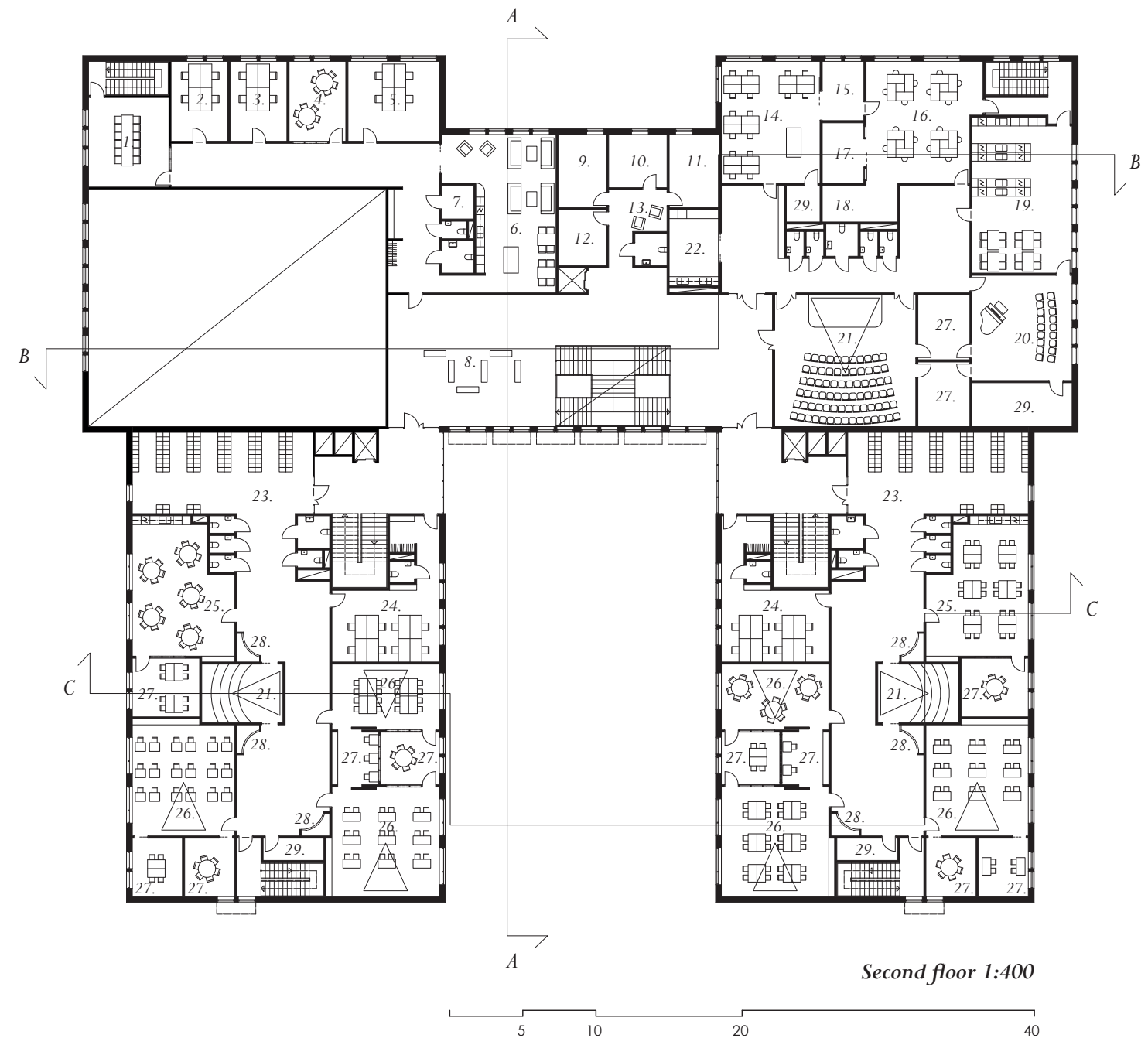
The canteen can be a difficult environment for students with neurodevelopmental disorders and concentration difficulties. Divisible rooms provide smaller spaces and sliding wall sections allow students to choose the level of seclusion.



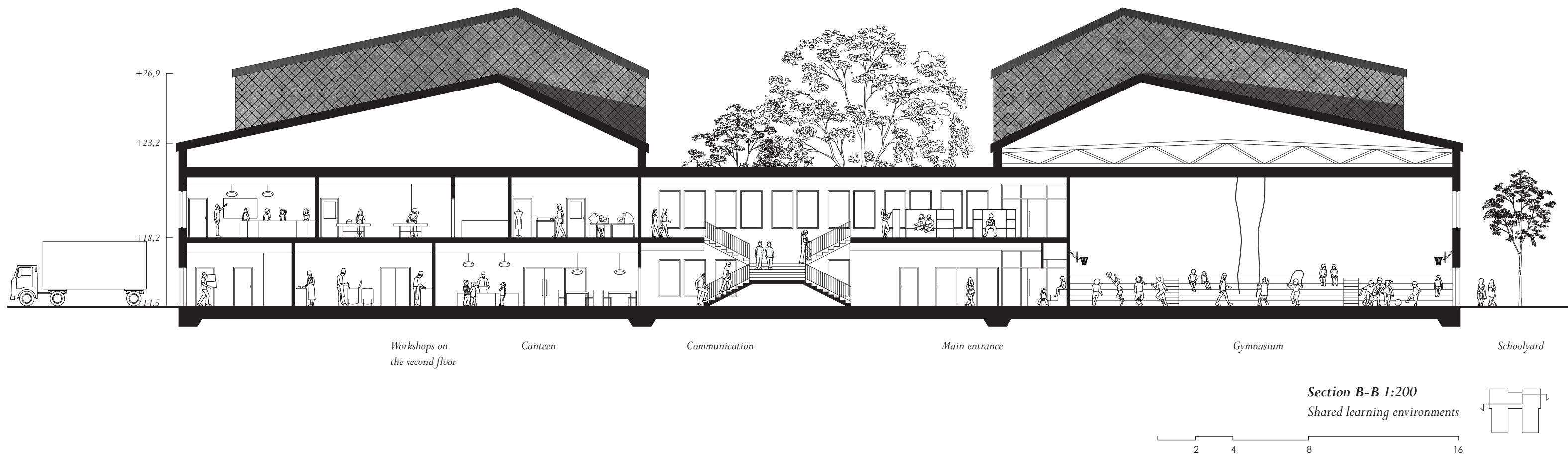
In the library on the second floor, the students can shelter themselves in the niches in the bookshelves.



The large staircase between the first and second floor offers multiple directions, enhancing the wayfinding by leading the students to the different learning environments. The multiple directions also offers a second path in case of crowding.



- | | | | |
|-----------------------------|-------------------------|--|------------------|
| 1. Conference room | 8. Library | 14. Handicraft textile | 23. Cloakroom |
| 2. Office principal | 9. School counselor | 15. Ironing room | 24. Office staff |
| 3. Office administration | 10. School psychologist | 16. Handicraft carpentry | 25. Atelier |
| 4. Meeting room | 11. School nurse | 17. Machine area | 26. Classroom |
| 5. Office special education | 12. Rest | 18. Storage material | 27. Group room |
| 6. Staffroom | 13. Waiting room | 19. Home economics | 28. Retreat |
| 7. Copy and post | | 20. Music | 29. Storage |
| | | 21. Theatre | |
| | | 22. Wet room (surface treatments, washing etc) | |



WORKSHOPS

The workshops are clustered on the second floor, in close connection to the main communication, to enhance the wayfinding and eliminate the passages through learning environments. The rooms can be used interdisciplinary, for both theoretical and practical subjects.

CANTEEN

The canteen can be a difficult environment for students with neurodevelopmental disorders and concentration difficulties. Divisible rooms provide smaller spaces and sliding wall sections allow students to choose the level of seclusion.

COMMUNICATION

A large staircase in the heart of the building leads the students between the learning environments. In the case of crowding alternate communications are possible to access in the units.

MAIN ENTRANCE

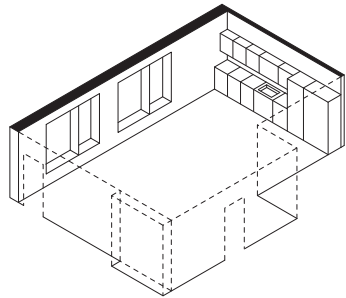
From the main entrance it is easy for students and visitors to orient themselves to the different parts of the school. The entrance holds places for retreat, where curved walls reduce acoustics, providing less noise in a large environment with a high flow of people.

GYMNASIUM

The gymnasium is placed on the first floor, in direct connection to the main entrance, allowing usage outside the regular school hours. Individual changing rooms can facilitate for students with neurodevelopmental disorders and concentration difficulties.

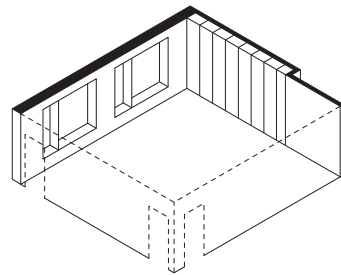
SCHOOLYARD

The schoolyard offers a range of spaces, from calmer, secluded environments to outdoor learning environments and active areas for movement and sport. On the schoolyard students can recharge by running, climbing, creating and playing in nature.



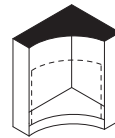
THE ATELIER

The atelier invites students to explore and create. It is a space where students can try their ideas and apply theoretical reasoning in practice.



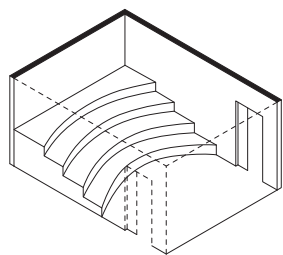
THE CLASSROOM

The classroom offers a large space for various activities where the students can learn together.



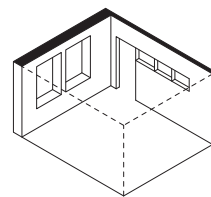
THE CORNER

The corner offers retreat when the environment becomes overwhelming and the energy levels are low.



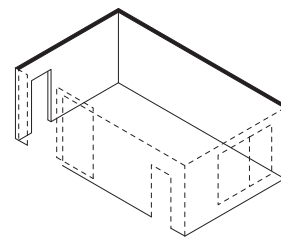
THE THEATRE

The theatre invites students to listen to presentations or share their knowledge with others.



THE GROUP ROOM

The group room invites students to engage in concentrated work where new insights can be made.



THE DEBATE ROOM

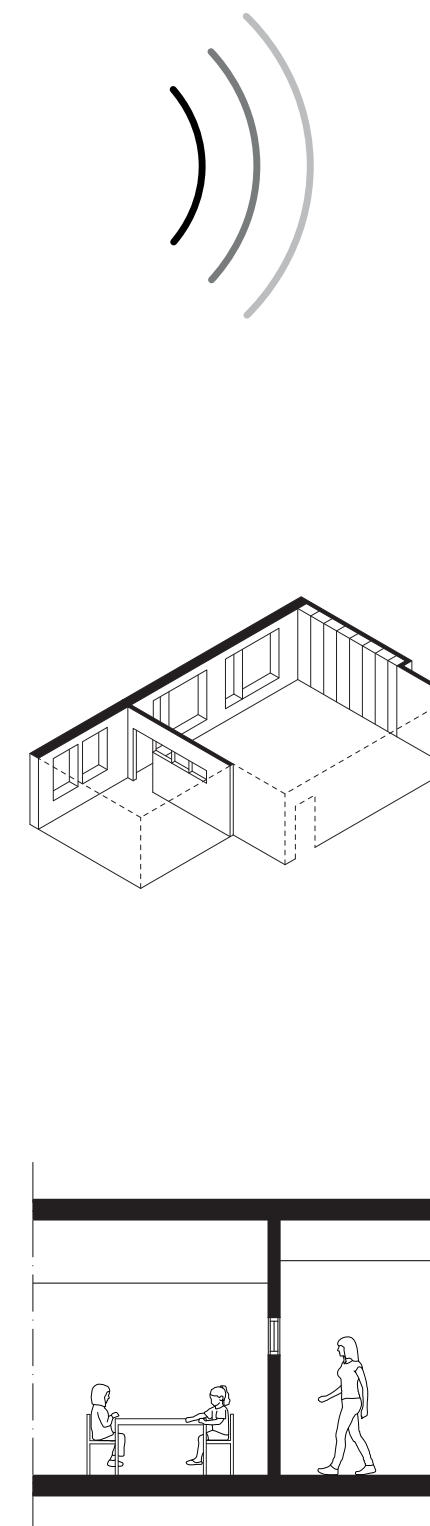
The debate room is a smaller space that invites students to collaborate. It is a space where students can work together, sharing their knowledge and engage in discussions.

8.1. THE UNITS

The learning environment is divided into six units; three for the years F-3 and three for the years 4-6 with approximately 90 students each. The units provide small scale learning environments to facilitate for the difficulties children with neurodevelopmental disorders and concentration difficulties experience in large scale environments with high levels of social encounters. The units provide belonging in the environment and the limited space for each child enhances the wayfinding in the large structure.

To provide good learning conditions for all students, the units provide a range of rooms for different activities and group sizes. To minimize the crowding the units can be reached either from a separate entrance or from the shared learning environments. Bright colors mark the entrance doors to every unit and the possibility to close of all units provides a quiet environment for learning.

To limit the sensory input in the environment, windows between rooms are only used between group rooms and classrooms. To minimize the views between the rooms, the windows are placed on a high level. There are no passages through the learning environments and the arrangements of rooms are made from a gradient of noise, where the quietest rooms are placed further away from the communication area.



8.1.1. GRADIENT

The rooms in the learning environment are organized by a gradient, with the noisiest environments by the communication areas.

8.1.2. GROUP ROOMS

Group rooms are placed in direct connection to all classrooms to provide smaller rooms for concentration without excluding students with neurodevelopmental disorders and concentration difficulties.

8.1.3. PLACEMENTS OF WINDOWS

In order to minimize the visual sensory input windows between classrooms and group rooms are placed higher up in the walls. This keeps the connection between the learning environments and allows teachers to have an overview, without disrupting the concentration of the students.



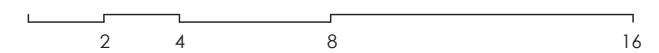
The group rooms provide smaller spaces for learning which are easier to handle for students with neurodevelopmental disorders and concentration difficulties. By placing the group rooms in direct connection to the classrooms, no child will be excluded from the social learning environment. Windows placed high up in the wall will enhance the connection to the classroom, without disrupting the student.

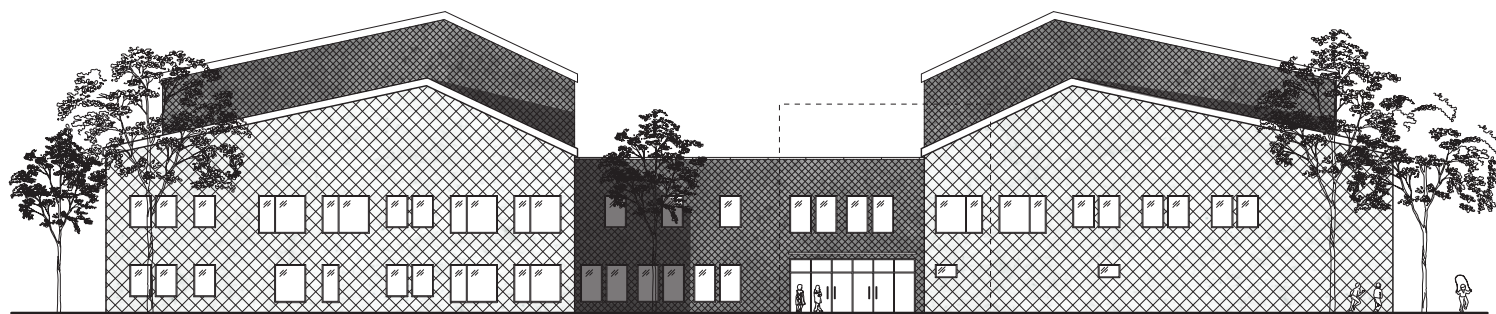


The corner offers a place for retreat in the units. By being able to retreat, students with neurodevelopmental disorders and concentration difficulties will have a higher toleration for other disturbing environmental factors in the learning environment.

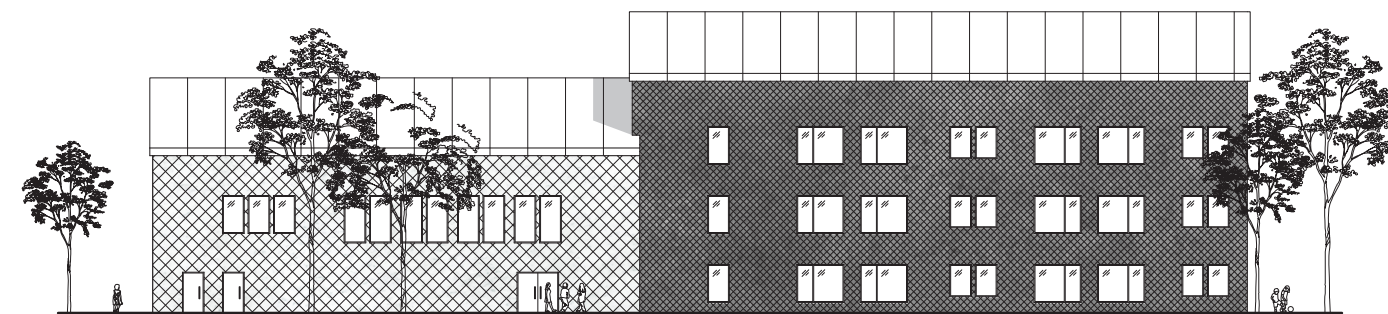


Section C-C 1:200
Units

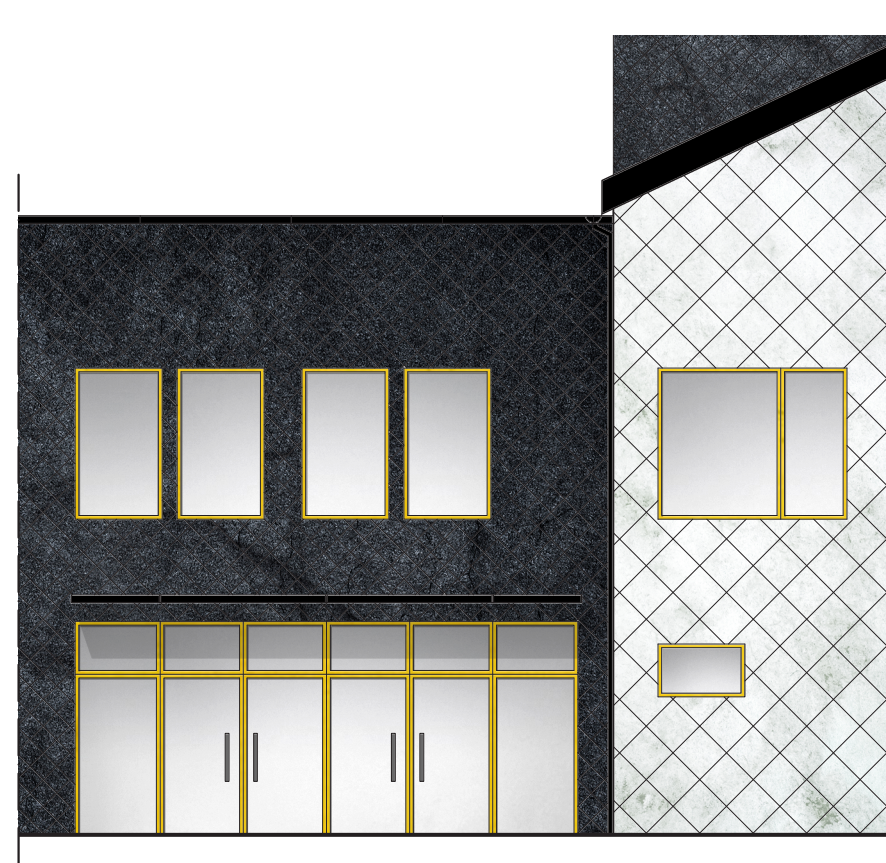
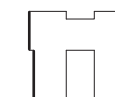




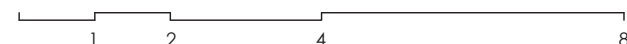
Entrance facade 1:400



Facade west 1:400

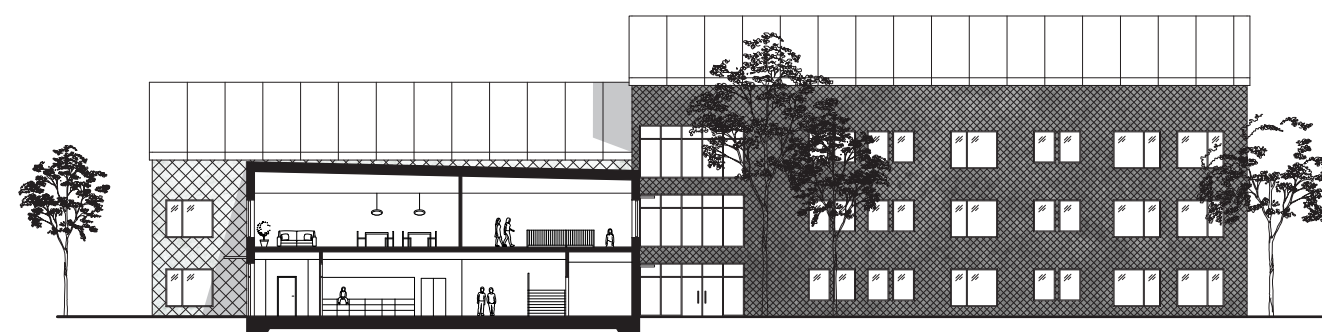


Facade detail 1:100

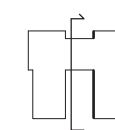
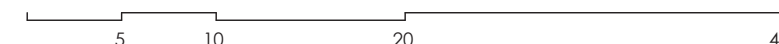


FACADE MATERIALS

A slate cladding in two contrasting colors, a black stone on the parts containing entrances and a lighter grey color on the shared learning environments, will be used to enhance the wayfinding. The pattern will be rotated at a 45° angle and two different sizes of stones will be used (500x500 and 250x250 mm). Frames of windows and entrances in a bright yellow color will mark out the entrances and adapt to the colors of the surrounding buildings.



Section D-D 1:400





9. DISCUSSION

Providing accessible learning environments must be considered important due to the disadvantages a lack of education can entail. Despite this many children struggle to participate in their education due to a lack of accessibility in their learning environment and one group particularly affected is children with neurodevelopmental disorders and concentration difficulties.

The thesis aimed to raise the question of accessibility by investigating how factors in the physical learning environment affect students with neurodevelopmental disorders and concentration difficulties. By a compile of theory and previous research three main categories of environmental factors affecting the specific group have been highlighted as significant for the level of accessibility in a learning environment; perception, flows and defined spaces.

To answer the thesis question “How can architecture be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties” the understanding of the environmental factors must be translated into a spatial organization. The thesis results in a proposal for an elementary school in Torslanda, where the design choices have been made based upon an understanding and interpretation of

the environmental factors. The proposal offers one answer to the question of how architecture can be used to create accessible learning environments for children with neurodevelopmental disorders and concentration difficulties, where the proposal gives an example of how the factors can be interpreted into architectural design.

During my investigation it has become clear to me that a general definition of the term accessibility is lacking and an architectural discussion regarding accessibility almost always entail only elevators and color contrasts. The thesis has contributed to broaden the perspective of accessibility by highlighting a specific group whose disabilities can hinder participation in the physical environment. The thesis has also addressed the question of accessibility and provided design solutions of how the environmental factors can be interpreted into a spatial organization.

Designing for accessibility can have various architectural solutions and even if the environmental factors can provide a general guide to which factors are of importance, the field lacks research on the actual design applications. How can the environmental factors be translated into a spatial organization and architectural design? And how do the spatial interpretations of the factors affect the accessibility for the user group? The field also lacks a general guide to what a specific factor could mean in numbers. What does for example crowding mean in the number of people? How many square meters is a large enough space? And so on. Without general definitions of terms it is difficult to reach a common understanding of which spatial qualities a physical learning environment should entail to be considered accessible.

The limitation of the thesis excluded the outdoor environment, as well as the social and pedagogical learning environments. To provide accessible learning environments it is however of great importance to have a holistic view and understand how the different types of environments affect each other. Accessibility in a physical environment does not necessarily mean that an environment is accessible as a whole. The relationships created between students and teachers, the peers, and what requirements the academic situation in a school entails are also factors that can affect the accessibility and are equally important to create accessible learning environments for all children.

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FOCUSED IN SCHOOL

“An accessible school building for students with neurodevelopmental disorders and concentration difficulties.”

Susanna Arsaëlsson

Chalmers University of Technology
Gothenburg, Sweden 2020