Sustainable Children's Library in Chwaliszewo

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MA4-ARK21, 2020
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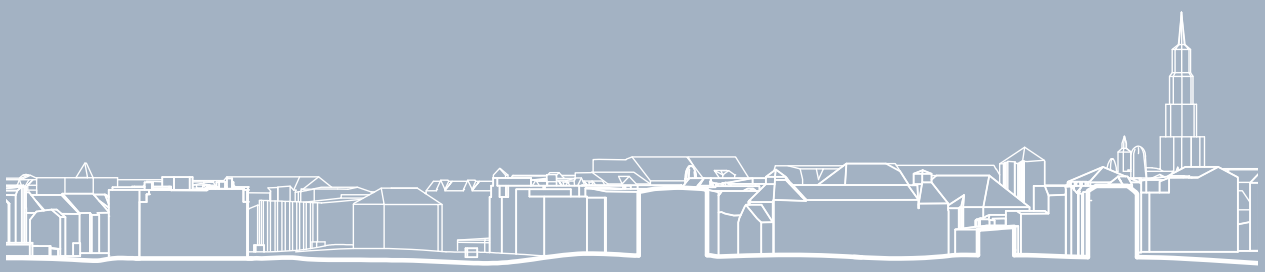

Title:	Sustainable Children's Library
Theme:	Sustainability
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Semester and group no.:	MA4-ARK21 03/02/2020 - 28/05/2020
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Number of pages:	151

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ABSTRACT

The Master's Thesis brings the social and environmental sustainability as a design focus through the proposal of the children's library in Chwaliszewo, district of Poznan, in Poland. The library, as a cultural building, has a great potential of carrying a societal mission of strengthening local communities and, through its wise and user-oriented design, can increase the number of visitors and encourage children to learn.

The project vision is based on conducted research and analyses of the site and users. The thesis demonstrates the concept development through the integrated design process, based on the relevant design-parameters, such as urban context, functions, indoor environment and energy performance, resulting with the design development and optimization.

The thesis completes with the proposal of sustainable library design, oriented on children as the main user group, where building form is highly determined by the site and climate conditions and the spaces are planned to respond to various children's needs, as well as to create an attractive and social spot for the neighborhood.

READING GUIDE

The report begins with a brief introduction and problem formulation, describing the motivation and challenges of the topic. The *Framework* section establishes the theoretical background and case studies, which will have an impact on the design. The *Site* and *User and function* parts contain the series of analyses of the location, in regards to urban context and climate, as well as analysis on building usage by the target users and functional requirements. The *Program* part is following by the research and analysis, and presents the building functional program and design parameters. The *Design process* section reveals the steps undertaken, which led into the final building design. The *Presentation* part is the demonstration of the architectural drawings and visualisations, supported by short descriptions. The *Conclusion* is presenting the summary and reflections. The report refers to attached *Appendix*.

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Ill. 1: Warta River, Poznań, Poland

Introduction

The aim of the project is to develop a sustainable library for children, situated in Chwaliszewo, district of Poznan, Poland. The place will function as a cultural place, gathering families and helping to create and strengthen local communities. The design decisions will be based on analyses of the site and research regarding the functional needs and sustainable design with a great focus on social and environmental aspects of sustainability.

PROBLEM STATEMENT

One fifth of the whole population of European Union visit libraries. As a place where the services are accessible and affordable by anyone, these buildings become the most frequently attended cultural buildings in many places (Lison and Reip, 2016). At the same time, the number of libraries and readers in Poland decreases (Jezierska and Budzyńska, 2018). Nowadays, libraries face challenges of rising users' expectations regarding the digitalised resources. The thesis will investigate how to design a library responsive to families' needs and how to achieve the supporting learning and social interactions through the building design. The thesis will demonstrate the way libraries can be a public community spaces, where children will spend their time after school for a joy of learning, not due to the learning obligation. Also, the project will be an attempt to establish a cultural and social hub for local society, popularizing knowledge and culture in a sustainable way.

Methodology

INTEGRATED DESIGN PROCESS

The whole project development is conducted by using the 'integrated design process', which is an interdisciplinary method established from the problem-based learning concept and which consists of five essential phases:

1. *Problem formulation* - setting main research question, which highly influences project idea and vision;
2. *Analysis* - an investigation and data collection which helps to find the potentials and challenges of the site as well as the needs of target users, in order to define design criteria and strategies;
3. *Sketching* - the most creative phase, where based on conclusions from analyses, different ideas come into play, in order to find design solutions and evaluate them in regard to functions, structure, climate and energy, by using multiple tools, like hand-drawing, model making and 3D software;
4. *Synthesis* - when the concept and main design decisions are taken, the synthesis helps to develop the project in detail to find its final architectural expression;
5. *Presentation* - the demonstration of the whole design process and explanation of decisions, in a form of developed architectural drawings, diagrams and physical models.

During the process, different design parameters are investigated simultaneously and the work through the phases gets a form of repetitious loops. The method allows to go back into previous steps of the design, in order to investigate aspects more and with better understanding of the design direction. It also helps to integrate architectural expression, function, structure and energy design aspects together, already in the early design process (Knudstrup, 2004).

SERIAL VISION AND GENIUS LOCI

The combination of the two analyses - the *serial vision* developed by Gordon Cullen (1961) and *genius loci* defined by Christian Norberg-Schulz (1979), helps to get a sense of the site visually and spiritually, to get the feeling of the scale and the atmosphere of the surroundings.

MAPPING

The site characteristics are identified through mapping, a series of map diagrams visualising different qualities of the site. The graphic representation is done in various scales, depending on the scope of analysis. Mapping is one of the key techniques used by architects and urban planners to illustrate information collected from sources or observations, to understand the place and find problems to solve in the design process (*Creative Mapping and Data Visualisation Techniques for Architects*, n.d.).

ENERGY DESIGN

The integrated design process goes hand-in-hand with the state-of-the-art tools to assess the energy performance of the building. The analysis and simulations of the location, climate, geometry, orientation and context inform the early design concept about its energy potentials. All the parameters taken into account when designing the form will give an optimized low-energy building concept.

EVIDENCE-BASED DESIGN

Project decisions will be based on undertaken scientific research, which will question what is libraries' role and mission and how libraries should meet user's needs nowadays. This will follow by investigation of how daylight, as an important factor of indoor environment, affects the perception and usage of spaces. The research will also explore how the library design can influence users' experience of the place, improve their well-being and how the library spaces should be designed to stimulate children learning process.

The method known as evidence-based design (EBD) has been by Roger Ulrich (1984). The research can be based on scientific papers, literature reviews, expert opinions and studies to analyze the effects of different solutions and design decisions (Hamilton and Watkins, 2009).

01

Framework

Brief history of libraries

First libraries existed in ancient times in Egypt, China and Athens, among others. The first libraries were closely associated with places of worship - for both pagan and early Christian societies, since at those times, mainly priests and religious had the ability to write and read. Therefore they created holy books, and with time enriched book collections with fine and scientific literature (Skowrońska, 2014).

Over the years, the societies have realized the importance of a library in the form of expanding circles of social influence. When in 1440 the Gutenberg's press has been invented (History.com editors, 2018), the librarian environments have gone the breakthrough, when the expansion of printing and copying books has begun outside of monastery walls (Skowrońska, 2014).

During the 20th century libraries were influenced by war and poverty. Libraries expanded their services by offering homework help, lectures and job fairs.

Due to technology growth libraries' management has gone through automation process, by creating library systems dealing with data, circulation and reservations. The information and resources have become more accessible for people of different ages and needs.

Finally, the internet (websites, social networks and online reference platforms) and access to digital resources in a form of e-books, electronic data bases made the information more accessible for people of different ages and needs, since they have become accessible outside the library buildings (*History of Libraries*, n.d.).

Importance of libraries nowadays

Public libraries are cultural institutions that function in the whole world, regardless of culture, environment or religion. However, these aspects influence the functioning and scope of services provided by the facilities.

In Poland, the tasks of libraries are specified in the *Act on libraries of June 27, 1997*. As the main responsibilities of libraries, it lists the collection, development, storage and protection of library materials, sharing collections and conducting information activities. In addition, library tasks may include other types of activities, such as bibliographic, documentary, scientific, publishing, disseminating and instructional and methodical (Skowrońska, 2014).

Beyond that, a library is a place having a mission to provide people with an *information* and *knowledge*, which are terms truly different. Information access and management have passive character, whereas knowledge gives a privilege of promoting and wisely utilising information. Transforming the gained information into dynamic knowledge is known as a process of learning. Knowledge-based society consists of people who actively learn throughout their whole lives (Piotrowicz, 2003).

Although the traditional role of a library has not changed, the ways of fulfilling the mission have changed, through transforming them into hybrid libraries, where creating multimedia collections were created, containing documents in both traditional and electronic forms (Skowrońska, 2014).

III. 2: The role of the library

While today's world provides many innovations and technologies, such as portable computers, tablets and smartphones, many people, including children, do not intend to use them on a purpose of gaining knowledge rather than an entertainment.

A library could be a place which promotes learning through technologies, inspires and encourages people to explore and gain more knowledge. Common and easy access to digital sources of knowledge means that the traditional role of libraries is no longer sufficient.

"THIRD PLACE" THEORY

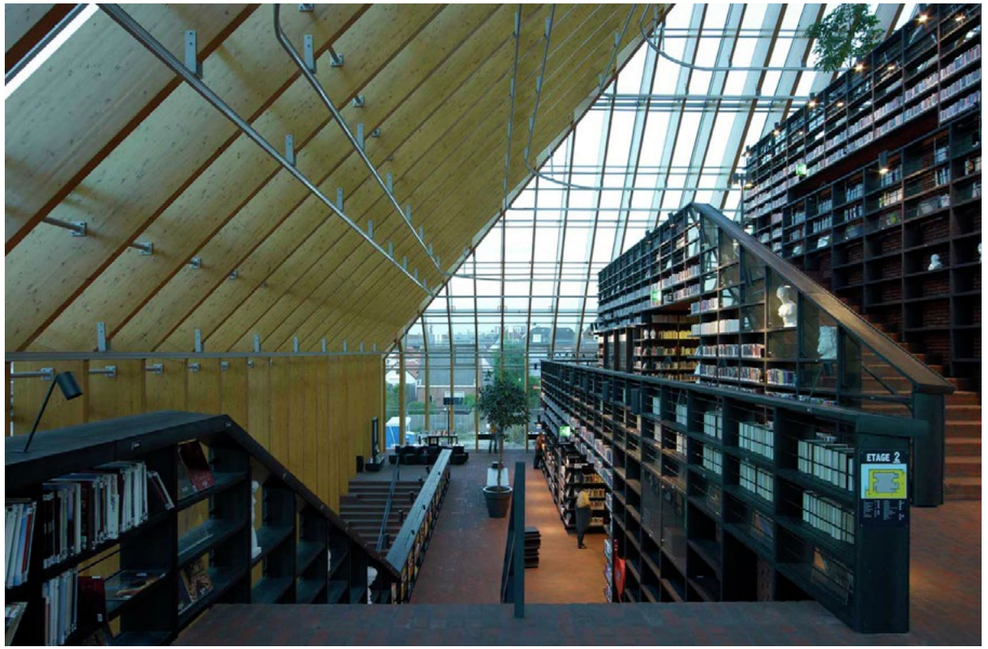
According to Ray Oldenburg's theory (1996), the human life takes place in three spaces: home, work and the "third place" - an informal place for relaxation and interaction with other members of society. These days, the "third place" is largely played by shopping centers, entertainment clubs and gastronomic places, although the concept could be fully implemented in libraries and culture centers (Oldenburg, 1996; Skowrońska, 2014).

POTENTIAL OF CHILDREN'S LIBRARY

Libraries could be a perfect place for children to fill out their free time after school. Some children require more time on studying than others and the school environment with fixed and limited time might not allow to follow the school program (Hassinger-Das et al., 2020). Libraries have a great potential to provide an additional support for children to increase their intellectual skills and social experiences. Besides the learning resources and tools, libraries offer help in studying and gaining knowledge, organize informal learning activities and teach how to love reading.

Ill. 3: “Boekenberg” Library in Spijkenisse

Ill. 4: “Boekenberg” Library in Spijkenisse



The “Boekenberg” in Spijkenisse

The “Boekenberg” (eng. *Book Mountain*) Library, designed by MVRDV in the suburbs of Rotterdam, is an example of a public library, which mission is to create a local community place.

The inner structure has been designed as a stepped pyramid. Each level gets smaller, creating a recessing form. All the internal walls of the pyramid structure are wrapped by bookshelves which depicts the idea of a book mountain. The building is covered with a glass roof and wooden structural system. Therefore, the interior is full of natural light, which is not beneficial for storing books, however, the idea of the place is to encourage people to come to the library and read out the books, until they get damaged by the light.

The interior of the place is designed in a way that it looks like a huge living room space. The architects achieved it by the selection of materials, such as wood and red brick, in combination with a number of plants and books, which create a warm and cosy space.

The simple form of a building contrasts with a variety of different interior spaces, which can be discovered while climbing the stairs. The building has majority of open spaces, although their size is significantly diverse - from small corridors, giving more privacy, to large and bright spaces for event purposes.

The glass openings make the interior and exterior get blurred and in a close relation. This helps people feel that both an inside and outside is an open public space.

The design of the public library makes users feel like home rather than like visiting an institution. This way, the library functions as a community center for the neighborhood, where people come by to spend their free time and meet other people (Gajda and Szcześniak, 2017; *MVRDV - Book Mountain*, n.d.).

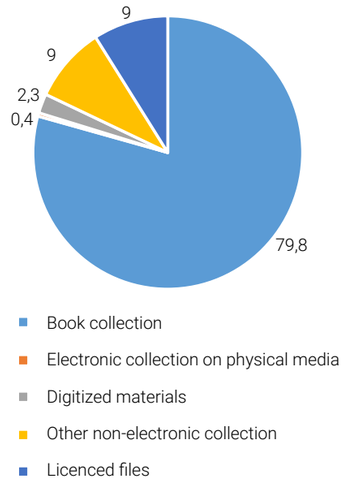
Public libraries in Poland

Polish libraries are a type of cultural centers that are traditionally perceived as institutions dealing with the collection and sharing of resources of the scientific and cultural achievements of humanity. In the librarian environment, it is believed that the model of the modern library should change nowadays and meet the expectations of users (Skowrońska, 2014).

LIBRARY RESOURCES

Libraries seek to build hybrid resources. Alongside traditional (printed) forms, they simultaneously develop electronic resources, such as electronic documents on physical media, licensed files and digitized. In 2018, 79,8% of the collections were traditional books (see: Ill. 5), although in particular types of libraries the percentage is different, depending on the profile of activity and the specific interests of the user groups for which they were established. In public libraries the book collection reaches even 94.4% of resources (Jezierska and Budzyńska, 2018), which means not many of them can offer new digital forms.

The number of public libraries in Poland has been slowly decreasing. In 2018, there were 7,925 public libraries - a decrease of 28 libraries compared to the previous year (Jezierska and Budzyńska, 2018; *Poland: number of public libraries 2015-2018*, 2019).



Ill. 5: Overall percentage of resources in libraries in Poland in 2018 (Jezierska and Budzyńska, 2018)

LIBRARY VISITORS

In 2018, nearly 11 million users visited libraries in Poland, making over 86 million visits for various purposes. On average, one user visited the library 8,5 times in a year. Users of public libraries were the most active, with 9,8 visits per person per year. However, the number of visits decreased slightly from 2014 (see Ill. 6) (Jezierska and Budzyńska, 2018).

USERS AGE

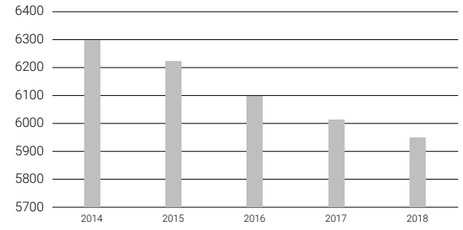
In 2018, public library readers accounted for 15.5% of the whole Polish population. Most often, public libraries are used by children aged 13-15 (see Ill. 7). Within library users, elderlies (people over 60 years old) are the smallest user group, although their presence in libraries gradually increases every year (Jezierska and Budzyńska, 2018).

READERS

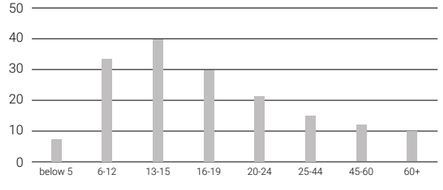
Within the 11 million library users, nearly 7,2 million are readers, meaning people who have borrowed a book or other document at least once a year. Six million of readers, which is 83.0%, are served by public libraries (Jezierska and Budzyńska, 2018), which makes them the most often used type of a library.

USERS ACTIVITY

When looking at library users' occupational status, the 38,1% of public library readers are people who study, 37,9% are employed and 24% are unemployed - elderly people and non-studying children (Jezierska and Budzyńska, 2018).



Ill. 6: Number of readers in public libraries in Poland between 2014-2018

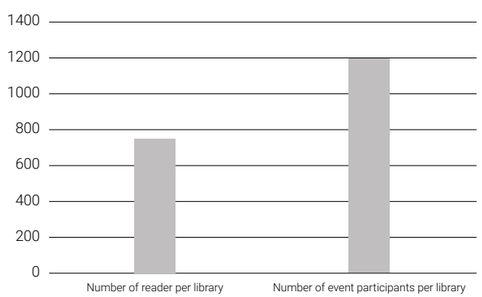


Ill. 7: Percentage of library users within the specified age categories in Poland in 2018

CULTURAL ACTIVITIES IN LIBRARIES

Libraries in Poland are expanding their offer, by organising cultural events, creating spaces for relaxation and social integration. In 2018, they organized a total of 278 900 events, where 97.2% of them took place in public libraries, accommodating a total of 7.6 million event guests. In addition, 2.6 million people participated in workshops and educational activities (1191 participants per public library). The average number of readers in public libraries is 751 per year, whereas the number of event guests is 1191 per facility per year (see Ill. 8).

Therefore, organisation of cultural events is a great step to encourage people to visit libraries and take a part in the social interaction.



Ill. 8: Percentage of library users in specific age categories in Poland in 2018

Sustainability

According to the Cambridge English Dictionary the term of sustainability can be described as '*the quality of being able to continue over a period of time*' as well as '*the quality of causing little or no damage to the environment and therefore able to continue for a long time*'. The idea is composed of three 'pillars': environmental, economic and social — also known informally as planet, profits and people (Grant, 2019), in order to find a harmony between technology, humans' behavior and way of life, and environment. It focuses on meeting the needs of the today's world challenges and future generations (Grant, 2019). In architecture the concept focuses on environmentally-friendly building solutions, initiating and strengthening interactions of societies as well as energy efficiency, and minimized costs and maintenance of a building.

SUSTAINABLE LIBRARY

Libraries promote sharing economy through distributing access to sources of information in both physical and digital way, therefore they contribute to minimizing consumption. This relates to both environmental and economic aspects of sustainability, through saving cost of resource production, and saving material (wood) of resources. Also, development of the 'hybrid' model of a library, introducing digital access to resources, contributes to material preservation.

Moreover, library is a perfect cultural institution for establishing a societal mission, which will provide places of social interaction and creating communities through open public spaces and access to common activities (Wyber, 2018).

Libraries provide access to information and knowledge, therefore, modern type of a library should introduce today's world climatic challenges and promote sustainability through its own sustainable building design. It can be done by designing energy efficient and water saving building, where the need for air conditioning is set to the minimum. Building constructed with recycled materials will promote the reuse and the close distance from residential areas, public transport and bike lanes will prevent people from using cars (Wyber, 2018).

Ill. 9: “My Tree House”, Central Public Library, Singapore

Ill. 10: “My Tree House”, Central Public Library, Singapore

“My Tree House” Library

“My Tree House” is a part of a Central Public Library in Singapore, which has been awarded the World’s 1st Green Library for Kids in 2013. The idea was to design a place which will encourage children to investigate and confront their curiosity in learning and increase sensitivity for the environment.

It is a first library in the world, where the design has been driven by green and sustainable principles. The structure of the tree - the central and iconic element of children’s library - has been constructed with over 3,000 recycled bottles. The building is eco-friendly with energy-efficient LED lighting and renovated furniture. The library’s collection provides 45,000 books, themed into books about green topics, such as nature, environment, animals, plants, climate, water resources and recycling (*Singapore: ‘My Tree House’, the World’s 1st Green Library for Kids*, 2013).

This way, the institution aims to build an environmental consciousness in children, in order to provide a positive human influence on the climate change in the future.

Well-being in libraries

Well-being in libraries is strongly related to how effectively people can use spaces as well as how comfortable they feel in them. The important factors are noise prevention within different activity spaces, sufficient daylight - both natural and artificial, the comfortable room temperature, balanced by sufficient ventilation and heating, as well as space and furnishing design, which comply with library functions and safety demands (IFLA, 2018).

VISUAL COMFORT

Daylight contributes to low-energy design, influences user's perception of the interior and affects the usage of amenities.

According to DS/EN 12464-1:
The minimum requirement for the occupied room's glazed area is 10% of the floor area, which shall be equivalent to 300 lux.

According to Polish regulations[1]:
The minimum requirement for the occupied room's glazed area is 1:8 of the floor area.
In rooms where daylight is needed due to the room's function and usage - at least 1:12.

Since the library is the place of reading, writing and studying, it is crucial to design light indicating the functions of specific spaces, as well as to avoid entry of direct sunlight.

INDOOR AIR QUALITY

The atmospheric comfort can be achieved by developing the design strategies for sufficient ventilation and wise choice of materials, in order to prevent from toxic particles, releasing smells and providing the healthy air humidity.

According to DS/EN 15251:
The required ventilation rate for occupancy is 7 l/s/person (category II).
The required ventilation rate for emissions from low-polluted building is 0,7 l/s/m^2 (category II).

The recommended CO_2 concentration above outdoor concentration is 500 ppm (category II).

THERMAL COMFORT

Temperature and draught are the factors, which contribute into creating a thermal indoor climate, that can be improved by developing the facade's thermal performance, and careful design of the openings.

According to DS/EN 15251:
The operative temperature for auditorium/ classroom should be minimum 20°C in winter and maximum 26°C in summer (category II).

Excessive solar heat gain should be minimized.

ACOUSTIC COMFORT

The distribution of sounds in the building can be controlled by designing the strategy for absorbtion through the building form and choice of surface materials, such as floors, walls and ceilings.

According to DS/EN 15251 the sound pressure level in libraries should be within the range 28-35 dB and in classrooms within 20-40 dB.

[1] Obwieszczenie Ministra Inwestycji i Rozwoju z dnia 8 kwietnia 2019 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Infrastruktury w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie. Poz. 1065', 2019.

Summary

The number of library users in Poland decreases, however, children are the most frequently attending users. The function of the library institution is sustainable through its sharing economy and has a great potential for promoting the principles of environmental sustainability through the building design. The reasearch has also shown that events organised in libraries, encourage people to visit the place. By creating open and liveable library, it will bring families back into libraries and strengthen local societies.

02

Site

Site and urban context

The site is situated in Poznań, in Chwaliszewo area. The city is fifth-largest in Poland, located in the central-west part of the country.

POZNAŃ

Poznań is the capital of the Greater Poland Voivoship, where the Polish nation has begun between 9th and 10th century. Today, the region is the most economically developed within regions of Poland, as well as an important communication hub between Warsaw and Berlin. The city is still developing by building new infrastructure, renovations, developing strategies to improve life of its inhabitants (*Poznań*, n.d.).

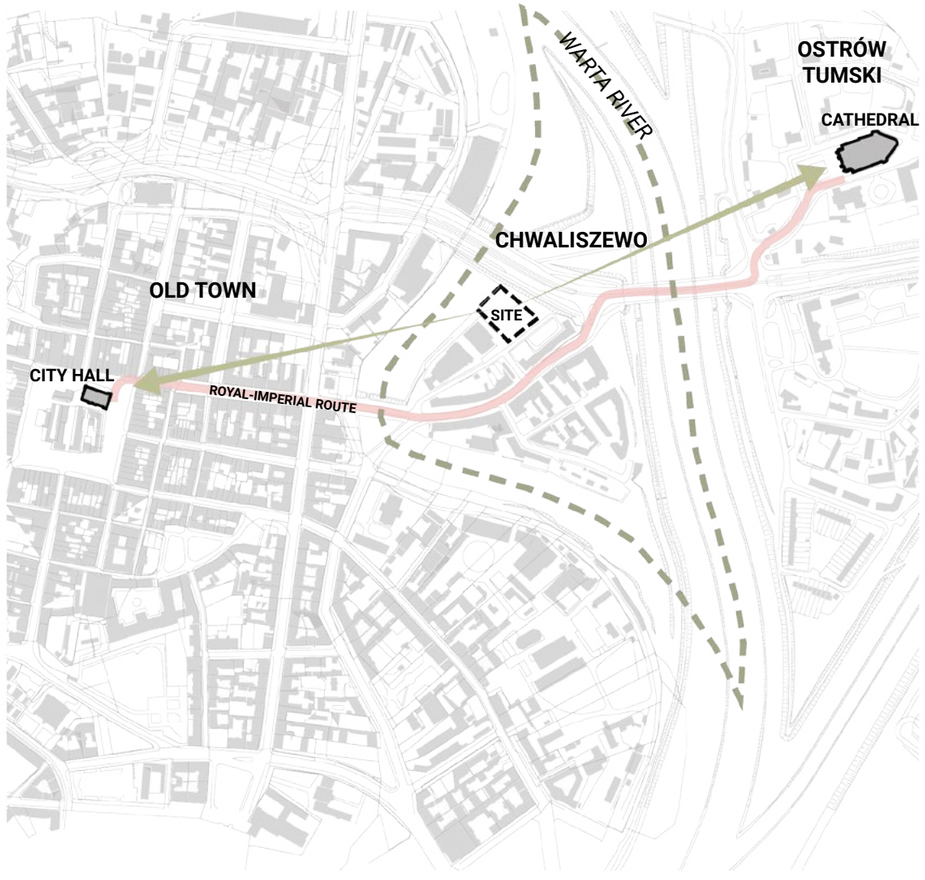
CHWALISZEWO

Chwaliszewo is a neighbourhood placed closely to the Poznań Old Town, until 20th century it was a separate town, situated on the island (*Chwaliszewo and Old Market Square*, n.d.). It is located in direct proximity to Warta, the third longest river in Poland (*Statistical Yearbook of the Republic of Poland*, 2017). The Chwaliszewo Street follows the medieval route, today named as Royal-Imperial Route, a trial of city's most significant parts, going between the Poznań City Hall and The Ostrów Tumski Cathedral - former residence of rulers of Poland. Nowadays, the route is an important touristic guide presenting most important historical points of the city (*Poznań*, n.d.).

DISTRICT PLAN

According to the *Resolution No. XL/421/V/2008 of the Poznań City Council of July 8, 2008*, the local authorities have decided on commencing the preparation of a local spatial development plan for the Chwaliszewo area, which will introduce:

- reorganisation of neglected and chaotic buildings, demolition of accidental and temporary buildings,
- fusion of Chwaliszewo with the Old Town area by renovation of the Royal-Imperial Route,
- establishment of public areas and setting the principles of their protection,
- adaptation of the area of the former Warta riverbed,
- restoring the city's relationship with the river and designating a river port,
- preservation of exceptional landscape values, view openings and panoramas,
- creating a comprehensive public transport solution (*Uchwała nr XL/421/V/2008 z dnia 2008-07-08*, 2008).



Ill. 11: Map of Poznań - Old Town, Chwaliszewo and Ostrów Tumski areas, 1:8000

Warta River

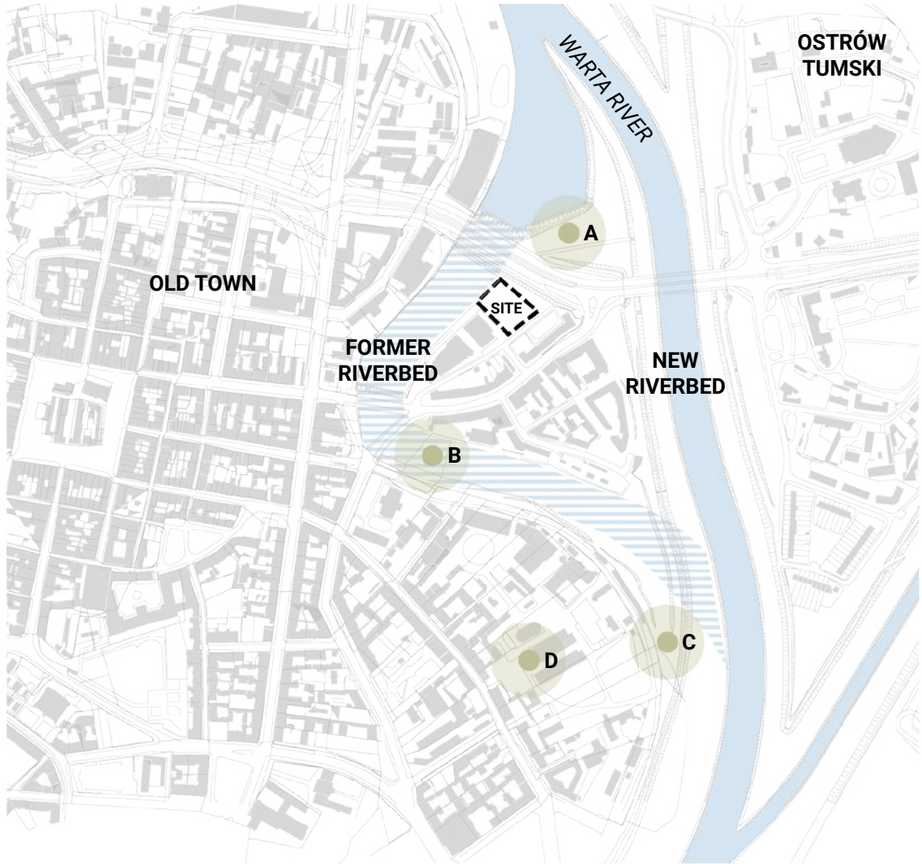
The Warta River had been crossing Chwaliszewo until the riverbed has been regulated to prevent flooding of the Old Town in 1960s (*Rzeka Warta/Historia*, n.d.). The fact of a human impact in the natural river course has been discussed and criticised by many authorities and inhabitants until today. The piece of land, where the river used to be running, is not suitable for a construction and has been abandoned for a long time. These days, the areas get more attention of the authorities who are planning on developing the 'Old Warta Riverbed'. The process has started by designing a city park (*Park Stare Koryto Warty nagrodzony*, 2018) which is just 150 metres from the site.

The 'new' Warta riverbed has been also forgotten by city planners and still remains mostly undeveloped. However, the newly built marine with restaurant (Bielicka M., 2019) and KontenerART - the cultural summertime initiative, organising cultural events by the water, discernibly attract people, who visit river areas more often (Ill. 12).

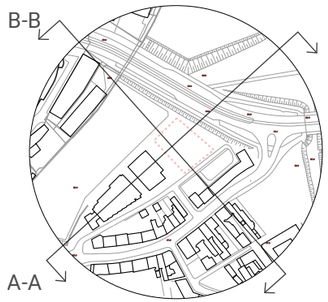
The area has a great potential of being an important cultural part of the city. The library and culture house building could be a next cultural attraction for inhabitants as a part of a large municipality strategy of developing the area.

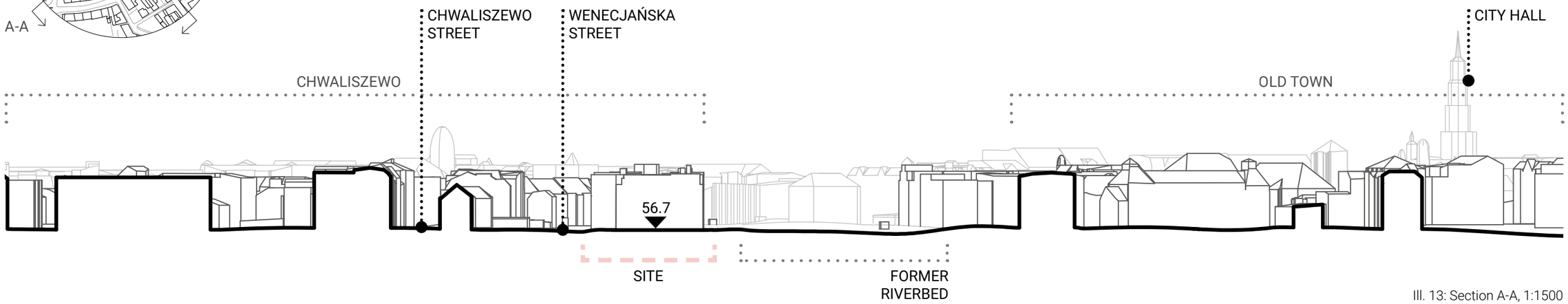
	NEW CULTURAL PLACES IN THE AREA
A	New marine (under construction)
B	Cultural center pavillion 'Nowa Gazownia' - art exhibitions
C	KontererART - summer initiative, place for exhibitions, concerts and workshops
D	'Stara Gazownia' (eng. Old Gasworks) - place of Malta Festival Poznań, international theatre festival with exhibitions, concerts and dance spectacles

Libraries and their users within 0.6 kilometer radius

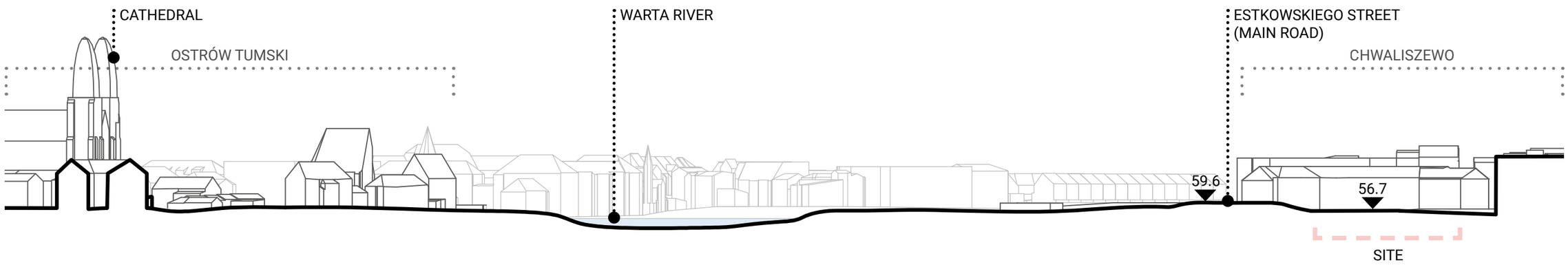


Ill. 12: Map of Poznań - Warta river, 1:8000





Ill. 13: Section A-A, 1:1500



Ill. 14: Section B-B, 1:1500

Libraries in the area

Poznań offers several libraries in the city. The best known is Raczyński Library, founded by Count Edward Raczyński in 1829, which has multiple branches throughout the city. The library located on Chwaliszewo is one of them, however, the department is intended for adults, and is not operating during weekends. The library offers book loaning and organises meetings with authors from time to time. All other libraries located within 0.6 kilometer radius from the site serve for either adults or students. There is no public library in the analysed neighbourhood, which would be serving for children.

	LIBRARY NAME	*USERS*
1	Main Library of University of Fine Arts	students
2	Kórnicka Library in Działyński Palace, scientific library	adults
3	Raczyński Library, branch 39: Arts collection	adults
4	Voivodeship Public Library and Culture Animation Center: Touring, photography, folklore collection	adults
5	The Western Institute - scientific research society: history, economy and politics	adults
6	Raczyński Library, branch 11	adults
7	Library of the Faculty of Theology, Adam Mickiewicz University	students

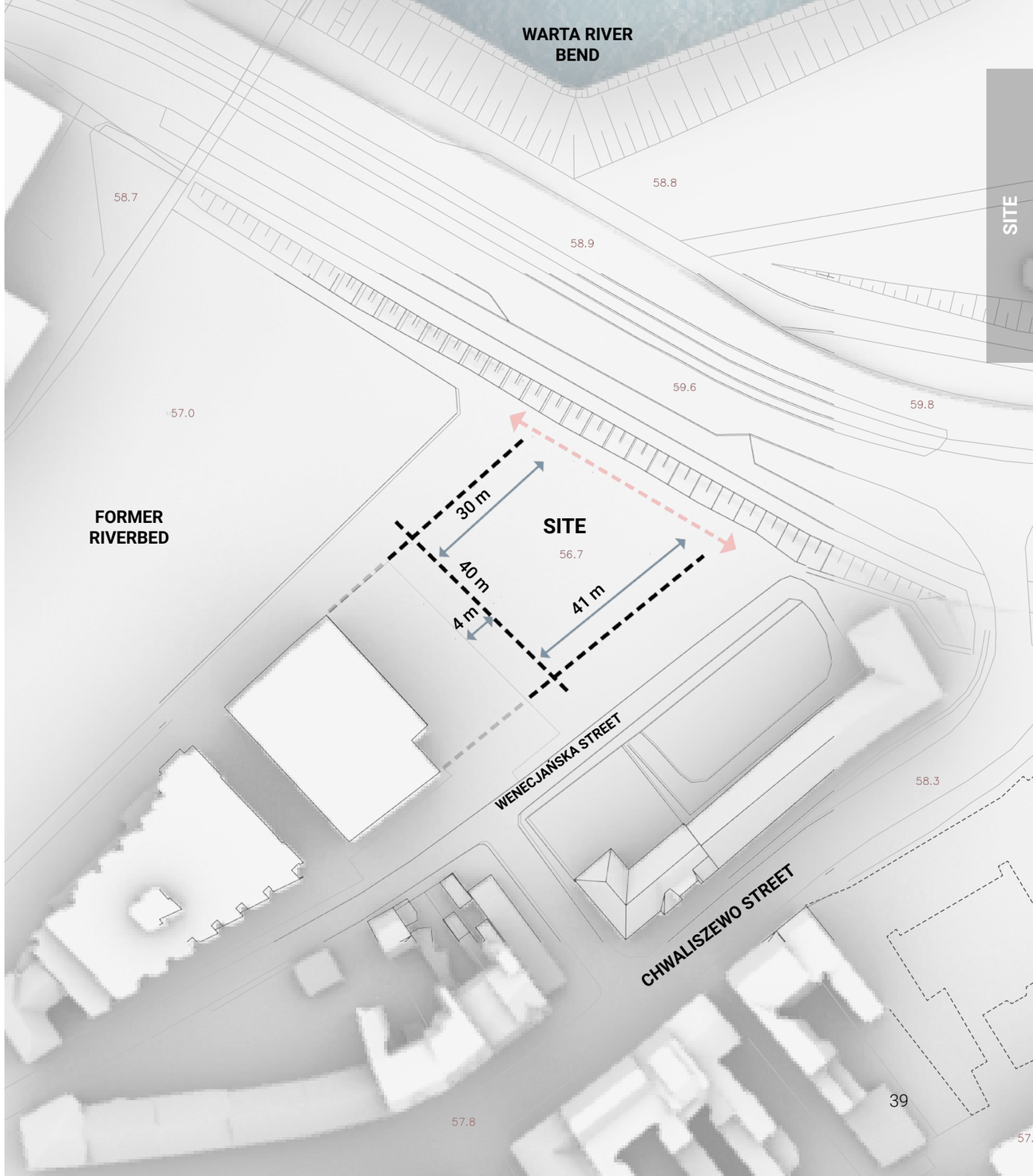
Libraries and their users within 0.6 kilometer radius

Ill. 15: Libraries within 0.6 kilometer radius, 1:8000

Site characteristics

The site is easily noticeable in the urban context, since it is widely exposed from the north, facing the main road, which connects east and west part of the city. The north area from the road is building-free, where the river bend is located and the new marine is being designed (Bielicka M., 2019). The site is also open from the west, where the terrain is not suitable for construction and is planned to become a city park (*Park Stare Koryto Warty nagrodzony*, 2018). Even though the site has highly exposed character, the surrounding from the south side four- or five-floor tenement houses are settled adjacently along the roads, which makes the urban area feel dense. The site is located by the Wenecjańska street which is the "back of house" street for the more representative Chwaliszewo street. Therefore, the buildings in direct neighbourhood are more irregular and chaotic. The new library and culture house building will attempt to reorganise the area and retrieve the values and uniqueness of Chwaliszewo.

III. 16: Site map, 1:2000



Genius loci

TERM OF GENIUS LOCI

Genius loci, in other words 'the spirit of the place', is a Latin term which declares every location is unique in terms of its physical characteristics as well as of how it is discerned. The qualities are crucial and valuable for the site to be perceived the same way and make one's feel special about it, even after human's manipulation. Therefore, it is an architect's responsibility to be sensitive to retain or even enhance the uniqueness and identity of the place (Curl, 2006; Norberg-Schulz, 1979).

THE CATHEDRAL

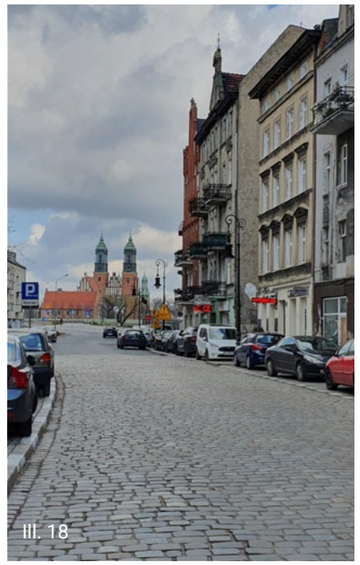
The cathedral is situated on the Ostrów Tumski Island, which is visible from the site and plays the dominant role in the urban context - due to its historical significance, scale and architectural expression. The Chwaliszewo's main road is leading towards the temple, marking its importance in the city as a major part of the historical Royal-Imperial Route.

THE CHWALISZEWO STREET

Walking through the Chwaliszewo Street feels grandiose. The four- to five-storey tenement houses, colorful and rich in architectural detail from 20th century, built alongside the road, give a charming historical character to the area. They emphasise the identity and historical importance of the Chwaliszewo. Beyond the main street, the neglected old buildings can be found, where some of them make parts of the district feel chaotic. However, Chwaliszewo has got quite a few new developments, which make this area of the city become more organised and attractive for people to live in.

Ill. 17: Chwaliszewo Street
Ill. 18: Cathedral view from Chwaliszewo
Ill. 19: Cathedral view from the site

Ill. 17


Ill. 18


Ill. 19

THE BUILDINGS
Architecture, surrounding the site directly, has been built in recent years (see Ill. 22 and Ill. 23). These are mainly multi-storey residential houses in contemporary style, simple in geometry and tall, with flat roofs. The building across the Wenecjańska Street represents distinct style - the house is lower, with sloped roof (see Ill. 20), which is more adapted to the Chwaliszewo Street on the other side.

THE GREENERY
The space in front of the site, is occupied by a garden belonging to the neighboring house (see Ill. 20 and Ill. 21). The greenery seems maintained not enough to provide pleasant recreational space for dwellers, however, it gives a potential of designing larger green area for the neighborhood and valuable end point of the Wenecjańska Street. The western side of the site is facing a large football playground, sitting on a former riverbed (see Ill. 12, p. 33), which could be a nice element of greater recreational area for children.

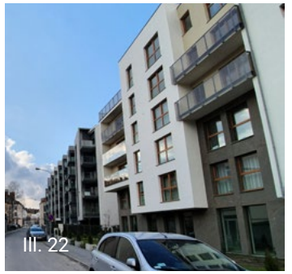
THE SITE
When approaching the site from Wenecjańska Street, it gives a feeling of approaching the large open space through a narrow corridor of buildings. Being on the site feels reaching a significant and empty space, exposed from many sides - especially from the north, facing the Ostrów Tumski Cathedral. When approaching the site through northern artery road (Estkowskiego Street), the site is easily noticeable, therefore the new building will become a significant element of the cityscape.

The area of Chwaliszewo is a brew of architectural styles. The site is facing various qualities, potentials and challanges from each side.

Ill. 20: The building of the Raczyński Library branch 11
Ill. 21: The garden in front of the site
Ill. 22: Wenecjańska Street with new residential development
Ill. 23: The site and the neighboring buildings

Ill. 20


Ill. 21


Ill. 22

Ill. 23

Mapping

residential
hotel
commercial (shops and services)
institutional/educational
cultural

III. 24: Typologies, 1:5000

TYPOLOGIES

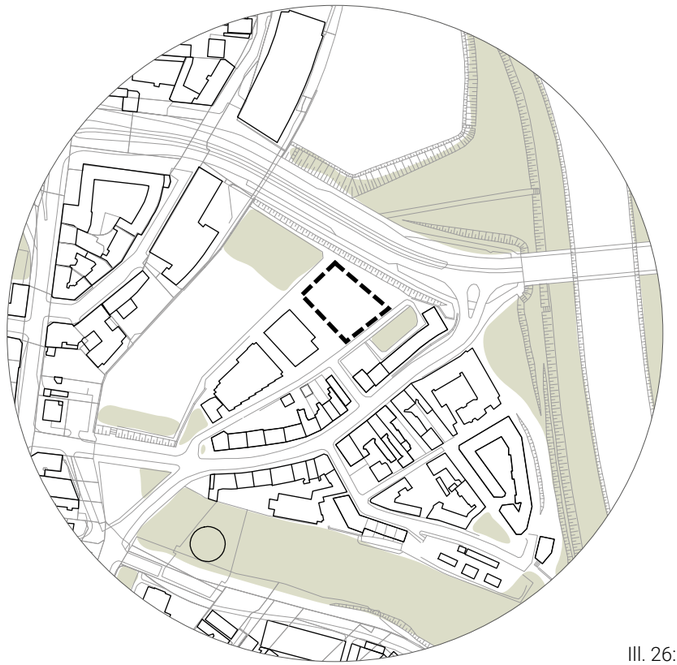
The surrounding buildings are mostly residential with small commercial units on the ground floor, destined for small shops.

59.6 m a.s.l.
56.3 m a.s.l.
52.9 m a.s.l.

III. 25: Topography, 1:5000

TOPOGRAPHY

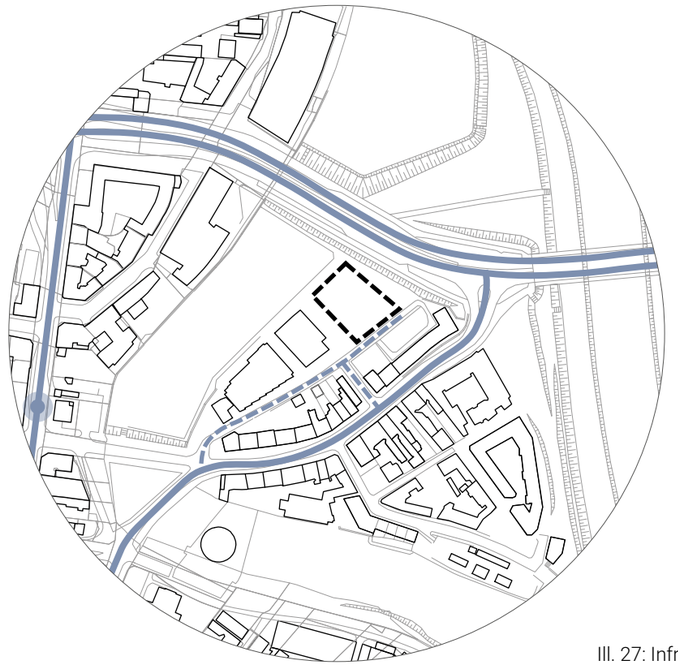
The topography of the site is relatively flat. However, the site is adjacent to the main road which is laying approximately two metres above the site level. The terrain close to the water has steep slopes, which function as river flood defences.



Ill. 26: Greenery, 1:5000

GREEN PUBLIC SPACES

The closeness to the river makes the area rich in green spaces, which are not forested. The “Old Riverbed” city park has been designed on the south part of Chwaliszewo and is the only developed landscape area right now, with paths, playgrounds and benches. The areas along the river remain undeveloped, however, it is a common recreational place for many people doing sports related to jogging, cycling or kayaking.



Ill. 27: Infrastructure 1:5000

INFRASTRUCTURE

The site is located close to the main road (Estkowskiego Street), although the access is through the small-traffic no outlet Wenecjańska Street.

Climate

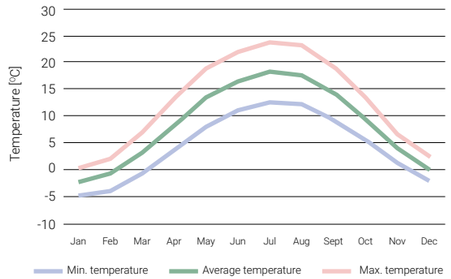
Poznań is located within the moderate climate zone - transition between the sea climate and continental climate.

TEMPERATURES

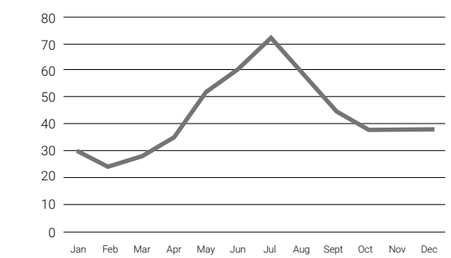
There are four seasons during the year, where summer is the warmest, with average temperature 18,2°C in July, and the winter is the coldest with -4.6°C in January. The average annual temperature is 8.5°C (*Climate and weather - POZnan.travel*, no date; *Poznań, Poland - Detailed climate information and monthly weather forecast | Weather Atlas*, n.d.).

PRECIPITATION

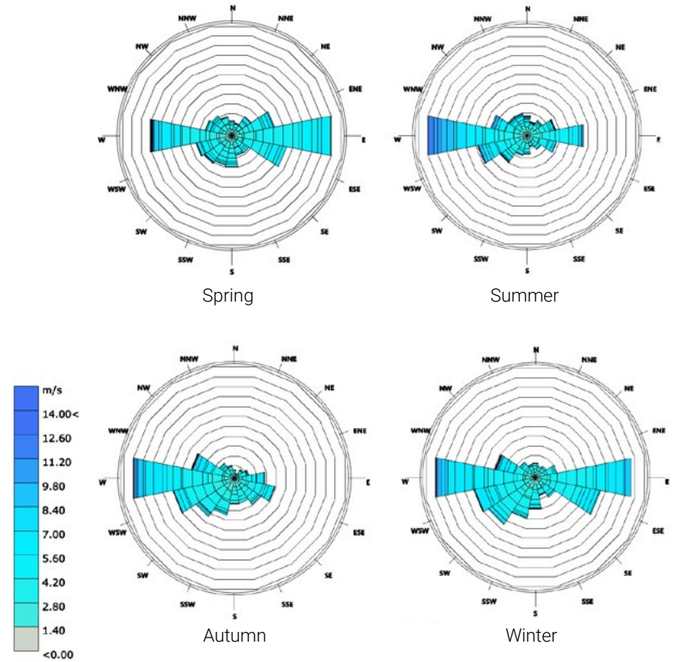
In Poznań, the average annual rainfall is 507mm, which is 30% less than Poland's average. In summer, rainfall occurs the heaviest, with around 76 mm in July and 60 mm in August (*Climate and weather - POZnan.travel*, n.d.).



Ill. 28: Average temperatures in Poznań during the year



Ill. 29: Average precipitation in Poznań during the year



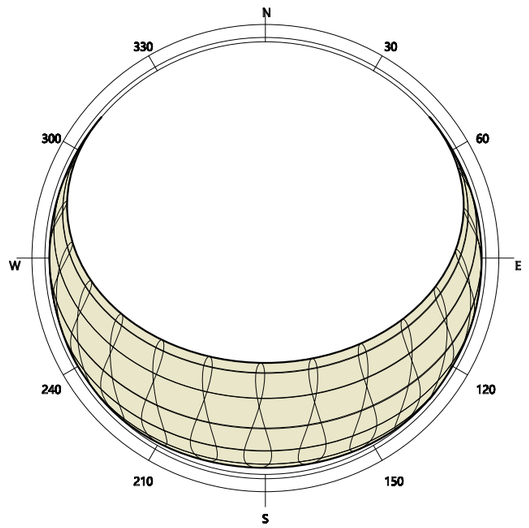
Ill. 30: Wind rose

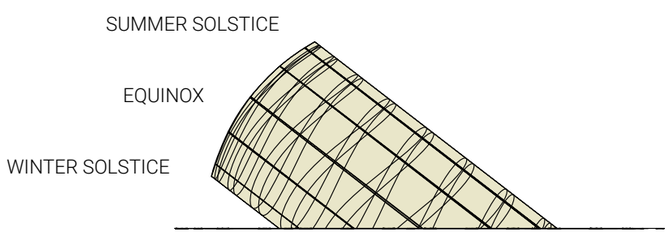
WIND

The windiest seasons in Poznań are autumn and winter, from October to March, with average wind speeds of more than 4.5 m/s. The windiest day of the year is in January, with an average wind speed 5.3 m/s. However, the experience of wind is highly dependent on local topography.

The predominant direction of the average hourly wind varies throughout the year.

In spring, the wind comes most often from the east. However, for eleven months, the wind blows most often from the west, with a peak percentage of 46% on January 1. (*Average Weather in Poznań, Poland, Year Round - Weather Spark*, n.d.).

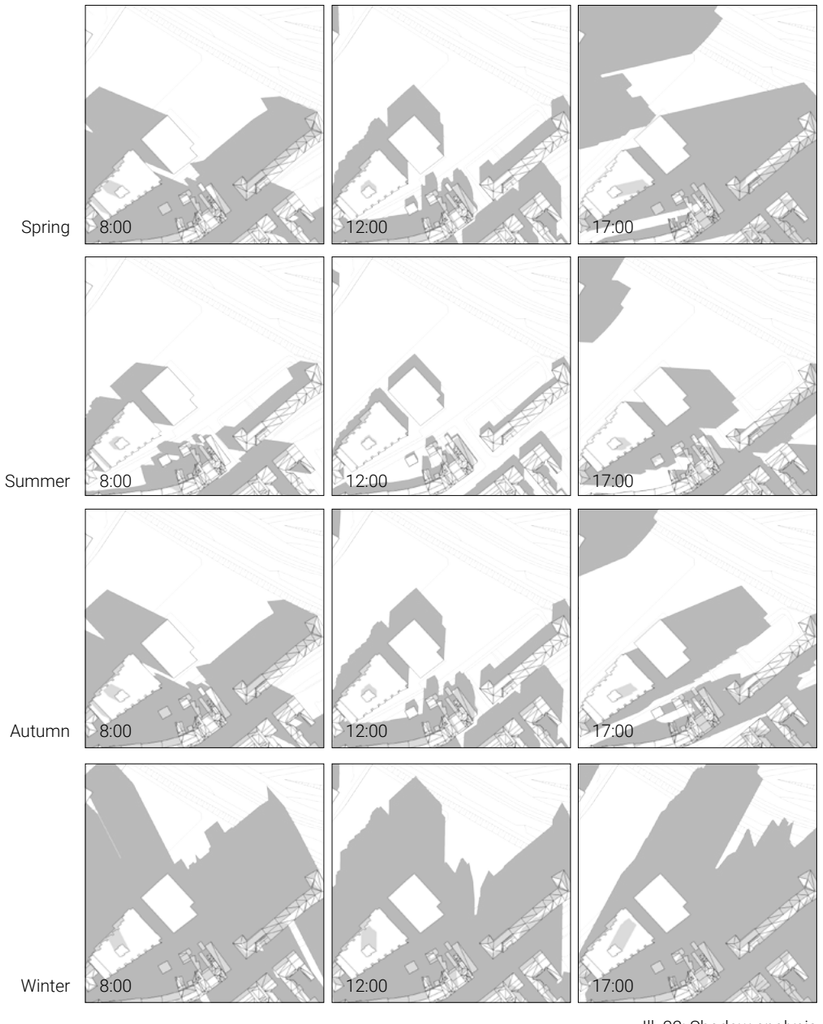




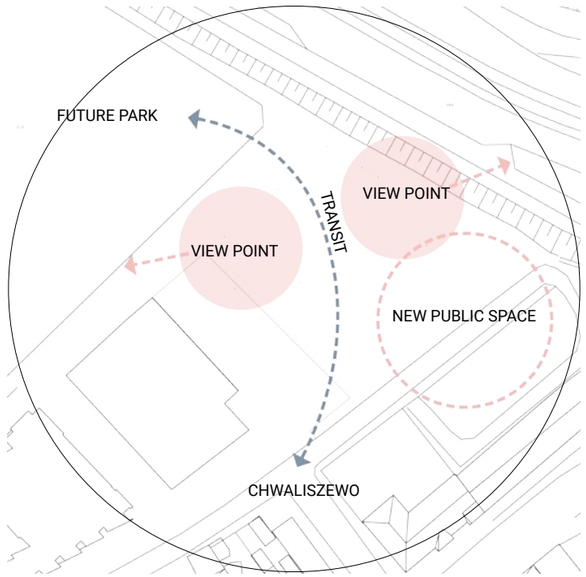
Ill. 31: Sun path

SUNLIGHT

The length of the day varies significantly throughout the year. The longest day is the summer solstice on 20th June, with 16 hours and 49 minutes of daylight. The average daylight in June is 16.7 hours. In winter, days are the shortest, when the winter solstice is on 21th December, with 7 hours and 40 minutes of daylight (*Average Weather in Poznań, Poland, Year Round - Weather Spark*, n.d.).



Ill. 32: Shadow analysis



III. 33: Site analysis conclusion

Summary

The site is located in a close relation to many attractive points of the city - the historical places and the river. It lies between former riverbed and the actual Chwaliszewo. The new built library could take a role of transit point between future recreational space and the residential area. Furthermore, it is place with great city views, situated between two important urban elements - the Cathedral and the City Hall. The presence of a garden adjacent to the site, brings an opportunity of creating a new public space by the new building.

The weather varies throughout the year. The site is quite exposed to the solar radiation, which could be utilised as energy source. The predominant winds come from the west for most of the year, which could be utilised when designing the strategy for natural ventilation.

The analyses show that there is a lack of libraries for children in the area. Chwaliszewo still requires to be developed, however, is becoming a more and more filled with cultural hubs and events. The library for children would be a great contribution into realising this strategy.

03

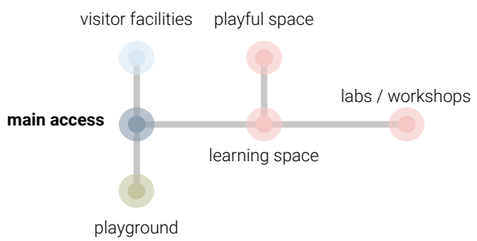
User and function

User profiles

PRE-SCHOOL CHILDREN

Activities:
Children making their first steps in learning - usually visiting with a caregiver, active physically and curious, the most effective way of learning is learning through play.

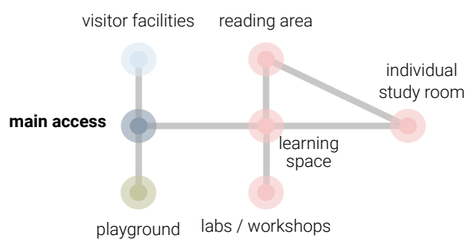
Time of visit:
Standard opening hours, mainly afternoons

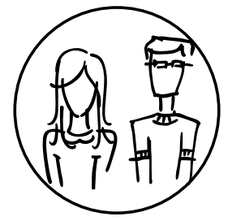


SCHOOL CHILDREN

Activities:
Children daily attending school, seeking space to do their homework, gain access to the internet as well as taking advantage of library program/ workshops/events to fill the time after school or as a part of a school trip.

Time of visit:
Standard opening hours, mainly afternoons

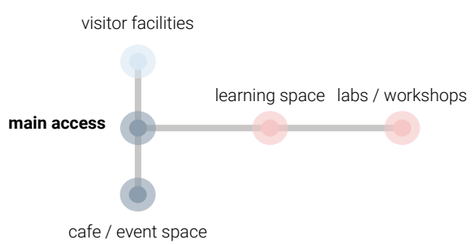




CAREGIVERS

Activities:
Bringing children to the library, coming to the library for social events and family activities, family workshops, visiting Cafe.

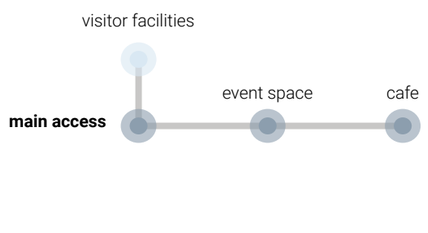
Time of visit:
Standard opening hours, mainly afternoons



FAMILIES

Activities:
Visiting Cafe, participating in organised cultural and social events, such as meetings with authors, lectures, workshops.

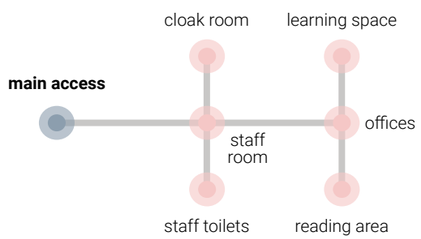
Time of visit:
Afternoons/evenings and weekends



LIBRARIANS

Activities:
Handling library's resources organisation and loans, helping children in finding resources, organising library events and workshops

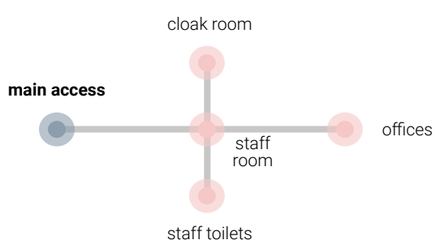
Time of visit:
Standard opening hours + event time



ADMINISTRATION STAFF

Activities:
Library management in the fields of finanse, IT, human resources and communication.

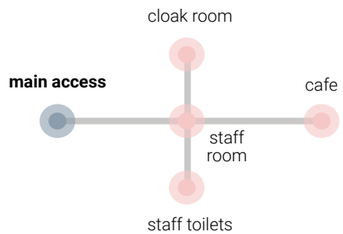
Time of visit:
Standard opening hours + event time

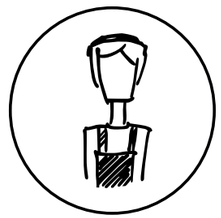


FOOD & BEVERAGE STAFF

Activities:
Serving in the library's cafe.

Time of visit:
Standard opening hours + event time

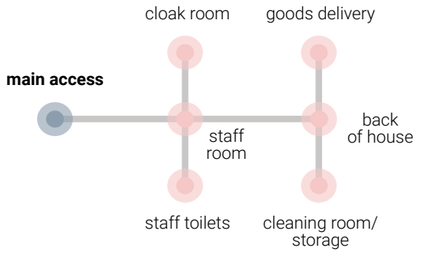




CLEANING / MAINTENANCE

Activities:
Cleaning in the library, technical services management and maintenance.

Time of visit:
Standard opening hours + out of hours access



The four-space model for libraries

Danish scientists Dorte Skot-Hansen, Henrik Jochumsen and Casper Hvenegaard Hansen have developed a model programme for public libraries, depicting the functional transition, from passive book repository into activating and inspiring spot, encouraging people to visit the place and socialize with the locals (IFLA, 2018; Danish Agency for Culture and Realdania, n.d.).

The model includes four essential spaces which are overlapping - *inspiration space, learning space, meeting space* and *performative space* (see Ill. 34), which are meant as the concept for functions and activities within the library, where the transition between them is not noticeable.

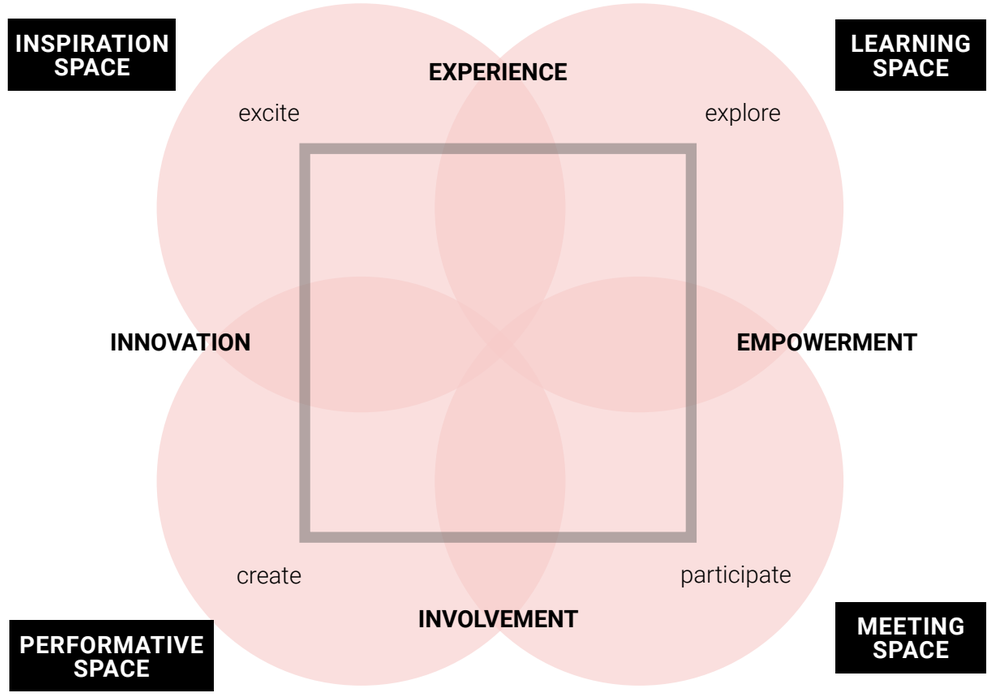
INSPIRATION SPACE
The space where people can find various kinds of expressions within all aesthetic and cultural patterns, different genres and with a use of all media.

LEARNING SPACE
Place where children can access information and knowledge, as well as satisfy their curiosity, through exploration and discovery. This can happen through experience-oriented learning with playful and interactive activities in a social environment. The goal of the learning experience is to increase the children's desire for knowledge, awake their creativity, which will lead them into innovation.

MEETING SPACE
A reflection of a public space, set for people between work and home, where they come to meet people with various interests, and at the same time become a part of a local community. This can be designed by establishing lounge areas, both public and more intimate, with newspapers and cafe service, event and discussions spaces.

PERFORMATIVE SPACE
Organisation of activities involving different senses and awaking creativity through experimental performances, art workshops and exhibitions (Jochumsen, Rasmussen and Skot-Hansen, 2012).

The model programme can be a useful tool to establish the role of the library in the neighborhood and society as well as the basis for the library building design and arrangement of interior spaces.



Ill. 34: The four spaces of a public library

Ill. 35: Children's Library in Billund

Ill. 36: Children's Library in Billund

Children's Library in Billund

The library in Billund designed by Rosan Bosch is focused on play as the key element of library for children. The interiors are filled with various installations and colourful furniture in different imaginative shapes. The spaces combine learning with physical activity and games.

The learning environment has a theme of a Journey. It begins on the island and continues through the desert, mountains, plains until the sea, where the giant jellyfish is marking the end of the path.

Systems of shelves and storage are built into the play elements, which encourages children and interacting with them caregivers, to grab a book in between the physical activities. Spaces are also equipped with art, music and many more theme based element of the exhibition.

The variety of spaces opens a lot of opportunities for both children and adults to acquire knowledge through experimental and creative play, as well as more concentrated in-depth learning.

The library has turned into a meeting and event space, and common readings and hosting concerts in a cooperation with local music school. Children and adults can find plenty of different ways to use the spaces - experimental learning, play, studying, relaxation and place to meet new people.

The design of the library refurbishment has been nominated for a Danish Design Award in 2016 (*Children's Library in Billund by Rosan Bosch*, 2017; *Billund Library: The library in the Children's Capital - Model Programme For Public Libraries*, 2018).

Summary

The goal is to design a family-friendly building, where children want to visit for learning, playing with their peers, and where caregivers can look after them, participate in learning and socialize with other people from the neighbourhood.

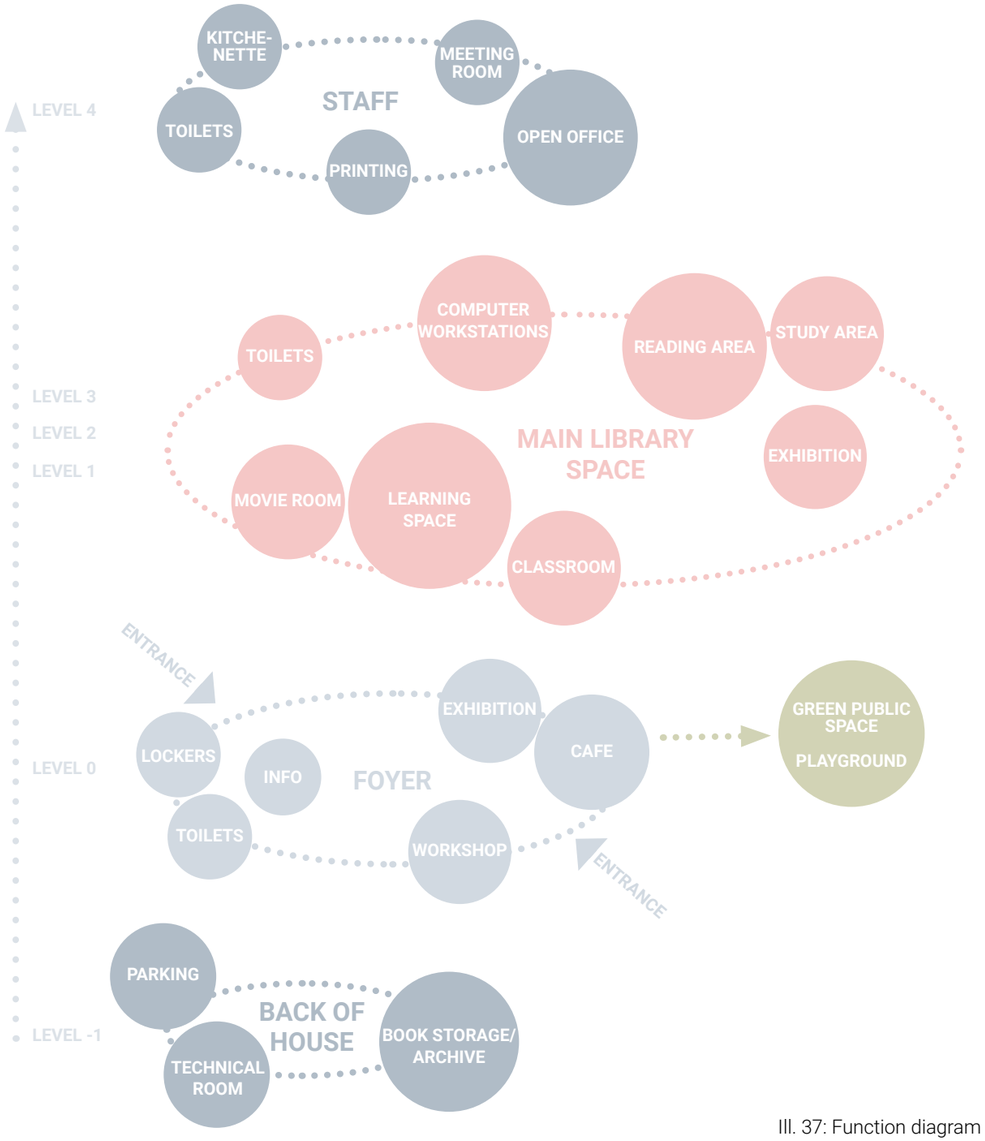
Based on the four-spaces model for libraries, the building should accommodate different kinds of spaces for different purposes, such as inspiration, learning, meeting and performance. This will contribute to enhancing and extending the library's offer for the users. As children are the target user group, the spaces will need to be designed in a response to their needs, according to specific age groups. The library will create a place, enhancing the quality of learning, through the spatial and functional design, and attracting children to naturally visit the place after school hours.

04

Program

Building program

Room name	*Levels*	*Total area [m²]*	*Pers. per room*	*Light*	*Air change*	*Acoustics*	*Comments - function*
Foyer (public space)							
Entrance	0	4					
Library foyer	0	296	30	200 lux	6 l/s/pers	≤ 30 dB	Includes space for main stair, information desk, lockers for visitors, exhibition space and playful areas for children
Event area	0	130	77	300 lux	10 l/s/pers	≤ 30 dB	Double-height space for meetings with authors, lectures, small performances, informal reading area when there is no event
Workshop room	0	37		200 lux			
Café	0	106	34	200 lux	4 l/s/m²	≤ 40 dB	Cafe unit able to work independently outside library's standard working hours
Café counter	0	50		200 lux	10 l/s/m²	≤ 50 dB	
Hallway	0	39		100 lux		≤ 40 dB	
Public toilets	0	36	7		ext. 10 l/s/pers	≤ 45 dB	
Underground lobby	-1	17		100 lux			
Underground parking	-1	1097					Unheated space, 25 parking lots (2 handicap)
Main library space							
Learning space	1,2	770	100	300 lux	7 l/s/pers	≤ 30 dB	
Staircase	0,1,2,3	72		100 lux	1 l/s/m²	≤ 40 dB	
Toilets	1,2	72	14		ext. 10 l/s/pers	≤ 45 dB	
Staff zone							
Staff room	0	28		200 lux	10 l/s/pers	≤ 50 dB	
Cloak room	0	5.2		100 lux	2 l/s/m²		
Loans	0	9		200 lux	1 l/s/m²		
Administration	3	93	15	200 lux	15 l/s/pers	≤ 35 dB	Open office for HR, IT, Finanse departments
Meeting room	3	18	6	200 lux	15 l/s/pers	≤ 35 dB	
Kitchenette	3	29	6	200 lux	18 l/s/pers	≤ 50 dB	
Printing room	3	20		100 lux	7 l/s/m²		
Book storage	-1	65		200 lux	1 l/s/m²		
Staff toilets	0,3	39	7		ext. 10 l/s/pers	≤ 45 dB	
Archive	-1	36		200 lux	1 l/s/m²		
Back of house							
Technical room/storage	0	47				≤ 40 dB	
Technical room/ventilation	0,1,2,3	36				≤ 40 dB	
Storage	3	5			1 l/s/m²		
Cleaning room	0,1,2,3	20.8			7 l/s/m²		
Hallway	-1	43				≤ 40 dB	
Service room	-1	49					
Landscape maintenance room	-1	66					Tools storage and water tank
	Net area	2172		*DS 700*	*DS/EN 15251*	*DS/EN 16798-1*	
	Gross area	**2739**					



III. 37: Function diagram

Vision

The new library on Chwaliszewo will create a new social environment, allowing children to find not only books, but also great environment for studying, high quality learning spaces, fascinating experience and stimulation to learn through different kinds of activities. It will promote knowledge, art and culture, in traditional way and with the use of digital tools. The library will also support children's social interaction.

The building will also enrich area with established new social and cultural functions, in order to enhance the quality of the place and encourage more people to visit library. The building's form will be strongly related to the identity of the area and form an extra value to its surroundings by creating new public space.

The Children's Library will be designed in accordance with social sustainability design guidelines, focusing on user experience and strengthening the society.

Design criteria

RESPECTING THE URBAN CONTEXT

- Building form fitting into the urban context.
- Utilising cityscape advantages such as views.
- Creating new public outdoor space, attractive for the neighborhood and activating local society.

ARCHITECTURAL EXPRESSION

- Designing an inviting building form with open and transparent groundfloor.
- Providing layout flexibility through open spaces.
- Providing variety of spaces for different activities and children's needs.

USER'S WELL-BEING

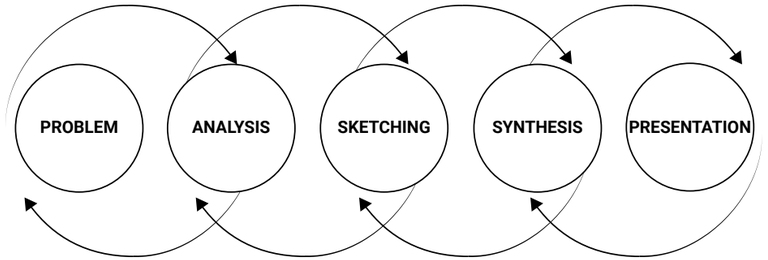
- Sufficient daylight in working spaces, avoiding direct sunlight and glare.
- Designing playful spaces, stimulating creativity and physical activity.
- Utilising natural ventilation as a passive cooling strategy.

ENERGY EFFICIENCY

- Designing compact form of the building.
- Utilizing wind for natural ventilation.
- Utilizing solar radiation as energy source.
- Orienting glass openings to avoid overheating.

05

Design process



Ill. 38: A scheme representing the idea of the integrated design process

Integrated design process

Within the design process three main phases can be distinguished:

1. Building form conceptual design
2. Layout development
3. Building design optimization

While working on initial building form, the few options, very different from each other, has been analysed through sketches, volume studies and simulations, in order to investigate the opportunities and challenges of the site, climate and find the general direction of the design, in accordance with the design criteria.

When the concept has been chosen, the layout development phase lead to reviewing the form in regard to functional and structural challenges.

The aim of the optimization was to improve and maximize the potentials of the indoor environment conditions and energy performance of the building, through layout, facade design and technical design decisions.

Throughout all the phases, the method of integrated design process has been used, where the nine parameters have been continuously considered and analyzed simultaneously - urban context, energy consumption, daylight, function, solar radiation, wind, shadows, thermal comfort, air quality and acoustics.

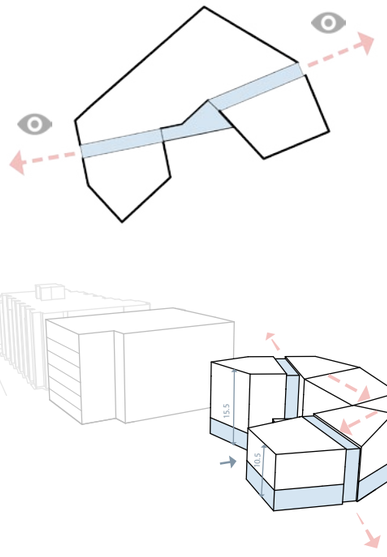
Ill. 39: Design parameters

Urban context

DESIGN GOALS
- utilising views
- creating new public space
- aligning to the existing buildings in terms of building scale, shape and materiality

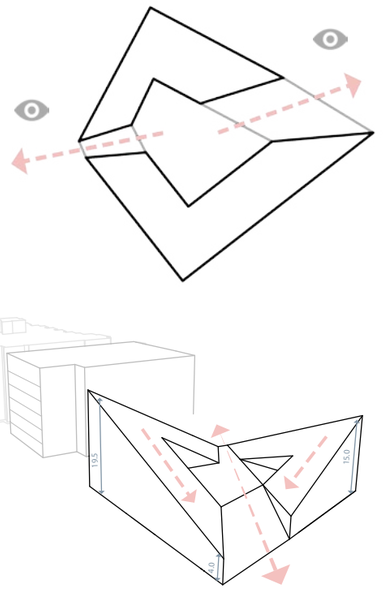
SCOPE OF ANALYSIS
The analysis has been done through mapping of the composition and valuable urban elements, views, history and spirit of the place, social and cultural environment of the area as well as existing greenery and infrastructure. All the aspects had an influence on the ideas developed through sketching and 3D modeling.

CONCEPT 1: *THE SLIDE*



The concept inspired by playground and the slide for children, formed by gradually "sliding" roof. The walls are facing important city elements, to create the views within the interior. Building shape also creates semi-courtyard, which would function as new public space.

CONCEPT 2: *THE PYRAMID*

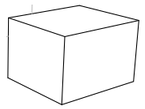


The main aim of the concept is to emphasise the perception of the city dominants in the urban scale through the roof sloping down the view corridor. All the facades are aligned to surrounding buildings and streets to maintain the urban harmony.

Energy consumption

DESIGN GOALS / REQUIREMENTS
The low energy requirement is 33 kWh/m^2 year according to Be18.

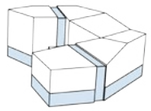
SCOPE OF ANALYSIS
The calculation has been done with the use of Be18 software and the Danish weather data, analogous to Polish, due to the lack of access to the Polish weather data file.
All three building forms have comparable heated area (~2,800 m^2) and the glazed area (~20% of the facade). The estimation does not include the energy use for the operation of the building.



SIMPLE BUILDING FORM
The simple building form shows the best energy performance with the 16.9 kWh/m^2 year.
The result is due to the highly compact geometry and limited area of external building components, such as roof and external walls, which provide low heat losses.

BE18 KEY NUMBERS

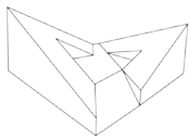
Total energy demand	**16.9 kWh/m^2**
Contribution to energy requirement	
Heat	7.9
Excessive in rooms	9.1
Net requirement	
Room heating	7.9



CONCEPT 1
The concept 1 represents the less compact form which is still low energy, only slightly higher - 17.8 kWh/m^2 year.

BE18 KEY NUMBERS

Total energy demand	**17.8 kWh/m^2**
Contribution to energy requirement	
Heat	11.8
Excessive in rooms	5.9
Net requirement	
Room heating	11.8



CONCEPT 2
The concept 2 form occurs less energy efficient, with the yearly energy consumption 30.4 kWh/m^2. The form marks with large areas of external building components, which cause heat loss, as well as many openings towards south, which cause excessive heat in rooms and would rewuire energy for cooling. The geometry does not fulfill the low energy frame requirement.

BE18 KEY NUMBERS

Total energy demand	**30.4 kWh/m^2**
Contribution to energy requirement	
Heat	14.8
Excessive in rooms	15.7
Net requirement	
Room heating	14.8

Daylight

DESIGN GOALS / REQUIREMENTS
The minimum requirement for the occupied room's glazed area is 10% of the floor area, which shall be equivalent to 300 lux.

SCOPE OF ANALYSIS
The analysis has been done with the use of the Velux Daylight Visualizer.
The analysis for three of the concepts has been undertaken on the groundfloor - the level with the least access to sunlight. The analysis shows the average daylight factor in March at 12.00.

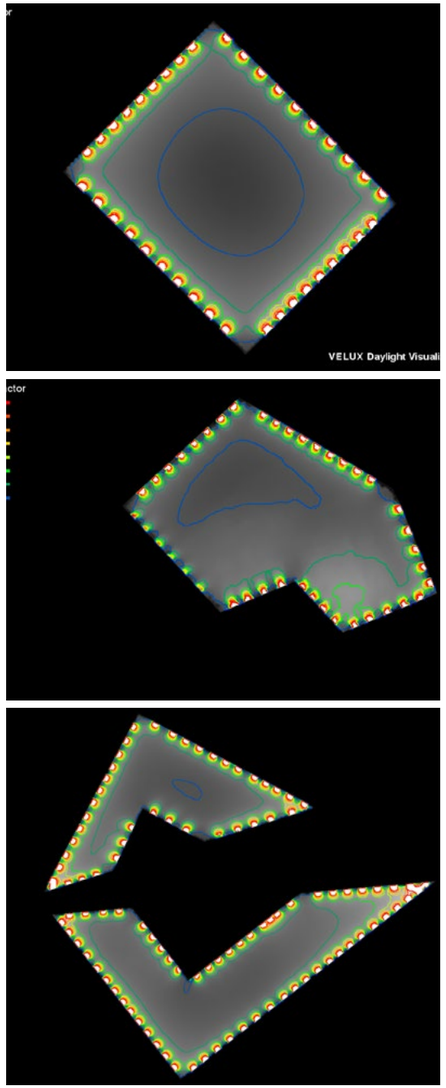
LEGEND

Daylight Factor
- 8.00
- 7.00
- 6.00
- 5.00
- 4.00
- 3.00
- 2.00
- 1.00

SIMPLE BUILDING FORM
The average daylight factor is relatively low, reaching 1.8 in overall and 0.4 in the central space.

CONCEPT 1
The building depth is smaller, therefore the average daylight factor in the whole space is 2.0. The central part of the building has 1.1.

CONCEPT 2
The average daylight factor for this concept is the highest, with 2.9 in the whole space and 1.3 in the central part of the building.



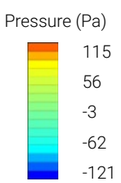
Ill. 40: Initial daylight analysis

Wind

DESIGN GOALS / REQUIREMENTS
A building form optimized in terms of natural ventilation use.

SCOPE OF ANALYSIS
The analysis has been done with the use of the Autodesk Flow Design, in order to assess the potential of the use of natural ventilation through wind pressure differences, with a consideration of the most common western wind in Poznan with the speed of 10 m/s.

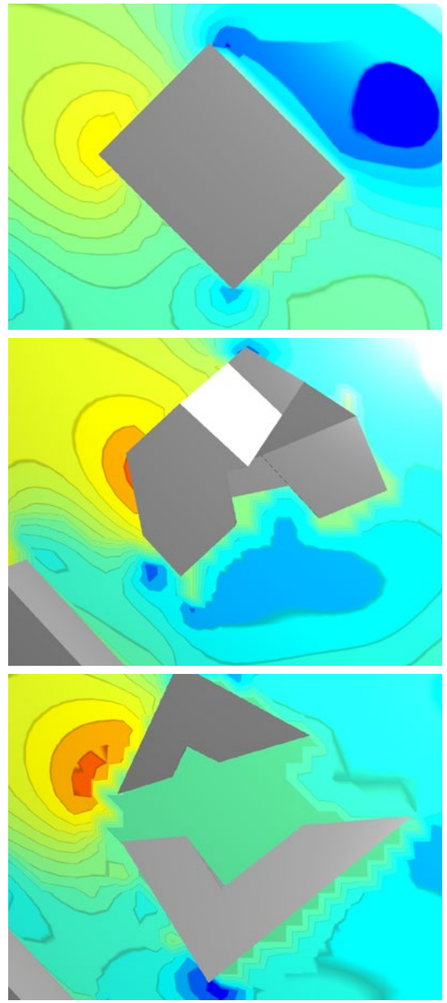
LEGEND



SIMPLE BUILDING FORM
The western wind creates a high positive pressure on the western corner of the building. The most negative pressure is created on the north-east facade. The analysis shows that the southern part of the building would have low chances of benefitting from the natural ventilation driven by the wind.

CONCEPT 1
The wind generates a high positive pressure on the north-east facade and the most negative pressure is created on the south west facade, which gives good conditions for benefitting from the natural ventilation driven by the wind.

CONCEPT 2
A high positive pressure is formed on the north-east facade, and the negative pressure occurs on the south corner of the building. However, the “courtyard” between the two buildings has a neutral pressure, which makes it diffucult to use a natural ventilation driven by the wind.



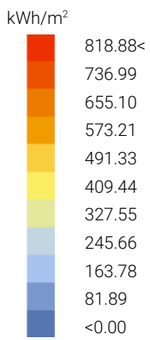
Ill. 41: Wind analysis

Solar gains

DESIGN GOALS / REQUIREMENTS
A building form optimized in terms of gaining solar energy, thermal mass and overheating prevention.

SCOPE OF ANALYSIS
The analysis has been done with the use of the Ladybug and Honeybee software.
The analysis helps to assess the risk of overheating and the potential of gaining solar energy on building surfaces.

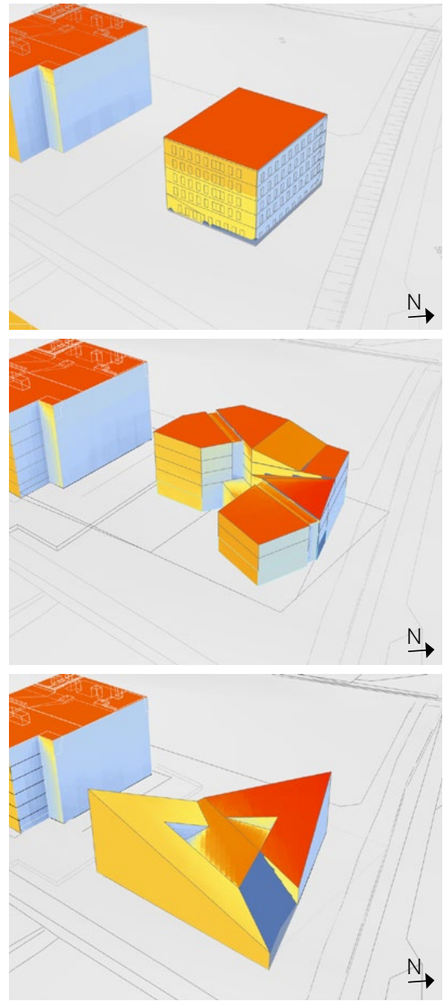
LEGEND



SIMPLE BUILDING FORM
Simple form of the building has provides 580 m² of highly radiated roof, which could be utilised for mounting solar panels. Since south-east and south-west facade are highly exposed, the openings might contribute into overheating.

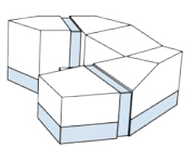
CONCEPT 1
The building form generates more area (1,817 m²) of highly radiated roof and provides various roof angles, which could be utilised for intalling solar panels. At the same time, there is less external walls exposed to the south, which could cause overheating.

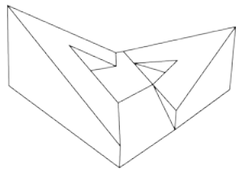
CONCEPT 2
The concept provides many radiated surfaces, although just the top roof level, with an area of 300 m², would perform efficient. The building also has a lot of wall surface oriented towards the south, therefore there would be a risk of overheating.



Ill. 42: Solar radiation analysis

Sub-conclusion

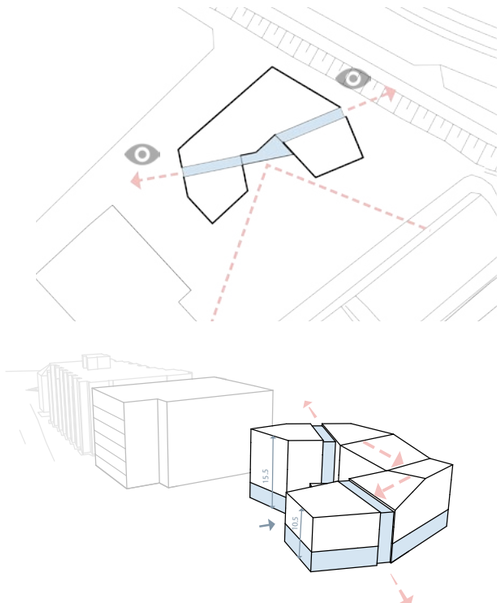




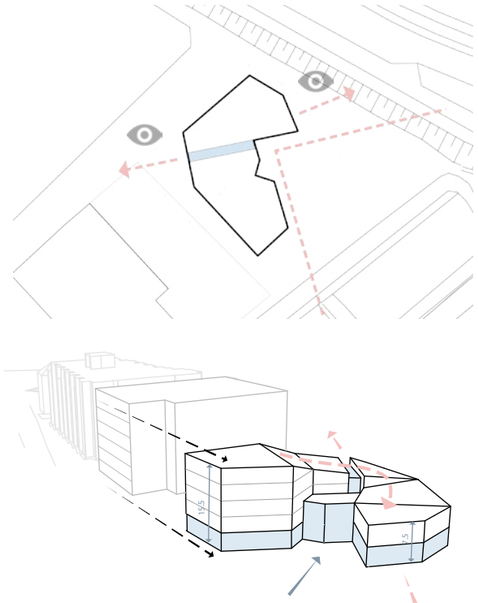
CONCEPT 1	CONCEPT 2
• The building form is compact, which provides high energy efficiency • The daylight factor could be improved by decreasing the building depth or designing skylights and double height spaces • The concept has a high potential of utilising natural ventilation effectively with the strong western wind • The orientation and shape of the building minimizes the risk of overheating; the sloping roofs can be utilised for gaining solar energy	• The building form has much higher energy performance • The daylight factor is higher due to decreased depth of the building • The potential of utilising natural ventilation through the wind effectively is relatively low • The orientation and shape of the building creates the risk of overheating

Concept development

In consequence of the analyses, the *concept 1* has been chosen for the further development. In the next step, the attempt to align the building to the neighbouring buildings resulted in rotation. The new form preserves the principles of the views towards cathedral and old town and opening towards a new public space.



Ill. 43: Concept 1.1



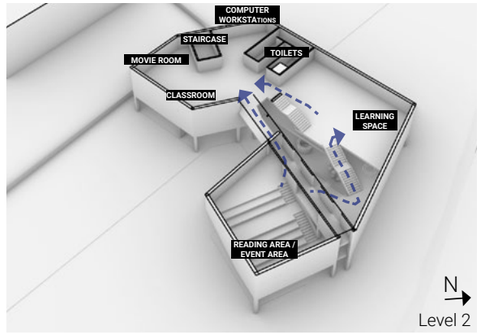
Ill. 44: Concept 1.2

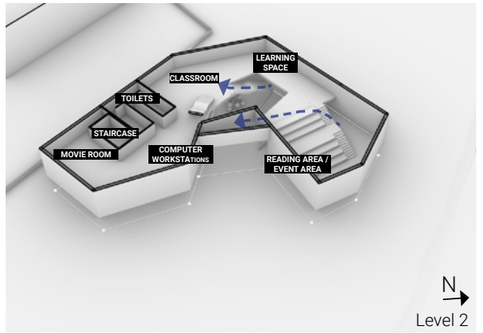
Spaces and functions

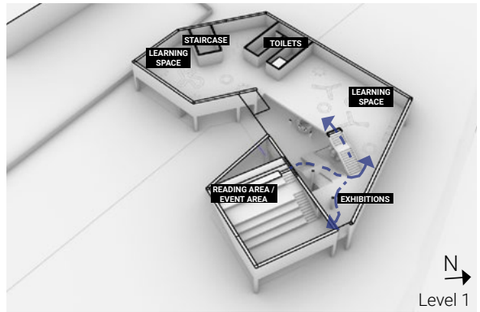
DESIGN GOALS
- providing views
- providing layout flexibility through open space
- providing variety of spaces
- atrium and stair communication as central element of the building
- transparent groundfloor and easily readable transit

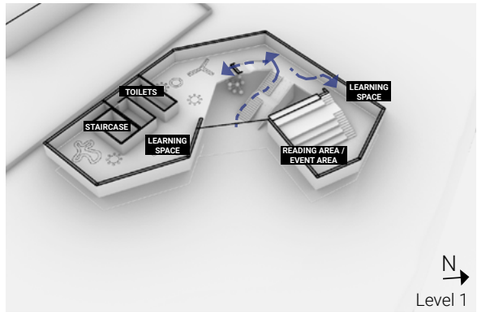
SCOPE OF THE STUDY
Following the function diagram developed after research and site analyses.
The layouts developed in steps:
1. Outlining view corridors
2. Defining main stair as central element
3. Defining entrance
4. Placing cores (staircase and toilets)

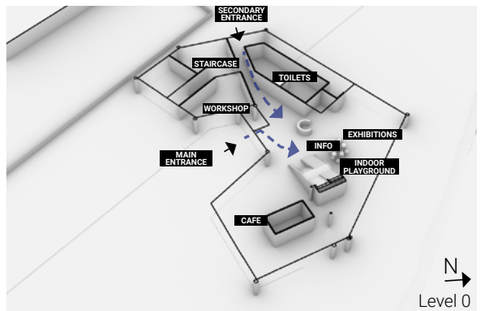
OUTCOME
The spaces on the groundfloor work better in the concept 1.2, where the foyer is clearly condensed in the center of the building, between two entrances. However, the layout of the library on levels 1-2 is more spacious in the concept 1.1.

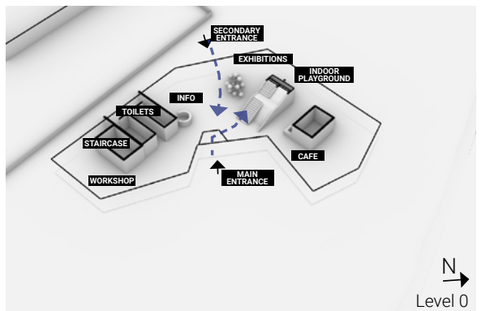












Ill. 45: Diagrams of the interior spaces for concept 1.1

Ill. 46: Diagrams of the interior spaces for concept 1.2

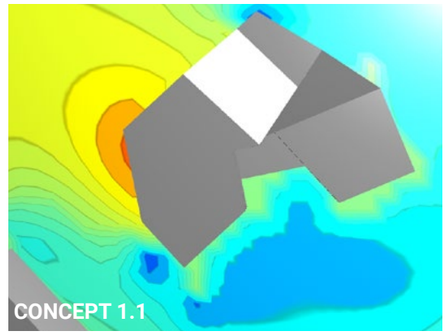
Wind

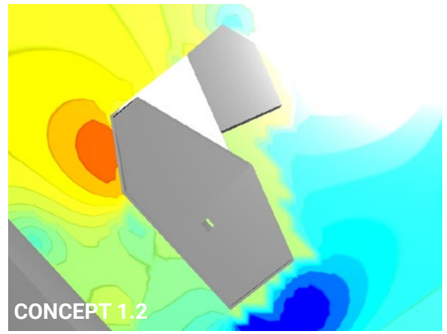
PURPOSE OF ANALYSIS
Investigation of which option works more efficiently in terms of potential natural ventilation use, as well as in regard to the usage of outdoor spaces.

LEGEND

Pressure (Pa)

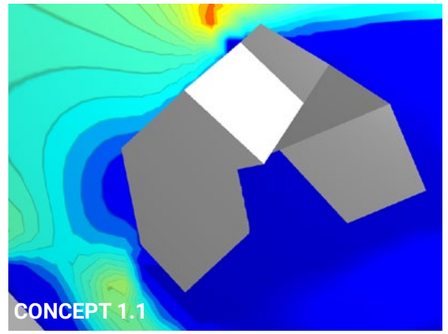
Velocity (m/s)

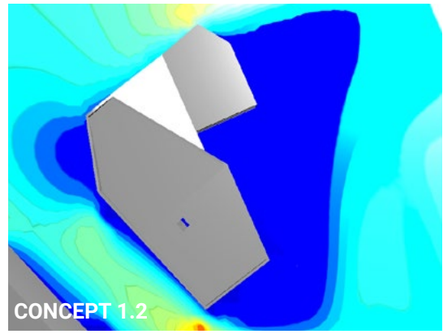




Ill. 47: Wind pressure comparison

WIND PRESSURE
Both options work in similar way, however, the concept 1.2 has bigger differences in positive and negative pressure - therefore the ventilation forced by the wind would be more efficient.





Ill. 48: Wind velocity comparison

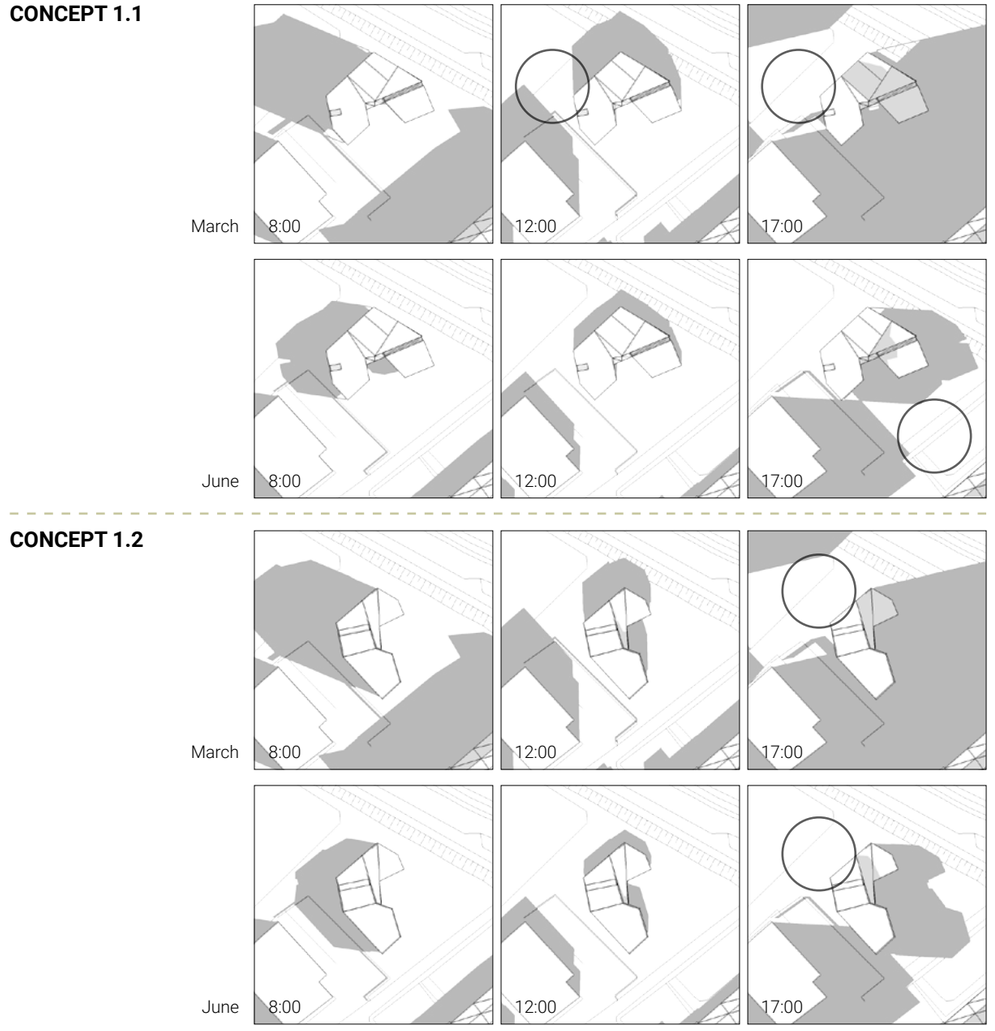
WIND VELOCITY
In both concepts, the wind weakens in the south-east part of the outdoor space, however, the building form 1.1 seems more effective.

Shadows

DESIGN GOALS
Providing outdoor space, which could be a new public area, for users of different ages, with as much sunlight as possible. At the same time, limiting the amount of direct sunlight getting into working and reading spaces in the building.

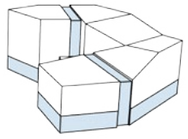
SCOPE OF ANALYSIS
The analysis has been done with the use of the SketchUp software supported with information from the geo-location.
The analysis allows to investigate which parts of the building are shaded by other buildings or how the building shades itself and surrounding outdoor spaces. Presented illustrations show analysis during spring, summer and autumn (the shadow analysis for autumn and winter can be found in Appendix 1).

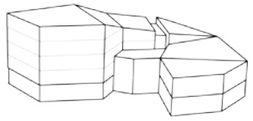
OUTCOME
The building is shaded mostly in the afternoon for both concepts - shading from another building for the southern part of the library and self-shading in the northern part. The building is facing unshaded outdoor area from the north-east in the afternoon, which could be used for designing playgrounds for children.



III. 49: Shadow analysis

Sub-conclusion





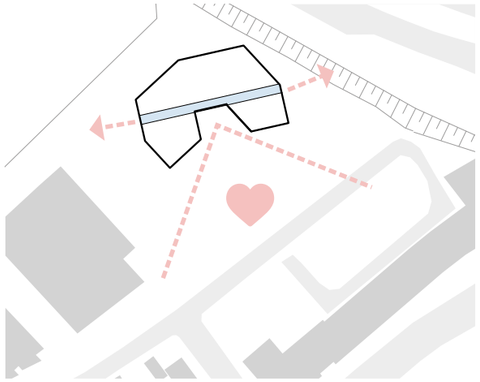
CONCEPT 1.1	CONCEPT 1.2
PROS: • creating larger outdoor space for public; • more inviting form towards neighbourhood • emphasizing the views towards cityscape dominants through the building form; • provides more views for the residential building on the neighbouring site. **CONS:** • does not fully align with the neighbouring building • requires improvement on the groundfloor layout • requires solving structural problems	**PROS:** • aligned with neighbouring building • providing views for most parts of the building • the idea of building as a transit between neighbourhood and future park is easily readable on the groundfloor plan **CONS:** • the learning spaces on upper floors require spacial improvement • the idea of creating view corridors within the building does not work out • covers views towards cathedral for the neighboring building

Building form and layout optimization

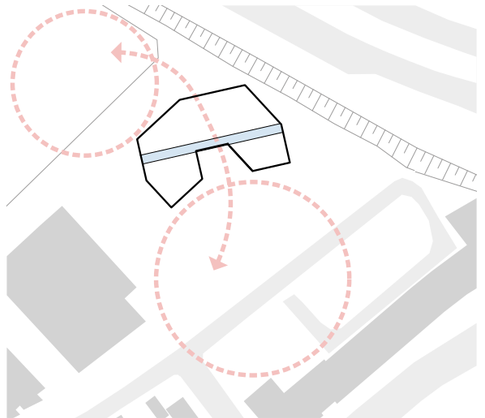
The concept 1.1 has been chosen for the further development.

The building form has gone through redesigning process, where the initial ideas and goals where intended to remain. The reasons for further development:

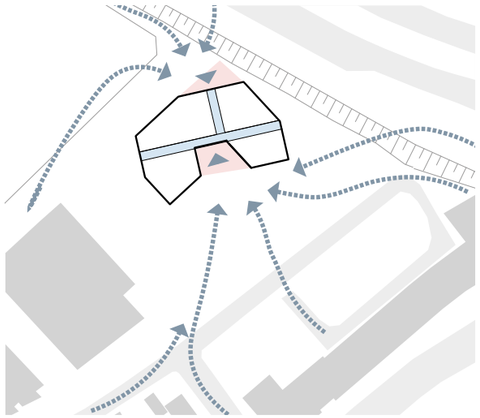
- finding structural principle
- optimizing daylight without increasing glazed area
- reviewing location of functions
- creating more opportunities for creating views



Ill. 50: Conceptual sketch - utilising views



Ill. 51: Conceptual sketch - creating transit



Ill. 52: Conceptual sketch - access

Daylight optimization

PROBLEMS TO SOLVE
Excessive sunlight on the grounfloor, especially cafe space, with large glass facade towards south. Insufficient daylight factor in learning spaces on levels 1 and 2 (DF = 1.0-1.2%).

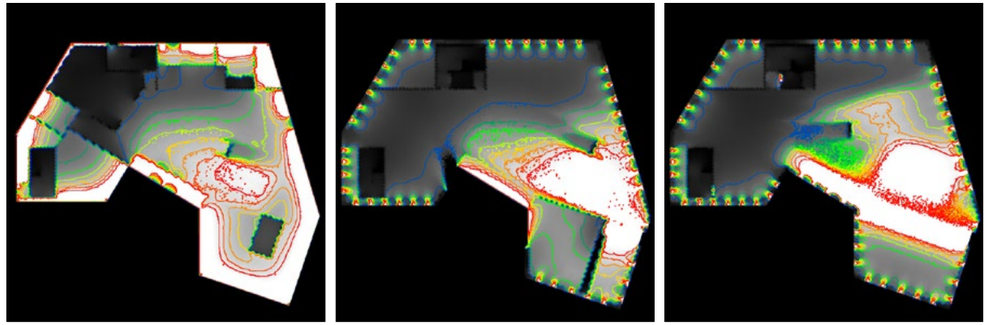
STEPS UNDERTAKEN
1. Optimizing building form in terms of building depth
2. Modifying building layout - relocation of the cafe and event space
2. Designing skylights with louvres for direct sun and glare protection
3. Developing facade module and openings in regard to rooms' functions and daylight conditions requirements

OPTIMIZATION OUTCOME
The indoor spaces get more diffused light into spaces. The light is distributed more evenly and the daylight factor is higher (for full daylight simulation after optimization refer to Appendix 2).

LEGEND

Daylight Factor
- 8.00
- 7.00
- 6.00
- 5.00
- 4.00
- 3.00
- 2.00
- 1.00

BEFORE OPTIMIZATION

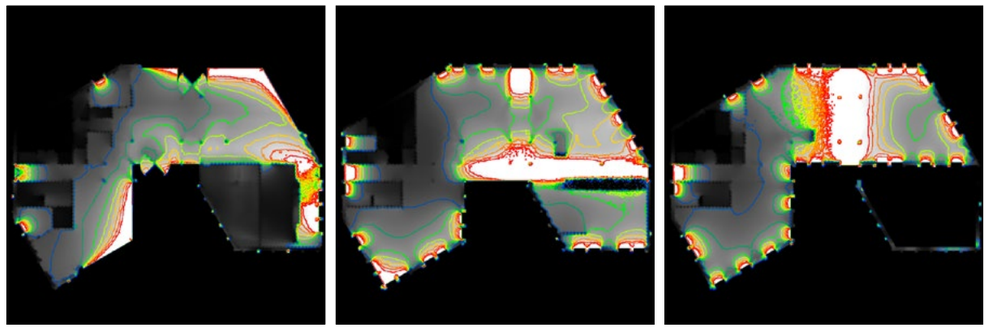


LEVEL 0
The library foyer - 5%
Cafe - 8.5% (excessive sunlight)
Workshop spaces - 4.2%

LEVEL 1
Library spaces - 1.0-1.7%

LEVEL 2
Library spaces - 1.0-2.2%
Event space - 7.2%

AFTER OPTIMIZATION



LEVEL 0
The library foyer - 3.9%
Cafe - 2.6%

LEVEL 1
Library spaces - 2.5-4.8%
Event space - 3.0%

LEVEL 2
Library spaces - 2.1-5.3%

Ill. 53: Daylight analysis

Facade development

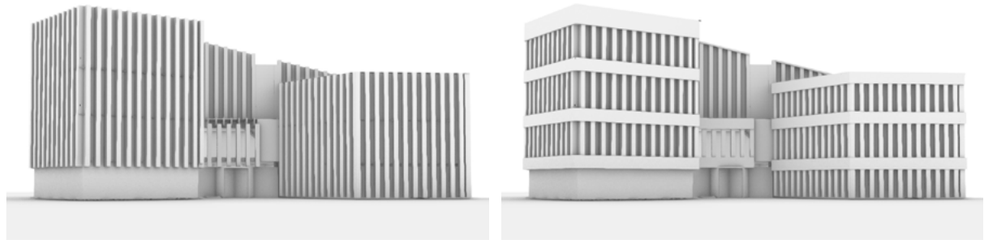
DESIGN GOALS

The aim is to design a facade, where:

- *verticality* is dominant, which provides good sun protection on east and west facades and visually elongates the building;
- features *flexibility*, which means it will consist of different panels, with different properties, fitting into the same module and provide different sun permeability, as well as possibility of controlling solar shading;
- associates with *nature* - made from environmentally friendly materials, such as wood.

OUTCOME

The study gave a great understanding of how different composition of the facade is perceived and helped to make a decision about the final expression of the building in terms of composition and materiality of the facade.



Ill. 54: Facade composition study

Ill. 55: Facade materiality study

Thermal comfort and air quality optimization

DESIGN GOALS / REQUIREMENTS

The aim temperature of the indoor spaces is above 20^{o}C, where maximum 100 hours per year above 26^{o}C and maximum 25 hours per year above 27^{o}C.
The recommended temperature range in winter is 20-25^{o}C and in summer is 23-26^{o}C.

The maximum CO_2 concentration of 850 ppm (500 ppm above the outdoor level) in the indoor spaces.
(DS/EN 15251)

Values for the air change rate for specific rooms can be found in Appendix 5.

SCOPE OF ANALYSIS

The analyses are done through calculation of 24-hour average temperature and simulation in BSim. This has been done for the administration open office space, considered the most critical in the building, due to its location on the top floor, southern orientation with openings facing the south (see Appendix 3 for BSim results).

THE GLASS OPENINGS AND NATURAL VENTILATION STUDY

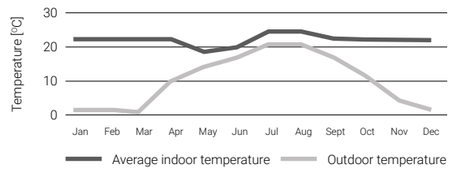
For better thermal, atmospheric and energy performance, the areas of glass openings on the facade has been limited. This helped to avoid overheating during summer and limit the heat loss during the winter. For the best efficiency of natural ventilation, the orientation and number of openings has been analysed and dimensions of the window openings has been calculated (see Appendix 4 - Natural ventilation calculation).

Ill. 56: Facade before optimization

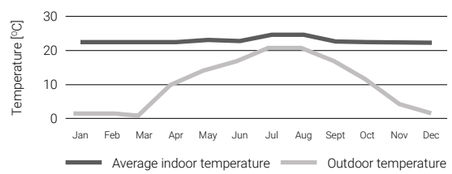
Ill. 57: Facade after optimization

THE NATURAL AND MECHANICAL VENTILATION USE

Initially, the mechanical ventilation had been designed to run between October-April and natural ventilation between May-September. The simulation has shown that the indoor temperatures in May are below 20^{o}C, therefore the requirement for the heating in May is larger than expected. The use of natural ventilation during the heating season is not energy-sufficient. Therefore, mechanical ventilation has been designed for May as well, and the natural ventilation will be used from June until September, when the heating supply is not needed in order to maintain indoor temperatures above 20^{o}C.



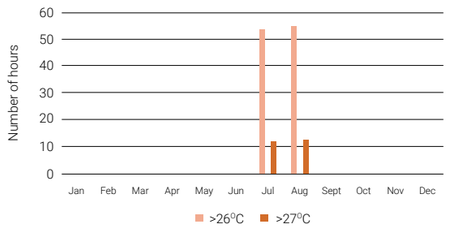
Ill. 58: Temperatures before optimization



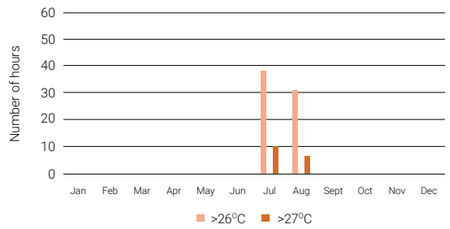
Ill. 59: Temperatures after optimization

IMPLEMENTING SOLAR SHADING

In order to achieve maximum thermal comfort for the users, some of the openings will be equipped with external solar shading system. The simulations have shown that implementing solar shading protects from the excessive solar heat gains during summer, therefore lowers the indoor temperature. In the result, the number of hours above 26^{O}C during the year has decreased from 110 to 69, and the number of hours above 27^{O}C has decreased from 25 to 17.



Ill. 60: Number of hours above 26^{O}C and 27^{O}C before implementing solar shading



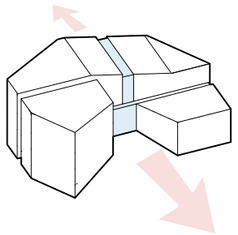
Ill. 61: Number of hours above 26^{O}C and 27^{O}C after implementing solar shading

06

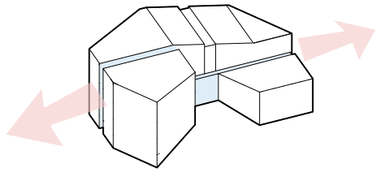
Presentation

Concept

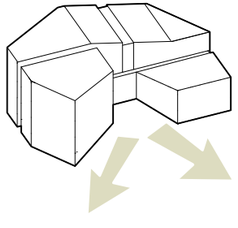
BUILDING AS A TRANSIT
The building is located between Chwaliszewo neighborhood and former riverbed which is planned to become a future park, with the city center behind it. The building could be an important spot merging the two city areas.



EMPHASISING VIEWS
The building form has been designed to utilise the views towards two important city dominants - The City Hall and the Cathedral.



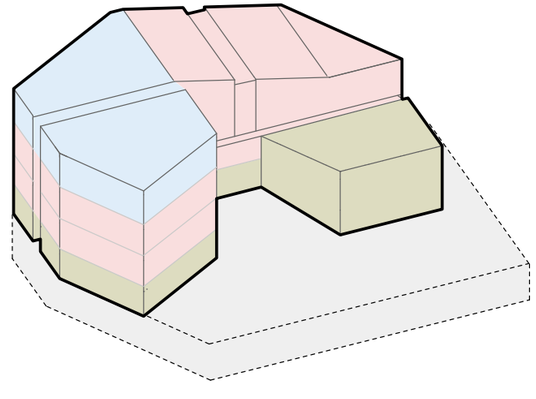
OPENING TOWARDS THE NEIGHBORHOOD
The shape of the building is opening up towards the Chwaliszewo district to clearly establish inviting entrance for the local residents.



Ill. 62: Concept diagrams

FUNCTIONAL ZONES
The building is divided into four zones. The library foyer is the most public, established on the grounfloor, and its role is to encourage people to explore the building through public events, exhibitions and spaces for children to play. The main library space is located on upper levels, with the largest spaces oriented towards the north, to provide more intimate and comfortable environment for children to learn. It offers a variety of spaces for different kinds of learning activities. The administration is the zone is on the top floor, where the staff can manage the library. The back of house is in the basement, where storage rooms, service rooms and underground parking can be found.

Library foyer
Main library space
Administration
Back of house

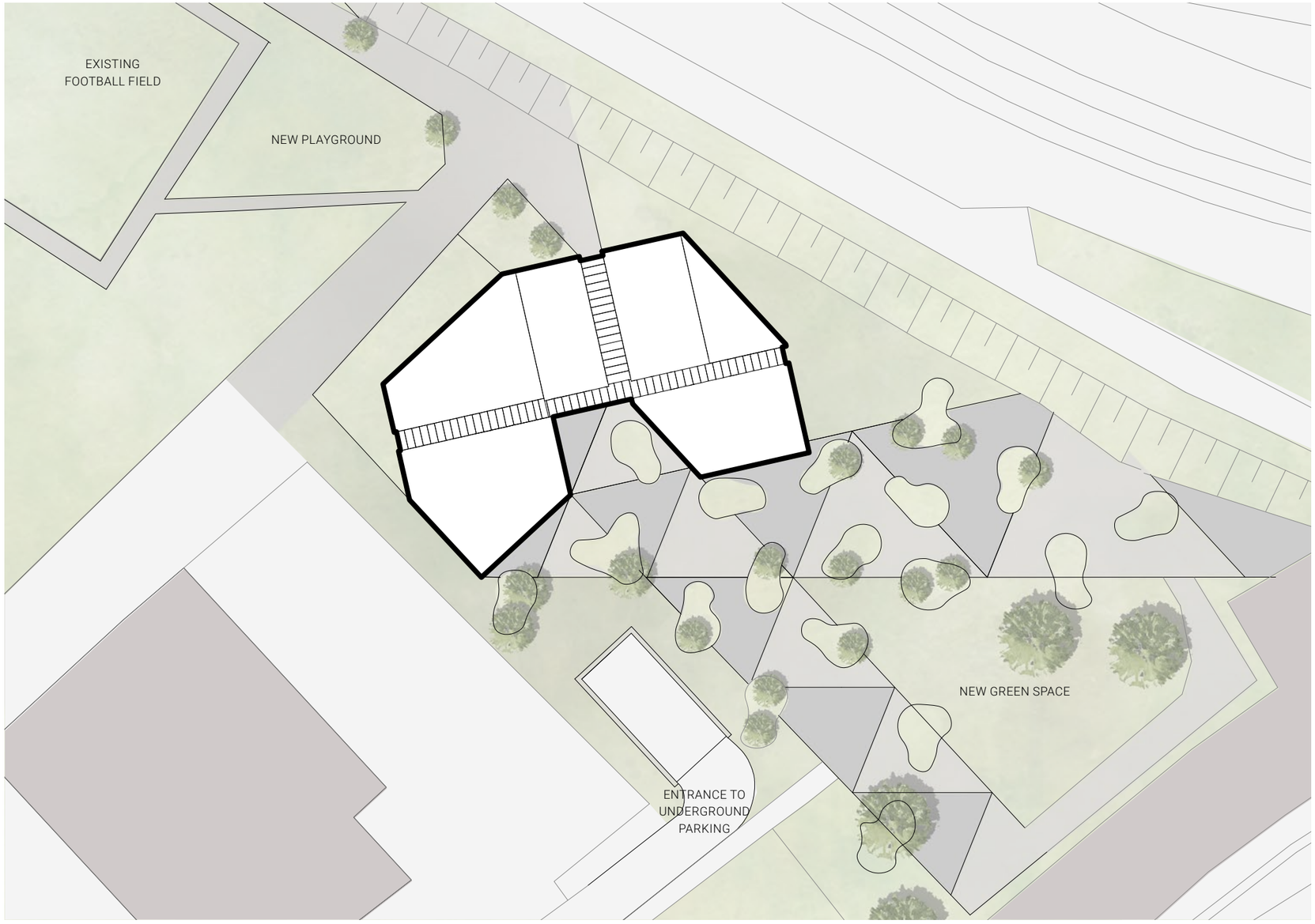


Ill. 63: Functional zones

Site plan

Centrally located, but at the same time, peaceful area with a historical soul and unusual cultural potential – that is how the location of children's library on Chwaliszewo feels like.

The building is surrounded by entirely new green area, coping the end of the Wenecjanska Street and sheltering it from the artery road. The secondary entrance, a bit more intimate in a form, enables the connection with the existing football field and designed playground for children, which will be full of sun during afternoons.



Ill. 64: Site plan, 1:500

The public space

The library interacts with the surroundings through its function and form. The building is opening up towards the neighbourhood, establishing the main entrance in a welcoming way with a broad green area, which functions as a noise and pollution buffer between the neighbourhood and the main road. It occurs as an attractive outdoor green space with a unique view towards the cathedral.

The new cultural place has a mission of creating and strengthening social interaction between families and boosting curiosity of children.

Ill. 65: View from the south-east

The library foyer

The library foyer is merging with the outdoors through its transparency and function. It is a place, where families can meet in the café or participate in an event and children take and advantage of common playful areas. They can also find there the interactive book machine, which displays available books, e-books and audiobooks, as well as allows to play the interactive educational games.

The groundfloor is transparent through the glass facades, which enables potential visitors and local residents to find out what is happening from the outside and helps to encourage them to explore the building in the inside and start the journey of knowledge and culture.

Ill. 66: The library foyer, floor plan, level 0

The event space

The event area is a special place, established right towards the marvellous view of the cathedral. During the regular opening hours, the space is an informal setting for reading and studying. In the afternoons, it becomes a cultural center of a library, hosting the events for families, such as meetings with authors, teachers or other representatives of culture and knowledge.

Ill. 67: The event space

The learning space

Learning spaces are established on two floors, where the first level is destined for primary school children and kindergarten.

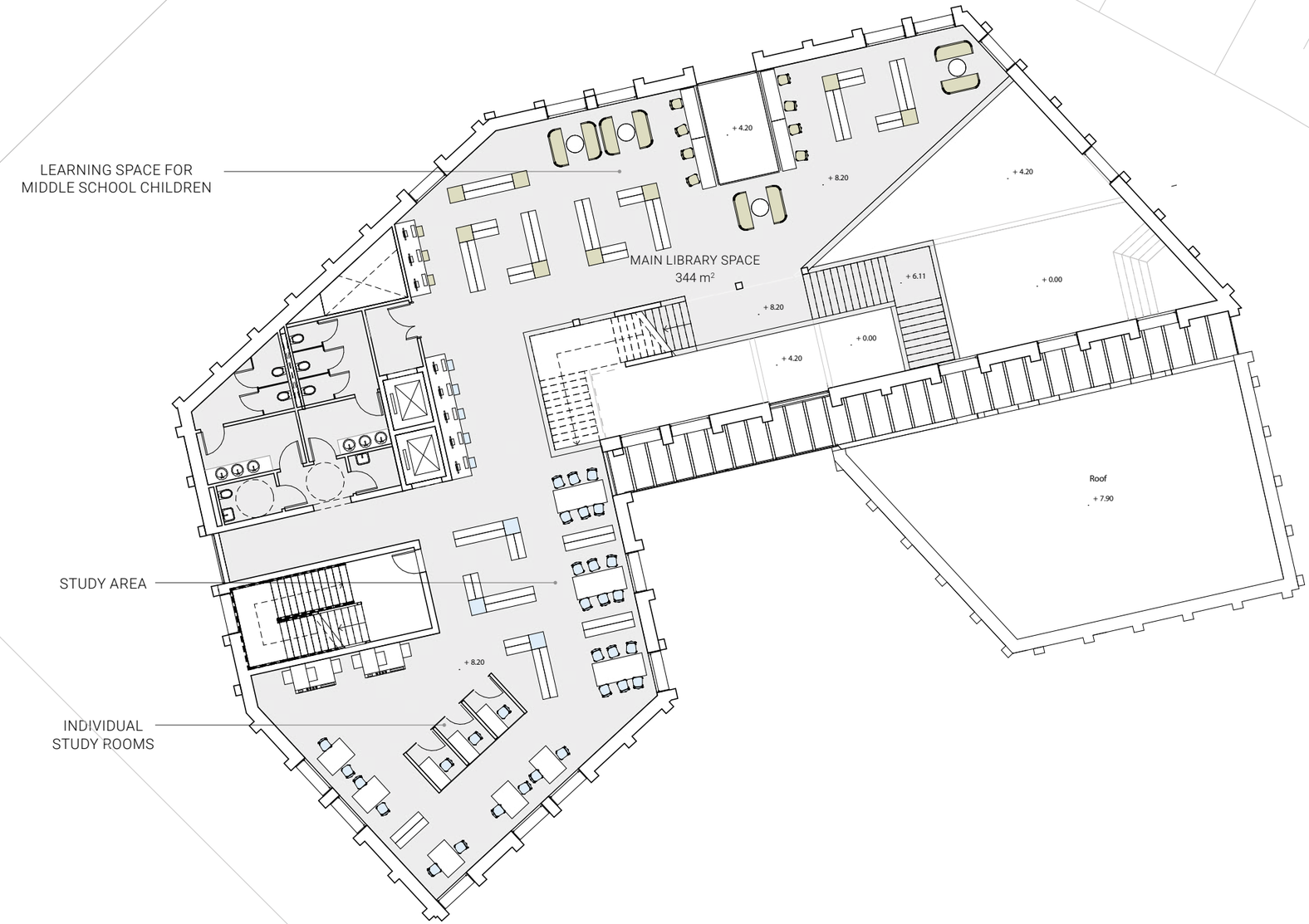
The space for the youngest children has been designed to offer a variety of possibilities for learning, from learning in concentration, creative and experimental to physical activities.

The learning area for primary school children offers more study areas surrounded by book collection, where the spaces are designed to appear informal, comfortable and multifunctional. All the bookshelves have the children's size, to allow them see them and reach them.

Ill. 68: The learning space, floor plan, level 1

The learning space

The learning space for middle school children accommodates large book collection and offers a great variety of study areas, where both groups and individuals will find a place to concentrate.

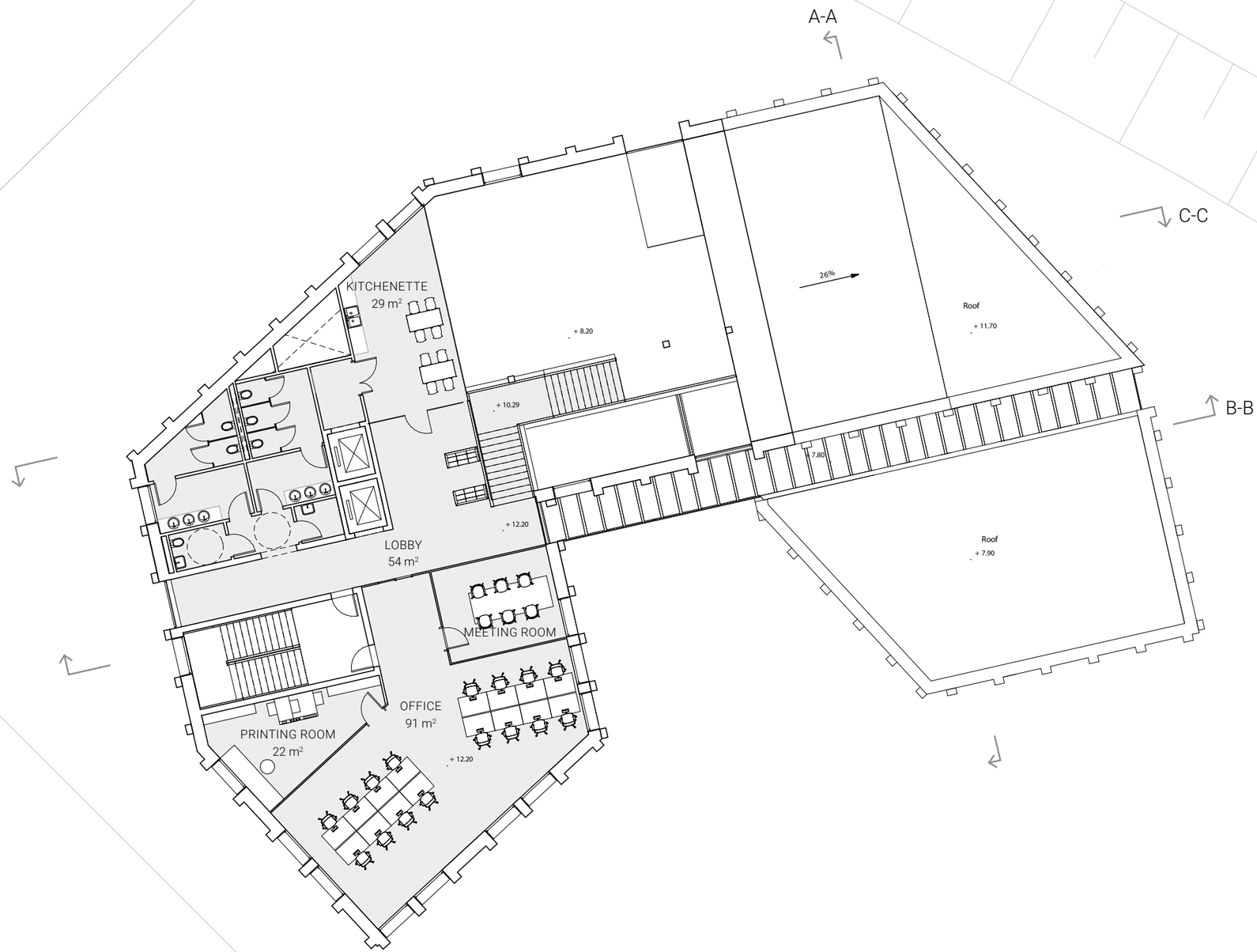


Ill. 69: The learning space, floor plan, level 2

The administration

The third floor is the office for staff - both librarians and administration. The kitchenette has a function of the staff room, where the employees can have a lunch or coffee break, with a view towards the learning spaces.

The administration floor has also a meeting room for the office, as well as printing room, where librarians can print out posters with announcements for library users. It is also a place, where small book damage can be repaired.



III. 70: The administration, floor plan, level 3

The back of house

In the basement, the underground parking area has been designed, with twenty-six parking lots, for both staff and families, coming to the library from further places.

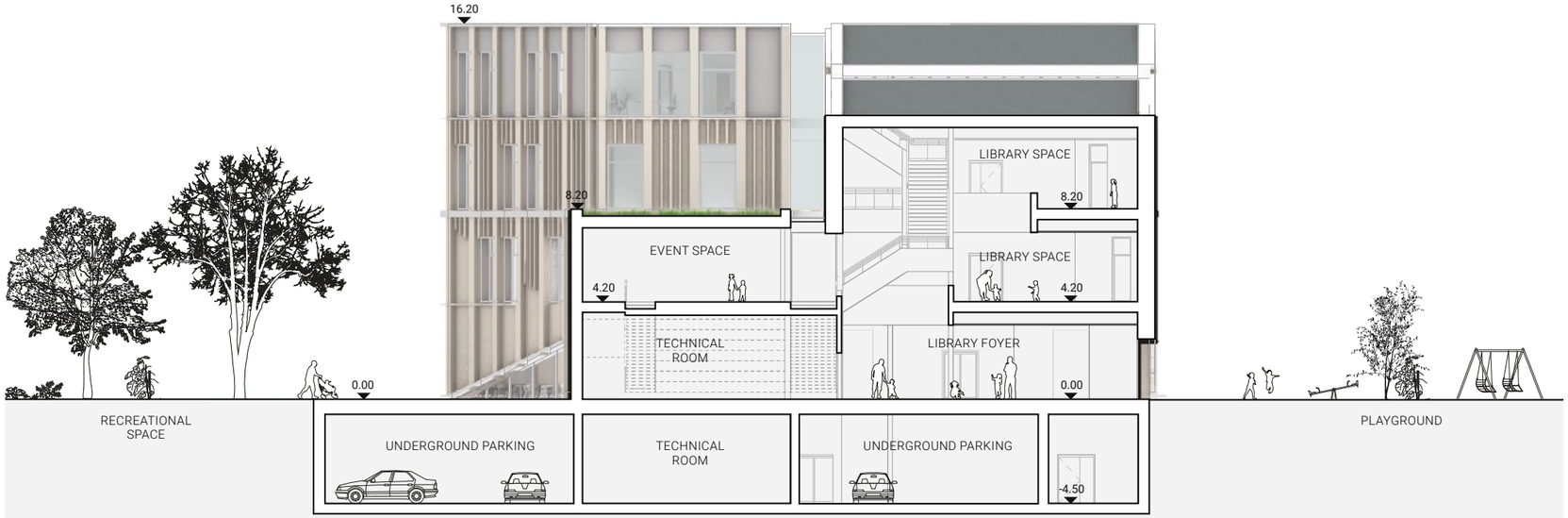
There is also a book storage and archive, which can be accessed only by library staff, through a separate elevator.

Ill. 71: The back of house, floor plan, level -1

The transit

The building creates a transit between Chwaliszewo district and the city center. The main entrance to the library is framed by the high greenery and broad recreational space.

On the opposite side of the library, the mostly sunny outdoor space during the afternoon hours, is the great place to accommodate the areas for children to play, which will connect the building with the existing football field and will fuse the building mission of the active learning with the physical activity.



Ill. 72: Section A-A, 1:250

The atrium

The library spaces are accumulated around the small atrium with the main central staircase. The learning spaces are designed with bright and warm colours, to maximize the sunlight from the glass openings and skylights in the central space.

The rising stair flights are following the rising height of the building, where the learning spaces can be easily perceived from. This helps to have an overview of the different zones and find a way around within the library. Easy navigation is crucial for new visitors and especially for the youngest users to feel comfortable within the building.

The administration staff, located on the last floor, can observe the library spaces from the lobby and kitchenette.

Ill. 73: View from the administration level towards the library spaces

Interior design

The indoor materials determine the quality of interior spaces. The goal of the interior design is to make spaces perceived pleasant aesthetically, tactilely and acoustically. Therefore, the wooden elements are instrumental, due to its porous, rough and warm surface.

Solid wood, as an element of interior design, in a form of a board mounted on the wall or floor, has effective sound absorbing properties, due to its surface structure and elasticity. Moreover, it gives sounds extra warmth feeling (Pollmeier, no date).

The furniture is designed to provide flexibility and comfort of the spaces - for learning and playing. The furniture is oval to ensure the safety of usage for the youngest users. Mellow colours of wooden furniture are supplemented with vivid elements, such as colourful seating, associated with the theme of the space, to make the library more vibrant and attractive for its users.

Ill. 74: The learning space for primary school children

Indoor environment

DAYLIGHT

The visual comfort is crucial in reading and study zones, therefore the learning spaces have sufficient glazed area, in either wall or roof, to provide maintained illuminance of 300 lux or daylight factor above 2%-4% (see Appendix 2). The building has long skylights which provide a lot of diffused light into spaces and the interior spaces are designed with bright ceiling and white-painted walls, to reflect the light in the rooms.

Artificial lighting is designed in accordance with the specific needs of functions within the spaces in a way that the lighting above reading table reaches 400 lux and the light above book shelves is only 100 lux.

The building envelope is mostly oriented towards east and west - this way, the chance of getting the direct sun from south is limited. Moreover, the facade consists of vertical battens, which help to diffuse the sunlight from east and west.

ACOUSTICS

The noise prevention is an important aspect when designing for children, since their high levels of activity can make noise. Therefore, careful design and separation of functional spaces for children of different ages was first of the strategies.

The event area, which can acoustically affect adjacent library spaces, has been designed as separate zone, with its own indoor conditions. Even though the area remains quite open in order to keep it inherent part of the building, it is still possible to close it by curtains.

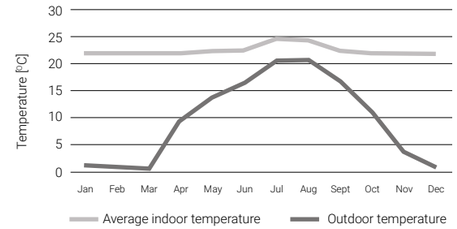
The library consists of open learning spaces, sharing the atrium - with a high risk of distribution of sound. In order to minimize this effect, the open learning areas are designed as quite zones for reading and individual learning. Functional spaces with high level (and noise) activities, such as playful area for the youngest children or group study areas are designed in enclosed part of the building, where the level separation is more effective for noise prevention. Moreover, all the spaces have absorbent panels for acoustic comfort within the room.

THERMAL COMFORT AND AIR QUALITY

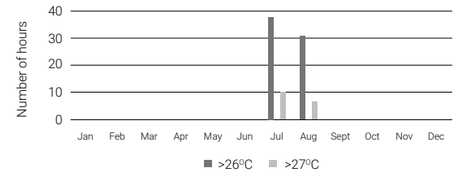
The optimal room temperature and air quality are mandatory aspects to measure in assembly places, such as libraries.

Children's library offers good indoor temperature and fresh air in all the seasons and regardless the amount of users. The building form has been designed to minimize the excessive heat from solar radiation, through decreasing the area of the facades facing the south and orienting the reading and study areas towards the north.

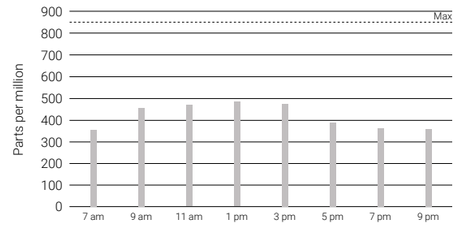
The passive cooling and air change are provided by the natural ventilation in summer and mechanical ventilation in winter. Natural ventilation is forced by the wind, which comes mostly from the west. In order to maximize the potential, the building has several openable roof openings, which will enhance the effect of thermal buoyancy (for natural and mechanical ventilation calculation refer to Appendix 4 and 5; for indoor environment simulation results refer to Appendix 3).



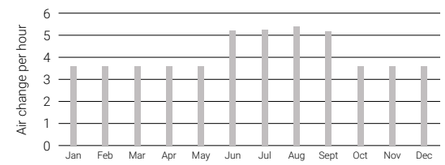
Ill. 77: The operative temperatures during the year



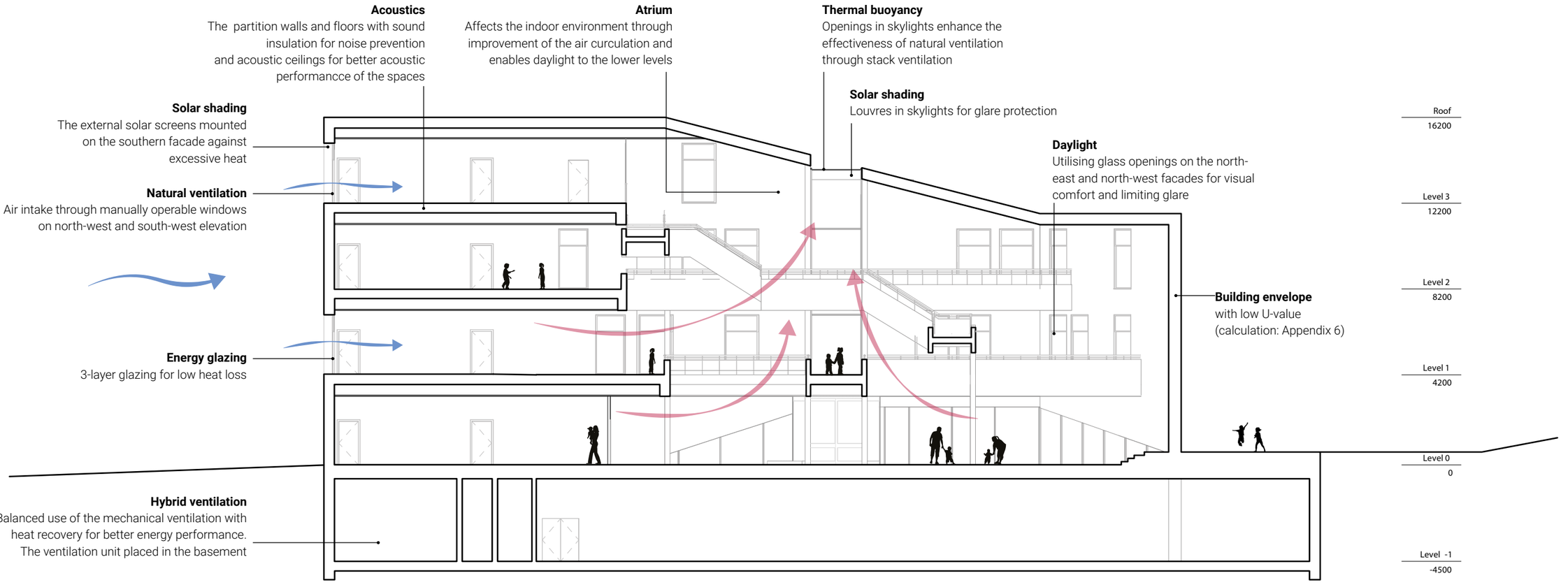
Ill. 78: Number of hours above 26°C and 27°C during the year



Ill. 76: CO_2 concentration during the regular workday in July



Ill. 75: The mean air change per hour during the year



Ill. 79: Section C-C, 1:200

Structure

Despite the fact that most of the contemporary buildings in Poznan are built with concrete as the main construction material, the library's structure has been designed with lightweight and high-performance timber elements.

Roofs and slabs are designed with linear cellular structure elements of spruce timber, which allow to get spans of 12 metres (*Kielsteg – Light and wide*, 2019).

For the beams and floor surfaces, the beechwood laminated veneer lumber (LVL) is used. Beech is the hardwood, which has bigger load-bearing capability than common softwood products, which helps to reduce the sizes of structural elements. This way, the building can gain larger spans and wider spaces, as well the material can be preserved (Pollmeier, n.d.).

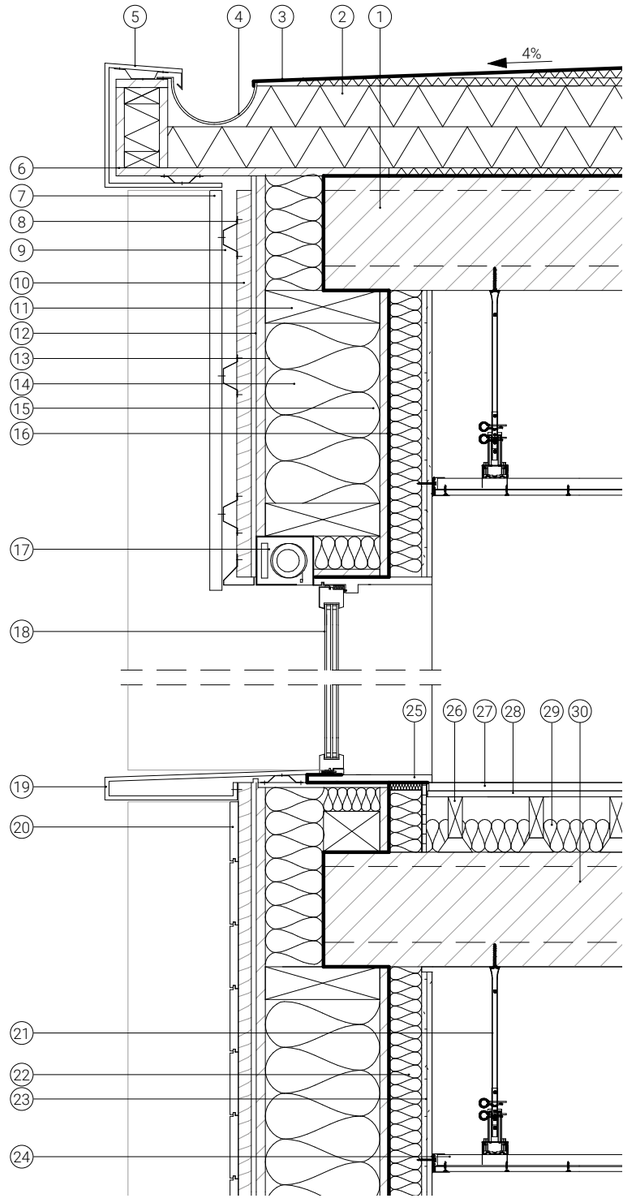
Both spruce and beech grow in central Europe, so the material is locally resourced, therefore the transportation cost and CO_2 emissions are minimized. Wood, growing in the forests, stores greenhouse gas and produces oxygen, which makes it highly sustainable material.

Solid hardwood has also good thermal properties, with a thermal conductivity of 0.2 W/mK, which contributes to limiting heat losses within the building envelope (Herzog *et al.*, 2013; Pollmeier, n.d.; *Wood. Forest. Timber.*, n.d.).

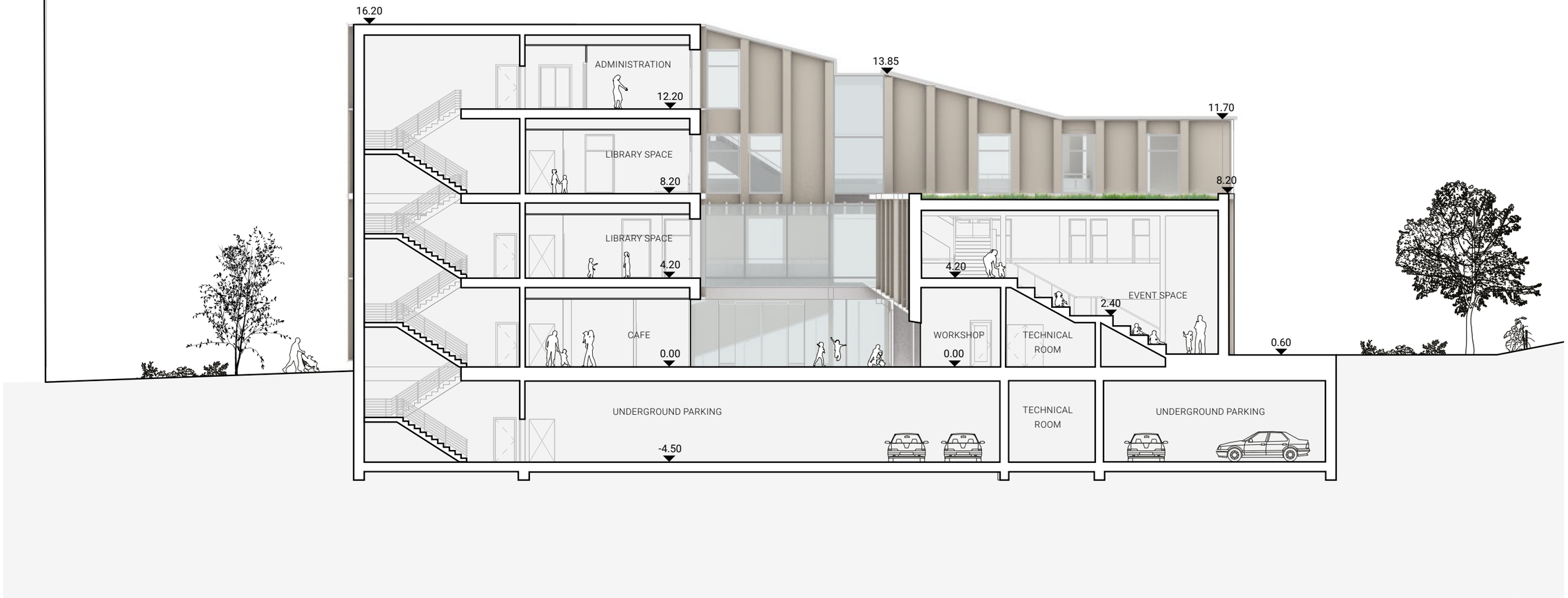
Roof
U-value: 0.12 W/m²K
Rw = 45.7dB
Fire: REI30
Total thickness: min. 502 mm

External wall
U-value: 0.1 W/m²K
L'n,w ≤ 53dB
Fire: REI60
Total thicknes: 498 mm

1. Wooden slab element KSE 280
2. Rigid insulation, min. 220 mm
3. Bitum felt, two layers
4. Aluminium gutter
5. Parapet aluminium profile
6. OSB board, 20 mm
7. Aluminium facade panel, 30 mm
8. Facade mounting
9. Mounting gap, 40 mm
10. Vertical wooden battens 36x36 mm
11. Wooden battens 80x200 mm
12. Windboard, 13 mm
13. OSB/3 board, 22 mm
14. Wood fibre insulation, 280 mm
15. OSB/3 board, 22 mm
16. Vapour barrier
17. Exterior roller screen
18. Glass panel with 3-layer energy glazing
19. Parapet aluminium profile
20. Larch exterior cladding, 20 mm
21. Suspended ceiling hanger
22. Wood fibre insulation, 80 cm
23. Plasterboard, two layers
24. Acoustic ceiling
25. PVC sill
26. Wooden battens 40x80 mm on wedges
27. Linoleum floor finish
28. Plasterboard
29. Wood fibre insulation, 80 mm
30. Wooden slab element KSE 280



Ill. 80: Detail: facade and roof connection, 1:15



Ill. 81: Section B-B, 1:200

Facade

The concept of the facade is based on four goals - *verticality*, *transparency*, *flexibility* and *nature*.

Vertical protruding elements are optically prolonging the shape of the building and provide good sun protection from east and west, which are dominant in the building design.

The facade consists of different panels, with different properties, such as glass panels, translucent glass panels, wooden cladding), fitting into the same module.

The primary material of the facade is larch wood, which together with green walls, establishes an environmentally-friendly approach of the building design.

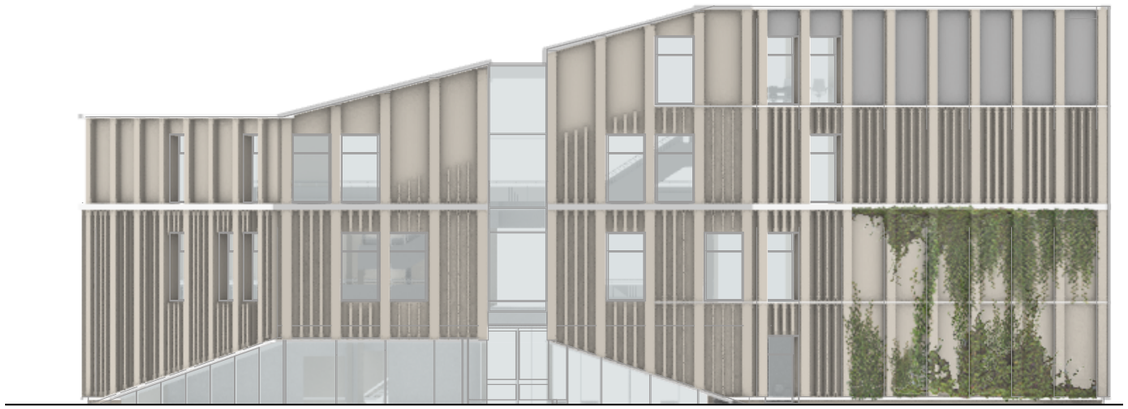
Larch is characterised by a slow growth in a harsh climate, which makes it particularly weather-resistant, without any maintenance. The wood is densely grained, and its natural colors include honey-red-brown shades. When larch kept without coating, it will cover with natural patina (Mocopinus, n.d.).
For better thermal and visual comfort, the building is equipped with several types of solar shading and solar screening.

The facade is also covered with white coated aluminium panels. The material can be produced from recycled aluminium and is recyclable after dismounting. Moreover, it is very durable and long-lasting (Colour-coated materials for facades, n.d.; Metal Sustainability — Zahner, n.d.).

The facade has also built in shading system, made from dirt repellent translucent fabrics, which allow natural ventilation into spaces when they are fully lowered. The system can be controlled manually or by motorized operation (Enviroblinds, n.d.).

Ill. 82: View from the north-west

Ill. 83: South-east elevation, 1:250



Ill. 84: North-west elevation, 1:250

Ill. 85: North-east elevation, 1:250

Ill. 86: South-west elevation, 1:250

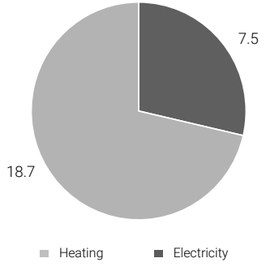
Energy frame

The energy consumption of the building has been calculated through Be18. The goal of the project is to fulfill the low-energy demand for non-residential buildings of maximum 33 kWh/m^2 per year without renewable energy sources.

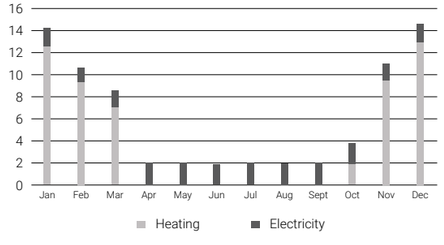
The careful design and consideration of the building form and analyses of the energy efficiency from the early stages of the design resulted in making energy efficient building. The total energy use of the building is 30.1 kWh/m^2 per year. The additional electricity will be supplied by photovoltaic panels, placed on the roof. Since the building is located in dense urban environment, the heating is gained from district heating.

BE18 KEY NUMBERS

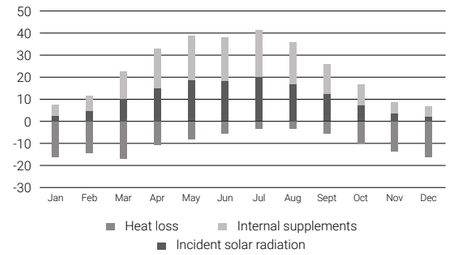
Total energy demand	**30.1 kWh/m^2**
Contribution to energy requirement	
Heat	18.7
El. for building operation	7.5
Excessive in rooms	0.0
Selected electricity requirements	
Lighting	2.2
Heating of DHW	2.8
Ventilators	2.4
Total electricity consumption	12.3
Net requirement	
Room heating	16.0
Domestic hot water	5.5
Cooling	0.0
Heat loss from installations	
Domestic hot water	0.3



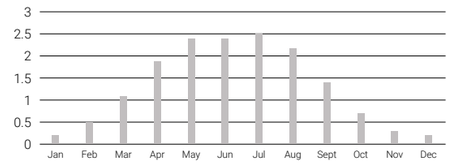
Ill. 87: Total energy requirement per year [kWh/m^2]



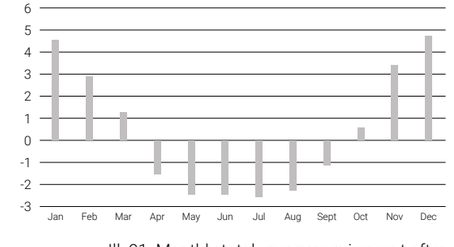
Ill. 88: Total energy requirement monthly [MWh]



Ill. 89: Heat gains and heat losses monthly [MWh]



Ill. 90: Solar cells performance monthly [kWh/m^2]



Ill. 91: Monthly total energy requirement after applying solar cells [kWh/m^2]

The photovoltaic panels, placed on the roof surface of 300 m^2, will generate electricity on site, which will cover 24.9 kWh/m^2 of the yearly energy demand. The building still needs to be supplied in external energy between October and March, but it is entirely self-sufficient during summer (for solar radiation analysis and calculation of photovoltaic panels refer to Appendix 7 and Appendix 8).

BE18 KEY NUMBERS AFTER APPLYING ACTIVE STRATEGIES

Total energy demand after applying special resources	**5.2 kWh/m^2**
Output from special resources	
Solar cells	13.1

07

Conclusion

Conclusion

The aim of the project was to design a building of a sustainable library for the youngest generation, which will respond to the challenges of decreasing number of readers in Poland and rising children's expectations. The library is located on Chwaliszewo, the historical district of Poznan, which had been abandoned by city planners and authorities for years, therefore, with plenty of neglected areas and urban challenges. However, the new cultural initiatives, established within past few years, make the area more and more attractive for people. The library project would be a perfect complement of the area's cultural development strategy.

The design process has been preceded by the research of the library design theory, Polish statistics regarding library usage, user's expectations, case studies and thorough analysis of the location. The studies have shown that there is a deficit in children's libraries in the area, therefore the young generation was chosen as the target user. The theoretical background, gained through the process, gave a strong starting point for the architectural vision. Based on the design criteria, the idea of the library has been evolving through the integrated design process, considering the challenging urban context, functional design oriented on the children as main users and atmospheric phenomena, which affect the energy performance and indoor climate. All these aspects have been studied to evaluate the consequences of alternative choices and gave a strong basis for the design concept.

One of the targets was to establish a building, which will be an important spot on the map for the residents of Chwaliszewo, a place of gatherings, not only for children, but for the whole families, strengthening local societies and relationships within families and neighbors. The project also claims how the children's needs can be addressed, in order to provide comfortable environment for studying and learning, and how to plan spaces, to stimulate young generation to learn and interact. Within the open spaces, the building has been divided into zones, with different qualities, to respond to different needs of the primary school children, middle school children or the youngest - kindergarten children.

The thorough analyses of the indoor environment, in regards to visual, thermal, atmospheric and acoustic comfort, resulted in designing an optimized building with sufficient daylight, comfortable temperature, good air quality and noise prevention. The building utilizes climate conditions, such as wind and sun, for better energy performance. The building has been designed with timber structure and wood as main façade material, which is highly sustainable and will contribute to promoting environmental sustainability in the city. Through its scale, cultural function and societal mission, the library occurs to be in a harmony with the urban context.

Reflection

The thesis problem formulation approaches two, out of three, pillars of sustainability - the environmental and the social. The framework of economic sustainability was out of the scope intentionally, and because it is equally important, it gives a room for further development of the project, with the parameters such as life cycle assessment and life cycle cost.

While doing the research about the site, the district plan of Chwaliszewo was not available. The only document found, was the draft, stating basic principles. Therefore, the design decisions were based on interpretation on these directions and my own predictions and ideas about how the area could be developed and improved. However, district plan is a great way of establishing the common rules for architects and urban planners. The authorities should be encouraged to develop the coherent strategy, which would lead designers to enhance the quality of the city and bring in the harmony.

Finally, the project and thesis have been developed during the challenging period of pandemic and social distancing, which brought in several limitations, such as no possibility to meet with supervisors personally and no access to the university's model workshop. However, it was also a period of learning new ways of digital communication and presenting ideas. It helped to develop new skills and trained in staying systematic, while working from home. Despite the unusual situation, I consider the project as very educative and valuable experience, which lead me to strongly develop my knowledge and competences as a designer and an engineer.

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Illustration list

The illustrations with no source listed above, are own illustrations.