# COLORED CRAYONS KINDERGARTEN

## SUSTAINABLE ARCHITECTURE

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“Creating space which is energy efficient, healthy, comfortable, flexible in use and designed for long life. Sustainable design means doing the most with the least means. ‘Less is more’, is, in ecological terms, exactly the same as the proverbial injunction ‘Waste not, want not’. It is about ideally using passive architectural means to save energy - rather than relying on wasteful mechanical services, which use up dwindling supplies of non-renewable fuel and produce pollution that contributes to global warming. But in the final analysis, sustainability is about good architecture. The better the quality of the architecture – and that includes the quality of thinking and ideas as much as the quality of the materials used - the longer the building will have a role, and in sustainability terms, longevity is a good thing. Obviously, if a building can be long-lasting and energy-efficient, that is even better”.

Norman Foster [Edwards 2001]

# SYNOPSIS

This project deals with the task of designing a new kindergarten in the district of Czuby, Lublin, Poland. The result is a day care centre, where considerations concerning architecture and construction have been integrated, and where the senses and motor functions of the children are being challenged, stimulated and strengthened. The project meets the intention of working with sustainable architecture, by enhancing moderation and efficiency in using materials, development space and first of all, the energy.

# INFORMATION

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"Colored crayons" Kindergarten

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SUPERVISOR Peter Lind Bonderup

TECHNICAL SUPERVISOR Rasmus Lund Jensen

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# PREFACE

The project represents individual work of $4^{th}$ semester's master program of Architecture at the Department of Architecture & Design, Aalborg University. The project is focused on the integrated architectural design process in the development of a sustainable kindergarten building in a local environment in the district of Lublin city in Poland.

The aim is the understanding the analysis and the application of different architectural and engineering disciplines, with particular emphasis on the approach that is capable of delivering an integrated product. This approach is an interactive investigative process of parametric design, applying different social, technical and environmental principles.

# READING GUIDE

**READING GUIDE REPORT**
Although the design process has been iterative, the report presents the phases in a thematical chronology. The report starts with a presentation of the final project proposal. This is done to give the reader an early idea of what the final design looks like, in order to better understand the thoughts and ideas of the design process. The base of the project is described in a program, while the design process is described in a sketching and synthesis phase that ends with a reflection of the project.

The attached CD contains:
The final report
Technical drawings folder
Appendixes

**REFERENCES**
References are used in accordance to the Harvard Method [author year] for books and articles, [“title” year] for reports and [designated name] for internet websites. These refer to the full list of references found at the end of the report. References for illustrations are indicated by continuous numbers through the report [ill. #] and refers to the illustration list found at the end of the report.

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# INTRODUCTION

In recent years Poland became one of the leading countries when it comes to the need for day care, which should be seen in light of the relatively large number of women are in the labor market. In some years, it has led to a focus at political level on child care, rather than how children institutions can be designed so that they promote good development in children. The transition to the information society and the new requirements for its citizens new skills, imagination, creativity, interpersonal skills, self-confidence, however, have questioned whether childcare guarantee should be replaced by a development warranty.

## CHILDREN'S RIGHTS

The UN Convention on the Rights of the Child states that every child has the right to play, and through the play children develop their motor, learning, emotional, social and creative skills.
Children must be provided learning through play, and the design must be based on conscious needs of institutional importance to children's lives. Children's experience of space must increasingly be reflected in the architecture, while be motivating and challenging for children to be active and thereby learn and develop. This can be done indoors and outdoors, but recent studies show that it has a positive effect on motor skills, concentration, and immune system to place the institution in a nature-related context and let the kids be out much of the day. With an increased focus on child development and the demands on spatial units arising out of these, combined with architectural quality and the industrial architecture advantages, will provide institution building to better serve both the public financial and time requirements as well as the children's needs for development while to create exciting spaces and architecture.
*[“Young Children and Nature” by Ashley Parsons]*

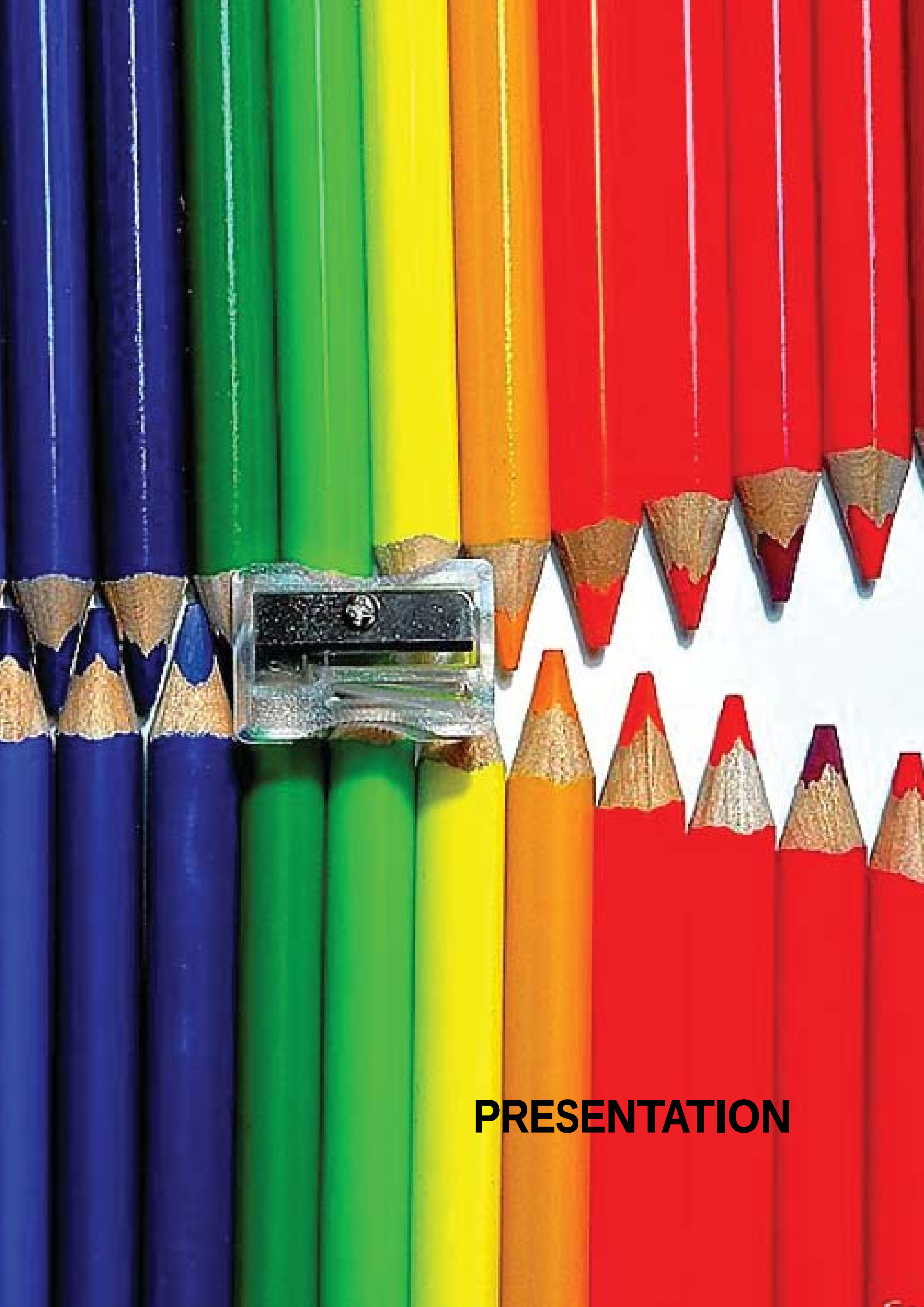
## SITUATION IN POLAND

Polish children are sent to the kindergartens under the six years old, mainly in the cities. In the villages only every third child can take advantage of this this privilege. Most of them are children aged 5; 3 and 4-year-olds are in the minority in nursery schools. The government wants to be a mandatory that minimum 90 % of Polish children go to kindergarten at age 3 years.
In 2009, the European Commission issued a recommendation: up to 2020 in each EU country over 95% of children have to attend to kindergarten. In Poland, however, there is a shortage of kindergartens in relation to the number of kids. It is missing about 15 000 facilities, particularly in rural areas. The government therefore plans to increase the number of places in the already existing and build new facilities.
*[http://fajnamama.pl/wszystkie-dzieci-obowiazkowo-do-przedszkola/]*

This project is a response to the alert of Municipality of Lublin to design a brand new building for a kindergarten in Czuby settlement area.

## IMPORTANT NOTE

However the plot and the project is situated in Poland, the design is based on Danish Building Regulations, norms and all calculations concerning energy consumption are based on Danish climate data.



# PRESENTATION

# Presentation

## ARRIVAL

### MASTER PLAN

In the middle of Czuby district in Lublin the new 'Colored Crayons' kindergarten rises on the corner of steets - Stokrotki and Ruciana.

The main facade is directed towards south, hence the pedestrains going through the Stokrotki street see the building at a high big angle. The building has been located in this way to get the morning and afternoon sun straight to sides of the building, and noon sunshine to south facade.

For pedestrians and bicyclist the main entrance to the plot is from the Stokrotki street. Just after the fence, there is a roofed shed destined for the bicycles and baby strollers, equipped also with the toilets.

Parents, who use the cars to drop off the babies, may use the second entrance from the east side of plot, as there is parking area designated for stuff and guests of kindergarten.

Another option to get to the building is to use the 'stuff entrances' at the north back of the plot, where also the area for goods delivery, the garbage and the shed for garden equipment have been located.

Major part of the plot is at the same level as Stokrotki street, with the playgrounds and small play gardens, and at one point the terrain slides gently down towards north, to reach the 1,2 m difference in the levels.

At the back of the building, a small pond has been created, with water depth app. 2-3 cm. The pond is surrounded by cluster of trees, as the plot borders with the small skate park.

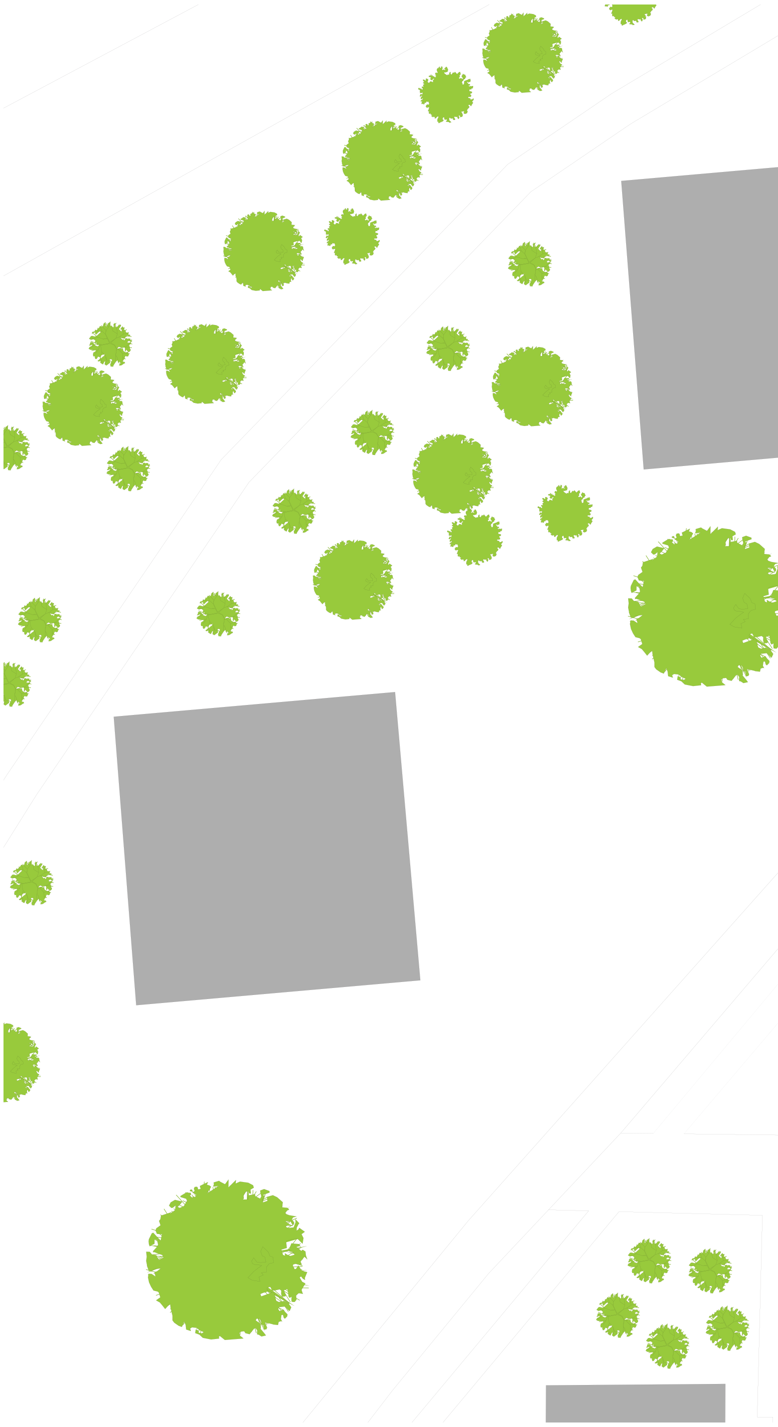
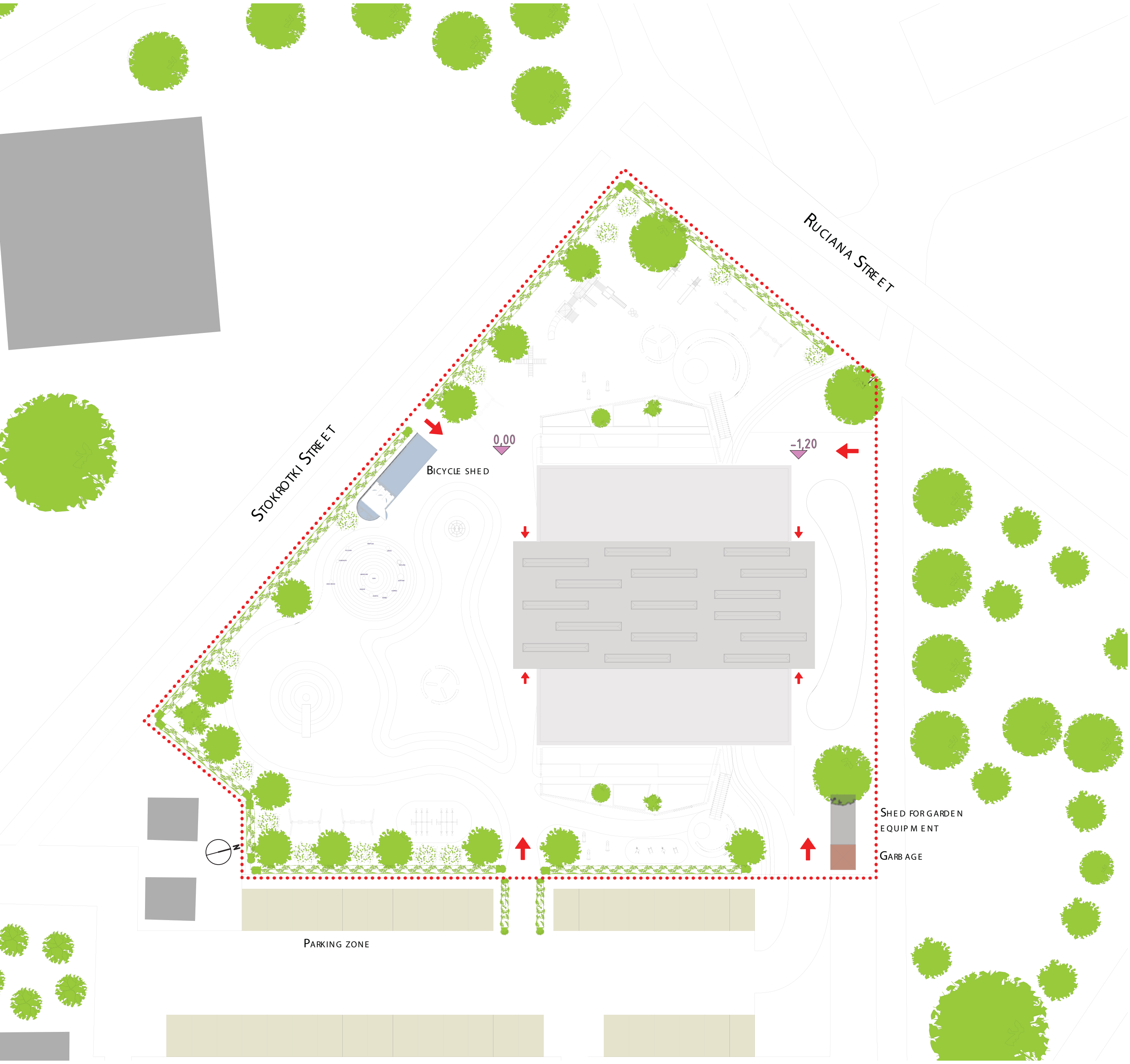


*FIG. 2.01. MASTER PLAN.*


Ruciana Street
Stokrotki Street
Bicycle shed
0,00
-1,20
Shed for garden equipment
Garbage
Parking zone
N

# EXTERIOR PERCEPTION

FIG. 2.02. VIEW ON THE WHOLE PLOT.


FIG. 2.03. MAIN ENTRANCE TO THE KINDERGARTEN.

*FIG. 2.04. THE PLAY GARDEN AND ACCESS BALCONIES TO FIRST FLOOR.*

*FIG. 2.05. THE NORTHERN FACADE WITH SMALL POND.*

# INTERIOR PERCEPTION - ATRIUM

*FIG. 2.06. LOOK INTO ATRIUM.*

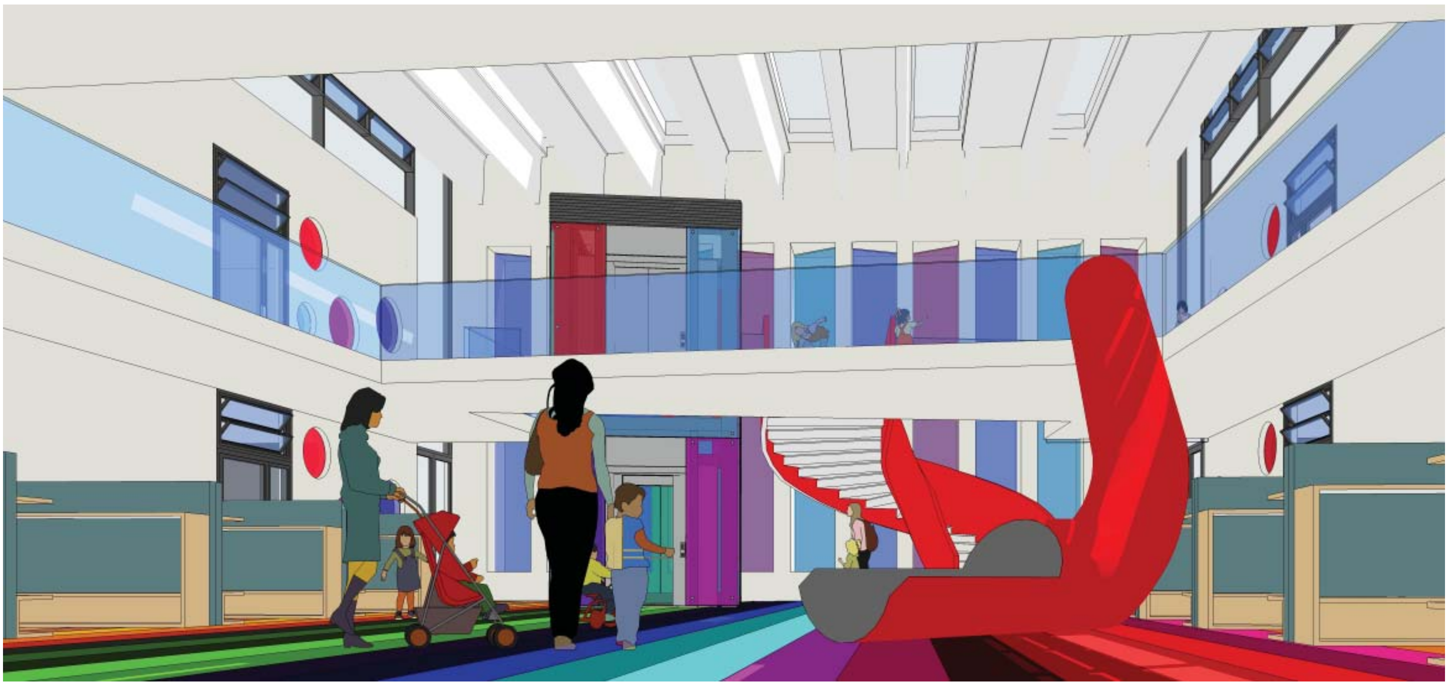


*FIG. 2.07. VIEW ONTO THE SLIDE, LIFT AND STAIRS.*

*FIG. 2.08. VIEW INTO MULTI-PURPOSE ROOM.*

*FIG. 2.09. THE WARDROBES ON THE GROUND FLOOR.*

# INTERIOR PERCEPTION - MULTI-PURPOSE ROOMS

*FIG. 2.10. MULTI-PURPOSE ROOM ON THE FIRST FLOOR.*

*FIG. 2.11. MULTI-PURPOSE ROOM ON THE GROUND FLOOR..*

*FIG. 2.12. VIEW TOWARDS THE STUFF'S SOCIAL ROOM.*

*FIG. 2.13. THE STAIRS IN THE MULTI-PURPOSE ROOM.*

# INTERIOR PERCEPTION - LANDINGS

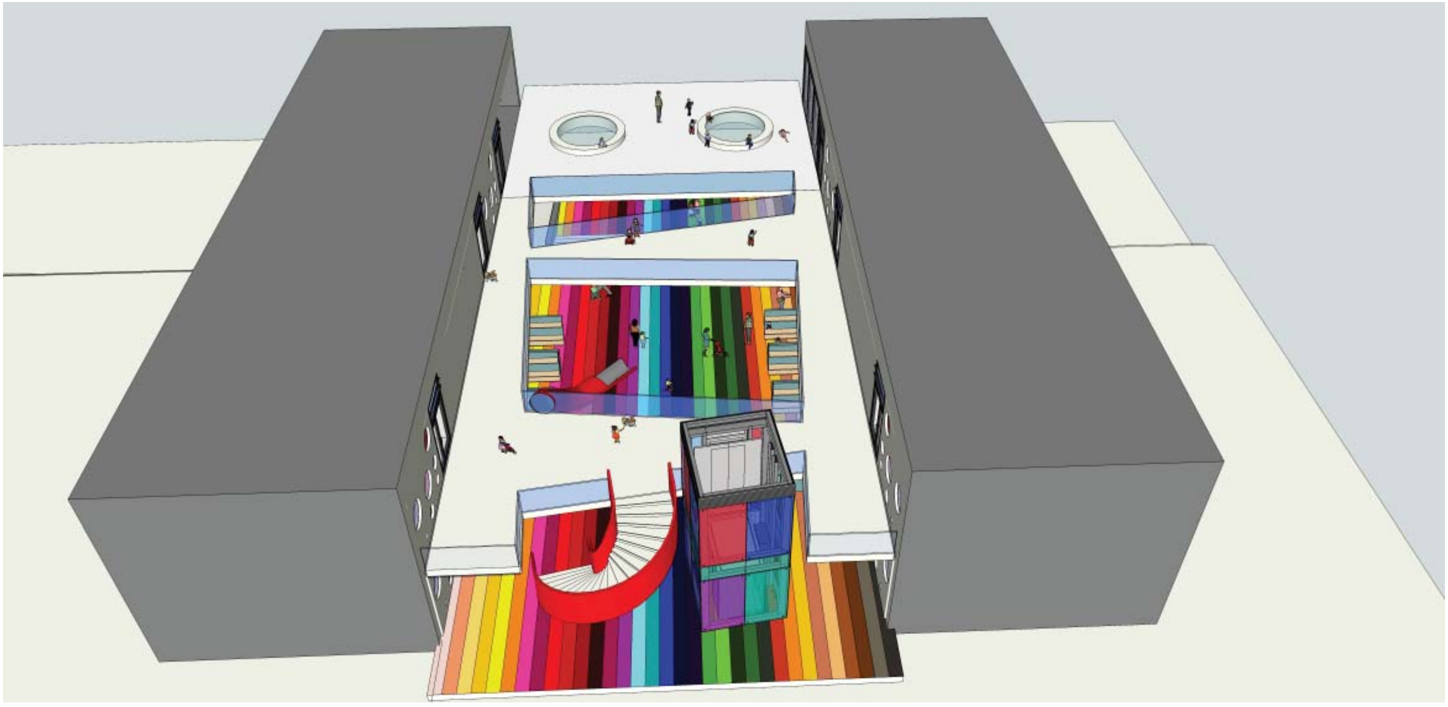


*FIG. 2.14. VIEW ONTO THE LANDINGS.*

*FIG. 2.15. LANDINGS ON THE FIRST FLOOR.*

FIG. 2.16. VIEW ONTO THE GROUP ROOMS.

FIG. 2.17. CHILDREN PLAYING ON THE LANDINGS.

# FACADES

## ELEVATION SOUTH

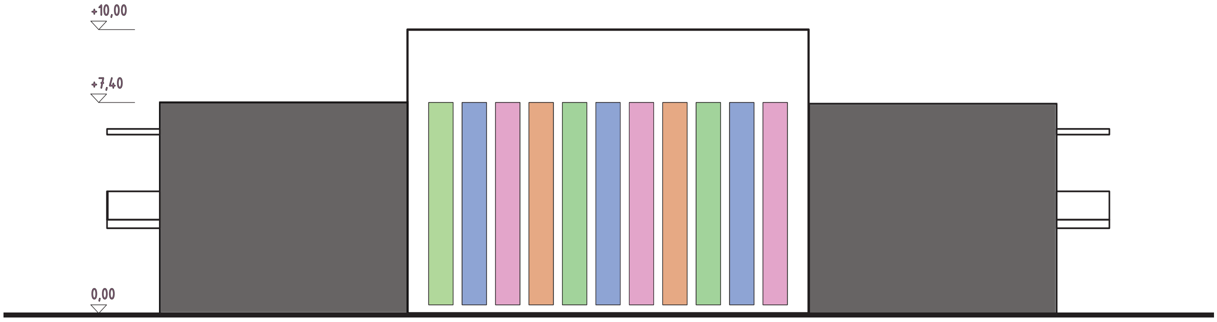



*FIG. 2.18. FACADE TOWARDS SOUTH, SCALE 1:250.*

## ELEVATION NORTH

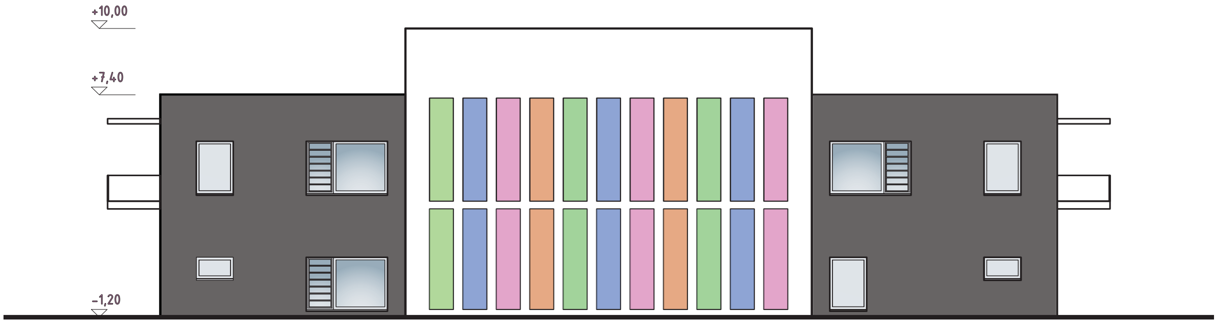



*FIG. 2.19. FACADE TOWARDS NORTH, SCALE 1:250.*

## ELEVATION WEST

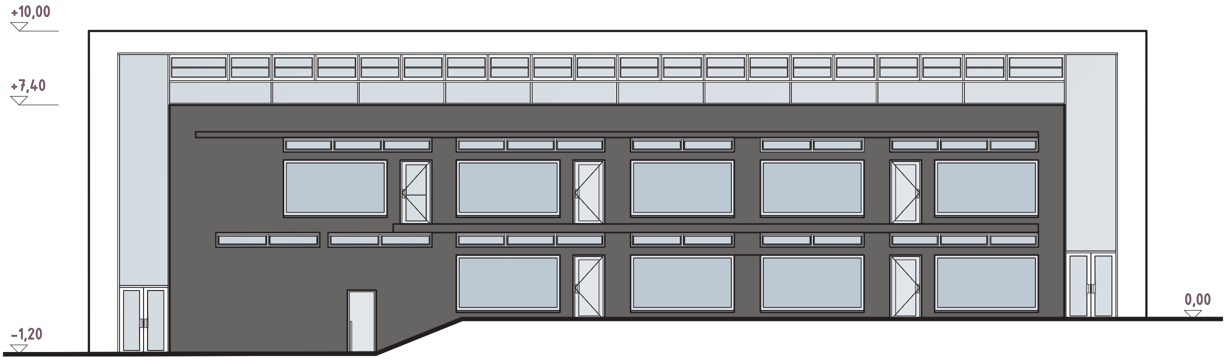



*FIG. 2.20. FACADE TOWARDS WEST, SCALE 1:250.*

## ELEVATION EAST

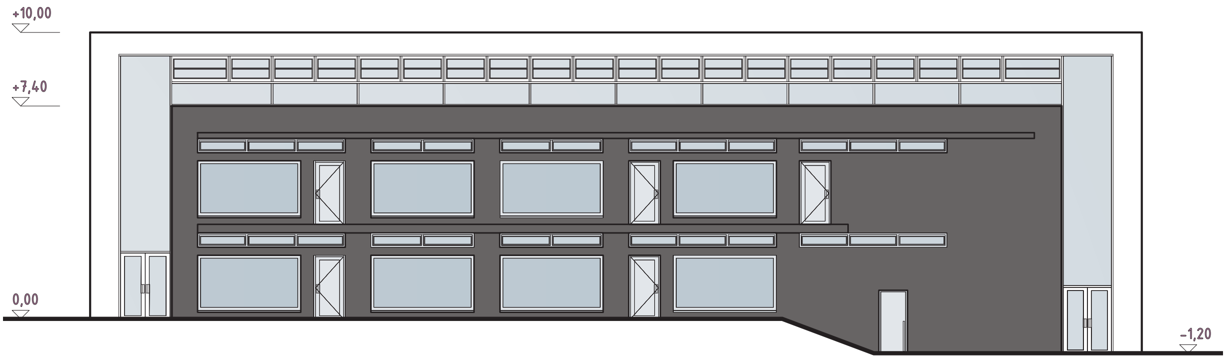



*FIG. 2.21. FACADE TOWARDS EAST, SCALE 1:250.*

# PLANS

## GROUND FLOOR PLAN

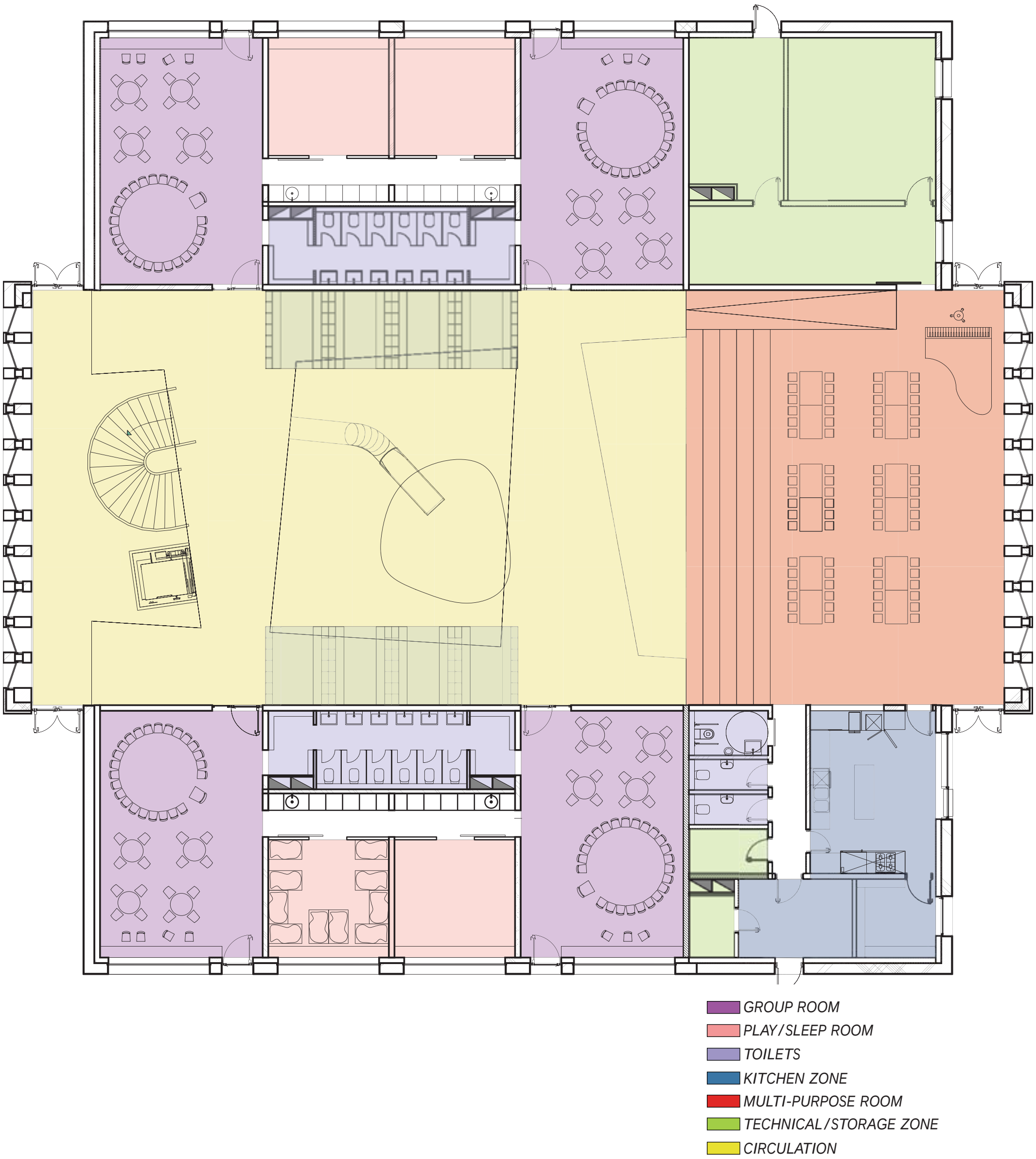



*FIG. 2.22. GROUND FLOOR PLAN, SCALE 1:250.*

## FIRST FLOOR PLAN

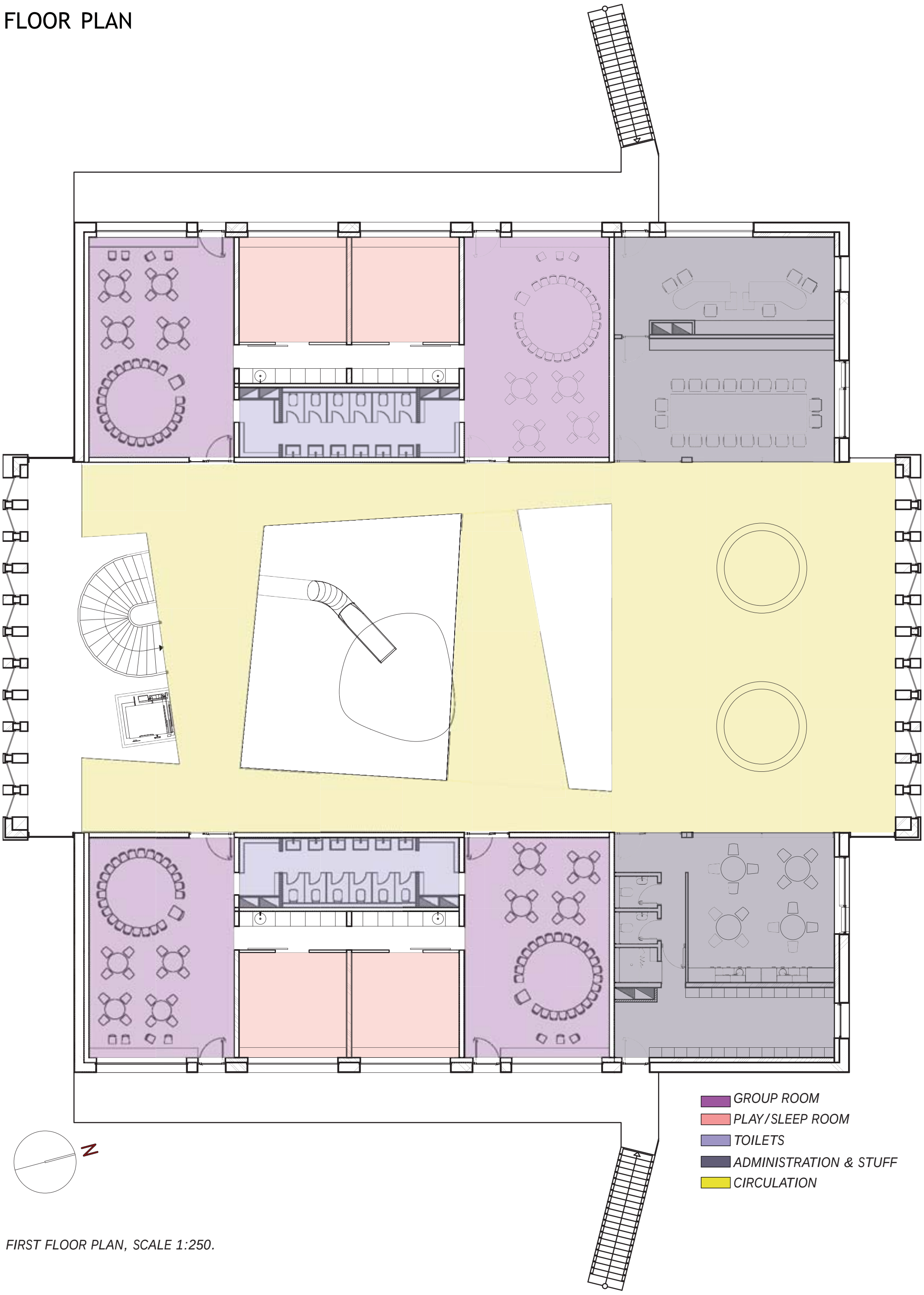



*FIG. 2.23. FIRST FLOOR PLAN, SCALE 1:250.*

# PLANS

## ROOF PLAN

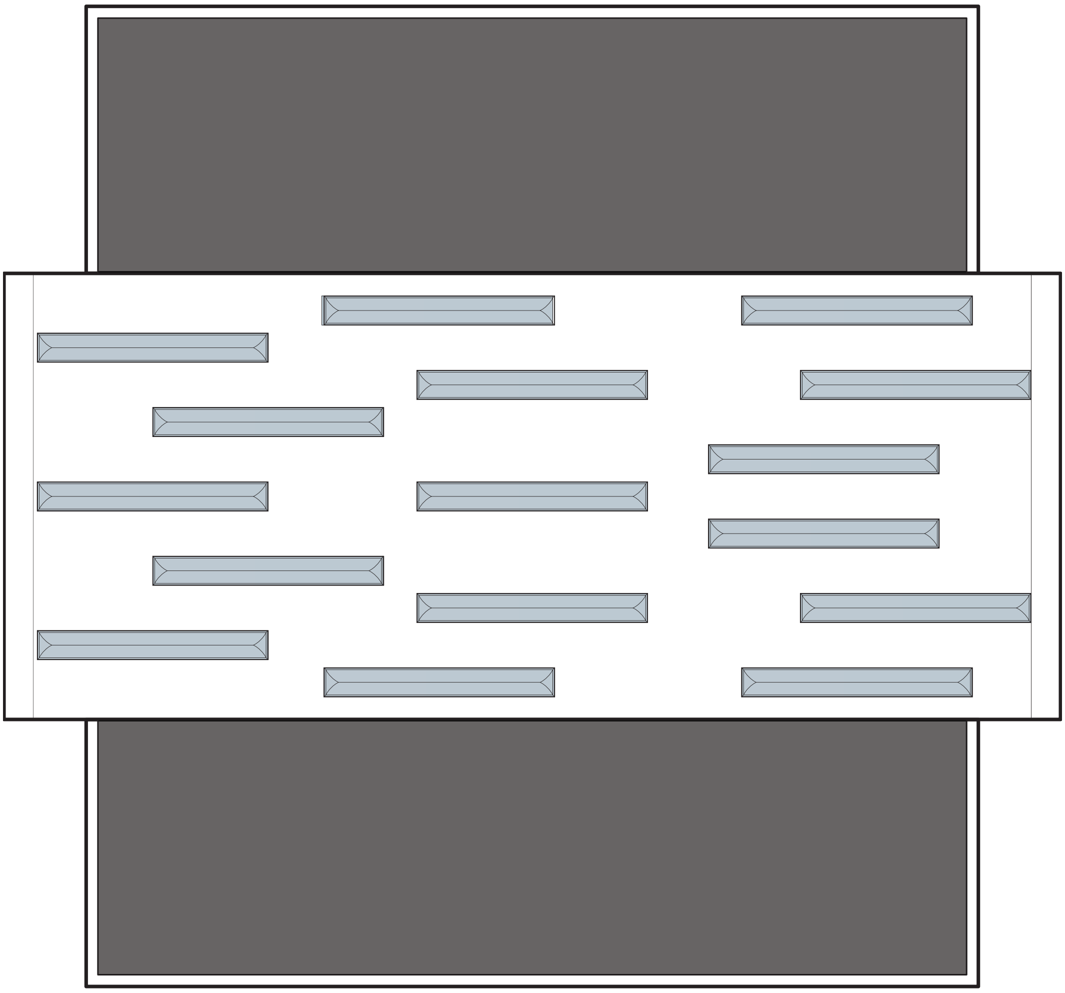


*FIG. 2.24. ROOF PLAN, SCALE 1:250.*

# SECTIONS

## SECTION A-A

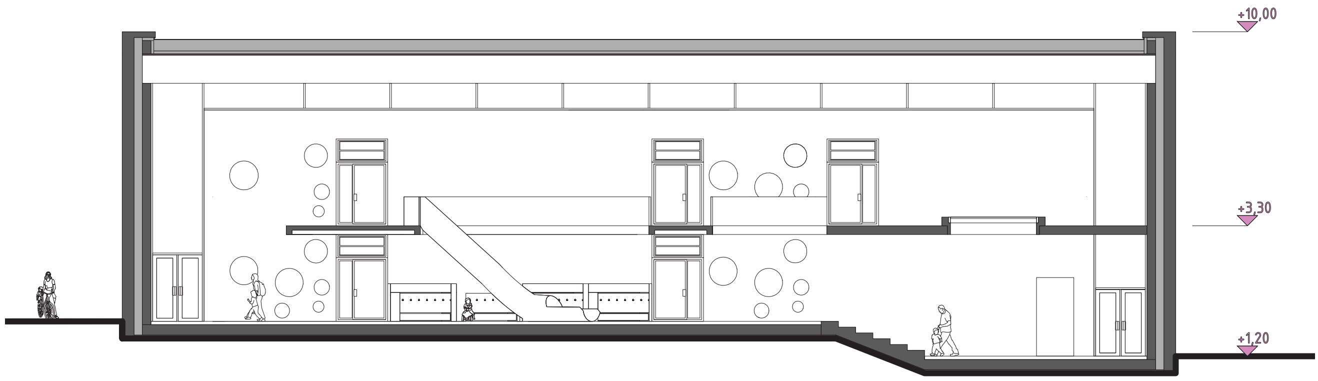



*FIG. 2.25. SECTION A-A, SCALE 1:250.*

## SECTION B-B

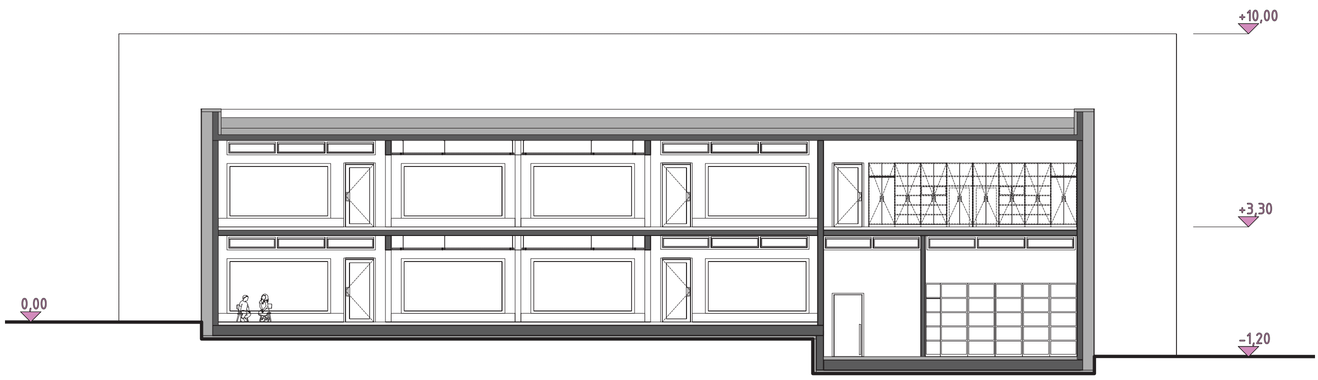



*FIG. 2.26. SECTION B-B, SCALE 1:250.*

# SECTIONS

## SECTION C-C

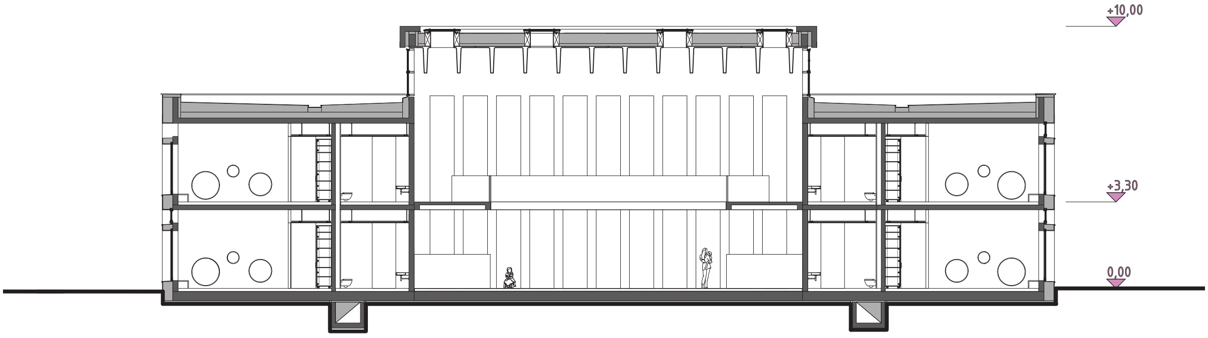



*FIG. 2.27. SECTION C-C, SCALE 1:250.*

## SECTION D-D

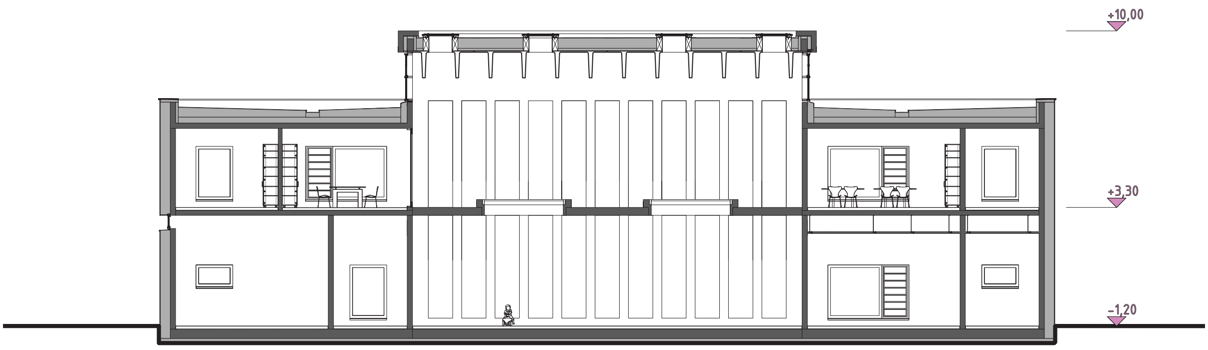



*FIG. 2.28. SECTION D-D, SCALE 1:250.*

# DETAILS

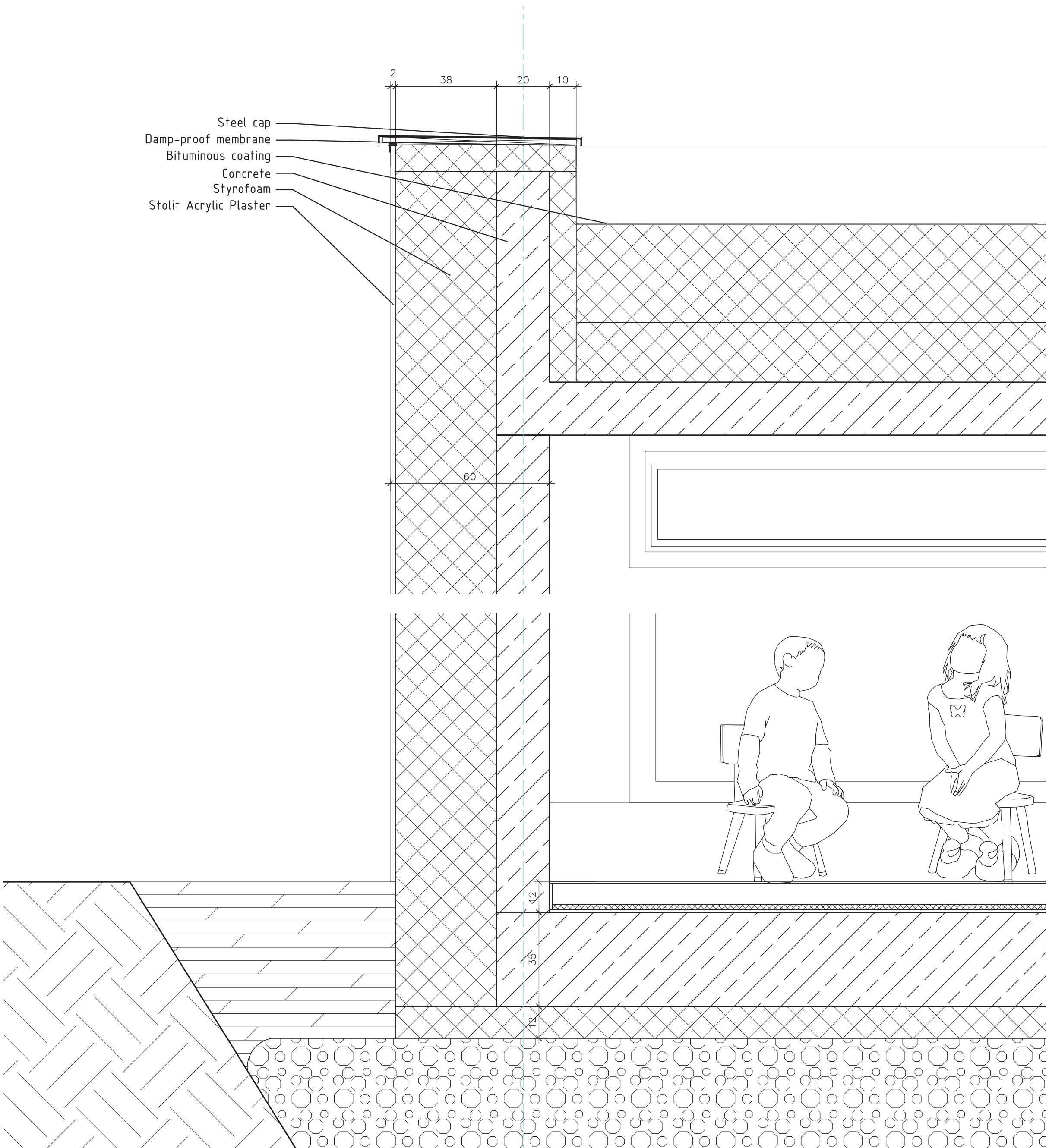



*FIG. 2.29. DETAIL OF ROOF CONNECTION WITH WALL.*

# DETAILS

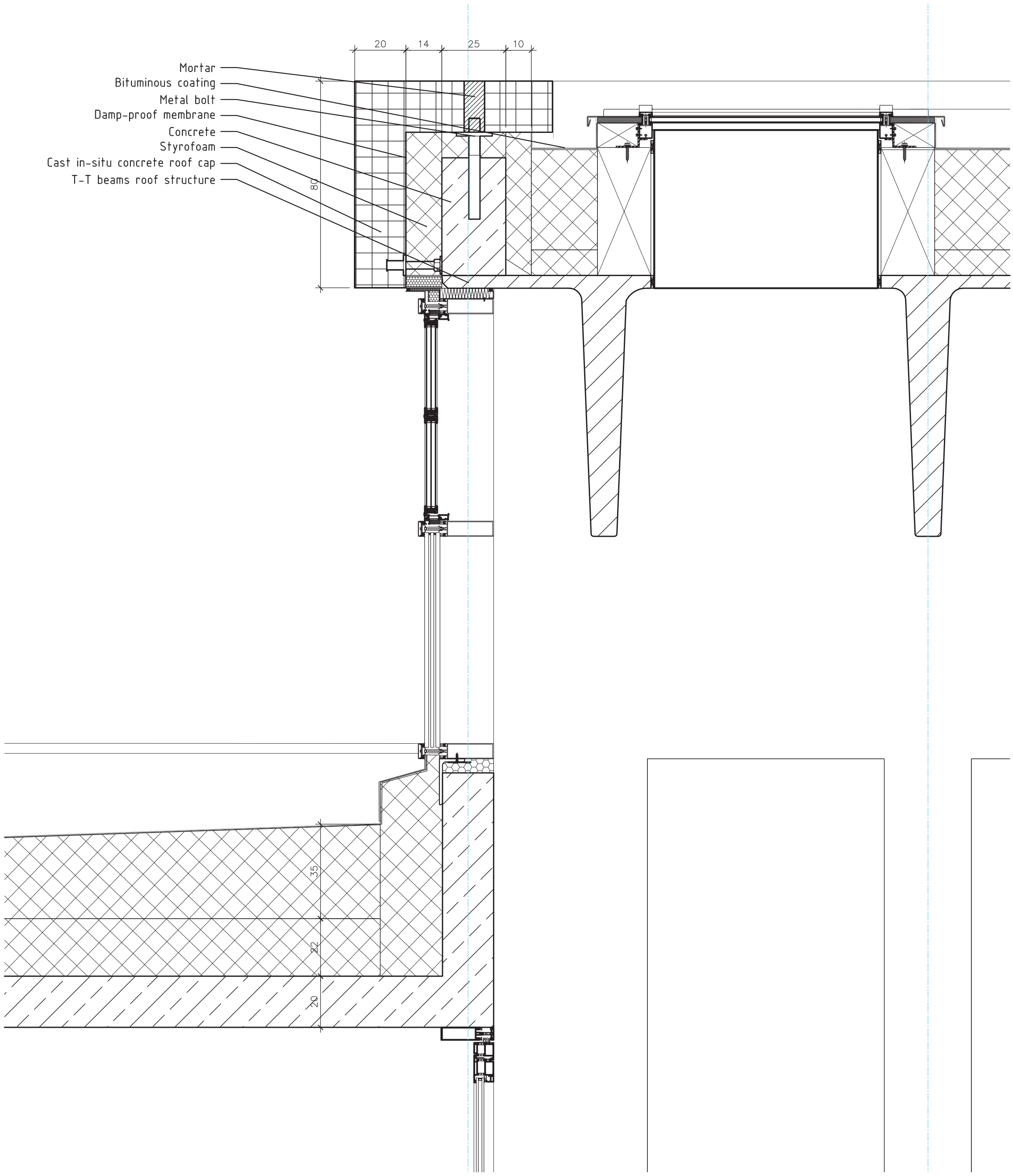



*FIG. 2.30. DETAIL OF ROOF CAP IN ATRIUM ROOF.*

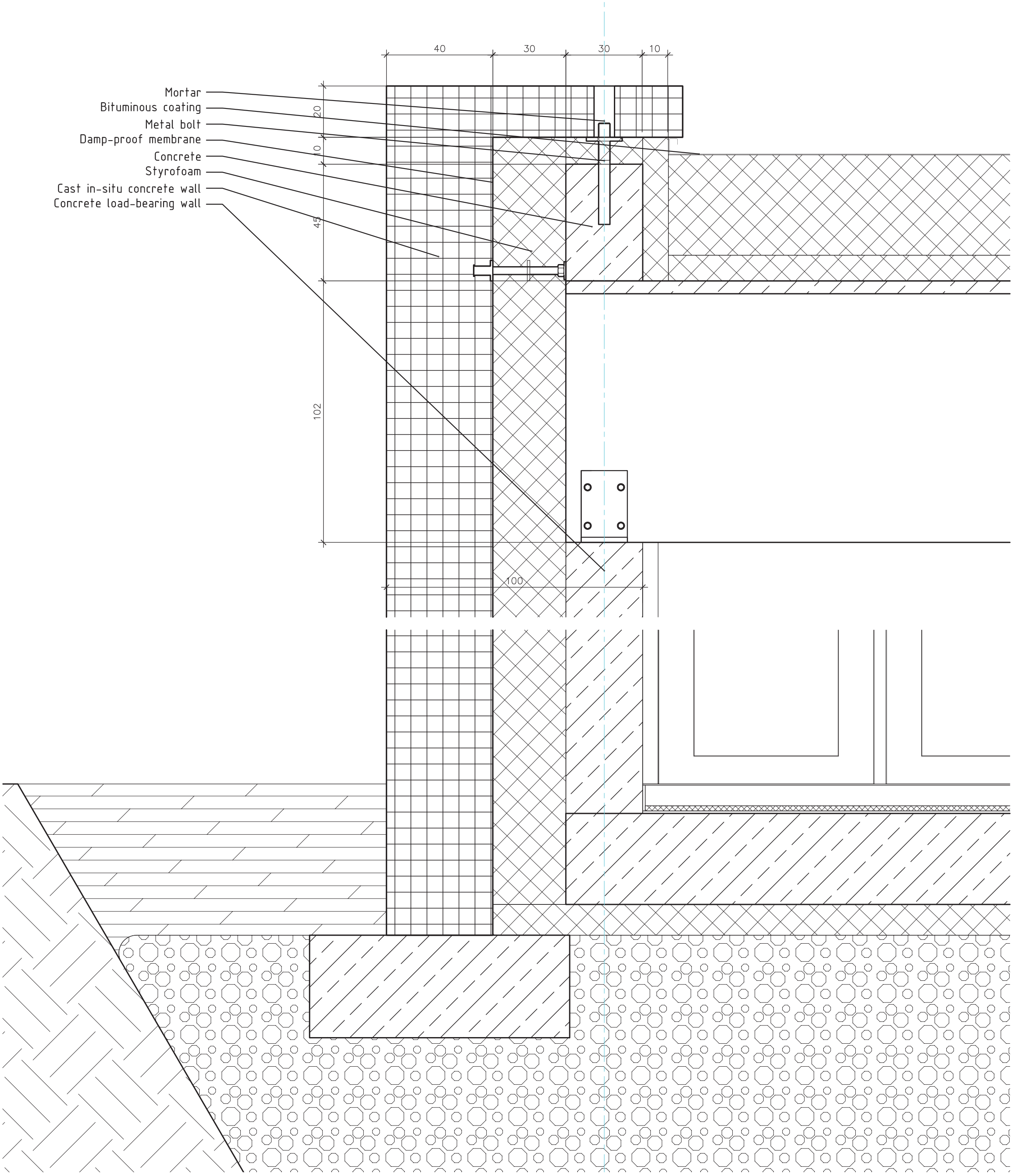



*FIG. 2.31. DETAIL OF ROOF CAP IN ATRIUM ROOF.*

# THE CLUSTER

FIG. 2.32. LOOK INTO THE GROUP ROOM.

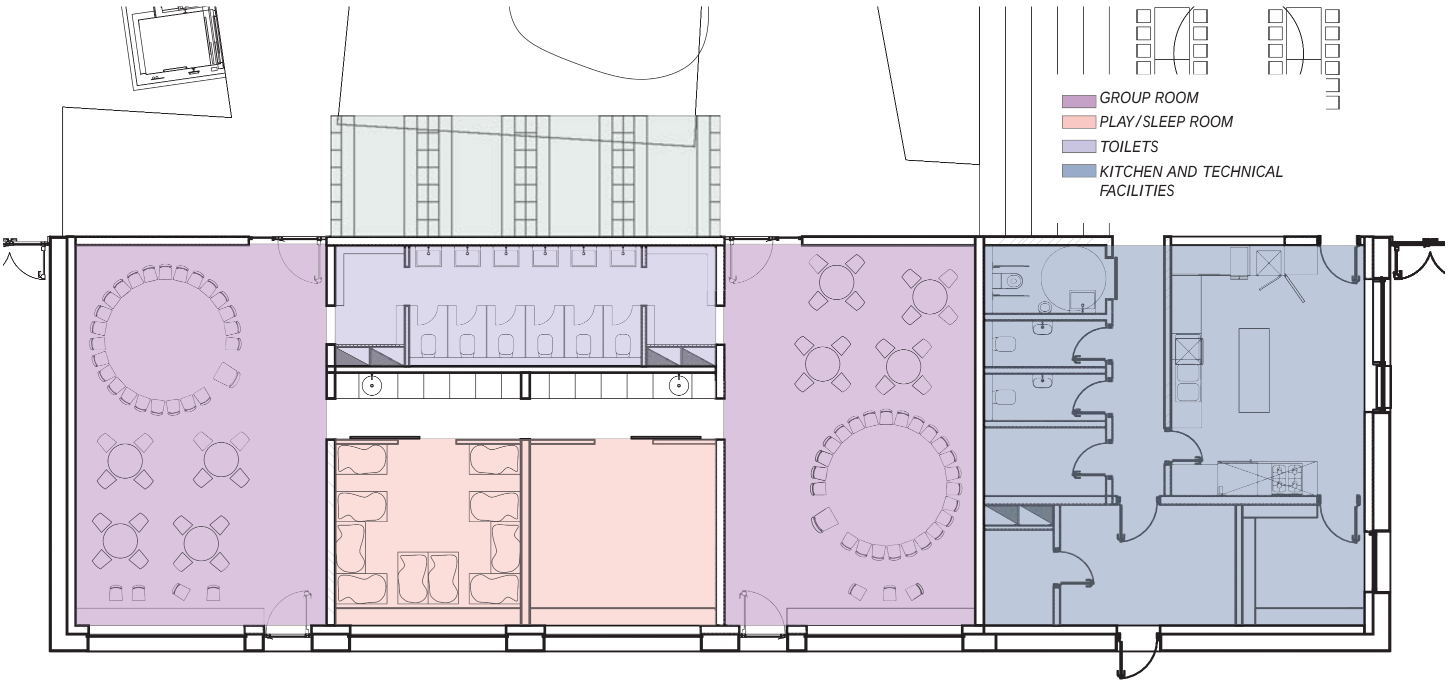



FIG. 2.33. PLAN OF THE CLUSTER.

*FIG. 2.34. GROUP ROOM WITH PLAY ROOM AT THE BACK.*

*FIG. 2.35. THE PLAY/SLEEP ROOM.*

# THE CLUSTER

*FIG. 2.36. IN THE PLAY/SLEEP ROOM.*

*FIG. 2.37. THE PLAY/SLEEP ROOM WITH GROUP ROOM AT THE BACK.*

*FIG. 2.38. IN THE FOYER OF SANITARY ROOM.*

*FIG. 2.39. THE SANITARY ROOM.*

# PLAY GARDENS FOR YOUNGER CHILDREN

The play gardens for smaller children (aged 2-3 years old) are directly connected with the group rooms placed on the ground floor level of the building. It allows to mix children from different groups and they can play together. To keep control on the running children, the space has been surrounded with foam piles in shape of colored crayons. On both ends of the fence there are wickets with protection, in case the children would try to open the gate by themselves.

The garden consists of three different levels, some of the steps are covered with wooden panels, some of them are covered with grass. There is also a place for sandbox. In the summer time the big umbrellas are spread onto the gardens, to protect children from strong sun light. Outside the fenced garden plenty of spring riders have been mounted. The whole area is separeted from the outside of the plot with the bush hedge.

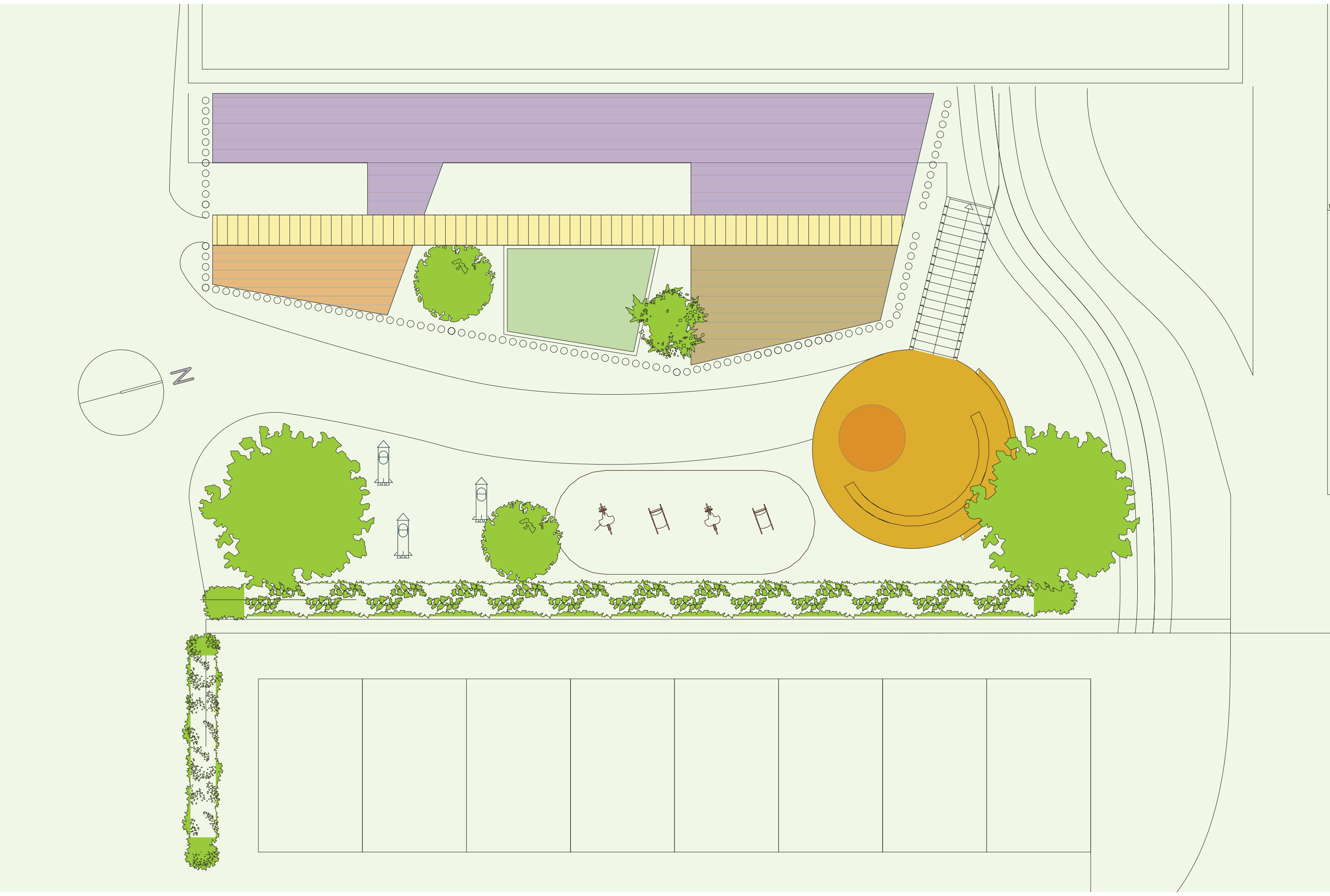



*FIG. 2.40. THE PLAN OF PLAY GARDENS FOR SMALLER CHILDREN.*

*FIG. 2.41. VIEW ONTO THE PLAY GARDEN, EAST SIDE.*

*FIG. 2.42. VIEW ONTO PLAY GARDEN AND RAMP ON THE FIRST FLOOR, EAST SIDE.*

# PLAY GARDENS FOR YOUNGER CHILDREN


*FIG. 2.43. PLAY GROUND FOR THE YOUNGESTS, EAST SIDE.*

*FIG. 2.44. IN THE PLAY GARDEN, EAST SIDE.*

*FIG. 2.45. LOOK ONTO THE PLAY GARDEN, WEST SIDE.*

*FIG. 2.46. IN THE PLAY GARDEN, WEST SIDE.*

# PLAYGROUNDS FOR OLDER CHILDREN

There are two different types of open playgrounds designed for older children (aged 4-5 years old). First, placed in front of the main facade, is a vast open space, consisting of 50-70 cm high earthworks, slightly rising above the ground level. Those little hills are covered with grass, and the aim is to encourage children to run up and down. At the top of those ground elevations plenty of swings, slides, roundabouts and seesaws can be found. The paths between the hills can be used for bicycle riding.
The playground from the west side is more likely condensed zone, with recreational equipment, like slides, swings, climbing walls, jungle gyms, which help the children to develop physical strength, coordination and flexibility, as well as provide enjoyment and recreation.
As the group rooms for older children have been placed on first level of the building, there are external stairs providing direct connection with the playgrounds level.


FIG. 2.47. PLAY GROUNDS FOR OLDER CHILDREN.

*FIG. 2.48. VIEW ONTO THE OPEN PLAY GROUNDS.*

*FIG. 2.49. SOUTH SIDE OF THE PROPERTY.*

# PLAYGROUNDS FOR OLDER CHILDREN

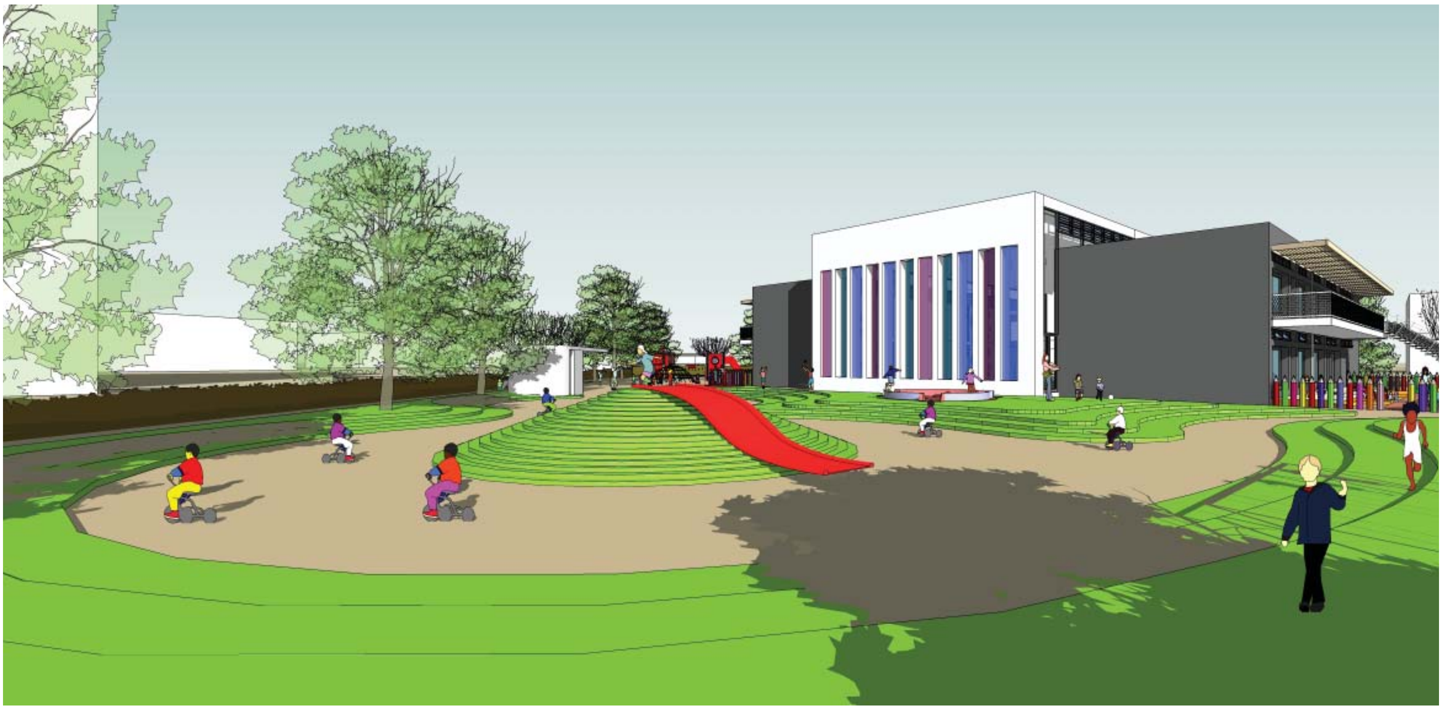


*FIG. 2.50. THE SLIDE AND BICYCLE TRAIL.*

*FIG. 2.51. VIEW ONTO THE MAIN ENTRANCE AND BICYCLE SHED.*

FIG. 2.52. PLAY GROUNDS AT THE WEST SIDE OF PROPERTY.

FIG. 2.53. WEST PLAYGROUNDS.

*FIG. 3.00.*

# PROGRAM

# Project Brief

## LOCATION

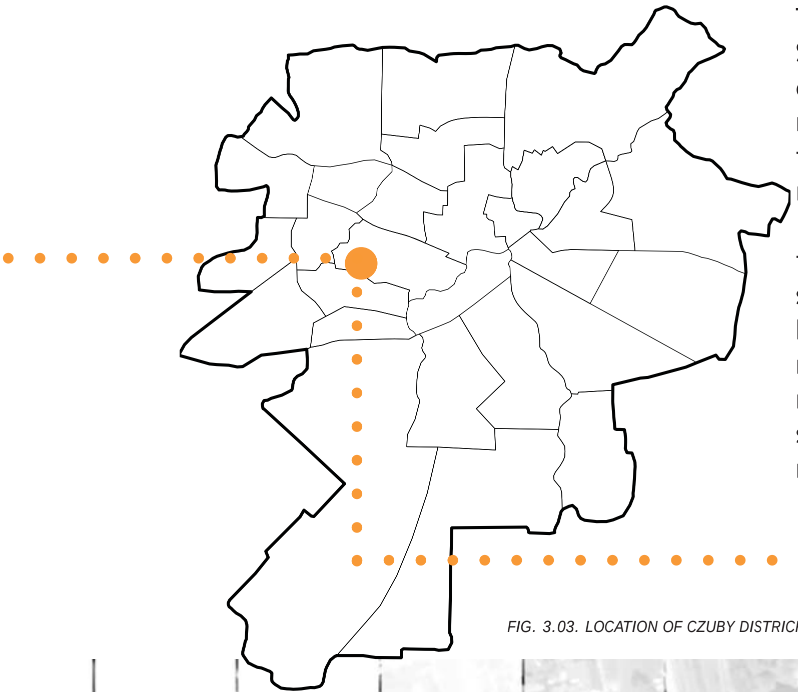
The mapping of the different factors influencing the site is carried out in order to gain consciousness about the potentials of the site, both from an architectural and environmental point of view.

Lublin City is the largest Polish city located on the eastern side of the Vistula River. In the Middle Ages the town played an important role in the life of the Polish state as a trade center and as a city with military significance. Every year there are ca. 100,000 students coming to Lublin to study, which accounts to 28% of the regular city population.
*[http://wikitravel.org/en/Lublin]*


*FIG. 3.02. LOCATION OF LUBLIN ON POLAND MAP.*

*FIG. 3.01. LOCATION OF POLAND ON EUROPE MAP.*

LUBLIN CITY
Latitude: 51°14′53″N
Longitude: 22°34′13″E
Time zone: UTC+1 hours
Country: Poland
Continent: Europe
Sub-region: Eastern Europe
Altitude: ~163-238 m



The project of kindergarten will be located at Stokrotki street, in Czuby settlement area, midle-west part of the city. The plot is ca. 3900 $m^2$ and for plenty of years has being used as a football field for local children. Part of the terrain is flat, at the same level as Stokrotki street (south-west side), and  part is lower with difference app. 1m towards north-east. The site is surrounded from south-east and south-west by blocks of multi-storey family houses, a supermarket from north-west and small squere from north side. In the immediate vicinity of the east side of the plot the parking area belonged to the nearest housing locators is located.

*FIG. 3.03. LOCATION OF CZUBY DISTRICK ON MAP OF LUBLIN.*

*FIG. 3.04. VIEW ONTO THE PLOT AND SURROUNDINGS.*

# GENIUS LOCI


FIG. 3.05. DIRECTIONS OF PANORAMIC VIEWS.

FIG. 3.06. PANORAMAS.

PANORAMA 01

PANORAMA 02

# Site analysis

## LOCAL CONTEXT

The district of Czuby is a typical for Lublin living settlement, where plenty of multi-storey family houses were built. Besides that, the area consists of few educational institutions like kindergartens and primary schools. The area is lively all day long since local residents and guests are shopping in local supermarkets and retail shops by all day long.
Within 10 minutes of walking, two catholical churches are available, and an aquapark at the west part of the settlement. Different open spaces for skateboarding, football and playgrounds are found just between the residential buildings. The outdoor areas are divided into different levels by using stairs and ramps, which creat a variety of smaller spaces with more opportunities and experiences for young people to use and play.
In the near distance, towards north-east, a naturaly made ravine can be found, which is used as a recreational place for walking and bicycling.

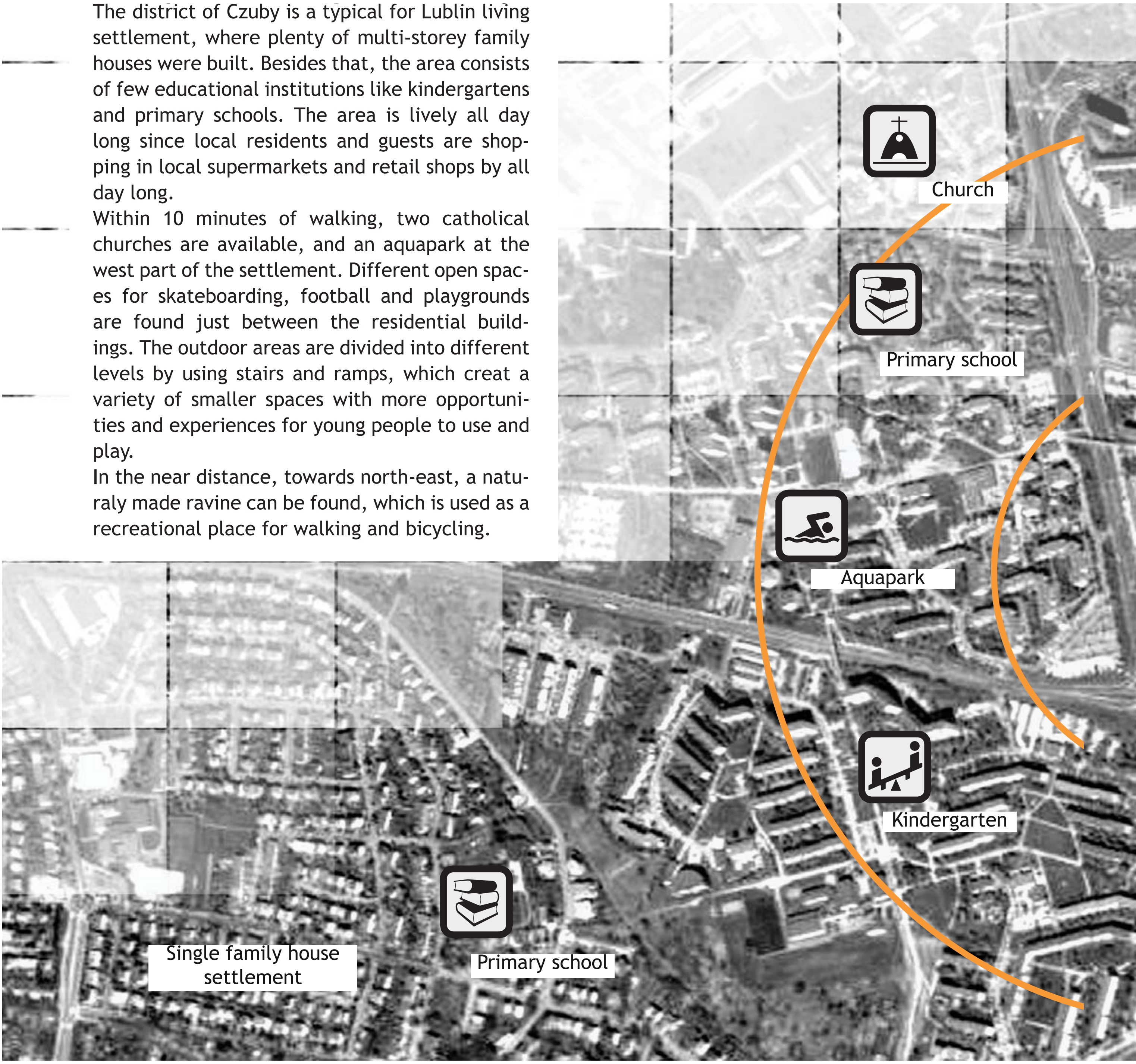
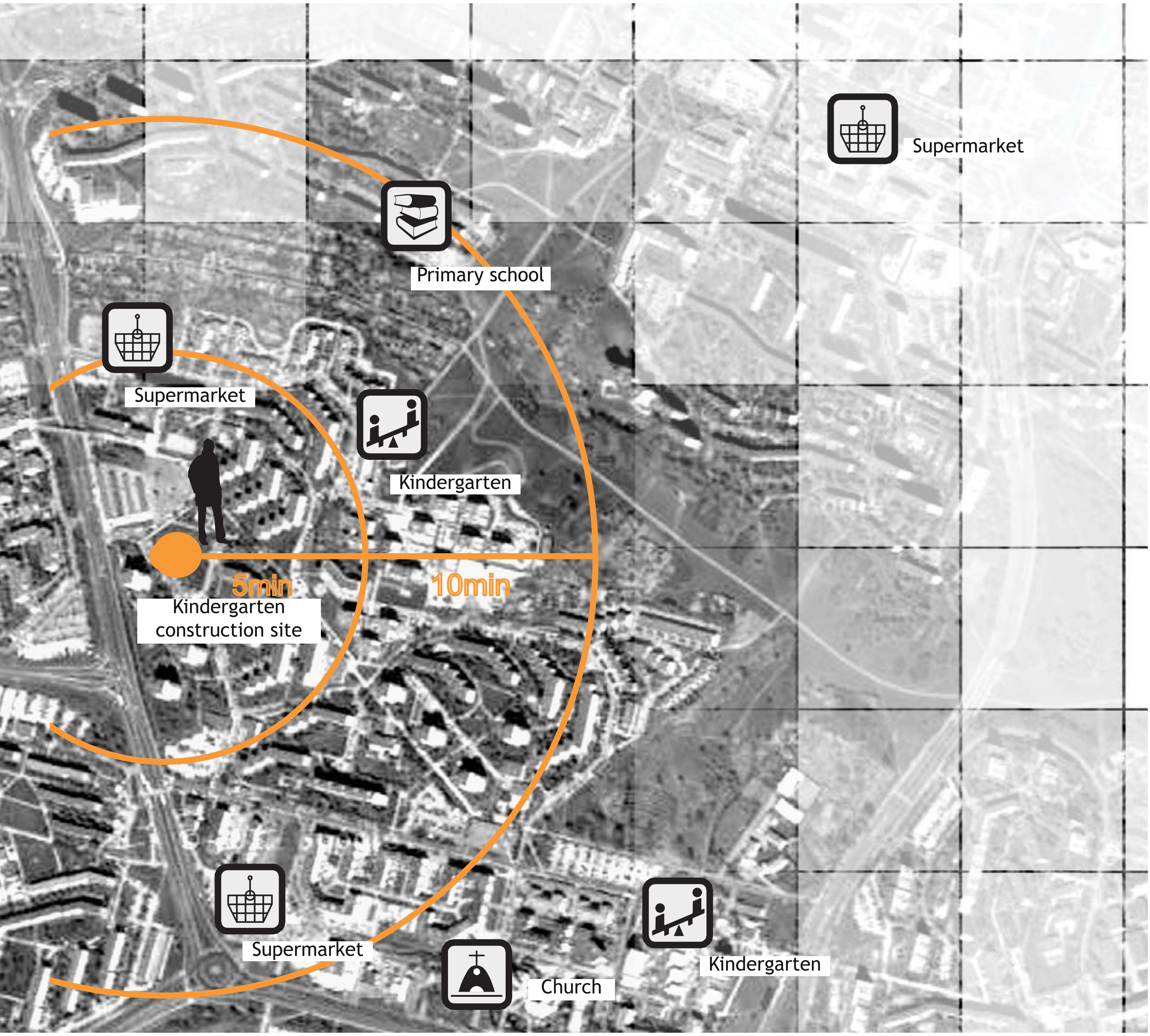



*FIG. 3.07. MAIN FUNCTIONS OF THE DISTRICT.*


Supermarket
Primary school
Supermarket
Kindergarten
5min
10min
Kindergarten
construction site
Supermarket
Church
Kindergarten

# GREEN AREAS

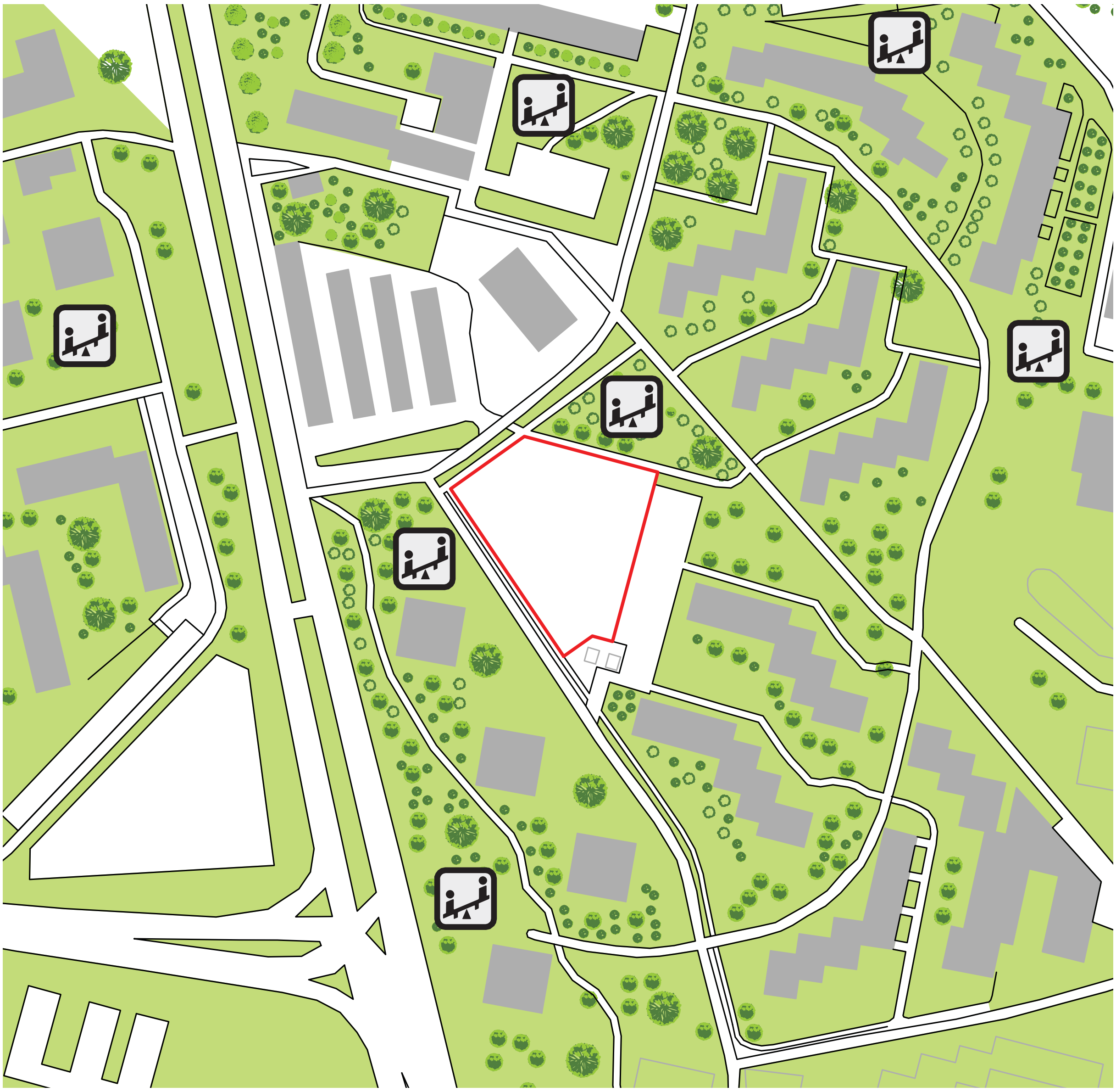


FIG. 3.08. VEGETATION.

The surrounding area is mainly dominated by middle high vegetation in form of grass planes, bushes and small trees. There are also many clusters of higher trees, mostly in terrains between the exsisting residential buildings. At the north side the plot borders with a squere, with plenty of trees and skadeboarding ramps. There is no significant occurrence of vegetation on the construction site as it has been for many years functioning as a football field. Not far from residential buildings, plenty playgrounds surrounded by small fruit trees and hedges are to be found.

# INFRASTRUCTURE

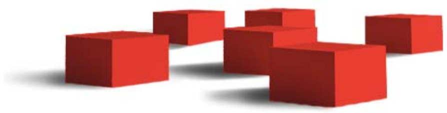

*FIG. 3.09. PEDESTRIANS AND BICYCLISTS.*

The traffic around the plot is generally light, as those are the access roads to the housing units. The heaviest traffic occurs on Armii Krajowej street, as it is one of arteries going through the city. The site is easily accessible by feet or bike. Local residents and school children can also benefit from public transport, since there are bus stops on near Armii Krajowej street and public transport is well developed. Along the local roads and designated places plenty of car parkings are to be found. The pedestrian paths form the dense network through the whole surriunding areas.

# TYPOLOGY OF SURROUNDING BUILDINGS

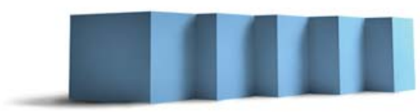
Great varations of building typologies and heights can be found in the area.

**RETAIL AND SERVICE BUILDINGS**
The buildings were built in the industrialization era. Mostly one or two storeys, serving different kinds of service: mainly they are groceries and other small shops with essentials.



**SINGLE FAMILY HOUSES**
The group of single storey buildings diverse with the form and shape. The urban setting has been based on a traditional grid structure. There are plenty of small gardens in front/back of the houses, which are used as private areas for the residents.

**BLOCKS OF FLATS**
These buildings are mostly four or five stories blocks of flats, with strictly defined form. There mainly made out of prefabricated concrete elements. There is no special visual connection with a other buildings.



**MULTI-SHAPE BUILDINGS**
These buildings are newly built housing development with post-modern facade designed. There is easy access to the buildings as they are just two to four storeys high. Buildings are mainly orientated toward north and south. Their appearance is similar to blocks of flats, however they have decorative elements in form of balconies and external cladding.

**HIGH RISE BUILDINGS**
These buildings are mostly 10-15 storeys high, and made out of prefabricated concrete elements, covered in some places with corrugated metal sheets. They occur in every corner of the settlement, strongly remining the comunism times in Poland. The residents of these individual apartments are not connected socially.

*FIG. 3.10. TYPOLOGY ON THE SITE.*

FIG. 3.11. TYPOLOGY OF SURROUNDING BUILDINGS.

FIG. 3.12.

# Climatic conditions

## WIND, TEMEPERATURE AND RAIN

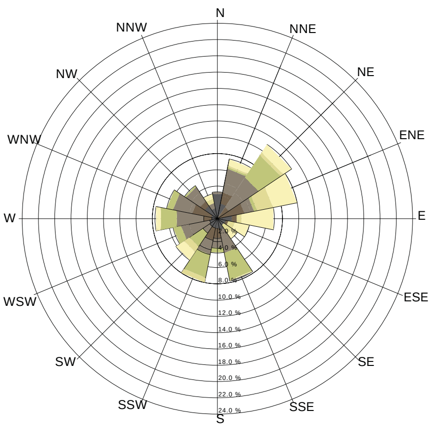
### FOREWORD

As mentioned in the introduction, the plot of construction site is based in Poland, but due to pre-set programs used in the design process, the Dannish weather condition are taken under consideration.

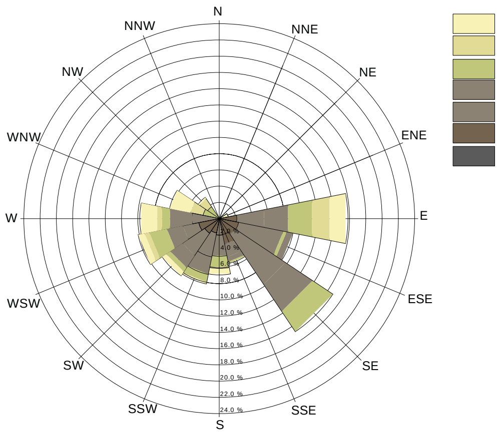
### WIND AND CLIMATE CONDITIONS

The weather in Denmark is strongly influenced by the country's location in temperate climate zone, under the strong influence of the Atlantic Ocean and lesser of the Eurasian supercontinent. The weather changes accordingly to the influence of air masses. Westerly winds from the North Sea typically bring relatively homogeneous weather: mild in winter and cool during summer, always accompanied by clouds, often with rain or showers. Easterly wind causes weather in Denmark to resemble the weather currently prevailing on the Continent: hot and sunny during summer, cold during winter.

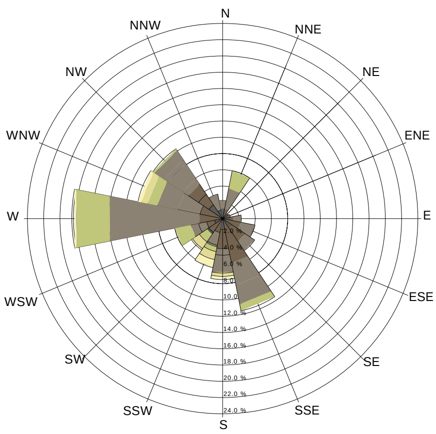
*[Cappelen and , 1999, p. 9-11]*



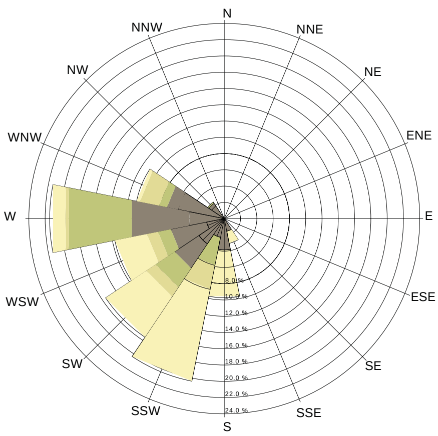

*Wind direction distribution March*




*Wind direction distribution September*




*Wind direction distribution June*




*Wind direction distribution December*

*FIG. 3.13. WIND DIAGRAM: DIRECTION AND SPEED OF THE WIND.*

Occasionally the weather can be influenced either by boreal air masses from northern Scandinavia which would always bring colder air or by subtropical air masses from Mediterranean that would bring warmer air. The local weather is further influenced by the proximity to the Danish straits, Baltic Sea and North Sea, with its daily system of breeze winds.
Following diagrams present temperatures and rainfall in Aalborg.
*http://www.worldweatheronline.com/Aalborg-weather-averages/Nordjylland/DK.aspx*

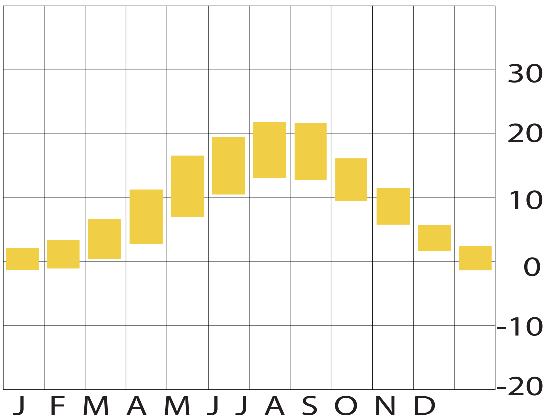



FIG. 3.14. TEMPERATURES.

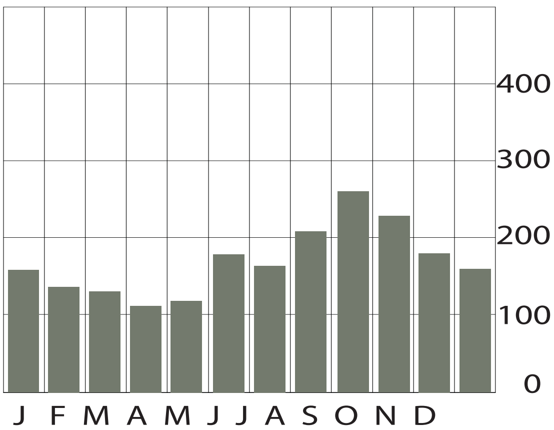



FIG. 3.15. RAINFALL.

# SUN PATH ANALYSIS

## SUN AZIMUTH AND ALTITUDE

Sun as a source of energy can have dramatic influence in reducing of a standard of thermal comfort in the building. It is important to consider movement and angle of the sun in particular periods of the year in order to design the dwelling, public or working spaces. In order to optimize the solar heat gain the orientation of the rooms in the building is important. It has also significance for daylight quality in the room. Good indoor climate and solar gain in the winter can be achieved by taking into consideration the principles of sun angle and functional disposition of rooms in the building.

In order to control heating and light in the dwellings it is important to be aware of the changing position of the sun throughout the year. As a guideline, the adjacent diagrams describe the path of the sun's movement, in the extremes at summer and winter solstice, and as well at equinox. The sun azimuth and altitude is calculated based on the site location in Aalborg, longitude 57° N and latitude 9°30' East.
*[PETES-1]*

## SHADOWS

A 3D model of the site and its surroundings has been built to investigate the effect of neighboring buildings to the building site. Surrounding buildings are differentatied high (from 1 floor on the west side of the site, through 4 levels from east and north, up to 11 floors on the south). The shadow from surrounding buildings may occur mainly from the east and south side of the plot, as there are blocks of flats in near distance. Besides that, the building shall be exposed to the sun at all times when it is sunny. The height of the sun influences the amount of sunlight penetrating into the school rooms with a low angle during winter and a higher angle during summer.

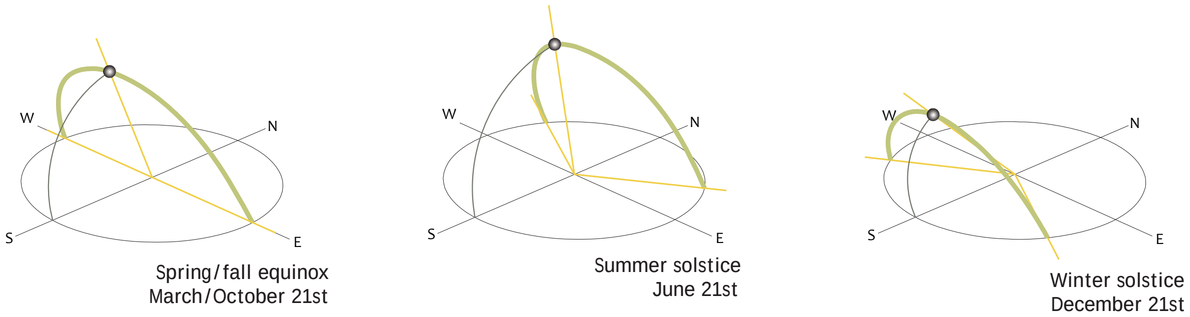



FIG. 3.16. DIAGRAMS OVER THE PATHS OF THE SUN DURING THE YEAR.

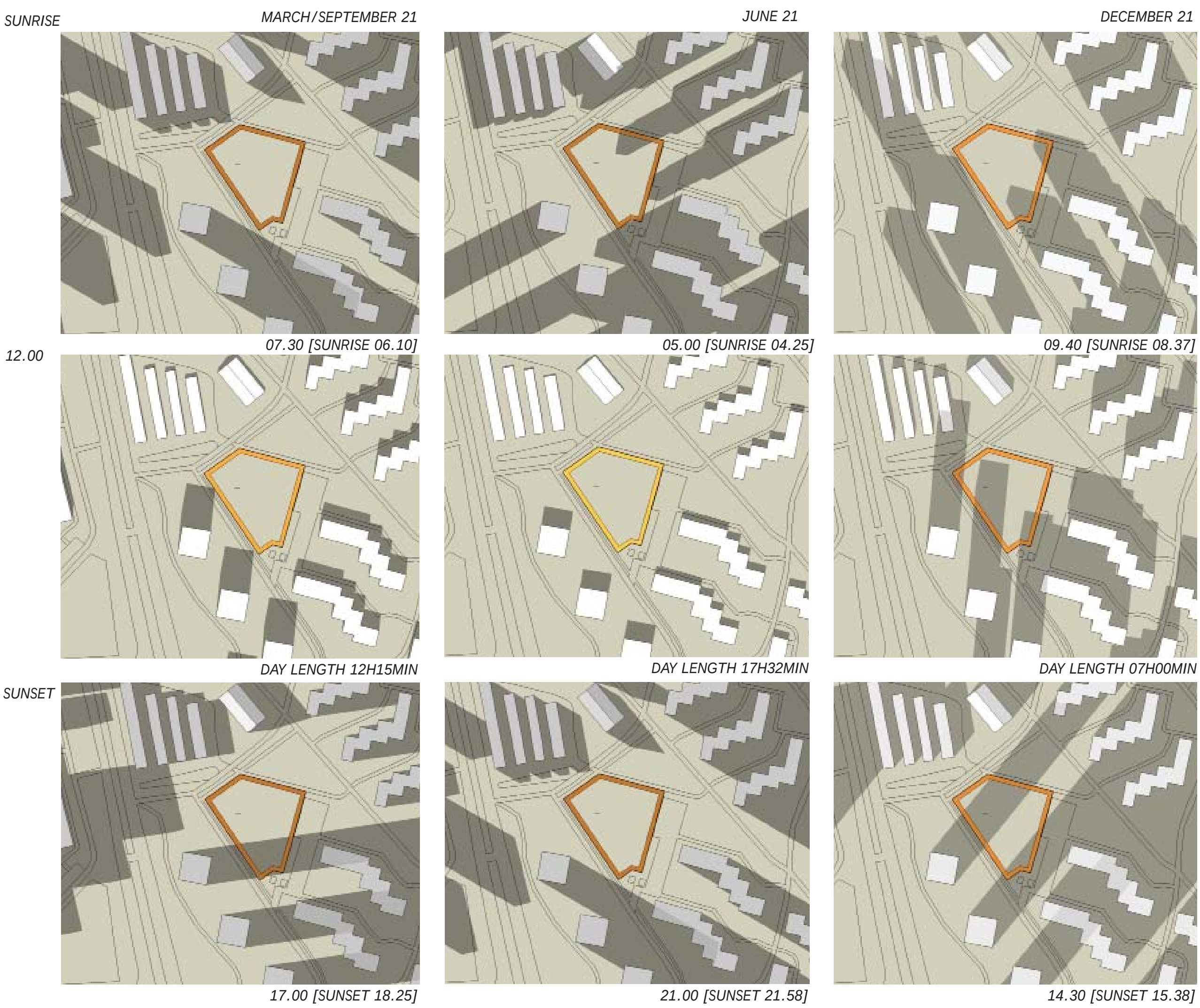



FIG. 3.17. SHADOW STUDIES.

# SUSTAINABILITY

## DEFINITION

### INTRODUCTION

Much of the world's current energy systems depend heavily on fossil fuels, energy source that has originated from our Sun, captured by living organisms in the chemical energy of hydrocarbon bonds over the past millions of years and trapped in Earth crust. Burning of those fuels in the presence of oxygen produces heat that we transform into mechanical, electrical and other forms of energy. We use that energy to heat up and light up homes and offices as well as produce materials to construct them. The problem is that the burning of hydrocarbons produces carbon dioxide, a greenhouse gas that contributes to climate change and global warming. Naturally carbon dioxide is captured from the atmosphere by plants and oceans phytoplankton, but because the speed of burning the fuels and other effects like deforestation, the balance in carbon cycle is heavily disturbed. Therefore the sustainability is essential to avoid further climate change and bring back the balance to the circulation of energy and carbon in our living zone of the planet. Ultimately all the energy we harness, fossil fuels, biofuels, wind and hydropower (except nuclear and geothermal) originate from the Sun. The concept of the sustainable building embrace the idea to capture as much energy as possible directly from the sun, in the form of visible light for our eyes, the heat radiation to keep it hospitable and the energy of photons to produce electric current in photocells. At the same time the materials and technologies used in construction should also be making least use of the fossil fuels and but ensure that quality standards of durability, strength, heat isolation and last but not least safety for human health are met. If fuel fossils need to be used, like during colder season or at nights, the use of that energy and loses to the environment should be minimized - a principle central to the sustainable design paradigm.

*[http://matse1.matse.illinois.edu/energy/prin.html]*

### DEFINITION

'Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future' [Brundtland et. al. 1987, p.51].

Sustainability deals with how human interaction impacts with the natural environment. It is a long term approach to environmental protection improvements. 'A sustainable development must - as an absolute minimum - not bring the natural systems that supports the life on earth in danger: the atmosphere, the seas, the earth and the living creatures. [Brundtland et. al. 1987, p. 51]

"Sustainable architecture (...) is a revised conceptualization of architecture in response to a myriad of contemporary concerns about the effects of human activity. The label 'sustainable' is used to differentiate this conceptualization from others that do not respond clearly to these concerns. Not long ago a major part of the image of good architecture was a building that was suitable for its environmental context – one that would adequately protect the inhabitants from the climate. More recently it is 'the environment' that has been seen as needing protection."

(Williamson, Radford and Bennetts, 2003)

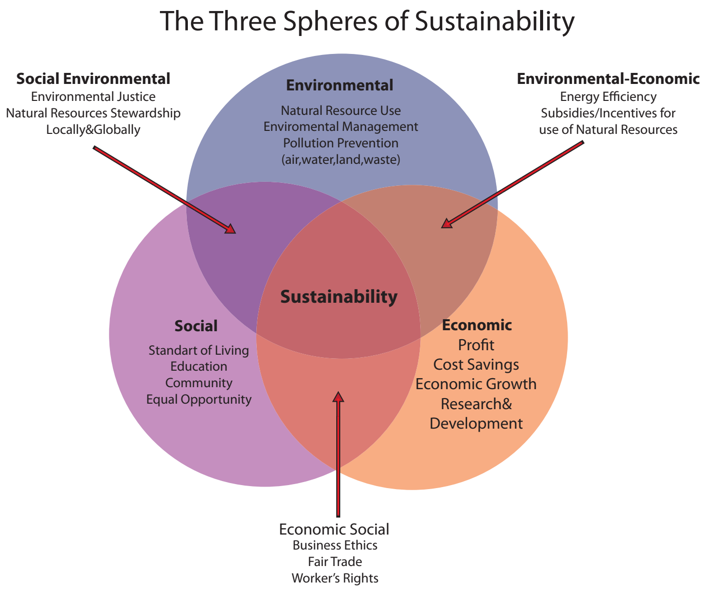



*FIG. 3.18. UNDERSTANDING SUSTAINABILITY.*

The sustainabily concept is mainly shaped by three primary elements as follows: environmental, social and economic sustainability. The project implements the three parameters in order to sustain a healthy-functioning of the overal building, as well as protecting the environment. The main aspect of the environmental sustainability is the energy consumption factor. Comparing today's buildings with traditional or classic building constructions, there are a series of factors that increase the energy consumption which were not cosidered in the past, due to the use of other types of materials, which by today were improved. The required temperature, humidity ranges, natural light reflection and so on are very important aspects when working with sustainability. For this matter, the choice of materials is esential for the project. In choosing the materials a series of aspects were considered as follows: lifespan of use, posibility to reuse, limited energy consumption in purchase of it and transportation as well as in the operating phases. Environmental sustainability involves the architectural aspects of the projects - the overal shape as well as the interior spaces, that create together a complex of functions and qualities which ad value to the program. A compact, yet flexible proposal will make the building worth keeping long term, as demolition is not a good option for the environment. The social aspect of sustainability concerns the sustainability of human connections, quality of working conditions, manufacture of building components and construction and of course use of the building(s). Social sustainability is achieved when the architectural choices establish proper good environments for the users for present use as well as for the future. As for the economic sustainability, the costs of the projects are to be considered from the concept phase and further on, constantly by reaching for improvement of environment and life quality.

*[Mobility 2030 meeting the challenges to Sustainability http://www.wbcsd.ch/plugins/DocSearch/details.asp?type=DocDet&DocId=NjA5NA]*

# APPROACHES

## APPROACH TO SUSTAINABLE ARCHITECTURE

This chapter on sustainable architecture is based on the PhD Thesis, ‘Sensitivity Analysis as a Methodical Approach to the Development of Design Strategies for Environmentally Sustainable Buildings’ by Hanne Tine Ring Hansen. The term ‘sustainable’ is generally used when discussing environmentally responsive architecture still different terms are used according to the different environmental approaches. The picture strip shows examples of each of the architectural terms.

### SELF-SUFFICIENT ARCHITECTURE

*ORIGIN: EARLY INDUSTRIALISATION PERIOD*
*FEATURES: INDEPENDENCE AND SELF-RELIANCE, SELF-CONTAINED, MOVEABLE STRUCTURES,*

### ECOLOGICAL ARCHITECTURE

*ORIGIN: 1960’S*
*FEATURES: RELATIONSHIP BETWEEN PEOPLE AND THEIR SURROUNDINGS, ENVIRONMENTALLY RESPONSIBLE, MATERIALS, RENEWABLE ENERGY, SELF-RELIANCE, LOWTECH SOLUTIONS, IMMOVABLE.*

*“Ecological Architecture merges the interests of sustainability, environmental consciousness, green, natural, and organic approaches to evolve a design solutio n from these requirements and from the characteristics of the site, its neighborhood context, and the local mirco-climate and topography.”*
*[http://www.ecologicalarch.com/designapproach.php]*

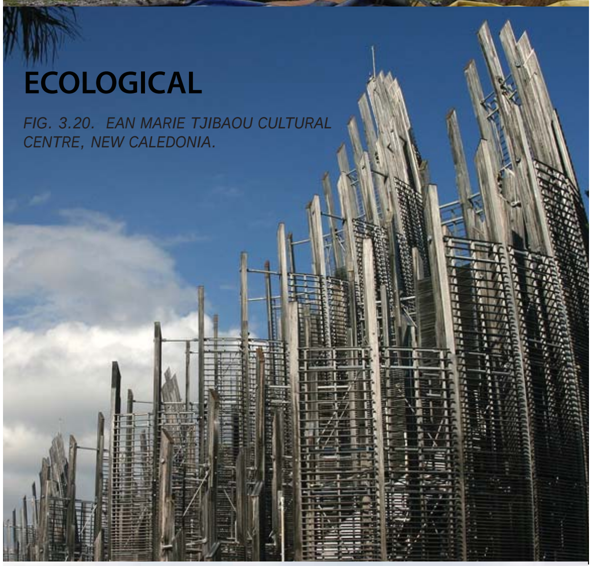
### GREEN ARCHITECTURE

*ORIGIN: 1970’S*
*FEATURES: ENVIRONMENTAL RESPONSIBLE, RESIST TO NUCLEAR POWER STATIONS, BASED ON GREEN-NATURE RELATIONSHIP, SIMILAR TO ECOLOGICAL ARCHITECTURE*

*“Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and the environment. The “green” architect or designer attempts to safeguard air, water, and earth by choosing ecofriendly building materials and construction practices.”*
*[http://architecture.about.com/od/greenconcepts/g/green.htm]*

**SELF-SUFFICIENT**

*FIG. 3.19. HOUSING EXAMPLE FROM FRILAND.*



**ECOLOGICAL**

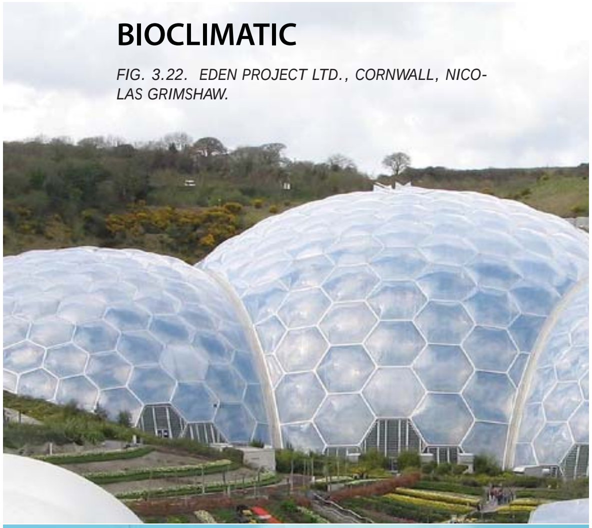
*FIG. 3.20. EAN MARIE TJIBAOU CULTURAL CENTRE, NEW CALEDONIA.*

**GREEN**

*FIG. 3.21. BRUNSELL RESIDENCE, USA, 1987, OBIE BOWMAN.*

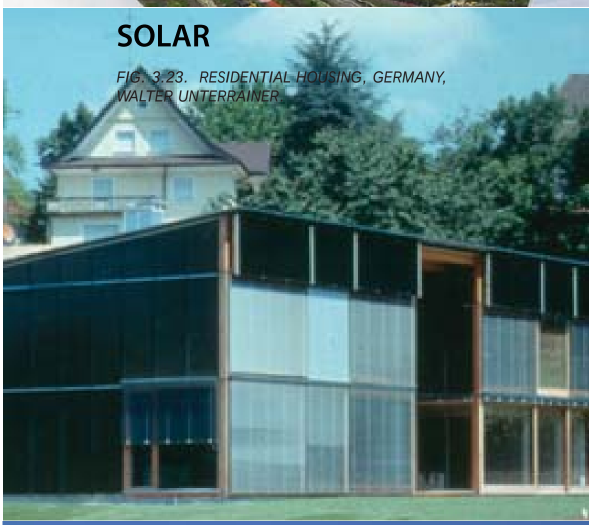
## BIOCLIMATIC

FIG. 3.22. EDEN PROJECT LTD., CORNWALL, NICOLAS GRIMSHAW.



## SOLAR

FIG. 3.23. RESIDENTIAL HOUSING, GERMANY, WALTER UNTERRAINER.



## ENVIRONMENTAL

FIG. 3.24. ARUP CAMPUS IN SOLIHUL, UNITED KINGDOM.

### BIOCLIMATIC ARCHITECTURE

***ORIGIN: 1960'S***
***FEATURES: WORKING WITH NATURE, FOCUSING ON CLIMATE, UTILIZING OF PASSIVE AND LOW-TECH SOLUTIONS, SPECIFIC SITE.***

*"Bioclimatic architecture is a way of designing buildings and manipulating the environment within buildings by working with natural forces around the building rather than against them. Thus it concerns itself with climate (or perception of climate) as a major contextual generator, and with benign environments using minimal energy as its target."*
*[www.msa.mmu.ac.uk 2006]*

### SOLAR ARCHITECTURE

*ORIGIN: 1960'S*
*FEATURES: UTILIZING OF SOLAR ENERGY PASSIVELY AND ACTIVELY IN BUILDINGS, FOCUSING ON FIRSTLY ENERGY-EFFICIENCY DURING OPERATION AND INTEGRATION OF ENERGY PRODUCING ELEMENTS, THEN SECONDARILY ON EMBODIED ENERGY.*

*Solar architecture integrates elements which passively and/or actively use solar energy in order to gain heat and produce energy. Its goal is either zero or low energy buildings. They are also known as, energy efficient or passive houses. Schnittich describes solar architecture as buildings which are total energy concepts; complex configurations that utilize passive and active processes.*
*[Hansen 2007]*

### ENVIROMENTAL DESIGN

*ORIGIN: LATE 1970'S*
*FEATURES: FOCUS ON THE RELATIONSHIP BETWEEN BUILDING AND CLIMATE, MAKING A BALANCE BETWEEN EXTERIOR AND INTERIOR CLIMATE, SELECTIVE VS. EXCLUSIVE DESIGN.*

*"Environmental Design encompasses the built, natural and human environments and focuses on fashioning physical and social interventions informed by human behaviour and environmental processes. It develops physical environments to meet both aesthetic and functional needs with harmony to their surroundings"*
*[Wikipedia]*

# PARAMETERS CONCERNING ENERGY EFFICIENCY

## SUSTAINABILITY PARAMETERS

Sustainability has been divided into four dominating concerns: Nature, Culture, Climate and Technology. Specific sustainable design parameters considered for this project, are categorized according to these four concerns.

| | Nature | Culture | Climate | Technology |
|---|---|---|---|---|
| Focus | Preserving and improving nature | Preserving nature by influencing the user's lifestyle | BASIC STRATEGIES to reduce energy consuption and loss | ADVANCED STRATEGIES to reduce energy consuption and loss, and also to produce energy |
| Description | User's relationship and impact on the natural environ-ment | Increasing user's environmental awarness and involvment of the area | Reduction of reliance on fossil fuels through the building elements | Self-production of energy and reduction of reliance on fossil and through emerg-ing technology |
| Heat Control<br>- Surface to volume ratio<br>- Orientation of building and windows<br>- Passive solar heating<br>- Thermal mass/insulation of building envelope<br>- Passive cooling<br>- Natural cooling<br>- Heat recovery | | | | |
| Air Exchange<br>- Natural ventilation<br>- Mechanical ventilation | | | | |
| Energy efficient instalations | | | | |
| Renewable energy sources | | | | |
| Energy producing elements | | | | |
| Utilsation of daylight | | | | |
| Reduce private transportation | | | | |
| Preserve biodiversity | | | | |

*FIG. 3.25. SUMMARY TABLE - DESIGN PARAMETERS IN TERMS OF SUSTAINABILITY'S FOUR DOMINATING CONCERNS.*


*FIG. 3.26. SCHEME CATEGORIZING THE SUSTAINABLE ARCHITECTURAL APPROACHES INTO PRINCIPLES AND DOMINATING CONCERNS.*

"... in the final analysis, sustainability is about good architecture. The better the quality of the architecture - and that includes the quality of thinking and ideas as much as the quality of the materials used - the longer the building will have a role, and in sustainability terms, longevity is a good thing. Obviously, if a building can be long-lasting and energy-efficient, that is even better".

Norman Foster (Edwards 2001)

# Institution of Kindergarden

## PEDAGOGICAL PRINCIPLES OVER TIME

### INTRODUCTION

The child, like any small creature for proper growth and development needs many different factors and help others. In addition to water, food and clothing a little man needs primarily heat, intimacy and support. A big role in a child's life plays a teacher. He teaches and educates at different levels of education. The first link in this process is the kindergarten.

### A LITTLE BIT OF HISTORY

The term of kindergarten appeared for the first time in Poland during so-called Teacher Parliament Meeting in 1919. The first time in history the group of female educators was set up. The name was introduced in the "Act on System of Education" of 11 March 1932, it was also found its place in the contemporary education system. Prototype was pre-nursery. They appeared in the nineteenth century. With the rapid development of industry and the associated demand for women's work was the problem of providing care for children of mothers working professionals.

The first nursery originated in England in 1816 on the initiative of utopist R. Owen and S. Wilderspin in 1824, the founder of the Society of Children's Nurseries (infant schools). They had to give their pupils a minimum of knowledge for life.

In France, the first nurseries were created in connection with the educational and social activities of evangelical Pastor JF Oberlin. They provided children with care and preparation for elementary schools through the development of speech, love to work, and to order. They were mainly in Paris and educational institutions for socially disadvantaged children, but they were actually "conserving" bringing together a large number of children, giving small educational opportunities. At the beginning of the nineteenth century the nursery were formed in Germany. Their organization were modeled on the English nurseries. The greatest development was in the years of Friedrich Fröbel's activity. The term of "children's gardens" was created for the play and activity institute that he created in 1837 in Bad Blankenburg as a social experience for children for their transition from home to school. His goal was that children should be taken care of and nourished in "children's gardens" like plants in a garden. The main intent of the activity was to teach and educate. They had to cultivate (develop, educate) a child as a gardener cultivates plants using appropriate methods.

In 1842 the count August Cieszkowski, social and political activist, drew an attention to the poor conditions in which children live in rural areas and the benefits of protecting rural development and educational childcare in rural areas. In Poland, by the time of independence in 1945, there were two types of pre-school institutions. Some of them were called "shelters", primarily providing care for working mothers, and the second based on certain pedagogical assumptions inspired by Fröbel's "gardens" or Montessori homes for children.

In 1932 Ministry of Religious Affairs and Public Education issued a guidance entitled "Tips and advices for educators in kindergartens". In 1945, the National Congress of Educational put forward the demand for the compulsory pre-school education for at least two years (for 5 and 6 year olds). Their goal was to create conditions for comprehensive development of children, adoption, social life, and to implement compulsory education. In those days was a clear tendency to centralize the management of kindergartens.

In the sixties the network of kindergartens run by Catholic associations “Caritas “was closed down, while the network of public kindergartens expanded. Since 1958, kindergartens started to be built together with primary schools.

The Act on the Development of Education in 1961 set goals of preschool education:
- the comprehensive development of children
- preparing for school
- support for working parents in providing care and educational

As we have seen over the years Polish kindergarten changed under the influence of the different concepts of teaching and depending on the system. From the offices of a guardian for educational and teaching. In the early nineties there were two extreme attitudes toward kindergarten. One reluctant kindergarten treats as a “relic of communism” or as a “nursery” and the second indicating the importance of stimulating the development of preschool children. It was also recognized that the existing buildings are limiting the possibilities for changing pedagogy why they sought new ways of planning, which many new types of institutions were established.

A new concept in teaching emerged with the active participation of teachers. Psychologists pointed out the importance of the child’s own spontaneous activity for its development. It was also observed that the Montessori teaching concept had been tried to move into Polish system. There was a change in the direction of working style trigger methods in the child a sense of empowerment. Teachers helped pupil search, explore and exceed its previous achievements.

In recent years, there have been significant transformation of Polish education. Nursery were opened wide for the children, and began to take into account the expectations of parents. The early childhood education prepares a child to participate in the following stages of education.

The most important tasks of modern school education include:
**First of all** - the integrity of the process of education and training and improving the child’s development, which in turn requires changes to the existing methods of teacher.
**Secondly** - kindergarten education must become a factor personal creativity, not only equipment of the child knowledge.
**Next task** is to empower the child in the learning process. Family is a team-ward in education, rather than suppliant.

These tasks pose to the practice of teaching far-reaching changes in the work of educational institutions in the wake of their need for a broader and more reliable competence and skills of teacher education.

There are not any officially formulated educational requirements for building design, why inspiration is often described are taken from historical, social or local conditions. However, in recent years there has been an increased focus on the quality of institutions, which shows there is a reason to be interested in the building characteristics, and what the children think about design and use of compartments.

*[http://www.przedszkola.edu.pl/przedszkola-w-polsce-i-w-europie-historia-i-zadania.html]*

“Activity and bodily expression is not to be restricted to scheduled activity hours in the day-care or kindergarten or to exercise classes in school, but must be incorporated in all aspects and activities, in architecture and in interior design.
Exercise should be a natural option inherent in all of the normal activities during the day. We must focus on activity when we design spaces for learning.“

[“Tomorrow’s buildings for children - space for play and learning” 2008]

# Activity of Children

## INTRODUCTION

People develop in the way they can control the actions their body makes for example walking, talking, manipulating things with their fingers, understanding the world around them, using their memory or remembering, forming relationships with others, and understanding and controlling their emotions.

The development of people can be divided broadly into five different life stages:
- Infancy 0 – 3 years
- Childhood 4 – 10 years
- Adolescence 11 – 18 years
- Adulthood 19 – 65 years
- Later adulthood 65+ years

During each life stage the development of people can be divided into four main areas:
Physical development: includes growth and changes in the body and the development of skills in using the body including balance and control of movements, being able to look after themselves and others.
Intellectual development: includes the development of language, thinking, reading, understanding, problem solving and knowledge.
Emotional development: covers the development of feelings and emotions including a sense of security, feelings of belonging, confidence, self-concept and being able to control their behavior.
Social development: includes the ability to interact with others, sharing, taking turns, playing, personal relationships, team working skills and working relationships.

In the following chapter the partially two groups will be discussed, children at age 2-3 and children at age 4-5, as children at those ages will be the target groups of the kindergarten.

## PHYSICAL DEVELOPMENT

### *INFANCY*

Fine motor skills
Fine motor skills involve hand and eye coordination to control the movements of the hands and fingers. Infants learn to use the smaller muscles to pick up objects and drop them again. As skills are practiced they become more accurate and allow them to develop more complex skills such as pointing, drawing.

At 15 months an infant is able to clasp their hands together and holds crayons with their whole hand. By 18 months the infant is gaining confidence and can turn the pages of a book several at a time. At three years they are becoming very independent and can feed themselves without dropping food. They can dress themselves but still need help with buttons. Undressing is more difficult but they still try at this age.

**Sensory skills**
At one year the baby can see almost as well as an adult. They watch people, animals and moving objects for long periods. Babies of this age know and respond to their own name, as well as to familiar sounds and voices. At eighteen months children will see and pick up small objects, such as beads, with a pincer grasp. They enjoy looking at picture books and recognize bold, brightly colored, objects on a page. By two years the child's sight has developed fully and they can see everything an adult can. Familiar people can be recognized in photographs.

### *CHILDHOOD*

Children at this age develop strength in their muscles and their coordination and control improves greatly. They become increasingly active and their practical abilities continue to develop.

**Gross motor skills**
The child gains confidence and is very reassured in using gross motor skills previously developed. At four years children will be able to kick and throw a large ball, stand on tiptoe and walk around. At five years children can catch a small ball with two hands, steer and pedal a tricycle confidently and can sit cross legged. At six years the child has good balance and can ride a two-wheeled bicycle.

**Fine motor skills**
At four years children can control a pencil to draw a person with a head, body and legs and can copy some shapes. When dressing, they can undo buttons but find doing them up more difficult. Children will have developed a preference for using one hand or the other by this stage. At five years old the child will be able to draw a clear picture of a person with the head, trunk, eyes, nose and mouth quite apparent. The child can dress and undress easily.

## INTELLECTUAL DEVELOPMENT

INFANCY
Intellectual development refers to the development of the mind. A child's mind is very active right from birth. As children learn to think, reason and explain their intellectual development is progressing. Intellectual development can be divided into two main strands, cognitive development (understanding) and language development including verbal and non-verbal communication. The development of these is very closely linked to the other aspects of development – physical, social and emotional. The pattern of intellectual development usually follows the same sequence. Intellectual development can be affected by inherited patterns of development. There may also be inherited learning difficulties which could affect the sequence of intellectual development.

Children quickly progress with their intellectual development between one and three years of age. Talking and listening become important ways of learning. As soon as they can ask questions they are able to find out more about their world.

***CHILDCHOOD***
During this life stage children learn to count, make decisions based on logic rather than their feelings, recognise words and develop their reading ability. They learn by watching others in a process called modelling and copy what other people do, including unacceptable behaviour. During this life stage children develop their understanding of concepts. They learn to organise their thoughts so that they understand that objects may be different colors but they are still the same shape. It is difficult for children to work things out in their heads or imagine the solution to a problem.

## EMOTIONAL DEVELOPMENT

***INFANCY***
Emotional development is all about the way we feel about ourselves, other people and the things we do. Children have feelings of fear, excitement, affection, pride, jealousy and contentment. They show these and many more depending on the situation they are in at the time and who is there to support them.
Bonding is very important for a baby. The first cuddle after they are born is the start of the bonding process and gives them a sense of security, feeling they are wanted.

***CHILDHOOD***
Children experience a wide range of emotions. By the age of 5 or 6 years children are becoming more independent. They can use a knife, fork and spoon to feed themselves and can dress and

undress themselves which gives a great sense of achievement. As children get older they understand more complex emotions and feel guilty when they understand the difference between right and wrong. Children understand that it is good to comfort a friend who is upset and can play games fairly, following the rules. Emotional stability and security are important in the development of children. This will build the foundations on which children develop in the future and are likely to affect their attitude towards life. A child who feels secure will be happy and enjoy themselves; however, a child who lacks stability is likely to be aggressive and withdrawn.

## SOCIAL DEVELOPMENT

### *INFANCY*

The socialization process is important for children and begins as soon as they are born. If they do not develop the skills and attitudes needed to be able to mix with others their lives are likely to be very lonely.

### *CHILDHOOD*

Children depend on their parents and carers when a child is young. A five year old is usually more independent and plays co-operatively with other children. The process of socialization teaches children how they are expected to behave in social situations. Children quickly learn that cheating and anti-social behavior is not tolerated as it leads to them being isolated.

## LANGUAGE DEVELOPMENT

Children use language to express their needs, to socialize and to share information with others. Children develop language or verbal communication by watching and copying those around them. Frustration is common in babies before they begin to talk as they find it hard to get their message across to their carers.

## VERBAL COMMUNICATION

When children learn verbal communication they have to also learn the rules of grammar as well as the meanings of the words. This is not something which can be learnt quickly. Verbal communication takes a lot of practice in order to get the sounds right and express them in a way which has meaning. Individual children develop verbal communication at different speeds. The differences are much more noticeable than in any other area of development. Some children will be well ahead of the average ages for developing speech, others may be a long way behind.

## LISTENING

Listening is a skill which children have to learn to be able to communicate effectively. Listening to the other persons contribution is essential to ensure the conversation flows and the child understands the information they have been given. For example, asking a child if they need to go to the toilet – if the child is not listening they will not be able to give the correct response.

## FACIAL EXPRESSIONS AND GESTURES

Children increase their use of facial expressions and gestures as their verbal communication develops and they form an important part of the use of language throughout life. Both can be used to enhance the words being said. Gestures are often used to replace word as they can have a greater impact. Individuals who are deaf, have hearing difficulties or who cannot speak rely on facial expressions and gestures when communicating.

*[http://www.fendip.net/pluginfile.hp?file=%2F1251%2Fmod_resource%2Fcontent%2F1%2FD7%20Growth%20and%20Development%20FINAL.pdf]*

*FIG. 3.28. CHILDREN'S DEVELOPMENT.*

## MOTOR DEVELOPMENT AND PLAY AT DIFFERENT AGES

**2-3 year:**
- "I can" - insists on helping and may even get dressed
- running and jumping
- grabbing balls
- play: role and imitation play
- play: oneleg (alone) or parallelleg (beside others)

**3 years:**
- jumping from low heights
- grabbing a ball with two hands and throwing a little with one hand
- loving to move - liking the music
- play: the game is social
- playing with some other children

**4 years:**
- climbing, cycling and using a lot of energy
- testing own energy and strength and seeking challenges for thrills
- play: playing with groups of other children (social play), usually play and imaginative play, boys also play agression
- able to concentrate on making games like puzzling and drawing for a long time

**5 years:**
- motor skills become more accurate
- able dribbling the ball in one hand
- fun to stand on one leg and walk on toes and have a good sense of balance
- play: conversational play, role play and usually play
- thinking it is fun to compete

**6 years:**
- movement becomes more lose in the joints
- fine motor skills strengthened
- play: fantasy games which are based on the unreal
- play rule is about ethical and moral issues, good and evil, right and wrong.

# INSPIRATION

## SIGHARTSTEIN KINDERGARTEN

**Location: Sighartstein, Land Salzburg, Austria**

Spatial dimension of the ornamental facade
Situated on the periphery of the site of green meadows and fields, the first impression of the construction site provided the idea for the sculptural facade by way of an elevated grass turf. The oversized “grass blades” communicate the building’s unique identity and provides an orientation marker for the kindergarten. The stylized grass blades are not only ornamental, but also act as a continuation of the landscape theme – namely, the staccato row of spruces visible at the meadow’s edge or the branches of the neighboring leafy trees. The resulting scenic correspondence takes place not only in the building volume itself but also in the structure noticeable from within.

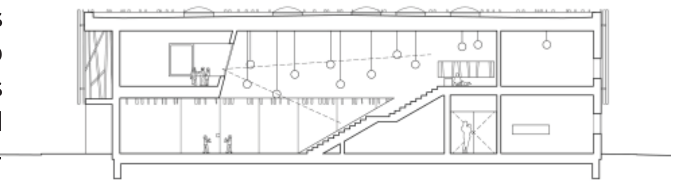
Architect: Kadawittfeldarchitektur
Construction Year: 2008-2009,
Public competition 2003, 1st prize
Constructed Area: 830 sqm

The fLat roofed two-story cubic building optimally distributes the functions of a kindergarten. On the ground floor, one finds the space for the kindergarten groups – with direct access to the garden. The crèche is accommodated in the protected upper story. In the crèche, an expandable third space has been made possible through a planned reallocation of the space.
The group rooms are lined up along the south side with direct access to the terrace and garden. The group rooms are comprised of two units – each with a wardrobe, sanitation area, and a storage space located in between the hall and the group areas. To the east are additional rooms such as the personnel area, administration, quiet room and mess hall.

Light + Nature

The floor-to-ceiling glassed-in ground floor invites nature straight into the building by lighting up the group rooms with plenty of sunlight; whereas the window openings of the upper level behind the ornamental facade create a completely different lighting and provide the youngest users of the crèche with an atmosphere of nurturing shelter.

*[http://www.archdaily.com/34252/kindergarten-sighartstein-kadawittfeldarchitektur]*



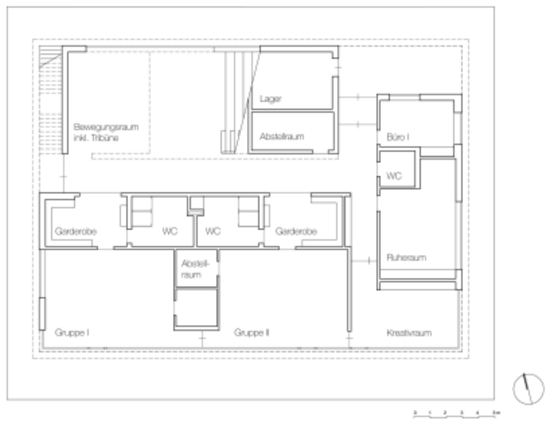



*FIG. 3.29. PICTURES OF SIGHARTSTEIN KINDERGARTEN.*

# INSPIRATION

## BERNTS HAVE DAY CARE CENTER

**Location: Holbæk, Denmark**

The new day care centre for children aged 0-6, Elverhøj, in Bernts Have is now open. Children and staff have entered the playgrounds, rooms and cosy common spaces of the centre and the entire area oozes of play, energy and sustainability.

The new day care centre is situated in the residential area of Bernts Have, which is designed by Henning Larsen Architects. The centre has room for 56 children aged 0-3 and 80 children aged 3-6 and is situated on the highest point in Bernts Have wedging into the hill below a large, green roof while opening up towards the landscape, sun and playground to the south.

Architect: Henning Larsen Architects
Construction Year:  2007-2009
Constructed Area: 1,350 sqm

Sustainability
The simple, minimalist building is made of glass and wood and comprises a nursery in one wing and a section for children aged 3-6 in the other wing. In-between the two wings, the human resources department is situated connecting the two age groups and wings.

Facing the playground, a so-called climate zone has been established - an unheated supplementary area that follows the changing seasons in terms of heating making it possible for the children to play “outside” without wearing gloves in the winter.
The climate zone functions as a sun protection and as a supplement to the preheating and heating of the wings.

*[http://www.archdaily.com/85118/bernts-have-daycare-center-henning-larsen-architects]*

The objective of the building design is to provide each child with the opportunity to express itself just as each child should feel part of the community. The large, open and flexible units encourage activity and community while the more quiet zones give the children the opportunity to withdraw - alone or in small groups. Along the corridors, the children can take a break in the small niches furnished with mattresses and cosy reading lights.
This means that the building is designed at eye level with children - that the design is characterised by space, light and a pleasant atmosphere and, not least, by materials that are comfortable for the children to touch. We want to give the children an experience of being taken seriously - of being an individual part of the community!", says Margrethe Grøn, architect at Henning Larsen Architects.

In the same way, the design of the building seeks to meet the needs of the staff by means of a welcoming, practical and flexible layout, a healthy indoor climate and sound absorbing acoustics - "qualities that we know help to facilitate everyday life and release resources for the staff", explains Margrethe Grøn, who is pleased to see how the users of the day care centre have embraced the building.

*[http://www.archdaily.com/85118/bernts-have-daycare-center-henning-larsen-architects]*

*FIG. 3.30. PICTURES OF BERNTS HAVE DAY CARE CENTER.*

# INSPIRATION

## LEIMOND-NAGAHAMA NURSERY SCHOOL

**Location: Nagahama, Shiga, Japan**

This nursery school for children, from years zero to five years, stands on the outskirts of Nagahama city in Shiga prefecture. The school has been planned as a single-storey structure with a feeling of transparency between each of the spaces as well as the exterior landscape and, the "House of Light",as we call it, has been placed in the main nursery area.

What we mean by the "House of Light" are conical, square light-wells of different shapes, different color and facing different directions in the high ceiling bringing in various "lights" into the interior space, changing with the time and the seasons.

The children may be able to feel the changes of these "lights", even chase them and play with them, and to enjoy this gift of "light" in their daily activities.

Furthermore, the shape of the "House of Light" may be seen from the outside as its unique silhouettes are outlined against the almost unchanging rural scenery, providing it with a little more character.

*[http://www.dezeen.com/2011/08/10/leimondo-nursery-school-by-archivision-hirotani-studio]*

Architect: Archivision Hirotani Studio
Construction Year: 2010-2011
Constructed Area: 690 sqm

*FIG. 3.31. PICTURES OF LEIMOND-NAGAHAMA NURSERY SCHOOL.*

# INITIAL ROOM PROGRAM

## NEEDS AND REQUIREMENTS

The initial room program has been established for 110 children and 20 care-takers and administration. The program has been created following Lublin municipality recommendations and after researches and analyses of familiar institutions. The major of program is based on similar projects such as; "Børnehus i Hånbæk" from 2013 by LBB3 and "Dandelion Clock Kindergarten" from 2006 by Ecker Architekten.

The new kindergarten should provide space for 2 different age-groups of children: aged 2-3 years and 4-5 years. Appropriate amount of rooms for teachers, administration and other staff needs to be designed accordingly.
The diagram 3.32. illustrates the relationship between different spaces in the kindergarten and shows how they interact with each other.

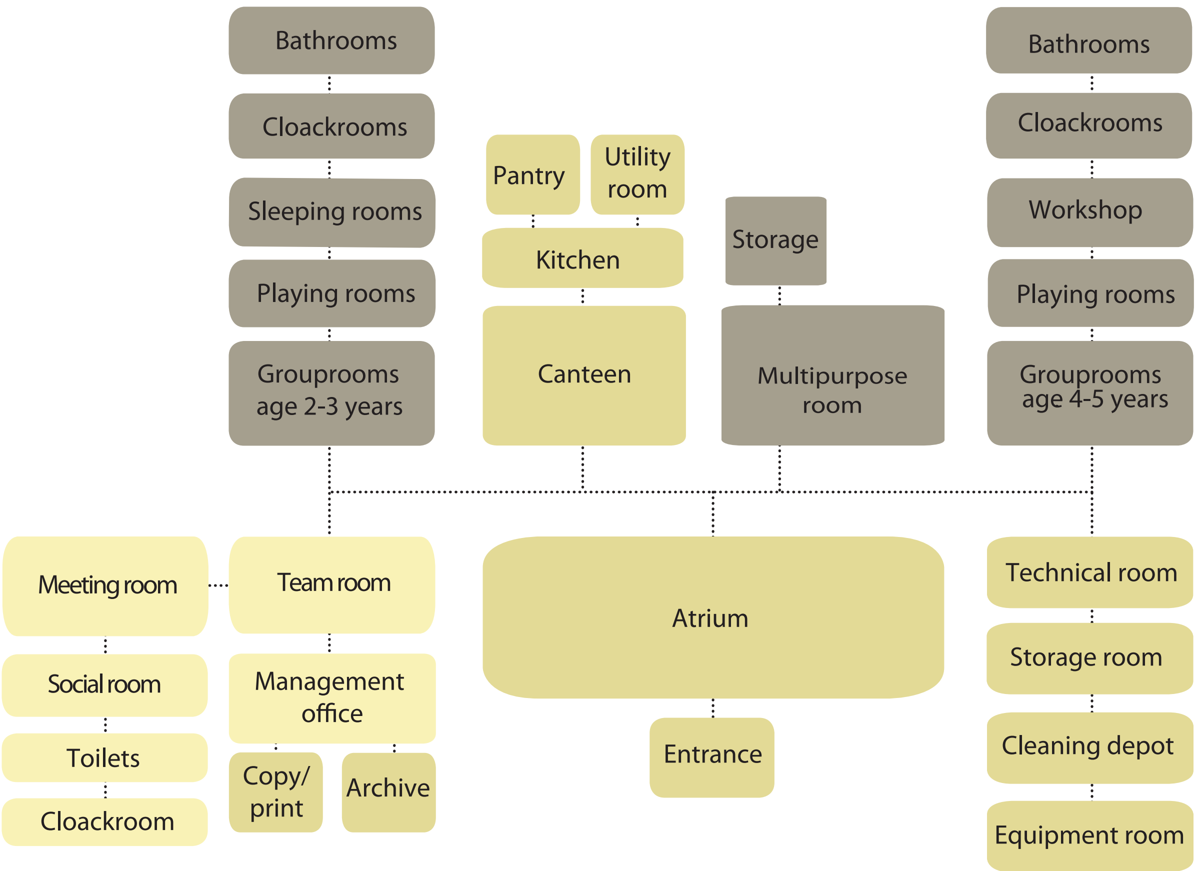



*FIG. 3.32. DIAGRAM OF RELATIONSHIPS BETWEEN THE PARTICULAR ROOMS AND ZONES.*

# ROOM PROGRAM

**Zone 01 - 4 nursery groups ca. 10 childs per group = 40 children (2-3 years old)**

| Room | m² | Notes | Notes |
|---|---|---|---|
| **Group room** | 200 | 4 nursery group rooms each 50m² | The group rooms shall be no trapped rooms and ground floor accessible as possible and have direct access to the outdoor play area. The clear height of the rooms must be at least 2.3 m in order to ensure the necessary air space of 5-6 m³ per child. Room shall include depot for storing small mattresses, pillows and blankets to sleep with indoor, app. 8-10m². Betwen the rooms shall be double sliding door so that the groups can be merged and help each other.<br>All groups of rooms should be in close association with the corresponding toilet and baby changing facilities. |
| **Playing/sleeping room** | 100 | 4 rooms each 25 m² | Some of the windows to the outside shall go to the floor, others must be with the windowsill placed at a child height where children can stand and play while they look out. |
| **Wardrobe** | 40 | 4 wardrobe niches, each 10 m²<br>enough space to jackets, backpacks, change of clothes, slippers, and personal mail for parents of home brought things such as: toys, stuffed animals, etc. | The wardrobe in the corridor should be mounted separately from the lounges. In addition to adequate space for coat rack should also caps and shoe racks and lockers for bags to be present. So-called wardrobe niches have been found favorable. |
| **Sanitary rooms** | 50 | 2 lavatory for max. 20 children 25 m²<br>equipped with number of toilets and hand washing sinks, changing and shower facilities, large-scale storage for diapers, creams and compartments for each child. | Sanitary facilities with bath and baby changing facilities, feces spout, children toilet and sink in children's height. |
| **Sum** | **390** | **m²** | |

*FIG. 3.33. ROOM PROGRAM FOR THE GROUP OF YOUNGEST CHILDREN.*

# ROOM PROGRAM

**Zone 02- 4 children groups ca. 20 childs per group = 80 children (4-5 years old)**

| Room | m² | Notes | Notes |
|---|---|---|---|
| **Group room** | 200 | 4 group rooms each 50 m² | The group rooms shall be no trapped rooms and ground floor accessible as possible and have direct access to the outdoor play area. The clear height of the rooms must be at least 2.3 m in order to ensure the necessary air space of 5-6 m³ per child. Room shall include depot for storing small mattresses, pillows and blankets to sleep with indoor, app. 8-10m². Betwen the rooms shall be double sliding door so that the groups can be merged and help each other.<br>All groups of rooms should be in close association with the corresponding wardrobe, toilet and baby changing facilities. |
| **Playing room** | 100 | 4 rooms each 25 m² | 4 Group rooms - Focus on creative work / studio space for work with sound<br>Some of the windows to the outside shall go to the floor, others must be with the windowsill placed at a child height where children can stand and play while they look out. |
| **Wardrobe** | 40 | 4 wardrobe niches, each app. 10 m² shall have enough space to jackets, backpacks, change of clothes, slippers, things brought home such as: toys, stuffed animals, | The wardrobe in the corridor should be mounted separately from the lounges. In addition to adequate space for coat rack should also caps and shoe racks and lockers for bags to be present. Be favorable so-called wardrobe niches have been found. |
| **Sanitary room** | 50 | 2 Sanitary rooms, each ca. 25 m² equipped with a sufficient number of toilets, wash hand basin, a floor drain, one of the rooms should be equipped with a changing table. | Each child in a sink height and a child-friendly toilets for 10-14 children, enough mirrors, soap dispensers and towel holders are provided.<br>A shower should be located at each facility. |
| **Sum** | **390** | **m²** | |

*FIG. 3.34. ROOM PROGRAM OF ZONE TWO - CHILDREN AGED 4-5 YEARS.*

**Zone 03 - common areas**

| Room | m² | Notes | Notes |
|---|---|---|---|
| **Areas with special use** | 60 | Kitchen 15 - 25 m²<br>Pantry m² 5<br>Utility Room 15 m² | Ability to create and provide breakfast for the 0-6 year old children who have come early. For all-day adequate kitchen facilities for distribution or preparation of lunch with appropriate cooling device and storage facilities for food is required. |
| **Canteen** | 50 | | Common room connected with the kitchen, where children are collected at morning and afternoon. The children delivered in the morning, eat breakfast and "processed" then on to their group. |
| **Sanitary room** | 10 | Children toilet about 6 m²<br>Disabled toilet 4 m² | |
| **Multipurpose room** | 100 | | A material space in connection to the multiroom is helpful. |
| **Movement space** | 200 | Movement space 100-200 m²<br>with direct access to the outdoors, flexible partition walls, spanning ceiling to fix swing hooks, climbing walls / wall bars | Use of the corridor for the movement: In order to allow running and circle games, there should not be too narrow hallways. Wardrobes and cupboards should be housed in a separate area to avoid overlap between the types of use. It is recommended that facility of a multipurpose room of 50-60 sqm additionally is provided (for rhythm, specific exercises and more educational activities). |
| **Sum** | **420** | **m²** | |

**Zone 04 - administration, maintenance**

| Room | m² | Notes | Notes |
|---|---|---|---|
| **Staff zone** | 150 | Management office 30 m²<br>Archive 5 m² Copy/print room 3m²<br>Social room 30 m² - for app. 20 employees<br>Team/meeting room 40 m²<br>Staff toilet / WC 2 x visitors 6 m²<br>Shower 3 m²<br>Staff cloakroom 20 - 25 m² | The office should preferably be in the entrance area. Possibility of keeping valuables in lockers. Space for extra clothes. |
| **Storage room** | 80 | Warehouse / storage room 25 m²<br>Cleaning products stoarge 5 m²<br>Equipment room 20 m²<br>Technical room 20 m² | An equipment room - 20 m² for sand toys and moving vehicles from the outdoor play area<br>Cleaner room - 5 m² must be lockable, and it should be equipped with a sink. |
| **Sum** | **230** | | |
| **Together** | **1,430** | **m² netto** | |

*FIG. 3.35. ROOM PROGRAM OF ZONE 3- THE COMMON AREAS.*

# REQUIREMENTS

## ENERGY

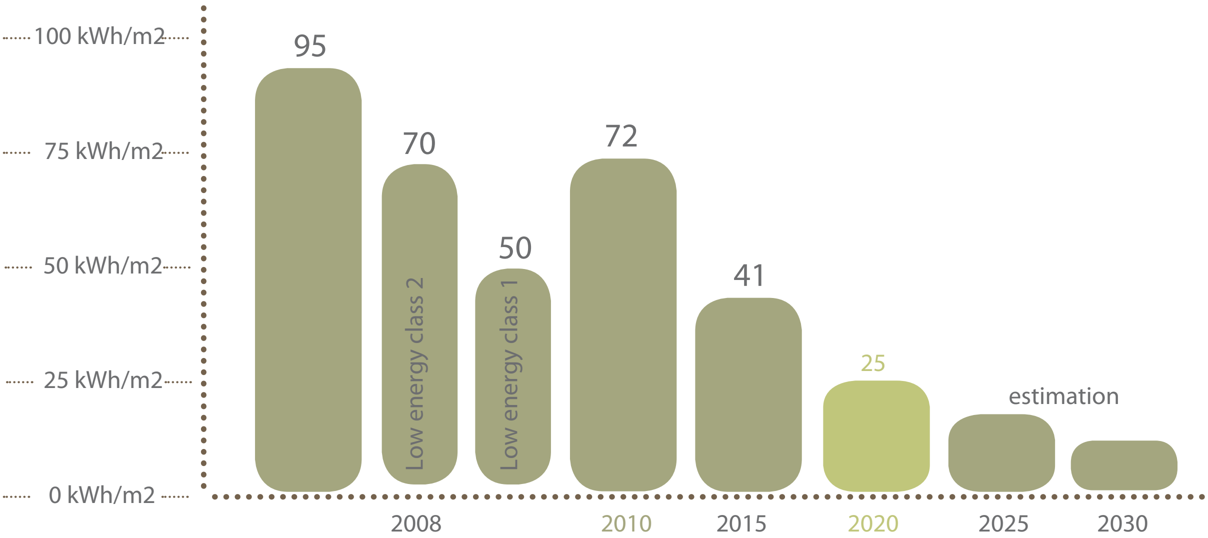



*FIG. 3.36. ENERGY FRAME FOR SCHOOLS, OFFICES, INSTITUTIONS [RAMBOLL 2010]*

BR20
The Danish Building Regulations (BR10) are being followed in order to fulfill the requirements for the energy frame. The diagram above presents an overview of how recently the energy demands for schools, offices and other public institutions have been changing. Evident tendency of reducing primary energy demands by 25% every 5 years is visible.

In 2010 the building regulations have been tightened, where the current energy frame is equivalent to the previous low energy class II. In order to comply with the new requirements, various strategies on lowering energy consumption must be taken into consideration.
Illustration on the following page presents the guidelines related to these concerns.

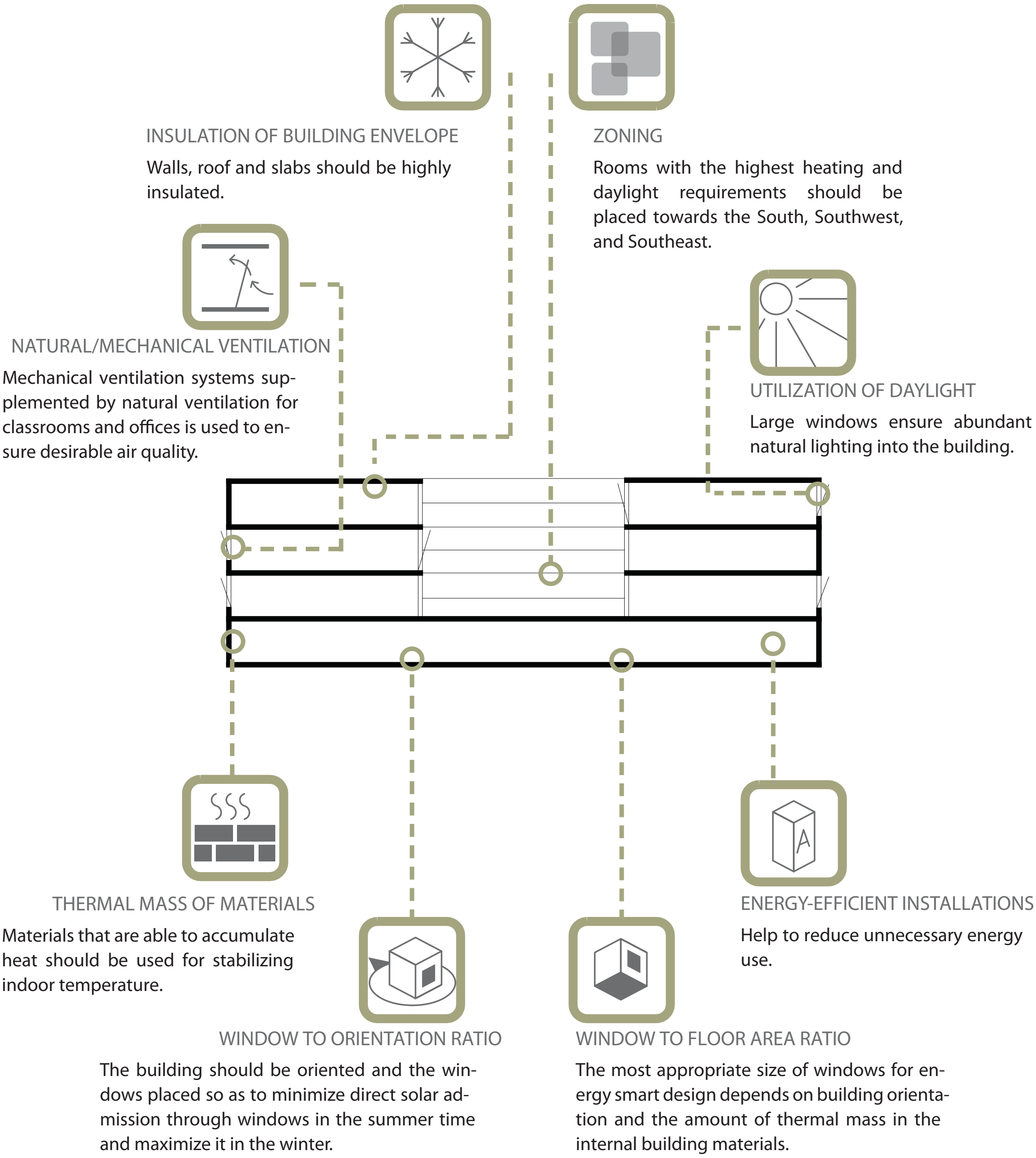



*FIG. 3.37. DESIGN PRINCIPLES FOR OPTIMAZING THE ENERGY FRAME. [KNUDSTRUP 2009]*

# INDOOR CLIMATE

## INTRODUCTION

Over the last few decades, in schools the considerable attention has been directed towards the problems of indoor air quality. It has become increasingly clear that exposure to contaminated indoor air may not only be unpleasant, but also may have serious negative health effects. Children of today spend in school environment increasingly more time. Children may be more sensitive to indoor air pollution as they breathe a greater volume of air relative to their body weight compared to adults.
*[“Demand based ventilation in schools” p.1-3]*

The focus of this project is to design a kindergarden in the integrated way, where good building physics combining the smart building systems will fulfill the requirements for A category for indoor environment quality.

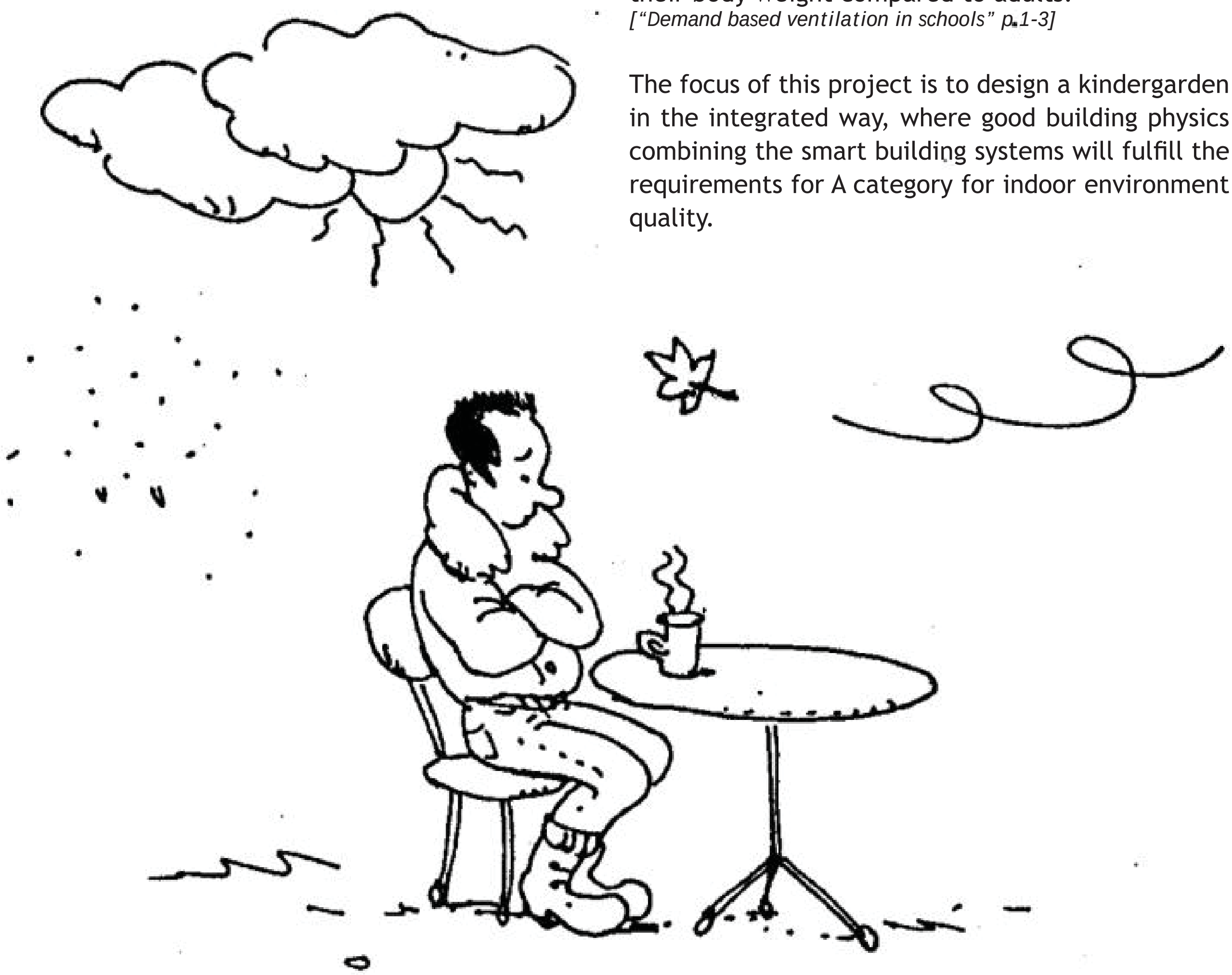


*FIG. 3.38 INDOOR CLIMATE.*

## DAYLIGHT

Good daylight conditions have a proven positive effect on the children's learning abilities. Therefore when designing a kindergarten, some strategies shall be taken into account, such as high-ceilinged rooms which provide better utilisation of daylight, as well as the colours of the rooms - especially of the window frames. Light colours help reducing glare around the windows. In order to support daylighting in rooms, artificial lighting shall be adjustable to the varying activities.
*["Sunny schools" 2001: p.23]*

Windows must be made, located and, where appropriate, screened in a way so that sunlight through them does not cause overheating in the rooms, and direct solar heat gain is avoided.
*[BR10 6.5>SBi 230]*

In order to enable people to perform visual tasks efficiently and accurately, adequate light without side effects like glare and blinding must be provided.
*[DS/EN 15251]*

Evaluation of light conditions must be seen in relation to the specific function in a room and in this project this is described in Fig. 3.48. where according to DS/EN 15251 the specific demands of all rooms are presented.

| | Room | Daylight type | Daylight factor, lux |
|---|---|---|---|
| Childrens' zone | Group room | Natural+ artificial | 300 |
| | Playing/sleeping room | Natural+artificial | 300 |
| | Wardrobe | Natural/artificial | 200 |
| | Sanitary room | Natural/artificial | 200 |
| Common space | Multipurpose room | Natural+artificial | 300 |
| | Childrens' canteen | Natural+artificial | 200 |
| | Kitchen | Natural+artificial | 200 |
| | Pantry | Natural/artificial | 200 |
| | Utility room | Natural/artificial | 200 |
| | Toilet | Natural/artificial | 200 |
| Children carers | Management office | Natural+artificial | 500 |
| | Social room | Natural+artificial | 200 |
| | Team/meeting room | Natural+artificial | 200 |
| | Archive | Natural/artificial | 200 |
| | Copy/print | Natural/artificial | 200 |
| | Staff toilet | Natural/artificial | 200 |
| | Staff cloackroom | Natural/artificial | 200 |
| Maintenance | Technical room | Natural/artificial | 200 |
| | Storage room | Natural/artificial | 200 |
| | Cleaning depot | Natural/artificial | 200 |
| | Equipment room | Natural/artificial | 200 |

*FIG. 3.39. LIGHT TYPES AND INTENSITY.*

# INDOOR CLIMATE

## THERMAL COMFORT

Thermal indoor climate concerns characteristics of the indoor environment which affect the heat exchange between the human body and the environment. The aim is to obtain thermal comfort, which is measured as satisfaction with the thermal environment.
*[BR 10 6.2]*

There is good evidence that moderate changes in room temperature affect children's abilities to perform mental tasks requiring concentration. However, while warmer temperatures tend to reduce performance, colder temperatures reduce manual dexterity and speed. Hence the need to avoid extreme conditions and to provide for as much individual temperature control as possible is strongly recommended.
*["IAQ and student performance"]*

As described above, temperature in the rooms should meet the limits of optimal operative temperatures. Furthermore, category A allows a permissible vertical air temperature difference of <2 $C^0$. In order to avoid overheating solar shading may be considered as an option, yet it must not obstruct the views and light, and interfere with architectural expression.
*["Sunny schools" 2001, p.23]*

## HUMIDITY

Humidity has only a small effect on thermal sensation and perceived air quality in the rooms of sedentary occupancy, however long term high humidity indoors will cause microbial growth, and very low humidity, causes dryness and irritation of eyes and air ways. Excessive rise of humidity is the most frequently observed sign of problems with air circulation, which often result from a faulty ventilation system. Relative humidity value indoors should range from 30% to 65%, the ideal being between 40% and 50%.
*[DSEN 15251, B.6]*

| | Room | Room netto area ($m^2$) | Room height in floors | Room volume ($m^3$) | Occupacy, people | Max people load | Activity level (met) | Clothing, summer/winter, clo | Summer (C) | Winter (C) |
|---|---|---|---|---|---|---|---|---|---|---|
| Childrens' zone | Group room | 50 | 3 | 150 | 22 | 0.44 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Playing/sleeping room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Wardrobe | 10 | 3 | 30 | 10 | 1.00 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Sanitary room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| Common space | Multipurpose room | 80 | 4 | 320 | 100 | 1.25 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Childrens' canteen | 50 | 4 | 200 | 60 | 1.20 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Kitchen | 25 | 4 | 100 | 10 | 0.40 | 1.4 | 0.5/1 | 23.5-25.5 | 19.0-21.0 |
| | Pantry | 7 | 4 | 28 | 5 | 0.71 | 1.4 | 0.5/1 | 23.5-25.5 | 19.0-21.0 |
| | Utility room | 15 | 4 | 60 | 5 | 0.33 | 1.4 | 0.5/1 | 23.5-25.5 | 19.0-21.0 |
| | Toilet | 8 | 4 | 32 | 4 | 0.50 | 1.4 | 0.5/1 | 23.5-25.5 | 19.0-21.0 |
| | Atrium | 300 | 7 | 2100 | 140 | 0.47 | 1.4 | 0.5/1 | 23.5-25.5 | 19.0-21.0 |
| Stuff | Management office | 30 | 3 | 90 | 5 | 0.17 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Social room | 30 | 3 | 90 | 20 | 0.67 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Team/meeting room | 40 | 3 | 120 | 30 | 0.75 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Archive | 5 | 3 | 15 | 2 | 0.40 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Copy/print | 3 | 3 | 9 | 2 | 0.67 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Staff toilet | 8 | 3 | 24 | 2 | 0.25 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Staff cloackroom | 30 | 3 | 90 | 25 | 0.83 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| Maintenance | Technical room | 20 | 4 | 80 | 5 | 0.25 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Storage room | 30 | 4 | 120 | 5 | 0.17 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Cleaning depot | 8 | 4 | 32 | 5 | 0.63 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |
| | Equipment room | 25 | 4 | 100 | 5 | 0.20 | 1.4 | 0.5/1 | 22.5-24.5 | 19.0-21.0 |

*FIG. 3.40. DESIGN CRITERIA DUE TO THERMAL INDOOR CLIMATE.*

# INDOOR CLIMATE

## INDOOR AIR QUALITY

*[BR10 6.3> CR1752> DS/EN 15251]*

The requirements for the air quality in a room are first that the health risk of breathing the air should be negligible and second that the air should be perceived to be fresh and pleasant. The atmospheric indoor climate is concerned with components in the air that affect the human body. In general it is a matter of the experienced air quality in proportion to pollution. Analysis of extensive studies from all over the world show that main problems related to indoor air quality in schools are: insufficient fresh air supply leading to high $CO^2$ concentrations, problems related to emissions from building materials as well as problems related to outdoor air pollution problems.

*[“Indoor climate and ventilation ofschools” 2007: p.2-4]*

Thus, a careful choice of ventilation strategy must be made. When designing for category A, in regards to CR1752 there are some general design criterias:
> 15% dissatisfied due to perceived air quality when pollution in air is 1,0 decipol (A.5);
> 0,1 decipol in perceived outdoor air quality (A.9);
> 350 ppm CO2 in outdoor level of air when designing in town with good air (A.9);
> 460 ppm CO2 above outdoor level of air quality (A.3.3.3);
> 0,1 olf/$m^2$ of pollution from the building (A.8);
> 1,4 olf of pollution from person (A.6);
> smoking is not permitted;

The limit of 810 ppm $CO^2$ in perceived indoor air quality is allowed in this project.

| | | | | | | | sensory pollution loads | | | pollutants |
|---|---|---|---|---|---|---|---|---|---|---|
| | Room | Room netto area ($m^2$) | Room height in floors | Room volume ($m^3$) | Occupacy, people | Max people load | Activity level (met) | Building, low-polluting,olf | People, olf | $CO_2$ from people, l/h (av.18 l per person) |
| Childrens' zone | Group room | 50 | 3 | 150 | 22 | 0.44 | 1.4 | 5 | 1,3 | 396 |
| | Playing/sleeping room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 2.5 | 1.3 | 180 |
| | Wardrobe | 10 | 3 | 30 | 10 | 1.00 | 1.4 | 1 | 1,3 | 180 |
| | Sanitary room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 2.5 | 1.3 | 180 |
| Common space | Multipurpose room | 80 | 4 | 320 | 100 | 1.25 | 1.4 | 8 | 1.3 | 1800 |
| | Childrens' canteen | 50 | 4 | 200 | 60 | 1.20 | 1.4 | 5 | 1.3 | 1080 |
| | Kitchen | 25 | 4 | 100 | 10 | 0.40 | 1.4 | 2.5 | 1 | 180 |
| | Pantry | 7 | 4 | 28 | 5 | 0.71 | 1.4 | 0.7 | 1 | 90 |
| | Utility room | 15 | 4 | 60 | 5 | 0.33 | 1.4 | 1.5 | 1 | 90 |
| | Toilet | 8 | 4 | 32 | 4 | 0.50 | 1.4 | 0.8 | 1 | 72 |
| | Atrium | 300 | 7 | 2100 | 160 | 0.53 | 1.4 | 30 | 1.3 | 2880 |
| Stuff | Management office | 30 | 3 | 90 | 5 | 0.17 | 1.4 | 3 | 1 | 90 |
| | Social room | 30 | 3 | 90 | 20 | 0.67 | 1.4 | 3 | 1 | 360 |
| | Team/meeting room | 40 | 3 | 120 | 30 | 0.75 | 1.4 | 4 | 1 | 540 |
| | Archive | 5 | 3 | 15 | 2 | 0.40 | 1.4 | 0.5 | 1 | 36 |
| | Copy/print | 3 | 3 | 9 | 2 | 0.67 | 1.4 | 0.3 | 1 | 36 |
| | Staff toilet | 8 | 3 | 24 | 2 | 0.25 | 1.4 | 0.8 | 1 | 36 |
| | Staff cloackroom | 30 | 3 | 90 | 25 | 0.83 | 1.4 | 3 | 1 | 450 |
| Maintenance | Technical room | 20 | 4 | 80 | 5 | 0.25 | 1.4 | 2 | 1 | 90 |
| | Storage room | 30 | 4 | 120 | 5 | 0.17 | 1.4 | 3 | 1 | 90 |
| | Cleaning depot | 8 | 4 | 32 | 5 | 0.63 | 1.4 | 0.8 | 1 | 90 |
| | Equipment room | 25 | 4 | 100 | 5 | 0.20 | 1.4 | 2.5 | 1 | 90 |

*FIG. 3.41. POLLUTION SOURCES.*

# INDOOR CLIMATE

## VENTILATION ACCORDING TO ACTIVITIES

Indoor environment problems are often caused by changed use of the building, changed teaching methods, changed physical behaviour of the pupils inside the building and inadequate building maintenance.
"Open school concepts" that lead to pupils moving around in classrooms and working part-time in the hallways affects school design and therefore school HVAC system design. Another issue is very often that schools are becoming more and more public by providing a public access to sports facilities, course centres or evening clubs with activities around the clock and throughout the year. Therefore, due to large variations in demand, there is a need of a ventilation system which enables demand-based control. Airflow control should be possible within very wide parameters so that differences in the size of the group can be managed energyeconomically. In a standard class, the possibility should be allowed of increasing airflow by 20% so that larger teaching groups can also be catered for.
*["Demand-based ventilation in schools": p.1-3]*

Acoording to Building Regulations 2010, hybrid or mechanical ventilation should be used in school rooms occupied by children, except for offices, which can be ventilated by natural ventilation. Teaching rooms in schools must be ventilated by ventilation installations comprising forced air supply and exhaust. Fresh air supply to and extraction from normal teaching rooms must be no less than 5 l/s/person plus 0,4 l/s/m$^2$ floor area.
*[BR10 6.3]*
Above a table is to show different needs for comfort demands, airchanges and ventilation rates according to rooms usage.
*[BR10]*

| Zone | Room | Room netto area ($m^2$) | Room height in floors | Room volume ($m^3$) | Occupacy, people | Max people load | Activity level (met) | Airchange (sensory polution, $h^{-1}$ | Airchange rate from co2 load, $h^{-1}$ | Airchange rate from temperature, $m^3/h$ | Airchange rate from temperature,l/s |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Childrens' zone | Group room | 50 | 3 | 150 | 22 | 0.44 | 1.4 | 6.6 | 8.0 | 270 | 75.0 |
| | Playing/sleeping room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 7.1 | 8.8 | 135 | 37.5 |
| | Wardrobe | 10 | 3 | 30 | 10 | 1.00 | 1.4 | 13.8 | 18.3 | 54 | 15.0 |
| | Sanitary room | 25 | 3 | 75 | 10 | 0.40 | 1.4 | 6.1 | 7.3 | 135 | 37.5 |
| Common space | Multipurpose room | 80 | 4 | 320 | 100 | 1.25 | 1.4 | 12.8 | 17.1 | 576 | 160.0 |
| | Childrens' canteen | 50 | 4 | 200 | 60 | 1.20 | 1.4 | 12.3 | 16.4 | 360 | 100.0 |
| | Kitchen | 25 | 4 | 100 | 10 | 0.40 | 1.4 | 4.6 | 5.5 | 180 | 50.0 |
| | Pantry | 7 | 4 | 28 | 5 | 0.71 | 1.4 | 5.6 | 7.0 | 50.4 | 14.0 |
| | Utility room | 15 | 4 | 60 | 5 | 0.33 | 1.4 | 3.0 | 3.3 | 108 | 30.0 |
| | Toilet | 8 | 4 | 32 | 4 | 0.50 | 1.4 | 4.2 | 4.9 | 57.6 | 16.0 |
| | Atrium | 300 | 7 | 2100 | 140 | 0.47 | 1.4 | 2.8 | 3.4 | 3780 | 1050.0 |
| Stuff | Management office | 30 | 3 | 90 | 5 | 0.17 | 1.4 | 2.5 | 2.2 | 162 | 45.0 |
| | Social room | 30 | 3 | 90 | 20 | 0.67 | 1.4 | 7.1 | 8.7 | 162 | 45.0 |
| | Team/meeting room | 40 | 3 | 120 | 30 | 0.75 | 1.4 | 7.8 | 9.8 | 216 | 60.0 |
| | Archive | 5 | 3 | 15 | 2 | 0.40 | 1.4 | 4.6 | 5.2 | 27 | 7.5 |
| | Copy/print | 3 | 3 | 9 | 2 | 0.67 | 1.4 | 7.1 | 8.7 | 16.2 | 4.5 |
| | Staff toilet | 8 | 3 | 24 | 2 | 0.25 | 1.4 | 3.2 | 3.3 | 43.2 | 12.0 |
| | Staff cloackroom | 30 | 3 | 90 | 25 | 0.83 | 1.4 | 8.6 | 10.9 | 162 | 45.0 |
| Maintenance | Technical room | 20 | 4 | 80 | 5 | 0.25 | 1.4 | 2.4 | 2.4 | 144 | 40.0 |
| | Storage room | 30 | 4 | 120 | 5 | 0.17 | 1.4 | 1.8 | 1.6 | 216 | 60.0 |
| | Cleaning depot | 8 | 4 | 32 | 5 | 0.63 | 1.4 | 5.0 | 6.1 | 57.6 | 16.0 |
| | Equipment room | 25 | 4 | 100 | 5 | 0.20 | 1.4 | 2.1 | 2.0 | 180 | 50.0 |

*FIG. 3.42. REQUIRED VENTILATION RATES.*

# DESIGN CRITERIA

## AESTHETIC AND FUNCTIONAL PARAMETERS

*The building's architectural expression is to be designed from the inside out; with main focus on the activity rooms and the user.*

*Materials, daylight and the buildings aesthetics shall create an exciting architectural, functional and spatial experience.*

*The kindergarten should function as a meeting point for children groups of all ages and be a building pulsating with knowledge and inspiration.*

## TECHNICAL PARAMETERS

*The building should obtain the 2020 energy demands for a public building.*

*The building shall utilize natural daylight, both to lower the energy consumption but also to create a beautifully lit building.*

*The placement of functions within the building shall be placed according the need for light, shadow, wind and sun to utilize these in the best way.*

*The buildings heat consumption and energy demand is to be lowered by designing a dense and optimized building envelope.*

# VISION

***The vision of the project is to create a building whose architecture both visually and functionally has its focus on children.***

***Leisure scheme will form the framework for a life with room for play and activities spanning several levels - wild and energetic, quietly, in large groups or in small ones.***

***Inside the building both have common areas where all assembled, zones with a specific use, free areas with multiple use options, as well as small, intimate and more closed zones.***

***The building shall enhance the sense of wellbeing and community feeling through variation of spaces and activities.***

***There shall be visual contact between a seating areas to a greater or lesser degree.***

***The building stays zones should be extended in the outdoor space in the way that a connection between them and the outdoor space must be through planting and paths defining different play zones.***

***The architecture must reflect the spirit of harmonious dialogue between building and environment.***

*FIG. 3.43. INTEGRATION OF CHILDREN.*

ILL. 4.00.

# PROCESS

# METHODOLOGY

## INTEGRATED DESIGN PROCESS

### INTRODUCTION

Architecture is not only an art. It is also a cross-functional science involving multiple disciplines, where the integration of the building design to serve daily human activities and to comply with environmental needs is the main objective, as well as to fulfill esthetic needs of receiver.

Design process is constructed as a system composed of the following phases: brief, concept, architectural design, engineering design (construction, installations), logistics and economic feasibility. The operational and maintenance aspects should also be taken under consideration as well as economic costs. If the need for building demolition would have ever arisen, the plan should also account for it. That process has linear character with milestones and documents for different stages that are interconnected, with a facility to loop back in the process if new findings are established that require the change of former assumptions.

**ANALYSIS PHASE** comprises of introduction, investigation and aspects analysis which must be mapped out in order to get the project started. The Analysis phase results in an Architectural Program which includes design criteria and constitutes the foundation for the further progress of the project and design proposal. Analysis of the site in connection to sun, wind, landscape, topography, functional diagram, urban development plans etc are gathered and compiled into Context Analysis. Furthermore, various case studies into sustainable architecture are elaborated. As a result the program for the kindergarten is set, including design criteria and demands for the architectural as well as the technical design.

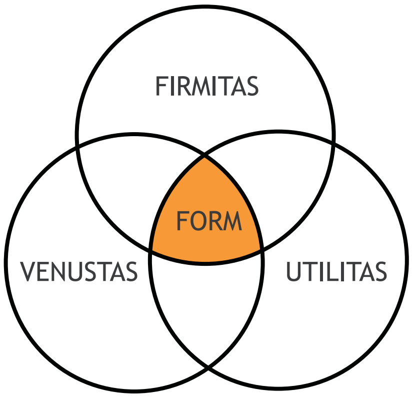



*FIG. 4.01. ARCHITECTURE AS INTEGRATION ON DESIGN ASPECTS.*

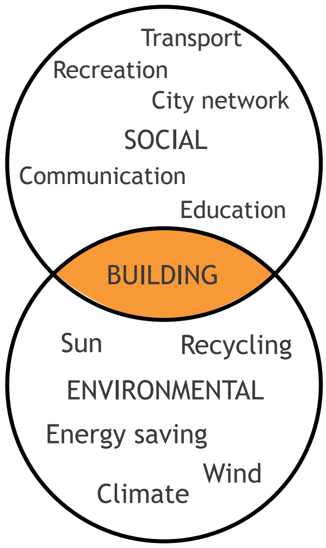



*FIG. 4.02. INTEGRATION OF THE DESIGN PROCESS.*

**SKETCHING PHASE** is the beginning of the design itself. The sketching is an iterative process which develops into the concept for the design proposal. It contains the sketching process to reach the architectural and structural aims stated in the analysis phase. The sketching is based on the parameters from the analysis phase and provides additional initial calculations of technical parameters to facilitate integrated design. At the end of this phase, the best concepts are selected for further elaboration and optimization.

**SYNTHESIS PHASE** consists of developing the concept into a realistic stage. The kindergarten finds its final form and expression based on the last adjustments and calculations based on optimization of considered parameters and solutions found in the sketching phase. Here the demands of the project stated in the analysis phase are fulfilled.

**PRESENTATION PHASE** comprise the presentation of the project; both process and final design proposal. The presentation will in this case be separated into two parts: a project rapport accounting for the phases and the design proposal and examination presentation accounting for verbal and visual elaboration and discussion. The intention of the presentation phase is to conclude, fulfill and justify the vision for the project, which can lead to qualitative discussions and reflection upon the project and the treated themes.
*[Knudstrup, 2004]*

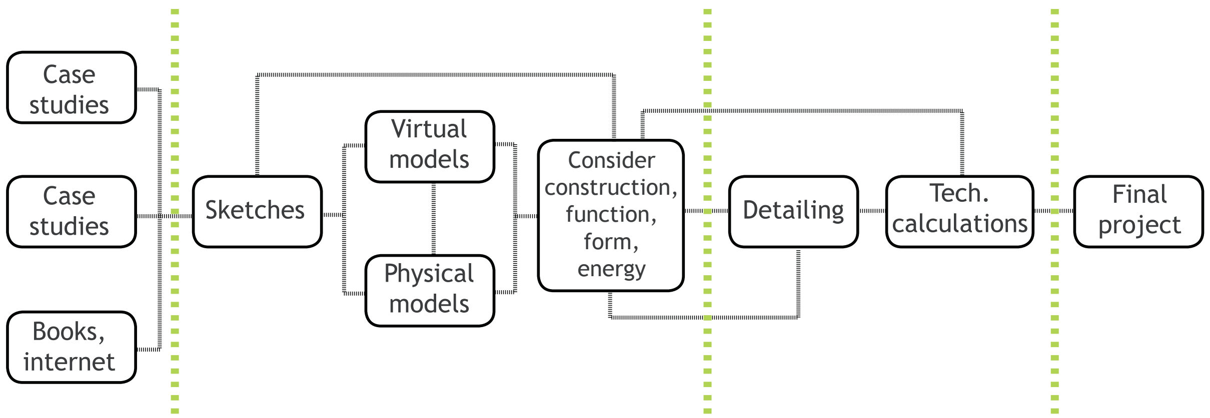



*FIG. 4.03. DESIGN PROCESS*

# WORKING METHODS

The work has been carried out with many angles. Four major design development methods were used: computer design/ graphic/ sketching/ physical model making. Each of tool has been used during the phases where it was most appropriate.

Sketching
In most of the projects sketching is used as a base to create preliminary design/ idea/ overview of architect's mind. It was still the fastest way to produce and present ideas and communicate them to the other team members. After preliminary design computer took over most of work.

Physical model making
Model making, on one hand is the best way to evaluate a volume and shape of the building, on the other is time-consuming, hence the process of model making was used in preliminary phase. In further stage it was limited to build models for the final design presentation.

AutoCad application
The computer drawing forms the major part of the work. The development of drawings starts with draft drawings as a means of feasibility studies. The next stage is drawings for a planning application which are followed by construction drawings. AutoCad was used throughout the design process as it was quick and generated useful clear information. It was used from the very beginning to the final stage of the project. The range of work was to make plans elevations and technical drawings and details of the project.

SketchUp 3d application
Computer model making has been a necessary tool throughout the whole project development as it presents a quick and comprehensive way how the design affects the building form from outside and inside.

Velux Daylight
Velux Daylight Visualizer has been introduced in early investigation of facade pattern, as well at the end of project, where the final investigation of the daylight condition was prepared.

BE10
BE10 - tool is used to document if the proposed design fulfills the demands of energy demands in Denmark.

# Sketching phase

## THE DESIGN PROCESS

The design process was started with sketching analysis. The primary concept was made supported by knowledge about site, local climate and principles for cultural complex and the rules state in building regulations. It set off with initial studies of capacity and orientation. According to the site limitation drawn in the municipality plan. It also contains sketching on site and on the building layout. The summary of the investigation should ideally lead to the synthesis of two or more concepts, or a development of the entirely new proposal utilizing the qualitative potentials of the evaluated concepts.

The area of app. 3900 $m^2$ has been reserved for the new building of the kindergarten. According to program, the gross area of building was app. 1500 $m^2$, hence the first investigations focused on searching for the possibilities of occupying the area. It was important to set up the closest line to the boundary of the plot, where the wall of building could be put. It was set up to 4 meters. The illustration below presents the first proposals for building shape, and green line indicates the position of the playgrounds and recreational areas.

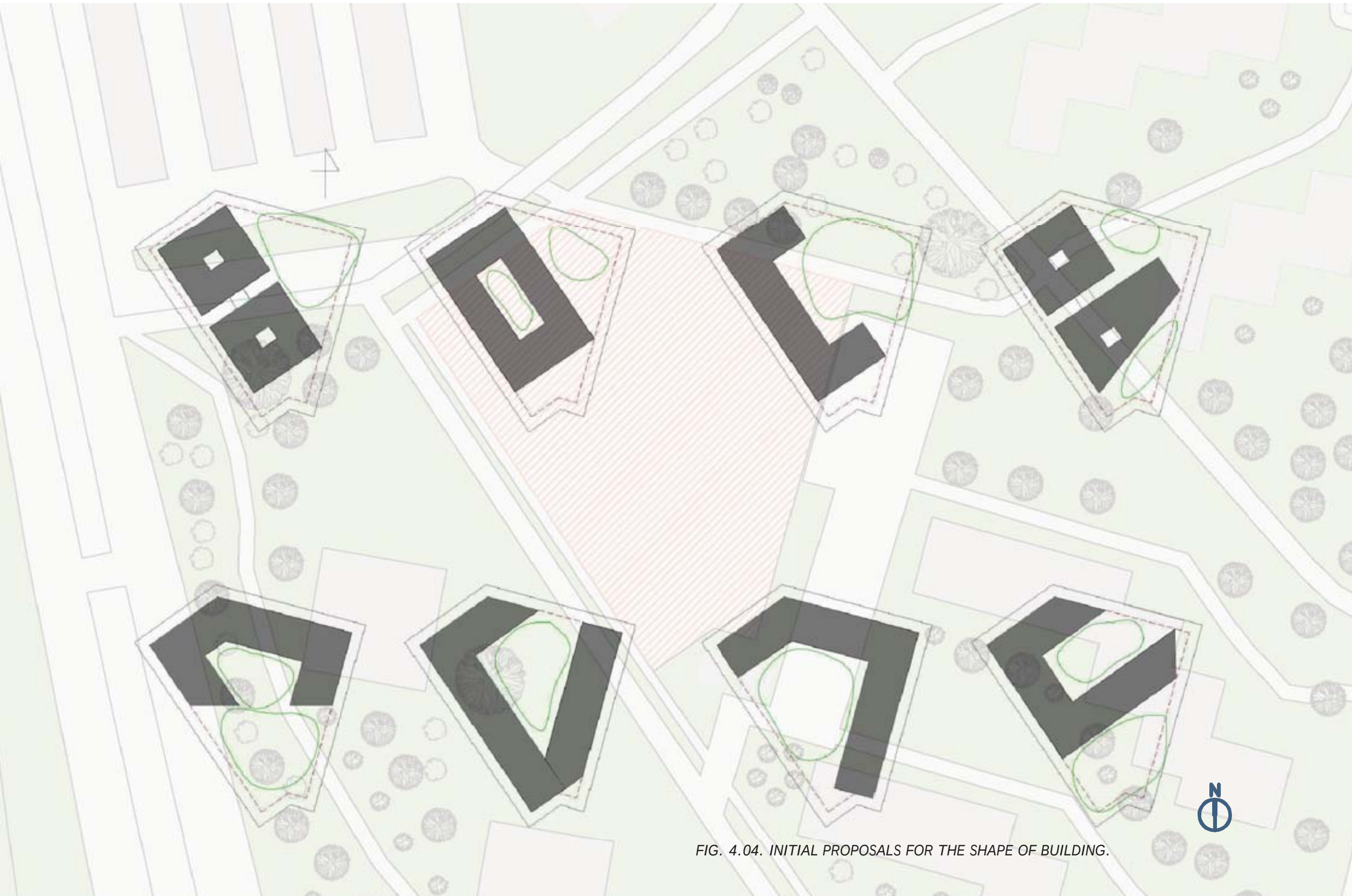



*FIG. 4.04. INITIAL PROPOSALS FOR THE SHAPE OF BUILDING.*

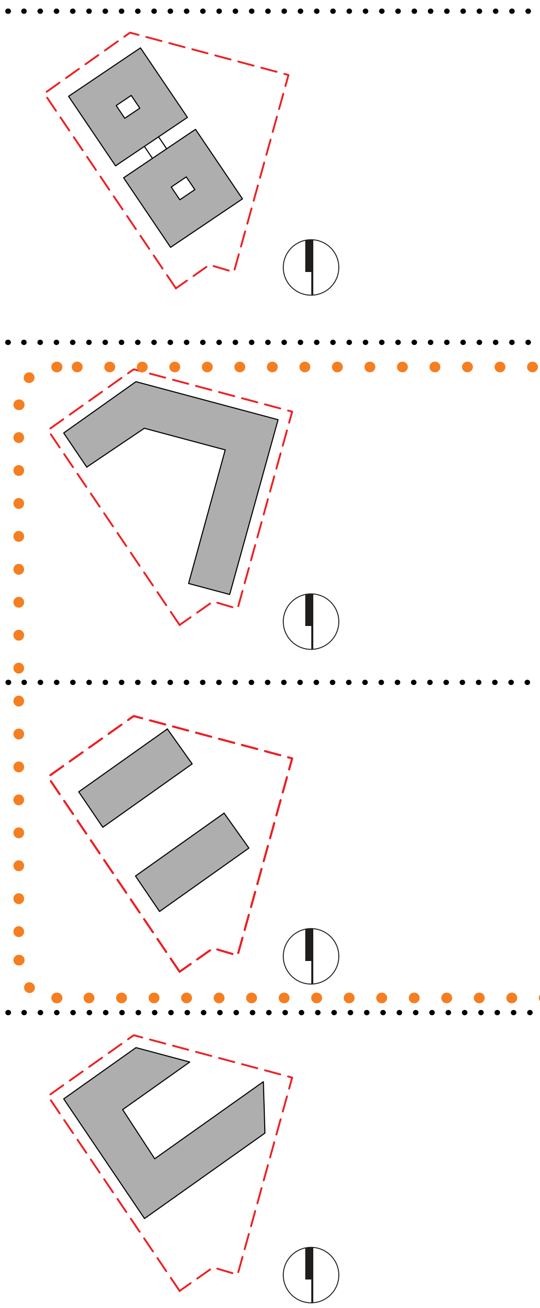
# SKETCHING ON THE SITE LAYOUT - THE FORM

As part of the iterative design process focus was also on the design of the school's outer form and its connection to the context. The four shapes of building were included early in the design process.
The original basis forms were placed on the project site, transformed and molded to relate to the context, for example by following the urban linear and introverted blocks structure along Stokrotki Street. The forms were further processed and manipulated by optimization in terms of scale, flow, orientation, daylight conditions, openness, closeness and the quality of outdoor areas in terms of wind, sun and accessibility.

Various experiments were made with the corner of Stokrotki and Ruciana in order to highlight it in different ways. This can be done by adding extra height or by the absence of volume, for example by pulling the building away and creating open space. By dissolving the simple and compact form it might be sought to create a more inviting form and allow more readily available outdoor space. By subtracting some parts of the building from the street, the urban space might be invited onto the site and the building no longer is to appear closed and repellent.

The attention was focus has on creating exciting and varying outdoor environments, strongly relating to the areas inside the building - especially to the group rooms that shall be in close contact with the outdoor areas in order to allow easy access for the children.

After evaluating the various experiments, two form concepts - each based on one of the original typologies - are chosen to further evaluation.



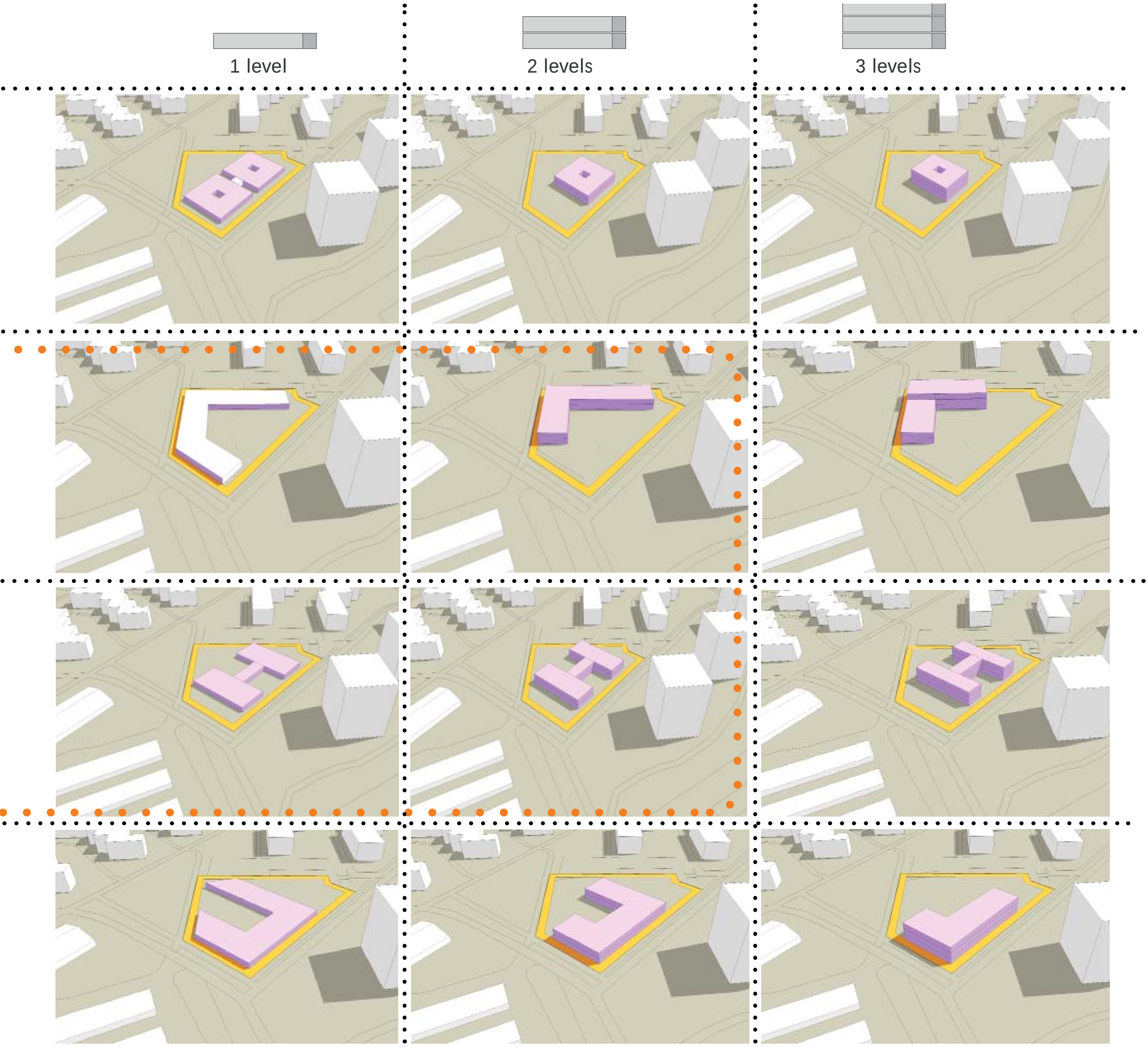



*FIG. 4.05. INITIAL INVESTIGATION OF BUILDING SHAPE AND LOCATION.*

# C-SHAPE CONCEPT

First proposal of the kindergarten design is the one-story building, with surface of 1500 m$^2$. The first idea was to follow the boundary of the plot. The width of the wing was set up to 10 meters, in aim to have very well light conditions in the rooms. The most surface of the facades shall be located in position east-west.
Another question to answer was the position of the building and garden.
First idea was to put the garden at the back of the plot, and establish a garden in front of Stokrotki Street. Those zone would be a buffer between high blocks at south-west side and the kindergarten. There is also a skate park with cluster of trees at the north side of the plot, so basically the building would be just in the middle of greenery.

Other option was to place the building just in front of main street, and let the garden be in between the wings of the building. The elevation would be directed to east-south-west, and garden would be the extension of skate park.

It was also a set from the beginning to incorporate the natural slope of terrain into the design. Some part of the building would be a t lover level than the rest of the building.

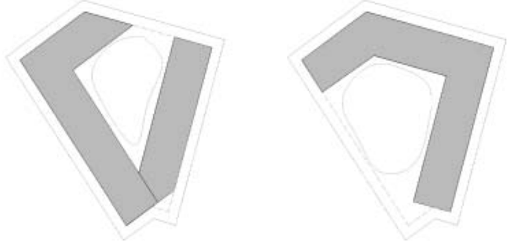


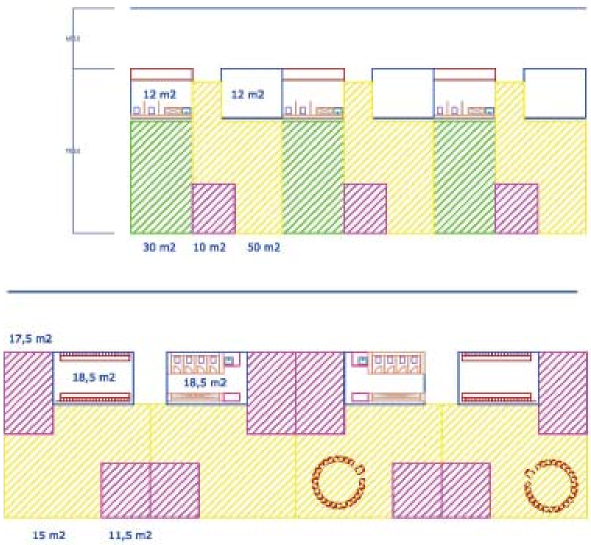
FIG. 4.07. THE C-SHAPE PROPOSAL.

FIG. 4.06. PLACING THE BUILDING ON THE PLOT.

FIG. 4.08. PLACING THE BUILDING ON THE PLOT.

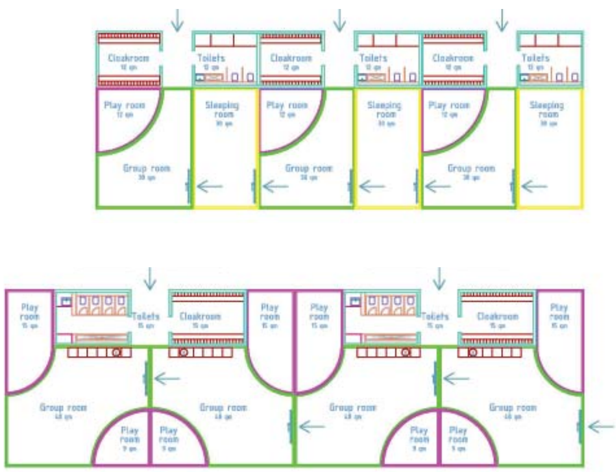
# IDEAS OF CLUSTERS

The first and basic idea was to create a cluster with all the rooms, where the groups of children at the same age could be located.
The cluster would consist of:
-group rooms
-play rooms
-toilets
-wardrobes
The smaller children, aged 2-3 years old, would need also the sleeping rooms, to have an afternoon nap.
The wardrobes and toilets were allocated in front of the group rooms, to create the buffer zone between the corridor and group rooms. The segments were placed one after another, creating the row, which would continue along the L-shape proposal. Between the rooms there are always sliding doors to provide better connection between the groups.
The cluster has been modified, and more rounded shape incorporated into the plans. It was establish to have an open view onto the rooms, no sharp corners. The play and sleep rooms would be divided by partition walls, but still there would be the visual contact with children playing in those rooms.
The first plans of administration zone and kitchen facilities were drawn according to room program with needed floor areas.




GROUP ROOM
PLAY/SLEEP ROOM
TOILETS
KITCHEN AND TECHNICAL FACILITIES

*FIG. 4.10. FIRST PROPOSAL OF ROOM SPACE FOR CLUSTERS.*




GROUP ROOM
PLAY/SLEEP ROOM
TOILETS
KITCHEN AND TECHNICAL FACILITIES

*FIG. 4.11. SECOND PROPOSAL OF CLUSTERS.*

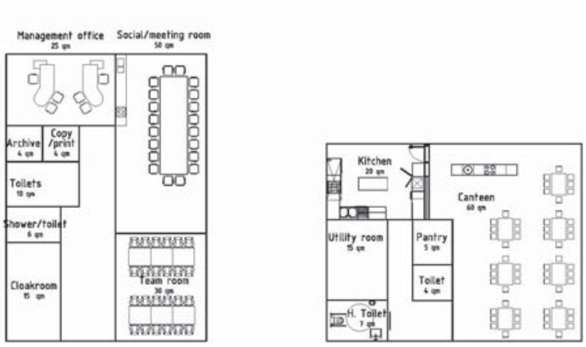



*FIG. 4.09. ROOM SPACE FOR ADMINISTRATION AND KITCHEN FACILITIES.*

# MID-TERM REVIEW

The design of the building presented on mid-term review consisted of two wings, reminding in shape the L-letter. It has been transformed from C-shape, as there was no need for so much floor area, and in some parts the building got the extra level.

The floors were spread on four different heights:
-basement with technical rooms: -1.20m
-older children zone: 0.00m
-small children zone, kitchen, canteen: +1.80m
-administration and stuff zone: +4.80m.

The smaller children were placed in eastern wing, with destination to have the entrance to the private gardens at west facade.

Bigger children were placed in wing positioned in east-west direction, with main facades toward north. There is the skate park, so children during the time spending in cluster would have visual connection with the nature. The daylight would be improved by adding skylights on top of the roof. In case they would go to playgrounds, would need to use the staircases placed along the corridor. Offices have been placed at the first floor, and kitchen with canteen would consist the heart of the building technical room located in the basements.

The design was criticized mainly because of the big ratio of surface to volume and the fact that building was not compact.

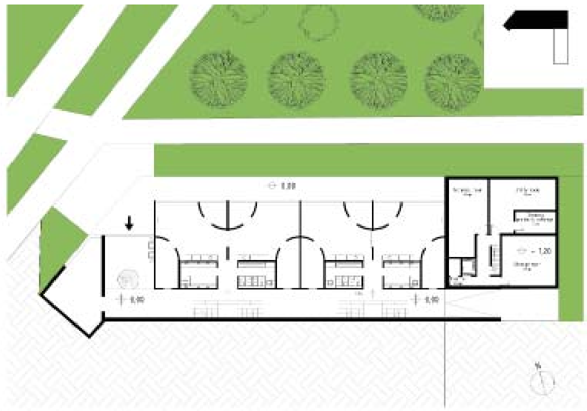


*FIG. 4.13. CLUSTER FOR OLDER CHILDREN-LEVEL 1..*

*FIG. 4.14. CLUSTER FOR SMALLER CHILDREN-LEVEL 2.*

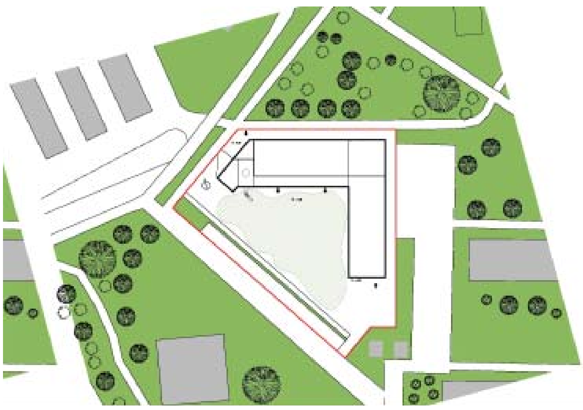


*FIG. 4.12. BUILDING LOCALIZATION ON THE PLOT.*

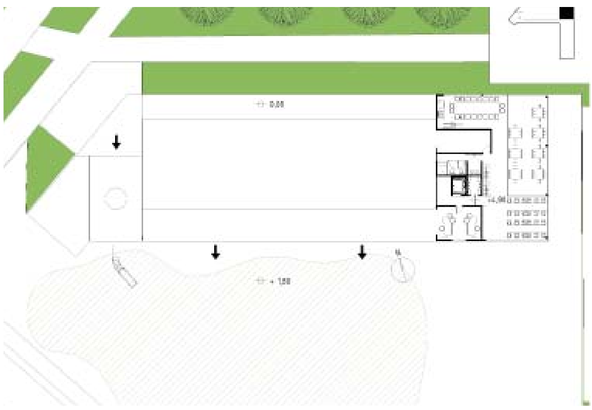


*FIG. 4.15. ADMINISTRATION'S ZONE - LEVEL 3.*

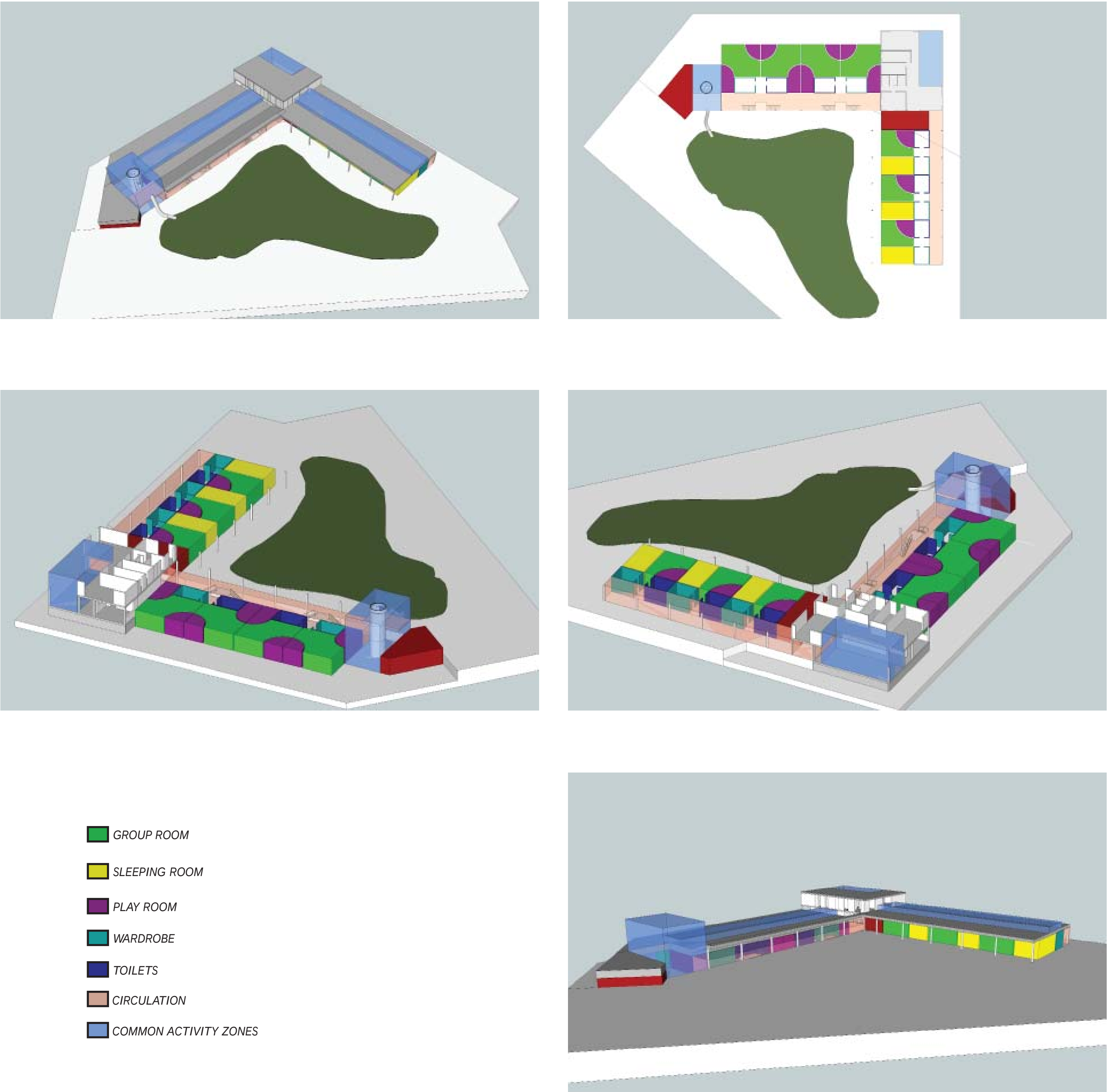



FIG. 4.16. ILLUSTRATIONS OF L-SHAPE BUILDING.

THE IDEA HAS BEEN ABANDONED

# TAKING ANOTHER WAY

## THE CONCEPT

After the idea of L-shape building has been abandoned, the new searching for shape has begun. It was decided to keep the solution of arranging the rooms in clusters, but instead of keeping them in one line, to put in opposite sides creating an open space between them.

The diagram on following page presents the allocation of the particular rooms. It was also established to place the clusters on two levels, to reduce the building area on the plot. In this way the building was divided into two four zones:
-two opposite blocks containing clusters with group, play rooms, toilets and wardrobes;
-between the blocks an internal two-level atrium;
-the back zone consisting of kitchen with canteen and technical facilities.

The floors would be connected with staircase placed in the open atrium.
There was also an intension to use the natural difference in levels, and sink the back of the building. It would allow to use a canteen as multi-purpose room, and use the stairs between those levels as a sitting place during the shows pr performances.

High technical room would also be used as a space for spreading the ventilation pipes towards other rooms.

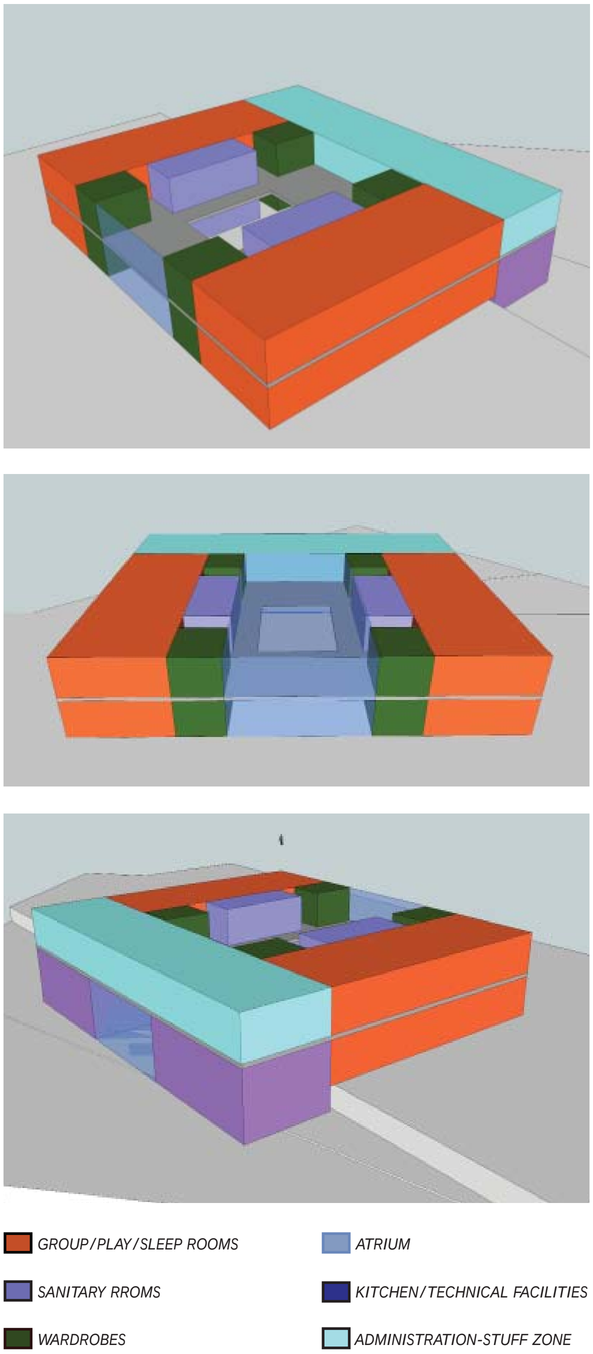



*FIG. 4.17. PROPOSAL OF BUILDING WITH CENTRAL ATRIUM.*

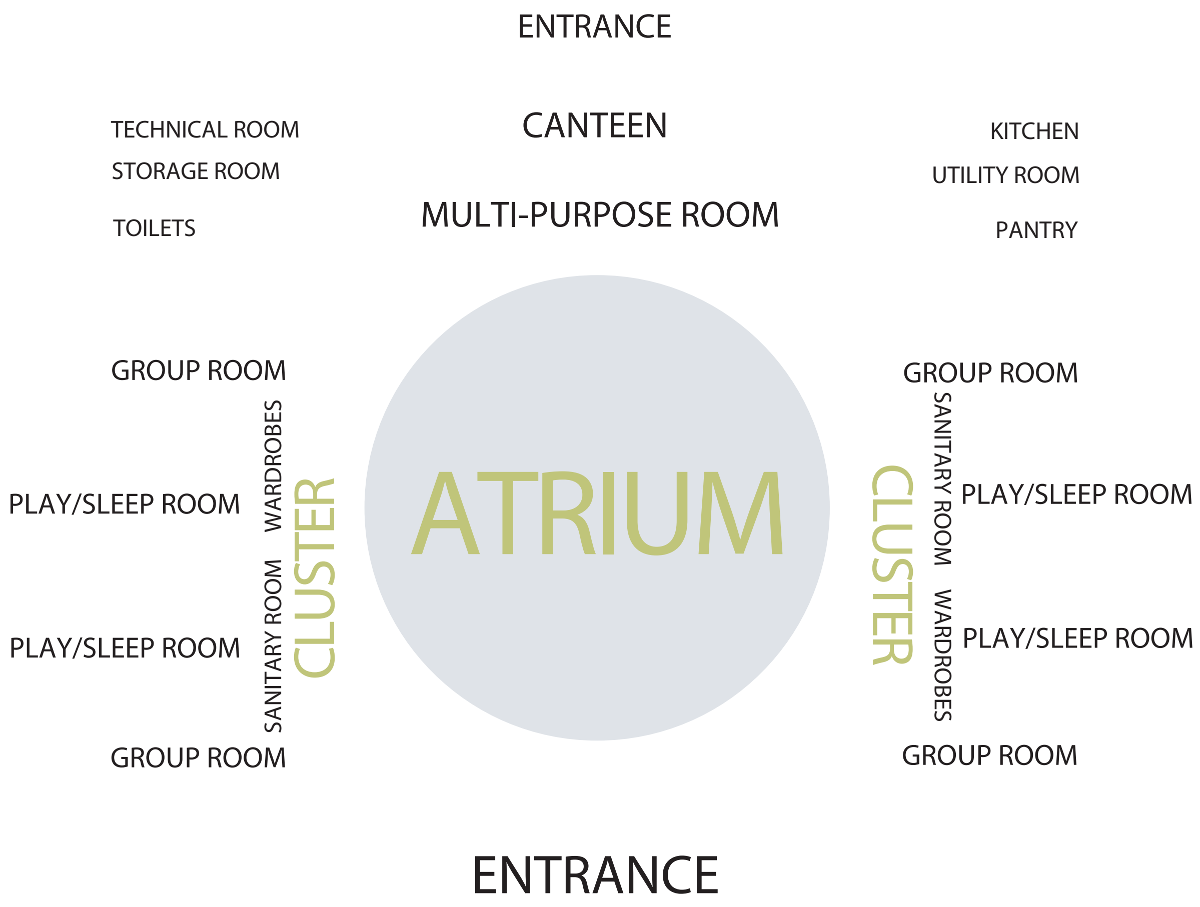



*FIG. 4.18. SCHEMATIC ALLOCATION OF ROOMS.*

# THE BUILDING LAYOUT

Next step of sketching phase was to focus on the cluster layout. It begun with testing different shapes and sizes of particular rooms and their allocation according to each other. It was also important to create an open and light atrium in between. In first proposal the wardrobes and toilets were placed in between the group rooms, to determine the shared area.
In second proposal toilets and wardrobes were moved in front of the group rooms, to be in the entrance zone to the cluster. In this case the building was much wider.

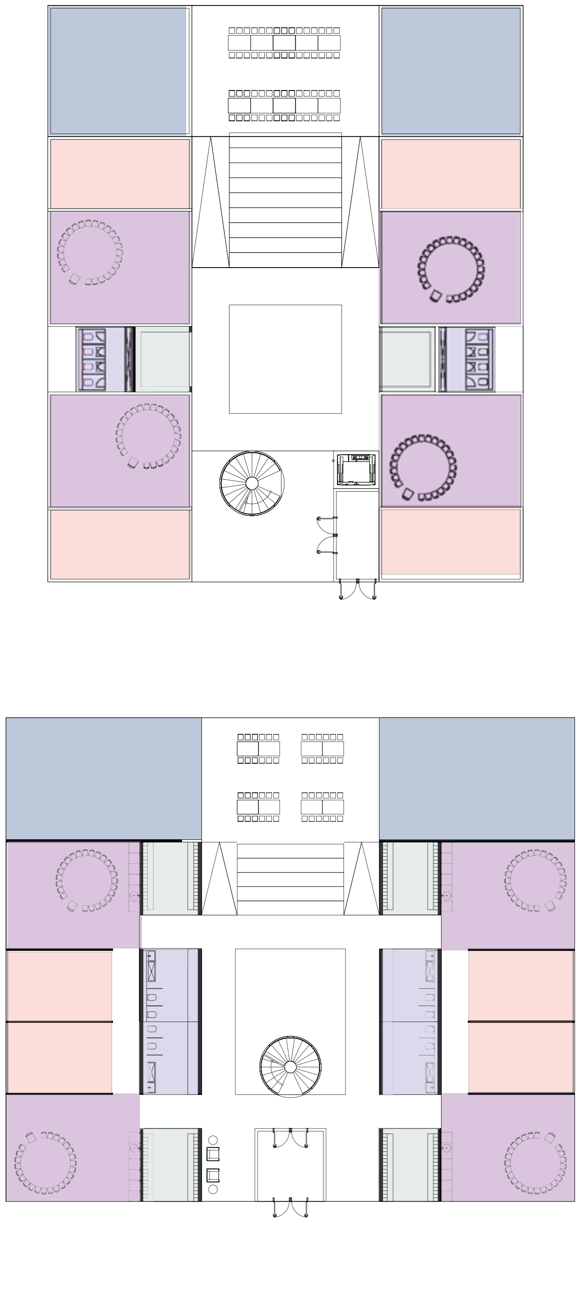
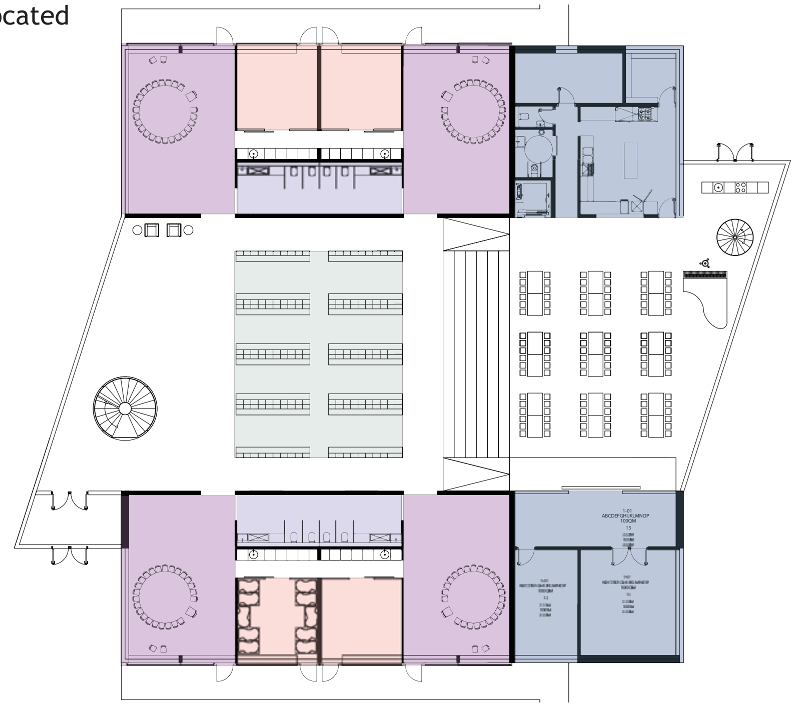


*FIG. 4.19. CLUSTER PLAN INVESTIGATION.*

Ground floor with wardrobes located in the middle of the atrium.



First floor with landings - bridges, connecting opposite sides of the atrium.

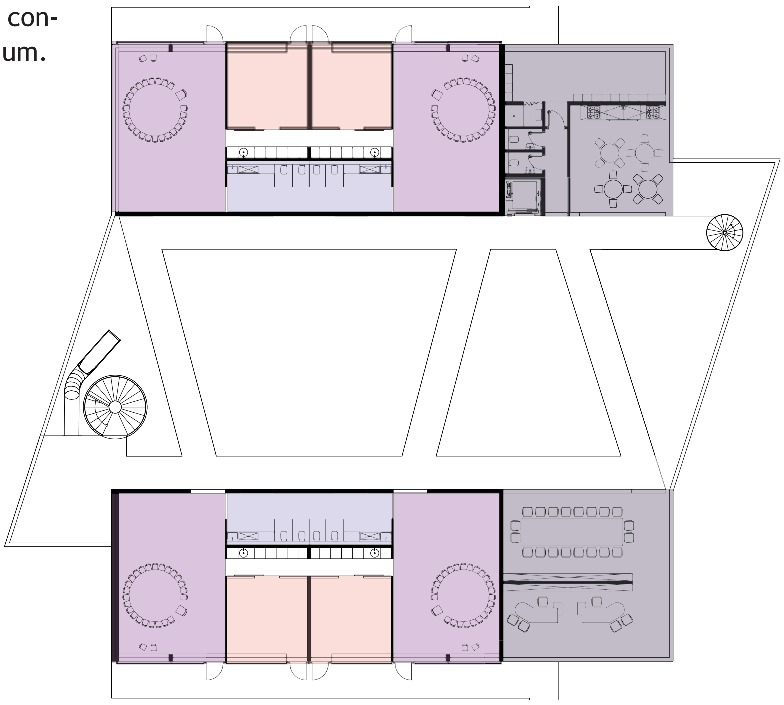


FIG. 4.20. DEVELOPMENT OF FLOOR PLANS.

# STRAY OFF COURSE

The idea to change the design came in a moment. The proposition was to move the office zone from first floor to the ground floor and stick it in front of south facade. The kitchen and technical rooms would stay at the back of the building, but above the canteen an opened external space would be created.
The building would have two main entrances in an east-west direction, and also technical entrances at the back.
The atrium still would remain an opened space, with wardrobes and play equipment.
Older children would be placed on the ground floor, and the smallest on first floor in space above the offices, the external opened gardens would be established- the playgrounds for the youngest.
The atrium would be covered with free-stranding roof structure, to provide shadowing as well for top glazing and south facade.
The exit to the playgrounds would be led through the doors in south facade or through the two main entrances.
The idea has been finally abandoned, as three was no coherence with in the form and function in this proposition.

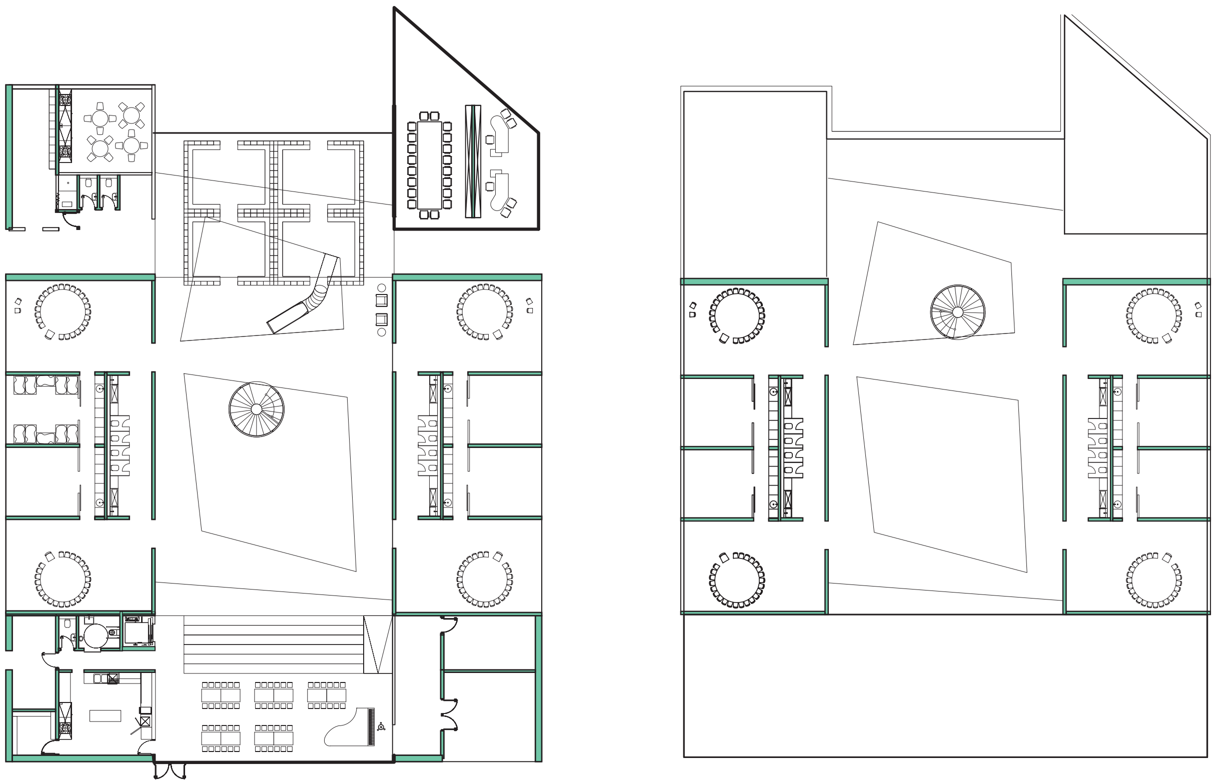


*FIG. 4.21. PLANS OF THE NEW BUILDING PROPOSAL.*

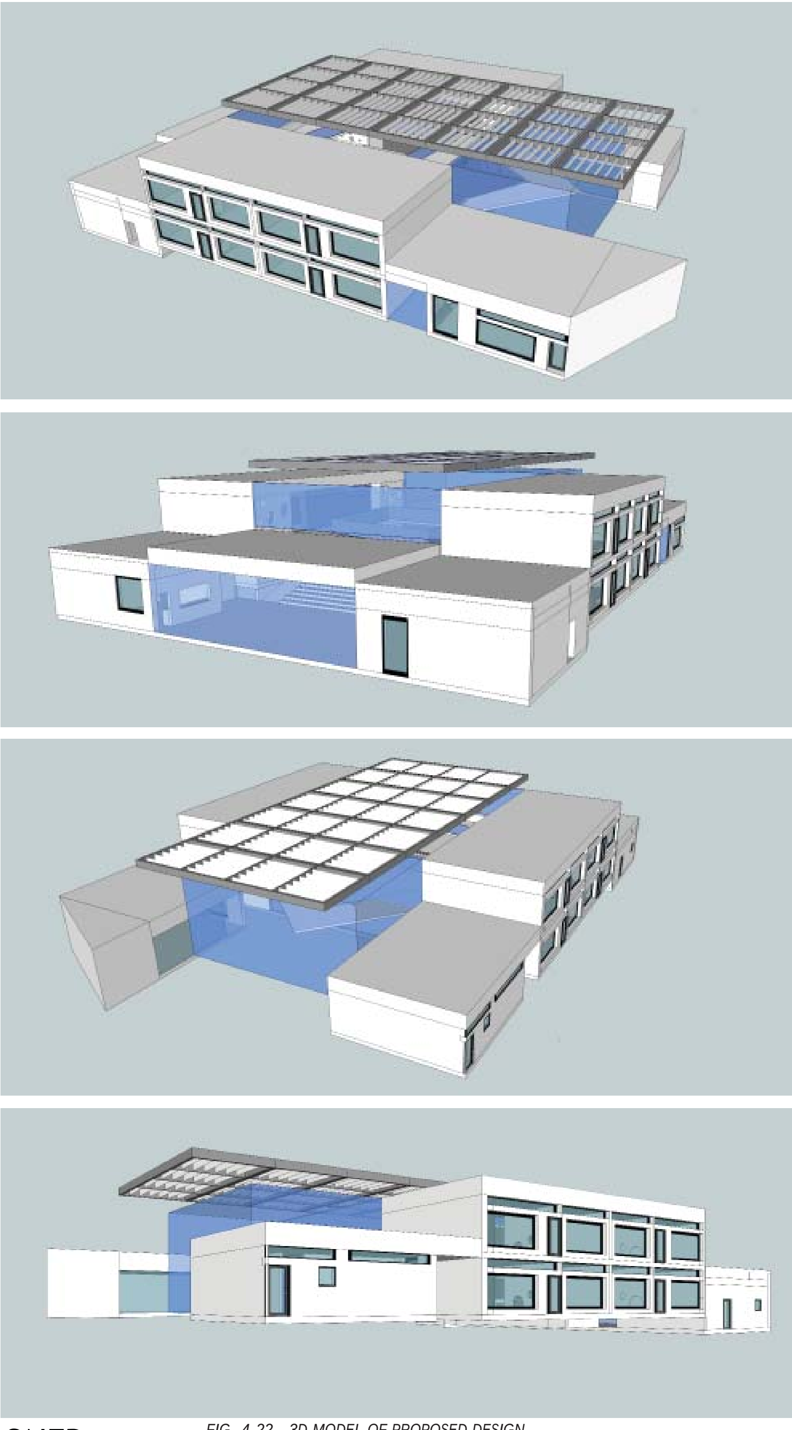


FIG. 4.22. 3D MODEL OF PROPOSED DESIGN.

THE IDEA HAS BEEN ABANDONED

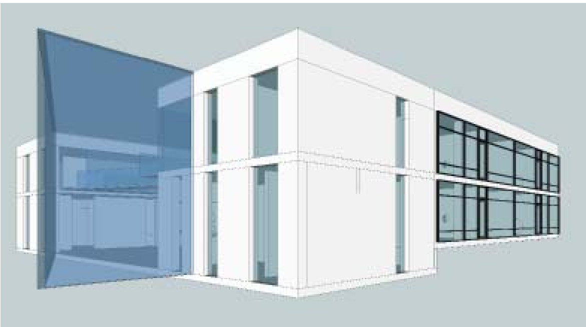
# FACADE METAMORPHOSIS

## THE PATTERN

Windows, their shape and size are one of the most important factors affecting the aesthetic appearance of the building. Locating them on the facade means a great deal for the light conditions in the group rooms and the final energy demand. Hence it is necessary that it all comes together in the design phase. The windows should apply the different rooms and functions with the right amount of light. Shall also be incorporated into natural ventilation system.

## PROPOSAL ONE

The external surface of the cluster consists of curtain wall window system. The surface of glazing spreads onto the whole length of the cluster, with height starting from floor till ceiling. The doors have been incorporated into the wall, allowing the straight connection of rooms with outdoor areas. The system allows to shed a lot of light inside the rooms.



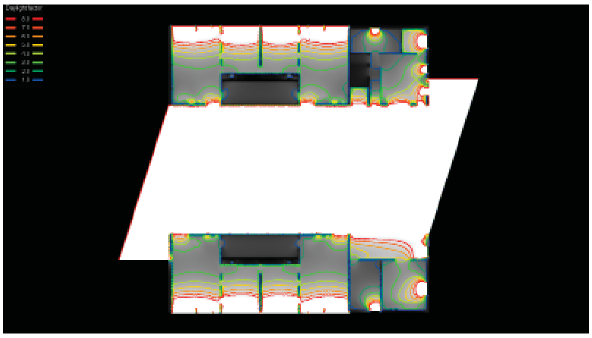
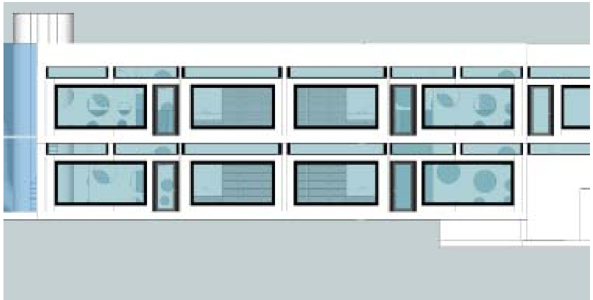


FIG. 4.23. FIRST PROPOSITION OF WINDOW PATTERN.

## PROPOSAL TWO

In this proposition the idea was to create the window as a big opening to the outside world. The window starts at 30 cm above the floor, and occupy more than half of the wall. It sheds o lot of light inside. For improving the air condition, the upper lamella would be used, also the doors. This facade has been chosen to continue work with as it is the medium between others proposed two.



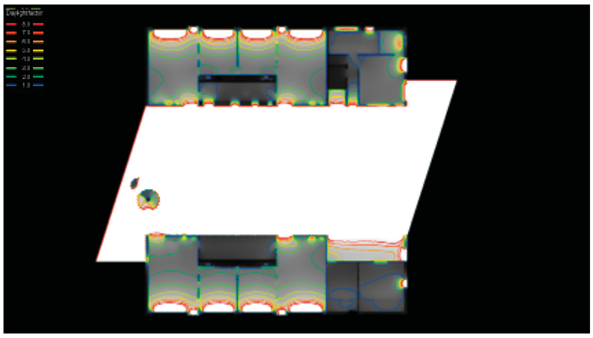
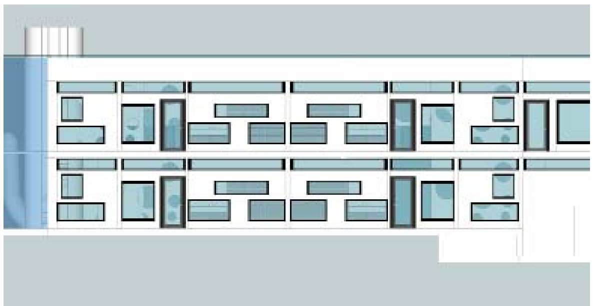
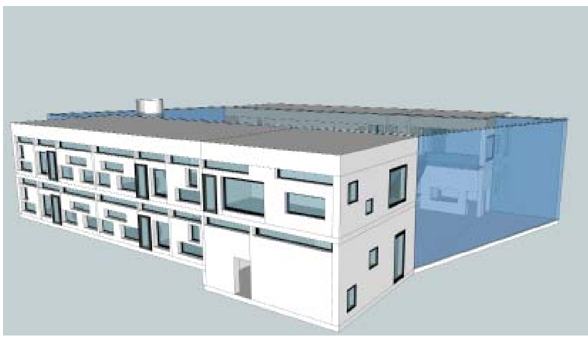


*FIG. 4.24. SECOND PROPOSITION OF WINDOW PATTERN.*

## PROPOSAL ONE

This elevation incorporates plenty of different shape and size windows. Some of them start just 30cm above the floor, so children would have straight view on surrounding world. Some of the windows are used to improve the light conditions in room, and other would be operable and used also for ventilation. In each of the group rooms the doors to outdoors area are provided.





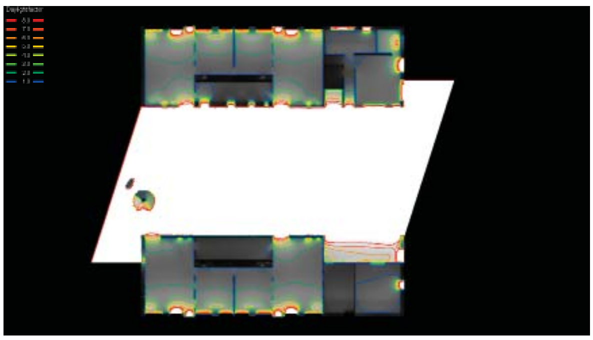


*FIG. 4.25. THIRD PROPOSITION OF WINDOW PATTERN.*

# LOOKING FOR ROOF CONCEPT

## PROPOSAL ONE

The first proposition for roof structure is the system of beams, which spread along the atrium, connecting two opposite blocks, all kept as one level above the beams, a steel-glass structure would cover the space, and have incorporated the shading panels in itself. As the screening panels would be mounted under glass layer, there would be big internal heat gain. The south facade is also shaded by the roof, as it extends beyond the facade.

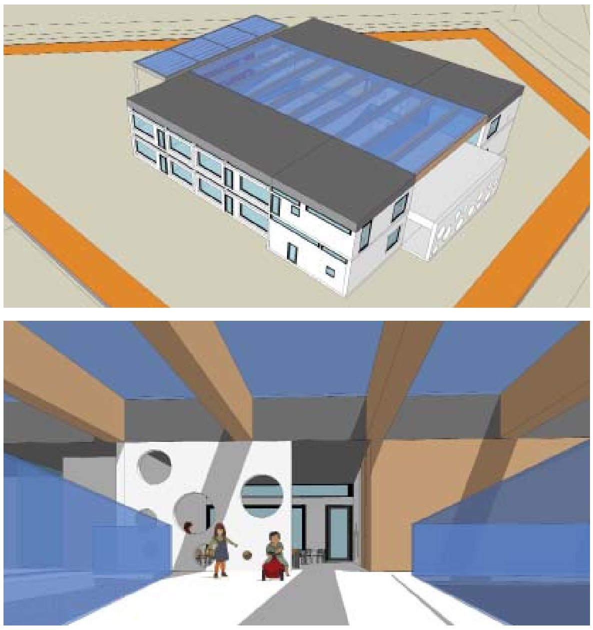


*FIG. 4.26  FIRST PROPOSAL OF ROOF FORM.*

## PROPOSAL TWO

This roof, spread along the whole building, is a free standing structure supported by columns, 1 m above the glazing of atrium. The roof has incorporated the shading system, and with this solution it keeps the warmth out of the atrium glazed zone. The roof extends beyond the south facade and provides the screening against the sun.

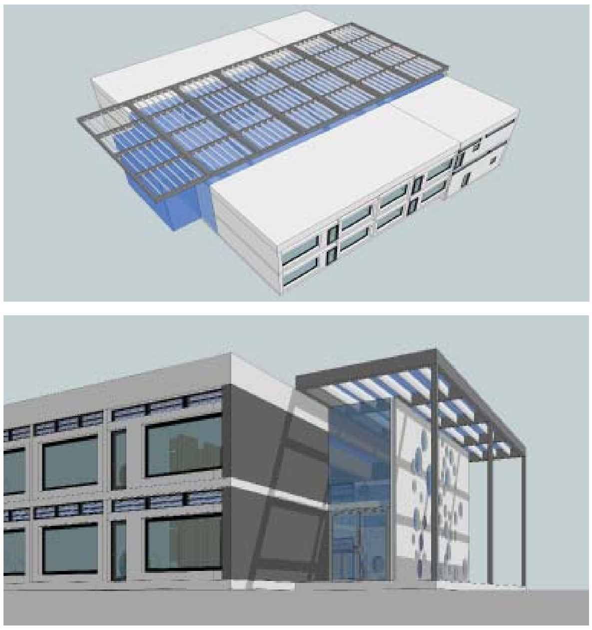


*FIG. 4.27.  SECOND PROPOSAL OF ROOF FORM.*

## PROPOSAL THREE

In this proposal the wall and roof would seem like one disjunctive solid element. The structure wide by 1 meter, would follow the shape of the side dark buildings. The white color will emphasize the volume of the atrium. Two structures connected by the glazing, where the operable windows would be mounted, which would contribute to natural ventilating of the building.

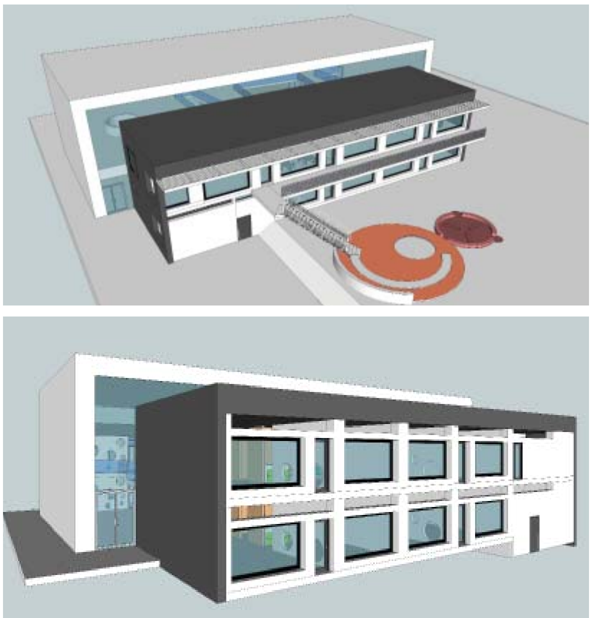


*FIG. 4.28. THIRD PROPOSAL OF ROOF FORM.*

## PROPOSAL FOUR

This proposal contains the modification of previous proposition. The corner where the connection between the wall and roof is, has been curved, following the shape of the Alvar Aalto's lounge chair's frame. Two solids would be connected with gentle glazing of curtain wall. Based on contrast, the two forms are being differentiated both by form and color.

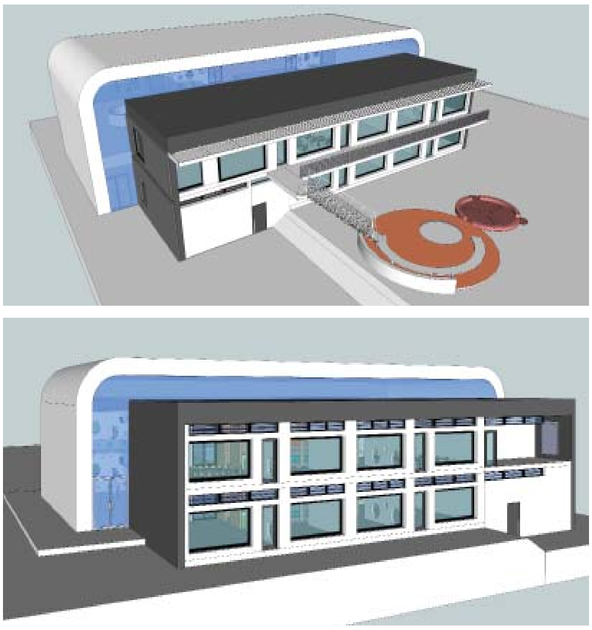


*FIG. 4.29. FORTH PROPOSAL OF ROOF FORM.*

# ATRIUM'S FACADE METAMORPHOSIS

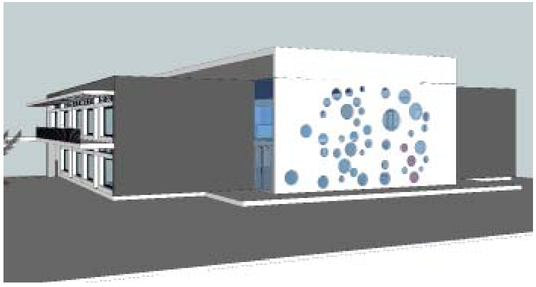
The intention was to create interesting building form when looking from outside, but also receive astonishing feeling while being inside the building.

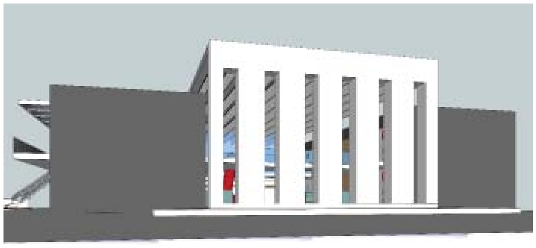
After the decision was taken to have a solid thick wall as a main facade, the idea of openings started to evaluate.

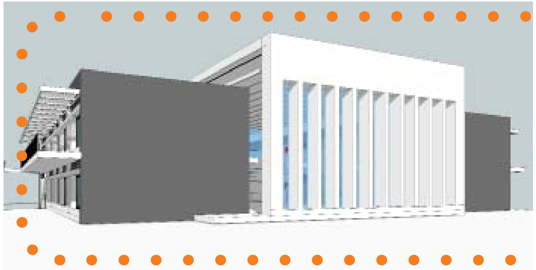
First proposal was to use circle openings, as it was done in the internal partition walls. This idea has been finally abandoned, as the intention was to keep the circles only inside the building, and as a contrast, and keep the straight lines outside the building.

Next proposal was to divide the facade with the row of vertical windows. Few dimensions of windows and horizontal partitions were tested. As the wall is 1m deep, the idea was to put the window as deep as it is possible. It would create an interesting feeling of depth when being inside the atrium.

As the structure of roof defines the pattern of stripes inside the atrium, also the proposal of facade with straight lines was chosen. The partitions in windows would disrupt the taxonomic order inside the building, hence the proposition of vertical openings are to be followed.







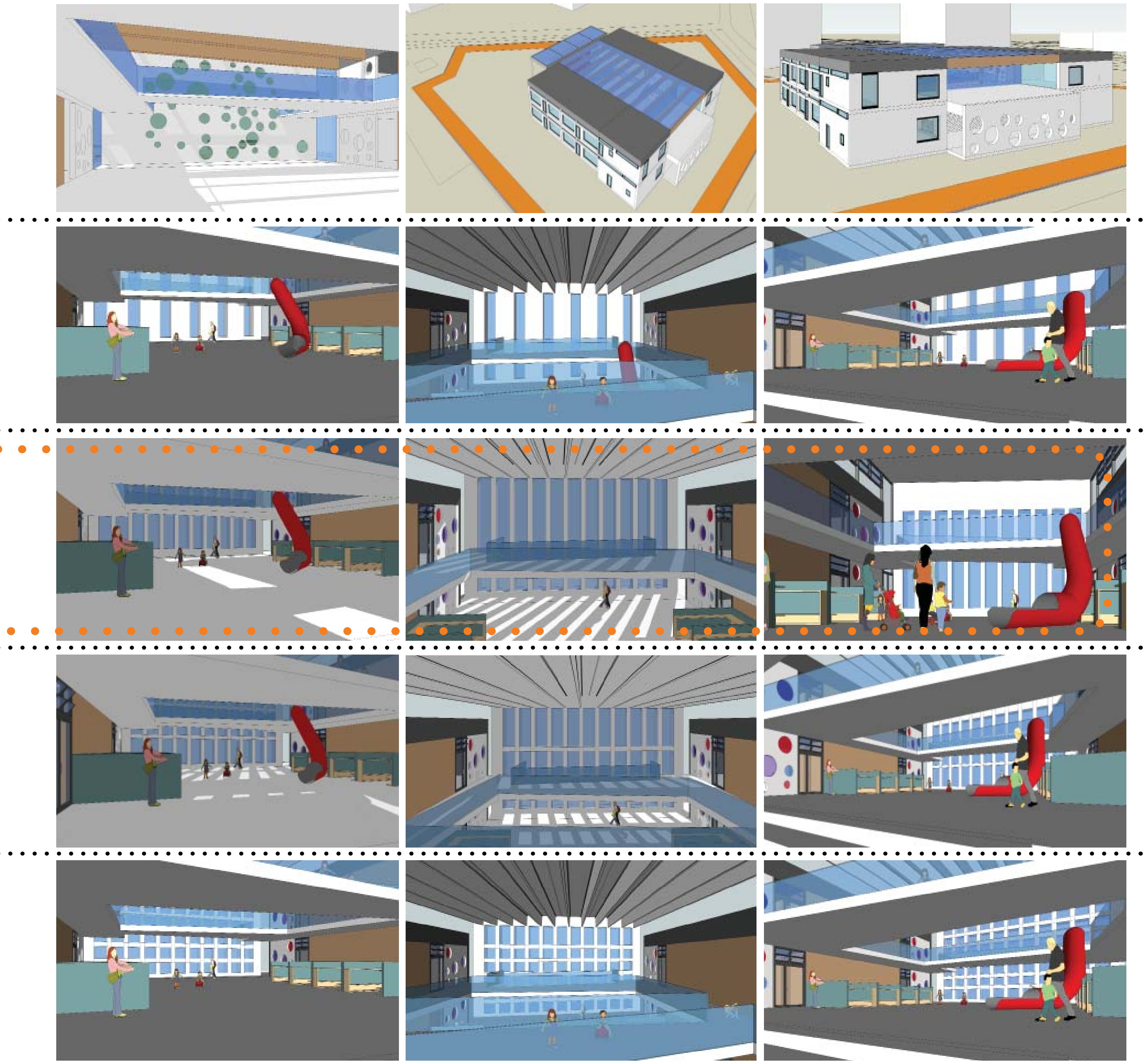


FIG. 4.30. FACADE DEVELOPMENT.

# EXTERNAL PLAYGROUNDS

The outdoor areas are also very important part of the project. As in kindergarten two different groups of children are going to spend the whole day, the outdoors alos designed differently for each of the age group.

## SMALL CHILDREN

Small children's age is 2-3 yeas old. As the youngest's group rooms have been placed on ground floor, it was also intention to prolong the internal activity zone outside the building. The play garden occupy the whole area in front of the cluster and  is surrounded by the fence in shape of colored pencils. The piles are made out of foam and covered with gum material, so there is no possibility for children to get hurt. Between the piles there are 10 cm gaps, wide enough to look through, but narrow enough not to allow children to slip between. Children also are allowed to go behind the fence, as there are plenty of spring horses and roundabouts, but all the time they must be under carers' supervision. In the area plenty of trees can be found. in summer time they will make a shadow to protect children from the direct sun. there is also a possbility to spread umbrellas in the garden, to protect either from sun, or against rain. Part of the garden is permanently roofed, as a balcony above has been established.
The children have direct access to the garden straight from the group rooms. It allows to use the same toys as inside, and in case children get tired, thre is short dostance to resting rooms.

*FIG. 4.31. INITIAL DESIGN OF SMALL CHILDREN'S GARDEN.*

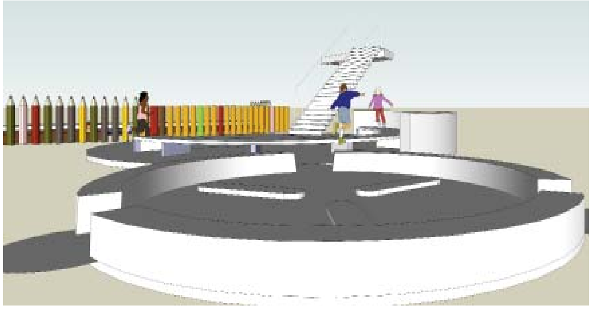


*FIG. 4.32. THE SANDBOX AND ROUNDABOUT IN FRONT OF THE PLA GARDEN.*

*FIG. 4.33. VIEW ONTO THE PLAY GARDEN.*

*FIG. 4.34. THE NORTH SIDE OF THE BUILDING WITH THE POND IN FRONT.*

## OLDER CHILDREN

The older childrens' clusters are placed on first floor, hence there was a need to make the direct connection with downstairs playgrounds. It was possible by involving the balconies and stairs.

The open space playgrounds are mainly divided into two zones.
First, organized just in front of south facade of the building, consists of few little earthworks, gently risisng above surrounding level. Those 'islands' are covered with grass, and on top plenty of playing equipment have been established. Those rises of ground have the aim to encourgae the children to climb, run up and down. The surface in between, covered with soft rubber material is dedicated for bicycle riding, or competitions in running.
Second, placed in the south-west corner of the plot, is filled with diiferentieted play equipment, where children can climb, jump, swing, run and play in sandboxes.

At the north of the building a pond has been located. The depth of water is app. 2-3 cm , so there is no danger to drawn. during the hot days children would be allowed to go into the pond and cool themselves. That is also a good palce for play, f.ex. launching paper ships, or just running through the water.

The whole area of plot is fenced and surrounded also by dense wall of bushes. The gates are blocked and protected against self-opening by children.

*FIG. 4.35. VIEW ONTO THE EARTHWORKS IN FRONT OF SOUTHERN FACADE.*

*FIG. 4.36. ISLANDS OF GRASS.*

*FIG. 4.37. THE WEST SIDE OF THE PLOT.*

*FIG. 4.38. RECREATIONAL EQUIPMENT ON THE PLAYGROUND.*

# SYNTHESIS OF THE BUILDING CONCEPT

At the beginning the defining of final plans pattern with the modular net was established. The distance was set to 3m and the multiply numbers of it.

The kitchen facilities have been moved to the east side of the building, as there will be easy access to the garbage and goods delivery zone.

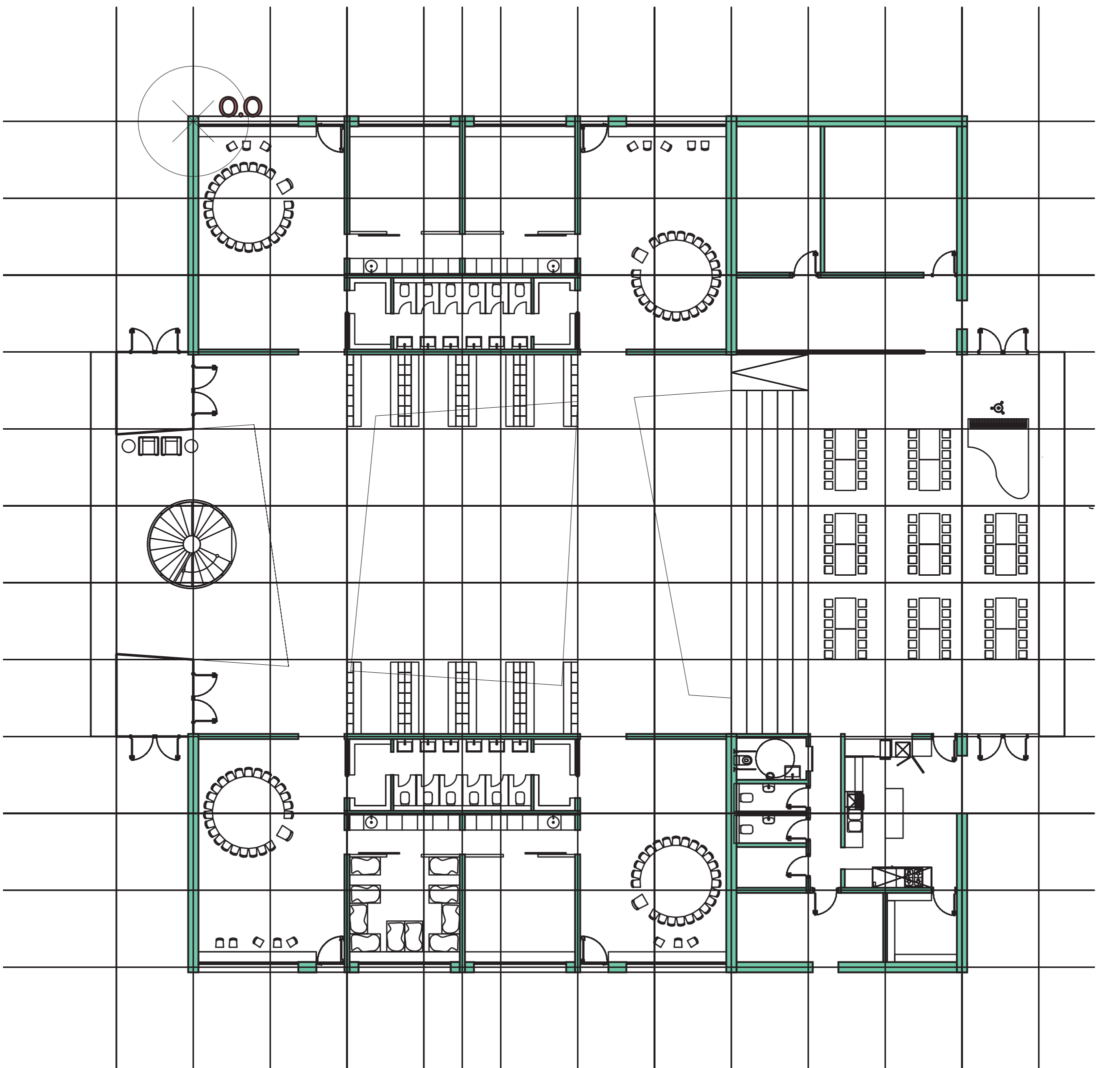



FIG. 4.39. SYNTHESIS OF GROUND FLOOR.

Next task was to organize the landings on the first floor. The assumption was to bring the live into the bridges and ensure the vast and interesting space for playing. In same places are widen to create space for playing or gathering of children. In the middle of opened zone a slide was built.

At the end of atrium, it was decided to organize the outdoor space for children and stuff. This zone would have the roof, so in case the raining weather children would still play outside the internal zone.

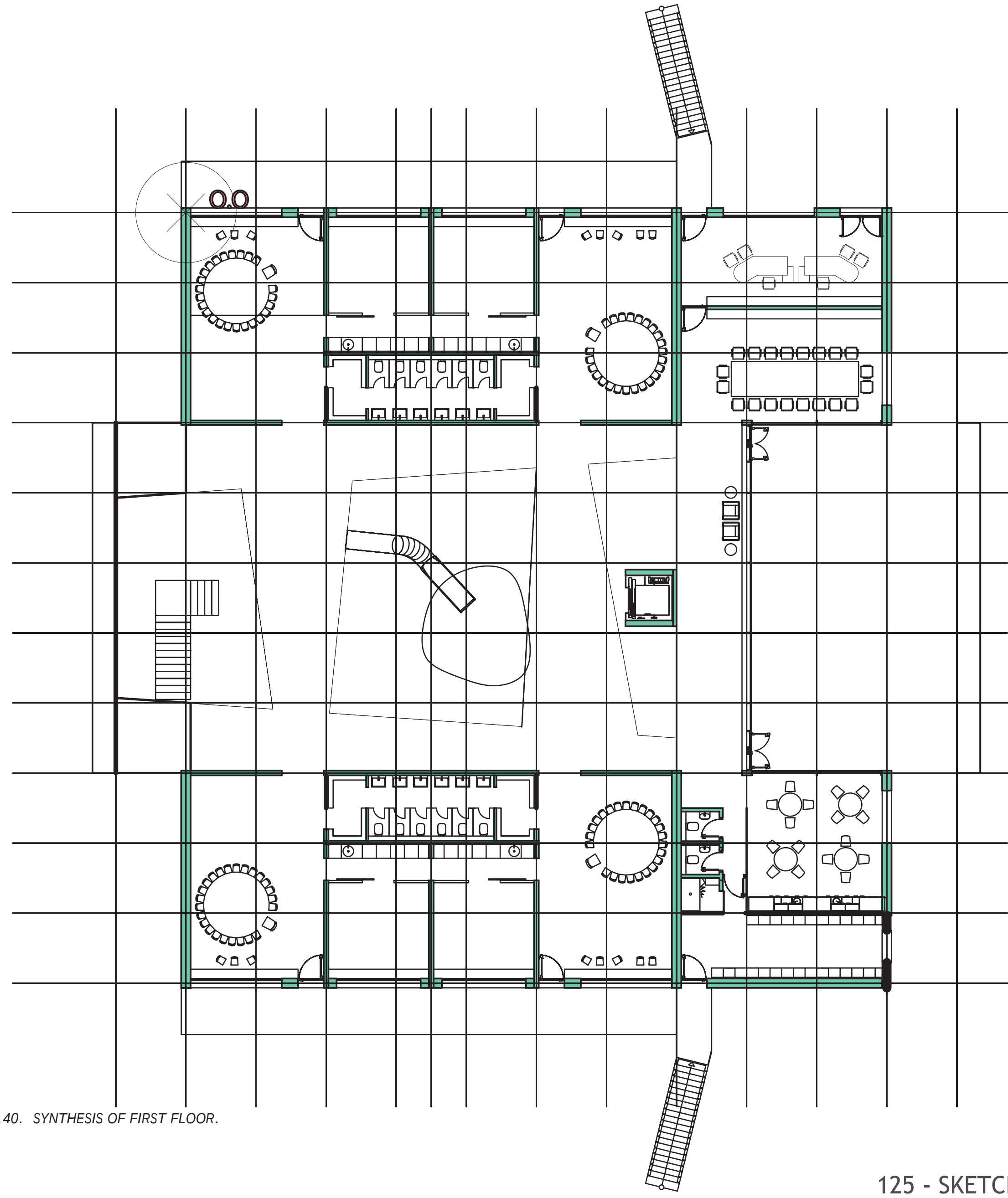



*FIG. 4.40. SYNTHESIS OF FIRST FLOOR.*

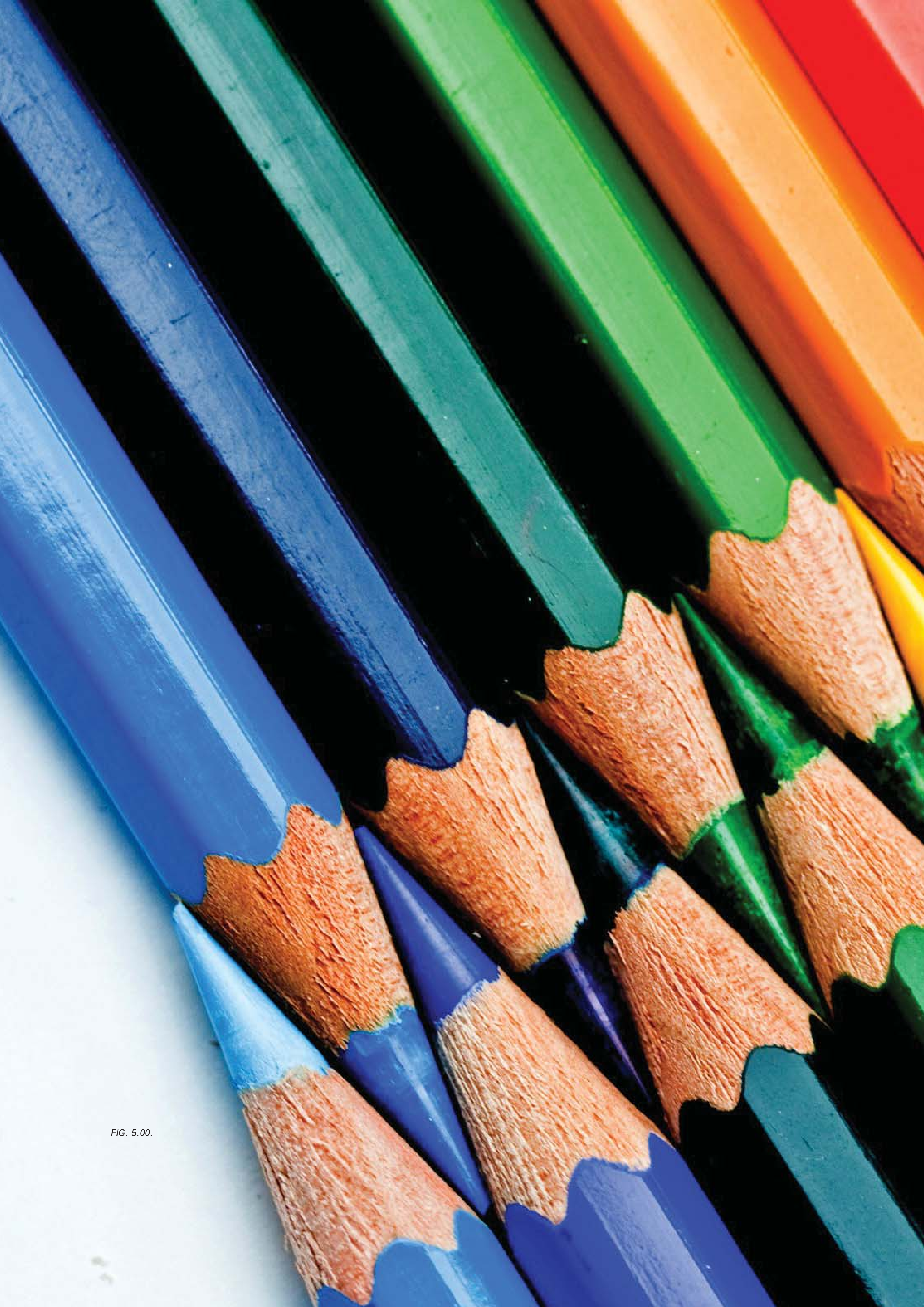


FIG. 5.00.

# SYNTHESIS

# SYNTHESIS OF THE CONCEPT

## SITE PLAN

The outdoor areas are also very important part of the kindergarten project.

The main flow to the property will be going through two main entrances: one from Stokrotki street (mainly for pedestrians and bicyclists), and second one from parking area at east side of the plot (for those who uses cars for dropping off babies or for kindergarten stuff).
At the back of the building, at north east side, there would be the ‘stuff entrance’ and place for goods delivery and garbage receiving. There would be also a shed for gardening and maintenance tools.

To distribute the activities for each group of children the master plan is divided into 3 zones: play gardens for youngest children, open-space playground for running and bicycling and playground with plenty of recreational equipment, both for older children.

To bring the life at the back of building, a small 2-3 cm deep pond was proposed, where children can play and cool themselves during the summer time.

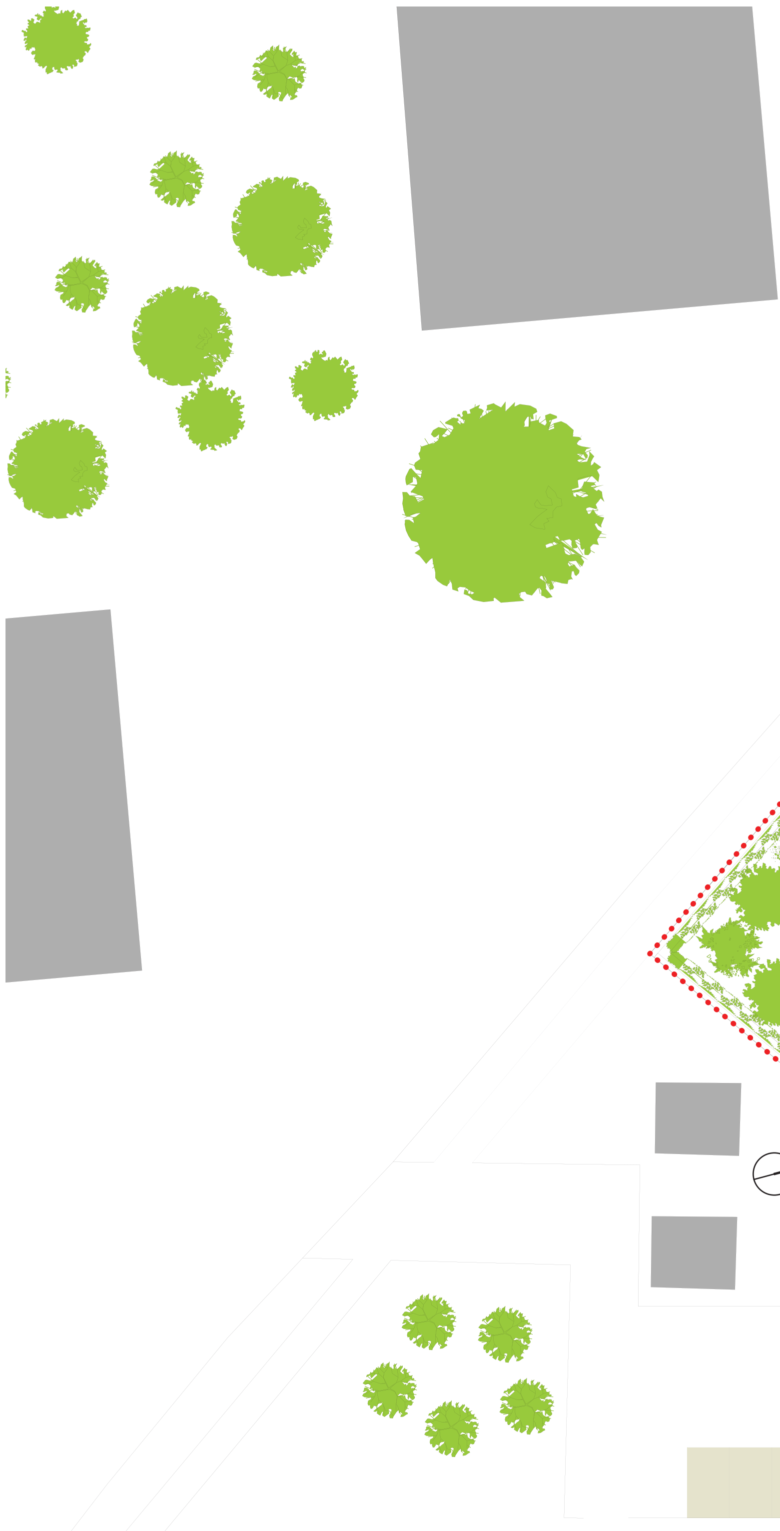
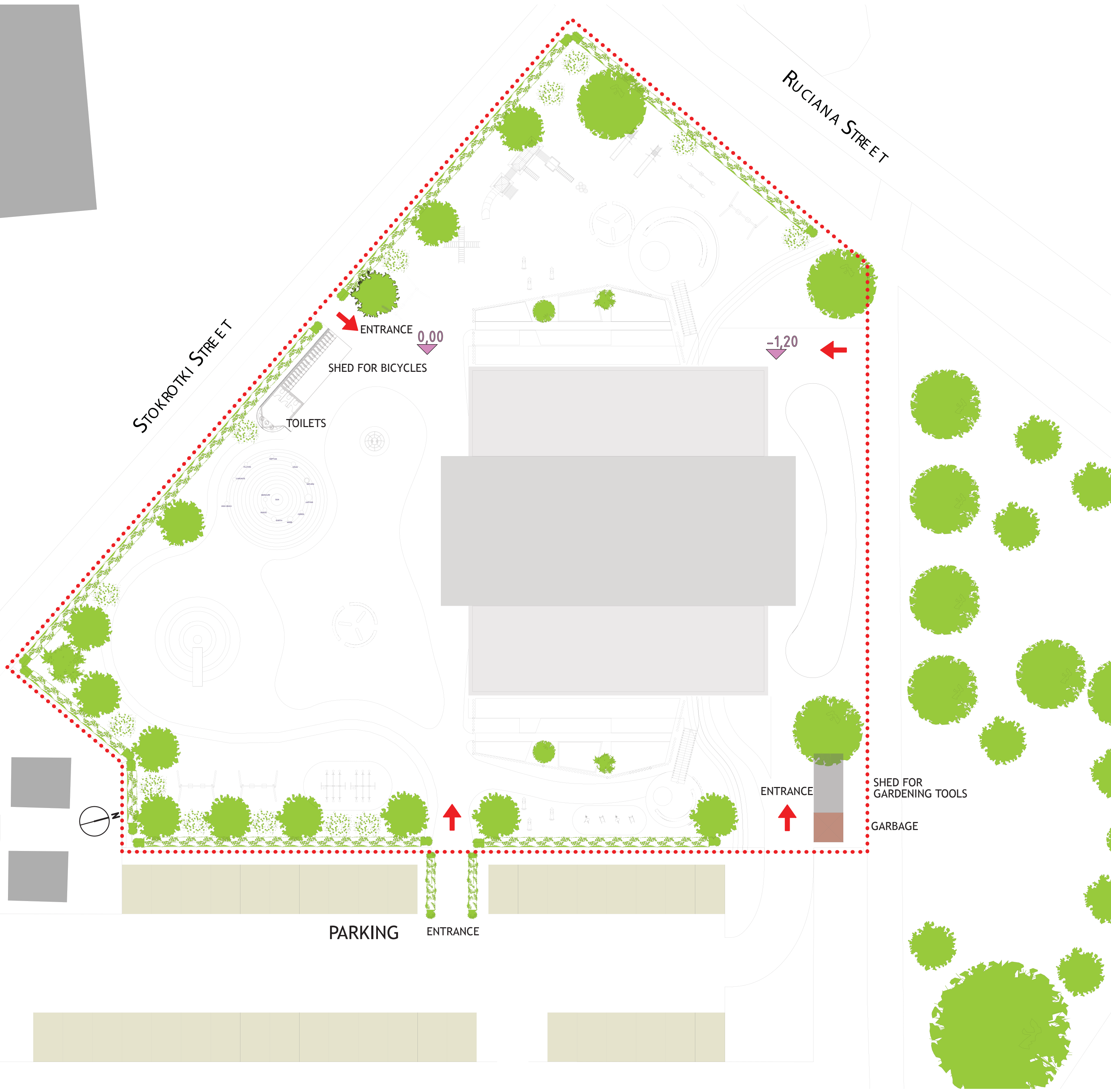


FIG. 5.01. SYNTHESIS OF MASTER PLAN.


RUCIANA STREET
STOKROTKI STREET
ENTRANCE
0,00
SHED FOR BICYCLES
TOILETS
-1,20
ENTRANCE
SHED FOR
GARDENING TOOLS
GARBAGE
PARKING
ENTRANCE

# BUILDING PLANS

The plans obtained the final solutions. The atrium has been enriched with staircase and elevator, in closeness to main entrances. To break the seriousness of the atrium's facades, the long vertical windows have been twisted and the glass got the color. The frame have been hidden beyond the construction to get the illumination, there is just glass with no frame filling the opening.

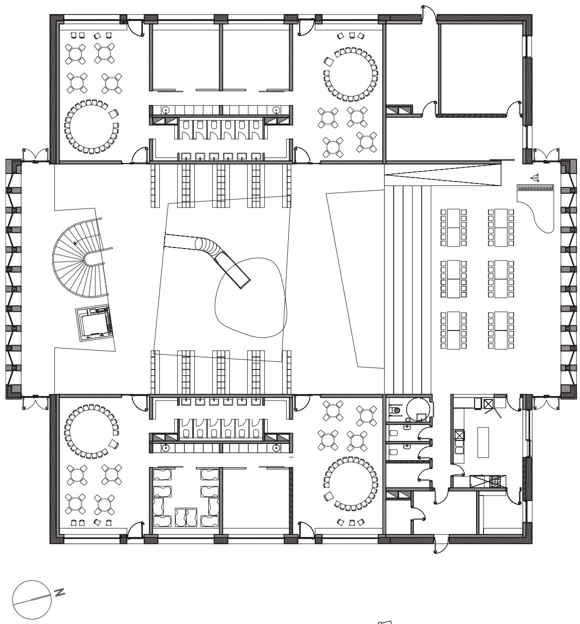


FIG. 5.03. FINAL PROPOSAL OF GROUND FLOOR.

FIG. 5.02. TWISTED WINDOWS IN ATRIUM'S FACADES.

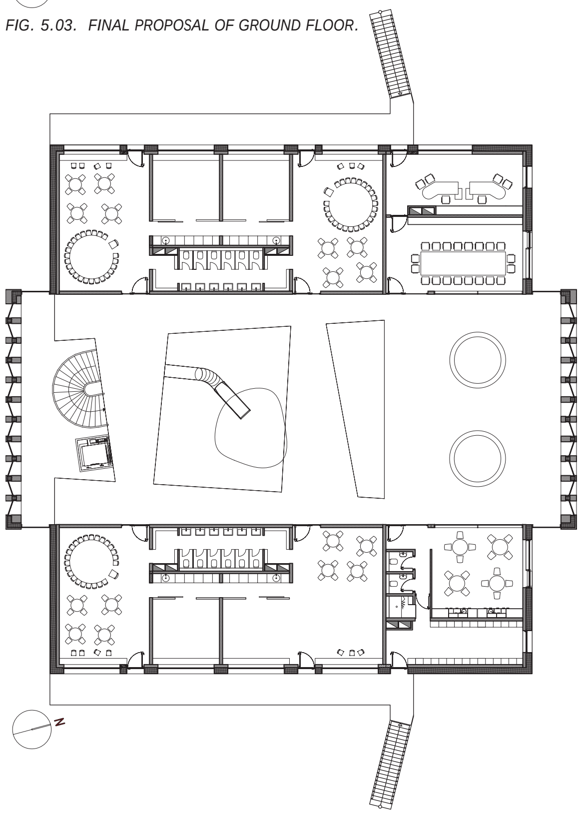


FIG. 5.04. FINAL PROPOSAL OF FIRST FLOOR.

The challenge for the architecture was to design spaces that at once could propose an openness and provide an overview with visual contact between the rooms and, at the same time to be confined that could protect against interference. It has been achieved by creating glass windows in internal walls, which create visual and spacious transitions from group rooms to play rooms and common areas in atrium. Play rooms offer the children vast space for moving.

At breakfast or lunch time the canteen is going to be used as a dining zone, but in others time it can be easily transformed into open flexible space for many different activities, which cannot be undertaken in regular group rooms, for example dancing or ballet classes, shows and performances.. That was the first idea of proposing the multi-purpose room. The stairs are to be used as audience, and this space can be separated from atrium at any time, using the movable panels.
The room above the canteen is the open space zone, used mainly for running and playing. The two wells shed the light into the room below, and also play role of bench on upper floor.

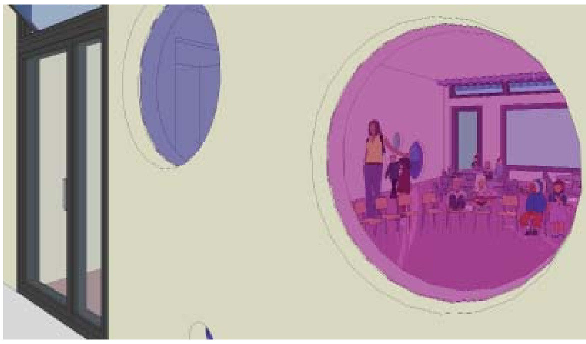


*FIG. 5.05. VIEW INTO THE GROUP ROOM.*

*FIG. 5.06. TRANSPARENCY OF PARTITION WALLS.*

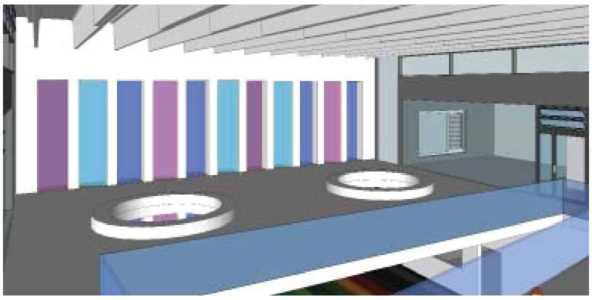


*FIG. 5.07. MULTI-PURPOSE ROOM ON FIRST FLOOR.*

*FIG. 5.08. MULTI-PURPOSE ROOM ON GROUND FLOOR.*

# VENTILATION STRATEGY

Two types of ventilating system have been established in the building (mechanical ventilation and natural ventilation). Its use depends on part of the year. During winter the ventilation for the building is entirely mechanical, while the ventilation during summer is combined with natural ventilation. During the summer natural driving force is to be using thermal buoyancy, stack effect and wind force.

According to Danish Building Regulations, rooms in kindergartens which are being occupied by children, must be mechanically ventilated due to high level of internal gains from children. Therefore mechanical ventilation in those zones is going to be used all around the year for supplying fresh air to the group rooms and other shared areas.

## MECHANICAL VENTILATION

In this project it has been chosen to ventilate the building with mechanical balanced ventilation, using mixing ventilation solution with a ventilation system based on the mixed principle, make up air is supplied to the room with high speed, and/or local fans are used to mix the air in the room to a homogenous mass.

The mixed principle is:
-suited in general for ventilation, cooling and heating systems;
-where homogeneous temperatures in the room are required;

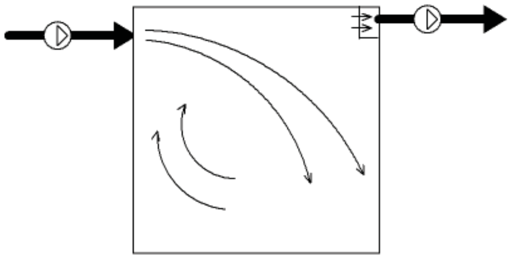


FIG. 5.09. THE MIXED VENTILATION PRINCIPLE.

-where homogeneous pollution concentrations in the room are required.
*[http://www.engineeringtoolbox.com/ventilation-efficiency-d_124.html]*

To ventilate the clusters and the atrium, the net of ducts has been located above the suspended ceiling in the sanitary rooms and partially in play/sleep rooms.
To avoid long distances in spreading the ducts from the main technical room, and leading the ducts through the atrium, the second small space has been established in the zone of kitchen facilities and then two independent ventilation units were created.
As there is no suspended ceilings in the group rooms, the ventilation ducts connecting the clusters with recovery units in technical rooms are led through the shafts built under the slabs on grade.
The rooms belonged to the kitchen facilities and the multipurpose room are ventilated by the system of ducts located in suspended ceiling above the kitchen and utility room.

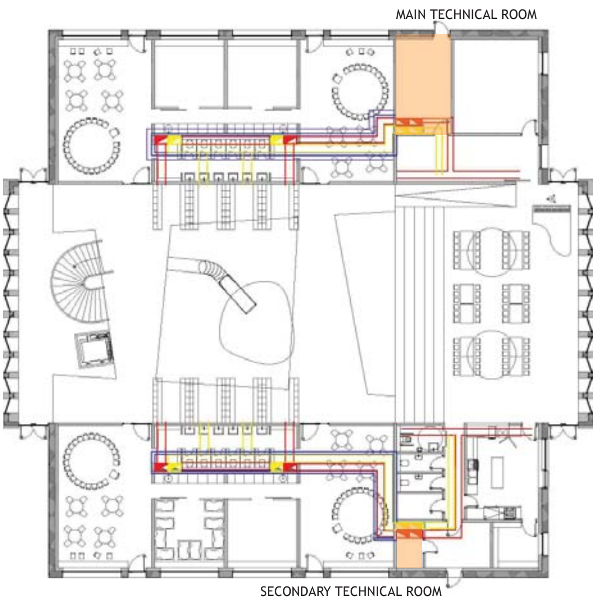



FIG. 5.10. THE SHAFTS WITH VENTIALTION DUCTS.

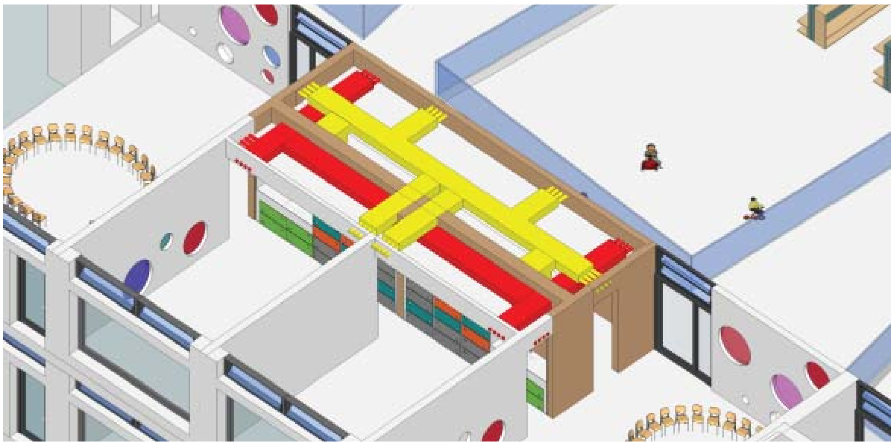


FIG. 5.11. MECHANICAL VENTILATION SCHEME IN THE CLUSTER.

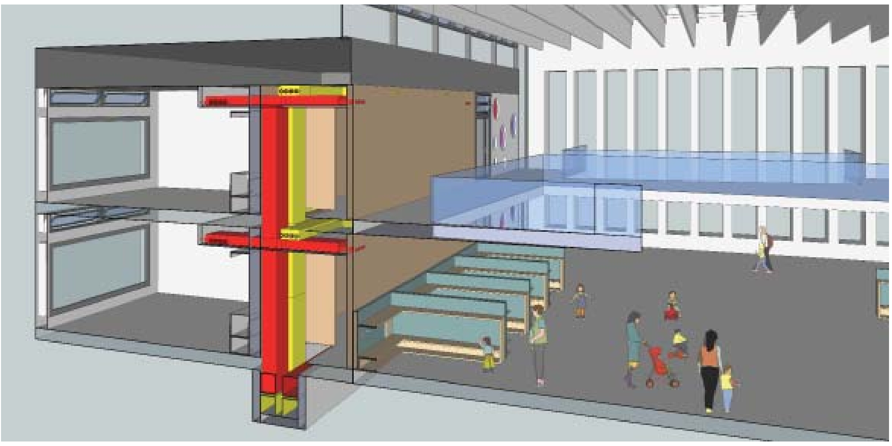
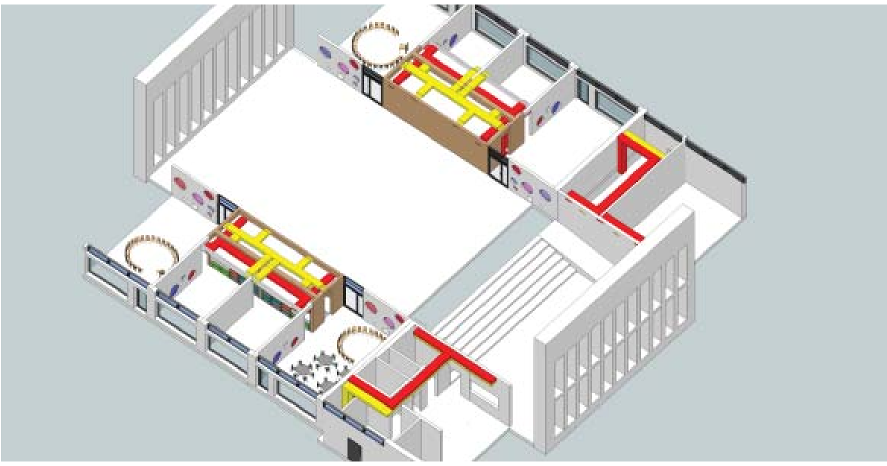


FIG. 5.12. VERTICAL SHAFTS WITH VENTIALATION DUCTS.



EXHAUST OF POLLUTED AIR

FRESH AIR SUPPLY

FIG. 5.13. MECHANICAL VENTILATION SCHEME ON THE GROUND FLOOR.

# VENTILATION STRATEGY

## NATURAL VENTILATION

Natural ventilation is an effective measure to save energy consumed in the buildings and improve indoor air quality.

The building has an integrated atrium, hence the cross and stack ventilation occurrence can be used.

The quality of air in the group rooms is improved by lamella windows located on opposite sides of the rooms. On the external wall, in group room the lamellas is 5.2m wide, in play room is 3.6m, and in both rooms 0.5m high. The fresh air is being pulled in the rooms by the system of operable elements, and on the basis of thermal bouncy effect, is moved move up through the room and out through lamella in internal wall, where after is rises up to the atrium ceiling and runs out of the building through operable lamellas located between the atrium's and clusters' roofs. Other rooms in the building, where it is possible, might benefit from single-sided and cross ventilation.

There is also possibility to take advantage of passive cooling. During the daytime usage through a combination of solar gain, user occupancy and electronic equipment the floor slabs absorb the built-up heat. As the external temperature drops at night, the building can be ventilated and cooled by partially opening the ventilating lamellas around the building. For this effect the atrium solution is utilizing stack and cross ventilation.
*[http://www.esru.strath.ac.uk/Documents/MSc_2004/dickson.pdf]*

FIG. 5.14. LAMELLA WINDOWS IN COPENHAGEN' RADIO.

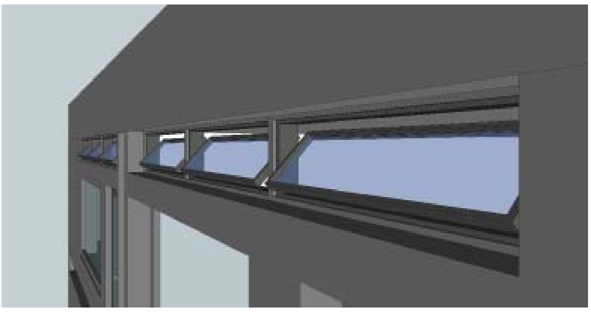


FIG. 5.15. LAMELLA WINDOWS IN EXTERNAL FACADE.

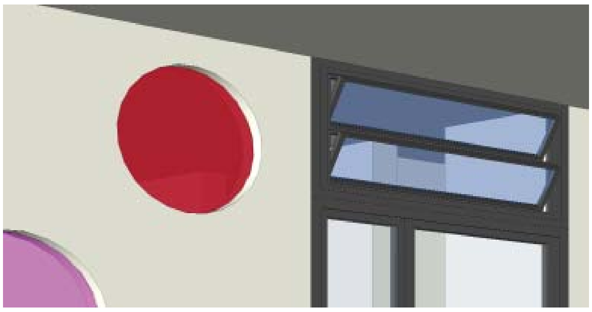


FIG. 5.16. LAMELLA INCORPORATED INTO THE DOORS.

FIG. 5.17. LAMELLA IN ATRIUM'S GLAZING.

*FIG. 5.18. NATURAL VENTILATION THROUGH STACK EFFECT IN ATRIUM.*

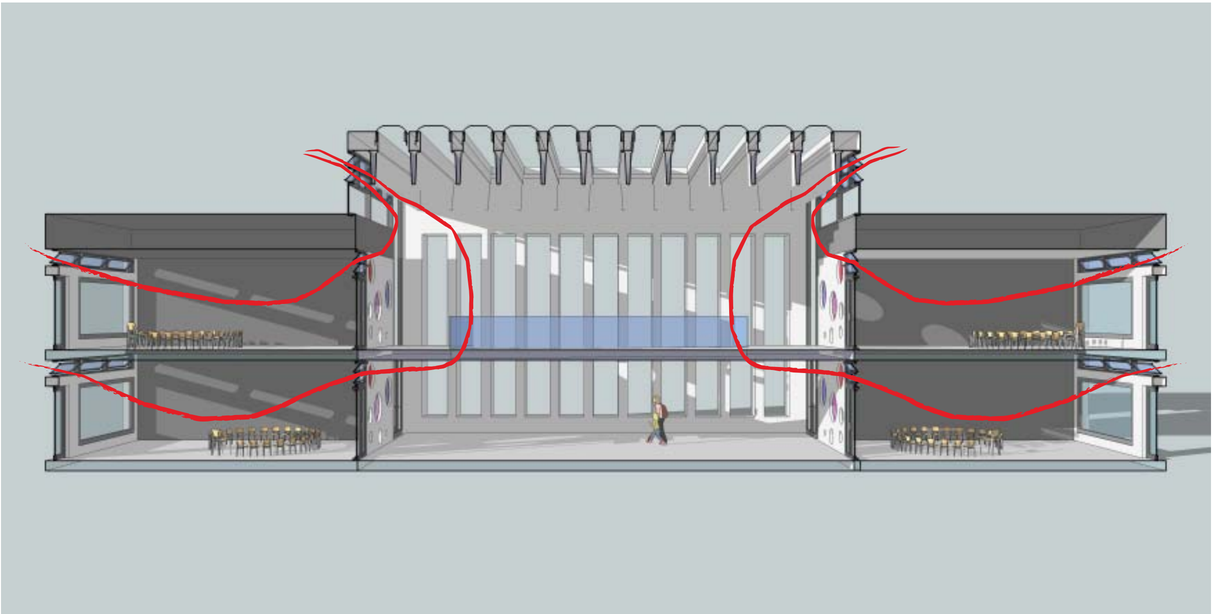


*FIG. 5.19. SCHEME OF NATURAL VENTILATION THROUGH STACK EFFECT IN ATRIUM.*

# DAYLIGHT VERIFICATION

Daylight is a very important parameter in the architecture, as humans thrive better in an environment with plenty of daylight. At the same time a large supply of daylight also determines whether the energy framework eventually complied. Not every room in the building is as suitable as dependent on large amount of daylight, but all group rooms, play rooms and atrium are primarily illuminated naturally.

There are modeled in Velux Daylight Vizualizer to ensure the right amount of daylight in the building, as well in summer as in winter. The program calculates lux on the surface where the external conditions are basically a cloudy sky at 10,000 lux. This takes no account of direct sunlight, but only on the diffuse light, so to calculate the amount of daylight that minimum will be in the building.

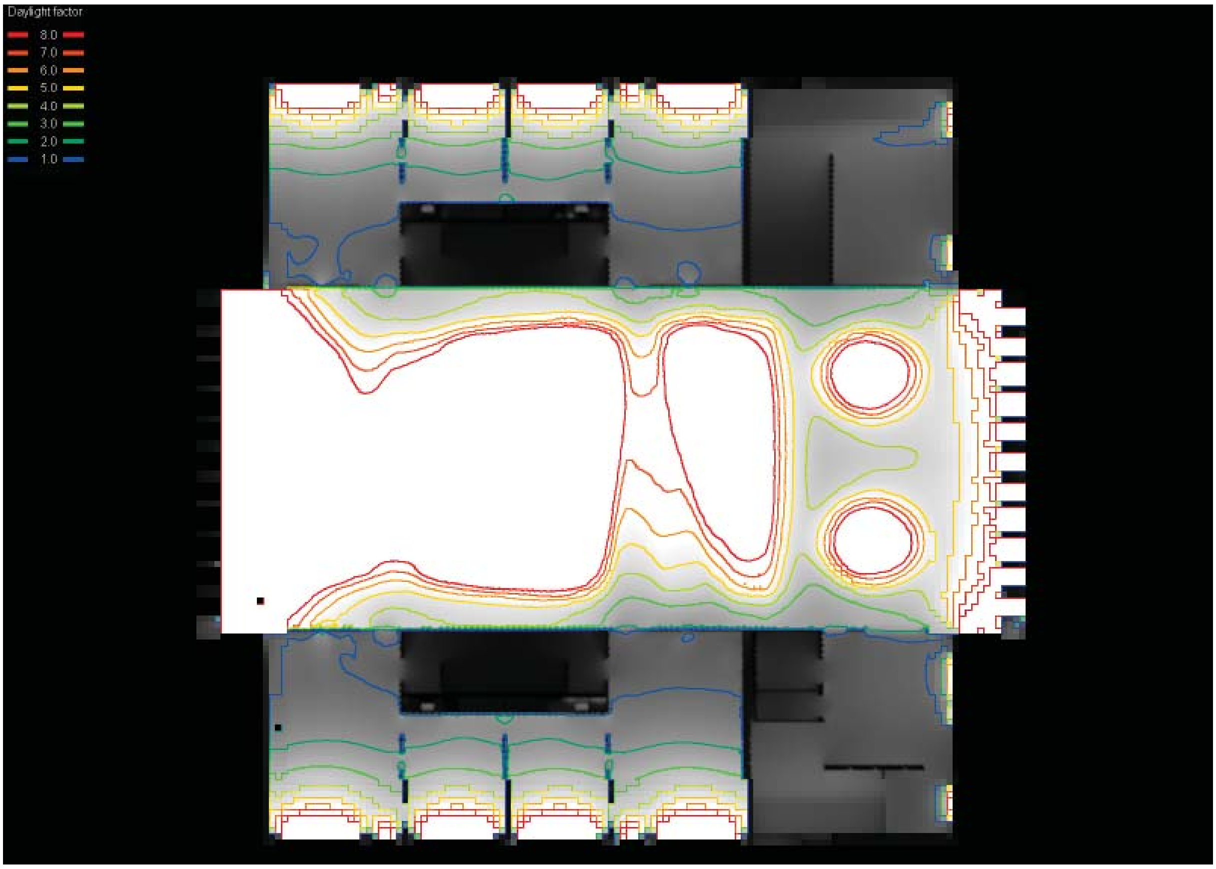



*FIG. 5.20. DAYLIGHT FACTOR DURING THE SUMMER TIME.*

The modeling shows that there will be large amounts of light in the summer. In winter, the amount of daylight satisfactory minimum 125 lux on the dark places in the building. It is possible that there will be a need for supplementation artificial lighting in some places.
It is made separate studies with group room where openings are positioned and dimensioned to provide a satisfactory amount of daylight at 200 lux and more in the space.

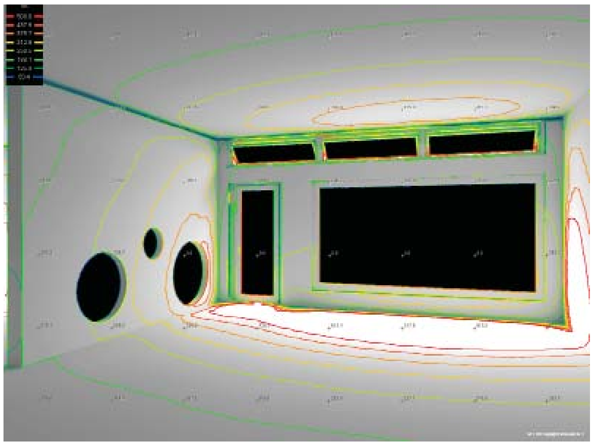


*FIG. 5.21. DAYLIGHT INTENSITY IN THE GROUP ROOM.*

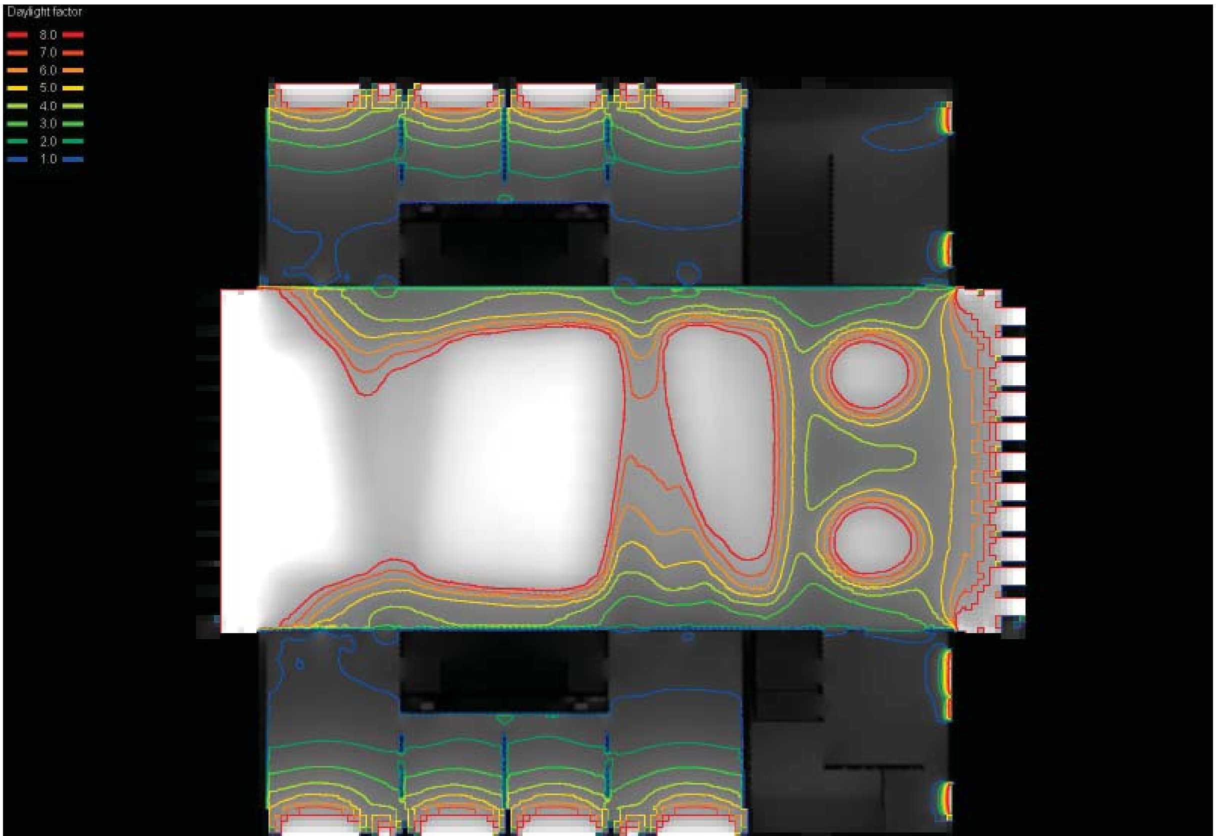



*FIG. 5.22. DAYLIGHT FACTOR DURING THE WINTER TIME.*

# BE10 - CALULATING THE ENERGY CONSUMPTION

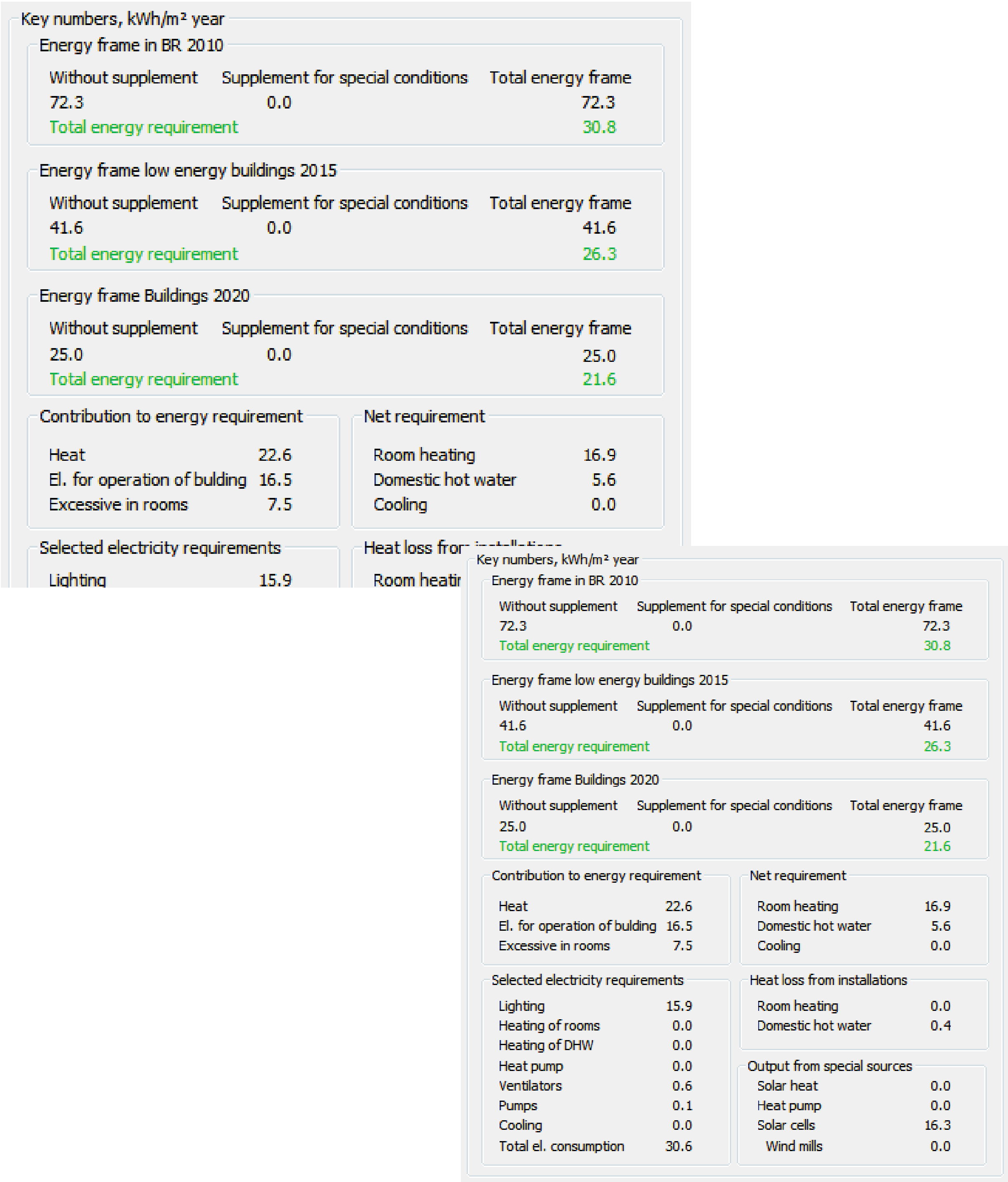
Be10 is a calculation program to calculate the energy consumption of designed building. As the ‘Colored Crayons’ kindergarten is to comply with the energy demands for 2020, the energy consumption shall be maximum 25 kWh/m$^2$/year.

The kindergarten operating hours has been set up to on 45 hours a week. To be able to calculate the energy consumption for the building different systems and values needs to be put into the program.

The following are entered into the calculation.
-the building envelope and windows and doors with shadows
-transmission losses
-internal heat gain
-lightning
-ventilation
-people load
-hot water
-heat pump
-solar cells

As seen in the diagram to the right the kindergarten’s energy consumption is under the maximum consumption for a 2020 public building. The building reaches the goal due to the energy production from the solar cells on the roof. Without the solar cells the building has an energy consumption of 50.8 KWh/per m$^2$ heated floor area which does not qualify to the 2020 demands. As seen in the diagram from BE10 energy consumption for building operation, heating and lightning have the largest posts. To reach the goal of a low energy building through the calculations the main focus has been to bring these three down. Regarding lightning it has been important to work with the placement and the sizes of the windows versus the need for artificial light in the kindergarten.

The goal has been from the start of the process to design a building that obtains the 2020 demand of maximum 25 kWh/m$^2$/year. This is in this project obtained by designing a building with a compact building envelope, by making qualified choices regarding the design in the process and by incorporating solar cells into the design.


Key numbers, kWh/m² year

Energy frame in BR 2010

| Without supplement | Supplement for special conditions | Total energy frame |
|---|---|---|
| 72.3 | 0.0 | 72.3 |
| Total energy requirement | | 30.8 |

Energy frame low energy buildings 2015

| Without supplement | Supplement for special conditions | Total energy frame |
|---|---|---|
| 41.6 | 0.0 | 41.6 |
| Total energy requirement | | 26.3 |

Energy frame Buildings 2020

| Without supplement | Supplement for special conditions | Total energy frame |
|---|---|---|
| 25.0 | 0.0 | 25.0 |
| Total energy requirement | | 21.6 |

Contribution to energy requirement

| | |
|---|---|
| Heat | 22.6 |
| El. for operation of bulding | 16.5 |
| Excessive in rooms | 7.5 |

Net requirement

| | |
|---|---|
| Room heating | 16.9 |
| Domestic hot water | 5.6 |
| Cooling | 0.0 |

Selected electricity requirements

| | |
|---|---|
| Lighting | 15.9 |
| Heating of rooms | 0.0 |
| Heating of DHW | 0.0 |
| Heat pump | 0.0 |
| Ventilators | 0.6 |
| Pumps | 0.1 |
| Cooling | 0.0 |
| Total el. consumption | 30.6 |

Heat loss from installations

| | |
|---|---|
| Room heating | 0.0 |
| Domestic hot water | 0.4 |

Output from special sources

| | |
|---|---|
| Solar heat | 0.0 |
| Heat pump | 0.0 |
| Solar cells | 16.3 |
| Wind mills | 0.0 |

*FIG. 5.23. RESULTS FROM BE10 PROGRAM.*

# CONSTRUCTION

The construction type of the proposed building is divided in four separate sectors:
--construction of foundations,
-construction of two side boxes,
-construction of atrium,
-construction of landings.

The foundations around the buildings are cast in-situ elements.

The structure of side boxes consist of prefabricated elements. The wall units with already made openings, as well as slabs are to be brought onto the construction site in pieces and put together. The span between the walls is either 4,5m, 6m or 9m. The windows must be established before the insulation comes, as the window frames are bigger than openings and are going to be partially hidden behind the insulation. The idea was to minimalize to minimum the visible frame from inside the rooms.
As an external surface, the acrylic black plaster has been chosen. After the plaster is freshly applied to the surface, the loose glass particles are to be blown onto the surface. Those small glass beads, adhering to the plaster as transparent particles, will reflect or refract light. The treated area will look all the time different - depending on the position of the viewer and lighting. And when the observer moves around - this effect seems to wander with him.
Technology used for building the roof over atrium is the T-T beams construction. The maximum span possible to build within this technology is 35.2m (see appendix 3). In this project the span of 34.8m is established. Between the pre-stressed piles it is possible to cut out the concrete and make the opening, hence there are plenty of skylights in the roof. The beams are further covered with insulation, anti-dump membrane and bituminous coating.
The atrium front facades and roof cap are cast in-situ solid element, made out of white concrete. It was decided to use this solution to avoid the separating lines on the surface.

The landings are made of cast in-situ elements, reinforced with steel rods. The structure is supported on side walls, and in appropriate places hanged with steel lines, which are connected to the T-T beams roof structure.

The side blocks are connected with the atrium structure by the glass curtain wall system, with operable lamella windows.

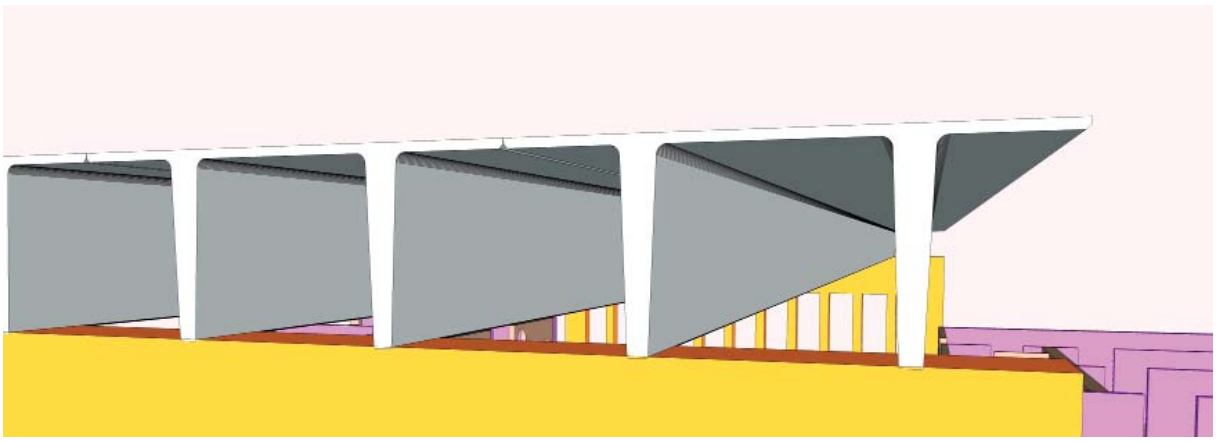
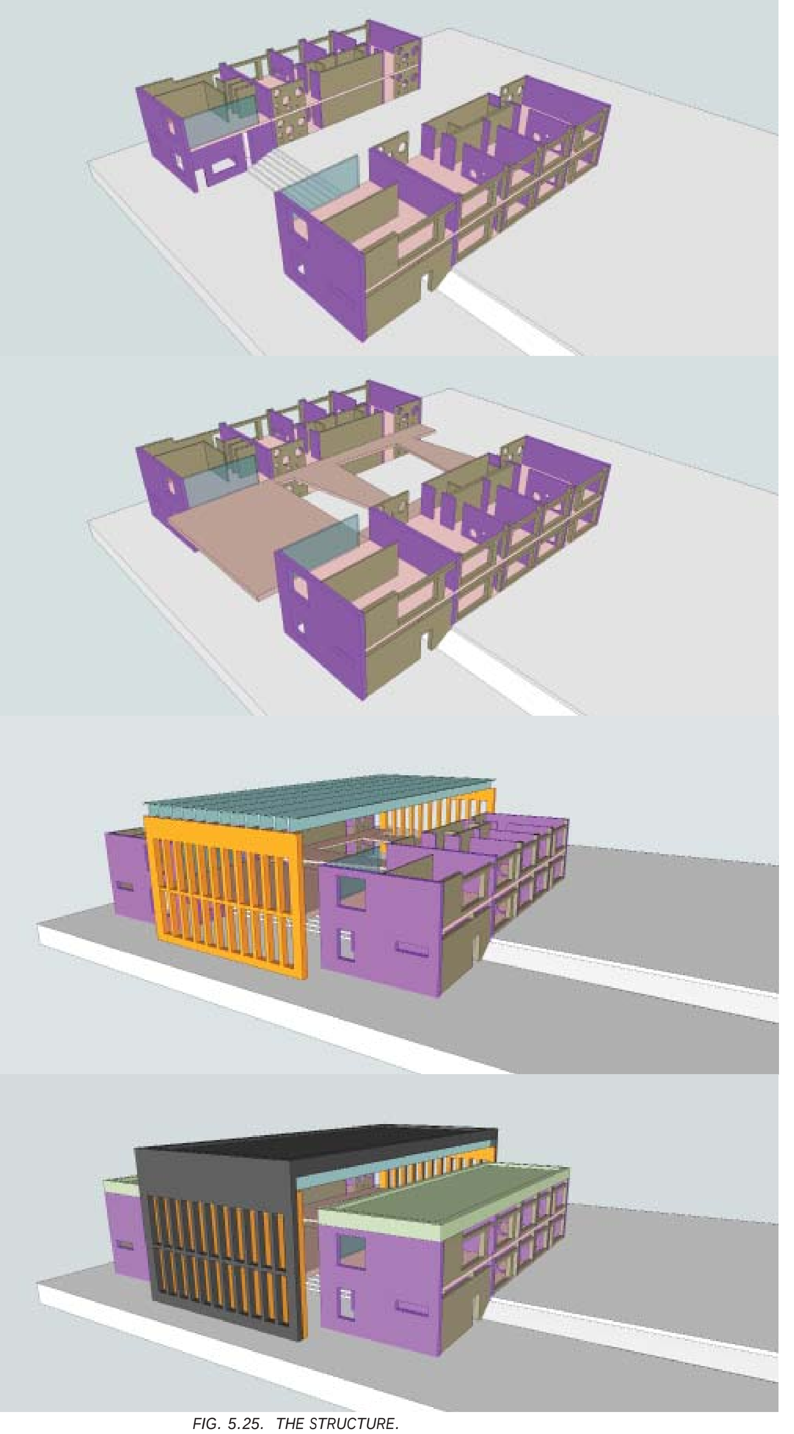


*FIG. 5.24. T-T BEAMS ROOF SOLUTION.*



LOADBERAING WALLS

FRESH AIR SUPPLY

SLABS

LANDINGS

FRESH AIR SUPPLY

FRESH AIR SUPPLY

ROOF

LOAD-BEARING STRUCTURE

CAST IN-SITU CONCRETE FACADE

FIG. 5.25. THE STRUCTURE.

# MATERIALS

## EXTERIOR

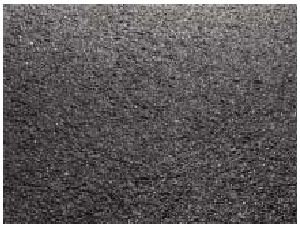


FIG. 5.26.

**Acrylic plaster**
-used on elevations of two blocks of clusters, color black, sprayed-with glass pearls, shinig in the sun light


FIG. 5.27.

**Brushed aluminium**
-used in window frames

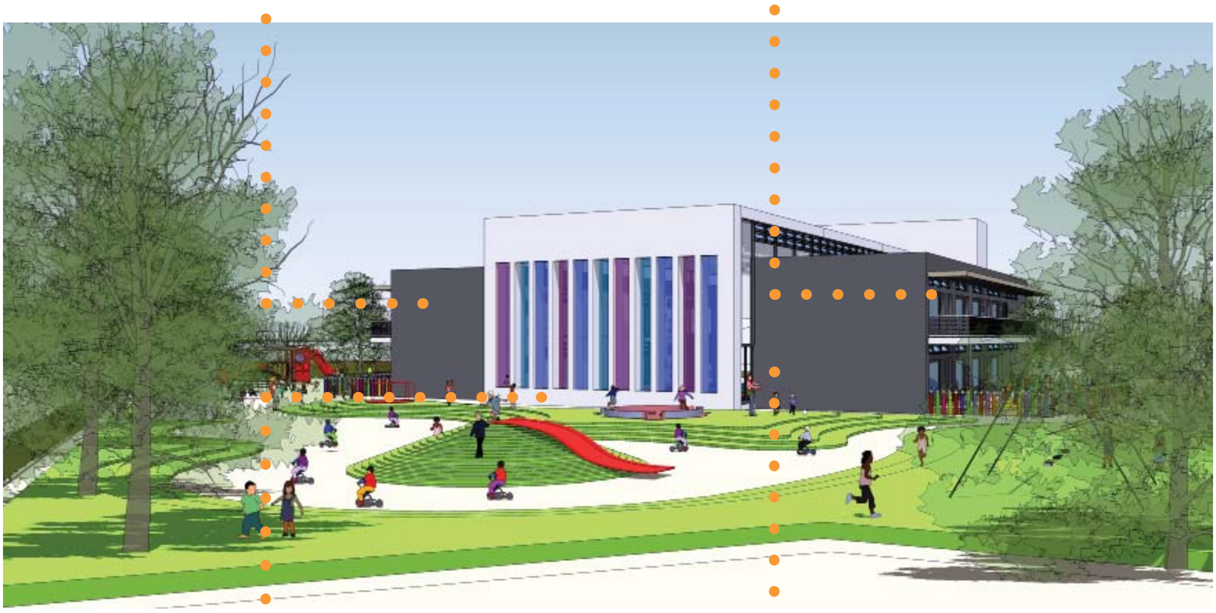


FIG. 5.28. EXTERIORS OF KINDERGARTEN.


FIG. 5.29.

**White concrete**
-used for atrium's elevation,


FIG. 5.30.

**Colored glass**
-used for window glass in front and atrium's facade

INTERIOR

FIG. 5.31.

**Color glass panels**
-used for elevator paneling and in circular openings in partition wallls

FIG. 5.32.

**Transparent glass**
-used for railings on the landings in first floor

FIG. 5.33. INTERIORS OF KINDERGARTEN.

FIG. 5.34.

**Linoleum**
- used for flooring in the atrium

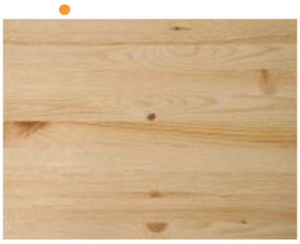


FIG. 5.35.

**Pine wood**
- used for benches and hangers in wardrobe

# FIRE SAFETY VERIFICATION

CATEGORY

The school building is according to BR08 specified as application category 2 comprises building sections for day time occupancy by a modest number of people in each room, in which the people who occupy the building section are not necessarily familiar with the escape routes from the building section but are capable of taking themselves unaided to a place of safety.

It is also advised that exits to escape routes should be located at or immediately next to the opposite ends of the room, and the distance from any point in the room to the nearest exit should be no more than 25m.

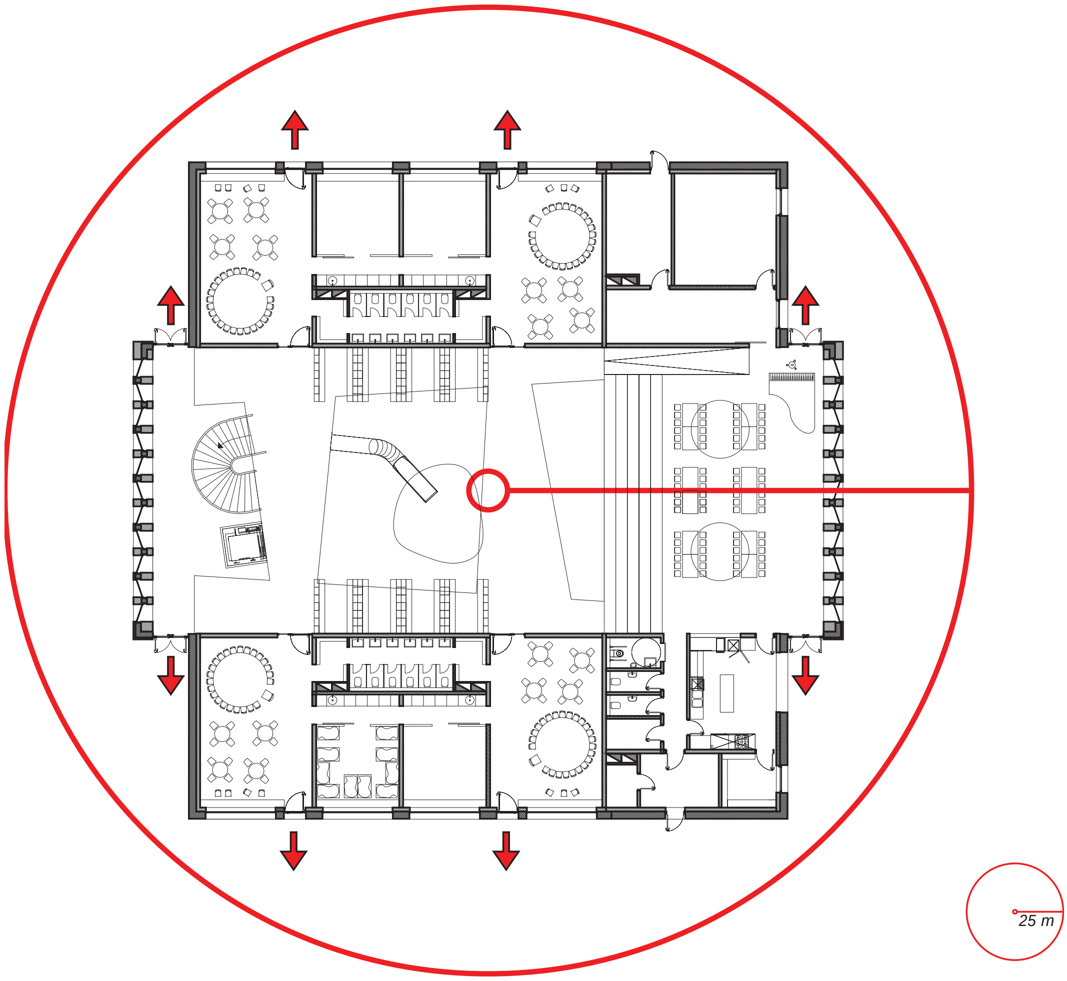
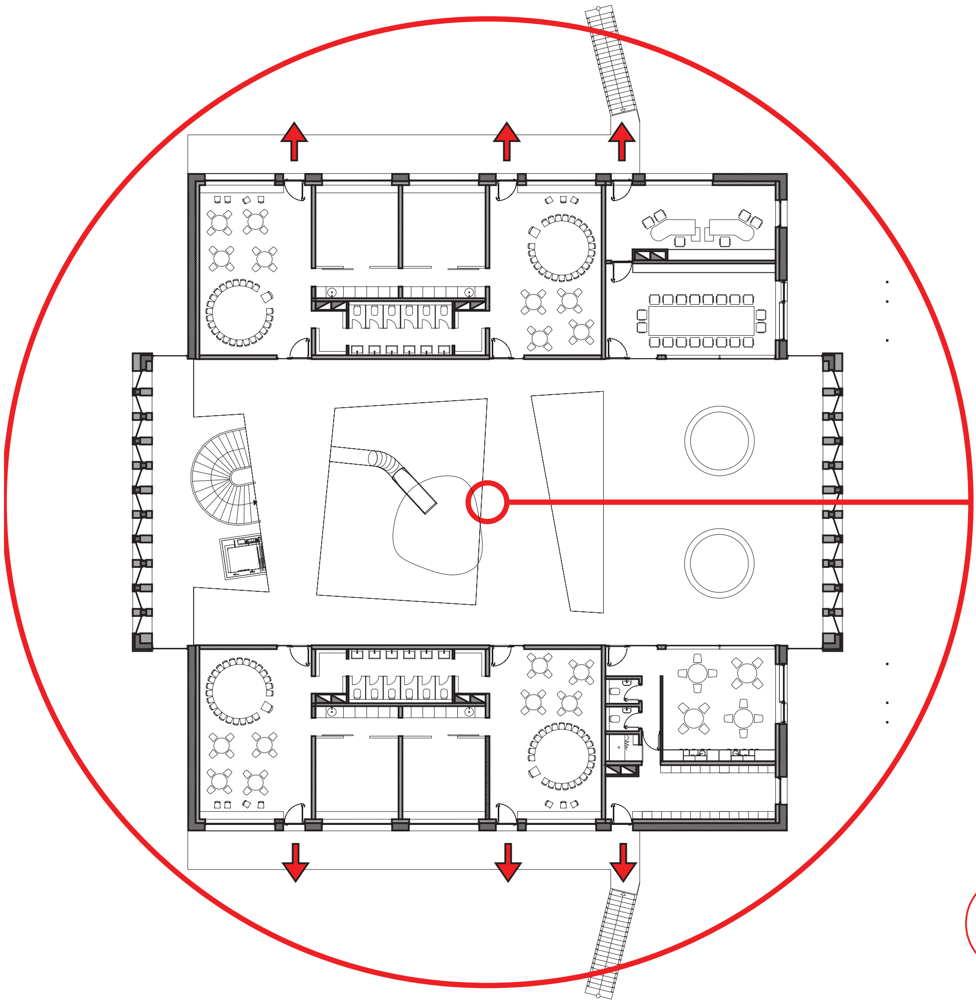



*FIG. 5.36. FIRE EMERGENCY EXITS ON GROUND FLOOR.*

All occupied rooms have the rescue opening in shape of operable doors. People from upper floors, in case of fire, have opportunity to escape through one of four staircases and plenty rescue opening on the ground floor.
[BR10]

**Usage category 2:**
**Teaching rooms, school day-care centres and other after-school facilities, day centres and similar rooms occupied by no more than 50 people. Each room is a fire-resisting unit.**
*[BR10]*



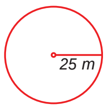



*FIG. 5.37. FIRE EMERGENCY EXITS ON FIRST FLOOR.*

# ENDING

# PROJECT VIEW

“No generation has a freehold on the earth-all we have is a life tenancy with a full reparing lease”

Margareth Thatcher, 1990

‘Colored Crayons’ came as a result response to the expanding demands of Municipality of Lublin for kindergarten buildings. The principles of sustainable architecture have been incorporated as a natural choice of building for the future. The aim of this project has been to investigate the possibilities of this approach without limitation the architectural design.

The openness and transparency of the building encourages its active use for whole day hours. Thanks to incorporating open-space atrium into the design, a spacious, centrally located welcoming zone has been created, that includes a canteen and multi-purpose rooms, serving as meeting and playing place. The users can admire beautiful views towards the playgrounds outside the building and greenery around the plot.

There is a gradual differentiation between shared and semi-public areas and the more private group and play rooms, however the rooms are transparent thanks to glazed openings in partition walls.

The energy demands of the school have effectively been reduced, through sensible design solutions and practical way of viewing compactness. The indoor climate is very high quality, making usage of natural cross and stack ventilation. The rooms are, in themselves, energy effective, thanks to big surface of glazing, where the light can penetrate the room from both sides, and through integrated solar cells the BR2020 energy requirements are easily fulfilled. Thus, in term of energy, the site actually gives back something to the inhabitants, the city and the global climate.

# REFLECTION

“Architecture is the will of an era shown in space”

Mies van der Rohe.

The global environment has been starting to show the consequences of earth’s inhabitant’s actions.
These consequences increased gradually the degree of concern regards the relation between buildings and the environment. Sustainable architecture begins to show the possible direction for the new era of buildings designing, that takes the environmental issues under consideration and contemplates the whole building process.
Architecture is to be incorporated in a building for user groups with limited knowledge and interest in the environmental considerations, it is important to combine sustainability principles and guidelines with appealing design for useful solutions. In this project the new kindergarten creates a unique opportunity for the children to use a place for learning, developing, working, and also resting and being entertained.
It has been of great importance to create a modern visual expression telling stories about environmental architecture combined with good functionality within the building.
By using sustainability rules as architectural approach the design process not only it was not limiting the solutions, but instead it was used as opportunity and challenge to solved the building’s architectural qualities.
The concept of sustainable architecture is new concept in Poland, and it is important to create well-functioning buildings that demonstrate interesting examples of environmental architecture. The subject has to be explored and developed to create new solutions fitting the concept and the inhabitants’ needs.
Architecture can be the transmission link to the public by creating great buildings that radiate environmental concern.

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# ILLUSTRATION LIST

| *ILLUSTRATION NUMBER* | *SOURCE* |
|---|---|
| FIG. 2.52. PLAY GROUNDS AT THE WEST SIDE OF PROPERTY. | OWN ILLUSTRATION |
| FIG. 2.53. WEST PLAYGROUNDS. | OWN ILLUSTRATION |
| FIG. 3.00. CHAPTER COVER | HTTP://WWW.SUPERBWALLPAPERS.COM/ |
| FIG. 3.01. LOCATION OF POLAND ON EUROPE MAP. | OWN ILLUSTRATION |
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| FIG. 3.03. LOCATION OF CZUBY DISTRICK ON MAP OF LUBLIN. | OWN ILLUSTRATION |
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| FIG. 3.05. DIRECTIONS OF PANORAMIC VIEWS. | OWN ILLUSTRATION |
| FIG. 3.06. PANORAMAS. | OWN ILLUSTRATION |
| FIG. 3.07. MAIN FUNCTIONS OF THE DISTRICT. | MAPS.GOOGLE.COM |
| FIG. 3.08. VEGETATION. | OWN ILLUSTRATION |
| FIG. 3.09. PEDESTRIANS AND BICYCLISTS. | OWN ILLUSTRATION |
| FIG. 3.10. TYPOLOGY ON THE SITE. | OWN ILLUSTRATION |
| FIG. 3.11. TYPOLOGY OF SURROUNDING BUILDINGS. | OWN ILLUSTRATION |
| FIG. 3.12. CHAPTER COVER | OWN ILLUSTRATION |
| FIG. 3.13. WIND DIAGRAM: DIRECTION AND SPEED OF THE WIND. | OWN ILLUSTRATION |
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| FIG. 3.16. DIAGRAMS OVER THE PATHS OF THE SUN DURING THE YEAR. | OWN ILLUSTRATION |
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| FIG. 3.18. UNDERSTANDING SUSTAINABILITY. | OWN ILLUSTRATION |
| FIG. 3.19. HOUSING EXAMPLE FROM FRILAND. | HTTP://WWW.FLICKR.COM/PHOTOS/KARENELIOT/356890660/SIZES/L/ |
| FIG. 3.20. EAN MARIE TJIBAOU CULTURAL CENTRE, NEW CALEDONIA. | HTTP://WWW.FL ICKR.COM/PHOTOS/ANTHONYLKDKING/2389565120/ |
| FIG. 3.21. BRUNSELL RESIDENCE, USA, 1987, OBIE BOWMAN. | HTTP://WWW.FL ICKR.COM/PHOTOS/21741488@N08/2362851194/SIZES/L/ |
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| FIG. 3.24. ARUP CAMPUS IN SOLIHUL, UNITED KINGDOM. | HTTP://WWW.PROFIMEDIA.SI/PICTURE/ARUP-CAMPUS-DESIGNED-BY-ARUP-ASSOCIATES-SOLIHULL/0078937810/ |
| FIG. 3.25. SUSTAINABILITY'S FOUR DOMINATING CONCERNS. | OWN ILLUSTRATION |
| FIG. 3.26. SCHEME CATEGORIZING THE SUSTAINABLE ARCHITECTURAL APPROACHES | OWN ILLUSTRATION |
| FIG. 3.27. COVER CHAPTER. | HTTP://WWW.FREEGREATPICTURE.COM/CHILDRENS-ALBUM/INTERNATIONAL-CHILDREN |
| FIG. 3.28. CHILDREN'S DEVELOPMENT. | OWN ILLUSTRATION |
| FIG. 3.29. PICTURES OF SIGHARTSTEIN KINDERGARTEN. | [HTTP://WWW.ARCHDAILY.COM/34252/KINDERGARTEN-SIGHARTSTEIN-KADAWITTFELDARCHITEKTUR] |
| FIG. 3.30. PICTURES OF BERNTS HAVE DAY CARE CENTER. | [HTTP://WWW.ARCHDAILY.COM/85118/BERNTS-HAVE-DAYCARE-CENTER-HENNING-LARSEN-ARCHITECTS] |
| FIG. 3.31. PICTURES OF LEIMOND-NAGAHAMA NURSERY SCHOOL. | [HTTP://WWW.DEZEEN.COM/2011/08/10/LEIMONDO-NURSERY-SCHOOL-BY-ARCHIVISION-HIROTANI-STUDIO] |
| FIG. 3.32. DIAGRAM OF RELATIONSHIPS BETWEEN THE PARTICULAR ROOMS AND ZONES. | OWN ILLUSTRATION |
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| FIG. 3.35. ROOM PROGRAM OF ZONE 3- THE COMMON AREAS. | OWN ILLUSTRATION |
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| FIG. 3.37. DESIGN PRINCIPLES FOR OPTIMAZING THE ENERGY FRAME. | KNUDSTRUP 2009 |
| FIG. 3.38 INDOOR CLIMATE. | OWN ILLUSTRATION |
| FIG. 3.39. LIGHT TYPES AND INTENSITY. | HTTP://WWW.SUPERBWALLPAPERS.COM/ |
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| FIG. 4.02. INTEGRATION OF THE DESIGN PROCESS. | OWN ILLUSTRATION |
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| FIG. 4.04. INITIAL PROPOSALS FOR THE SHAPE OF BUILDING. | OWN ILLUSTRATION |
| FIG. 4.05. INITIAL INVESTIGATION OF BUILDING SHAPE AND LOCATION. | OWN ILLUSTRATION |
| FIG. 4.06. THE C-SHAPE PROPOSAL. | OWN ILLUSTRATION |

# APPENDIXES

## 1 - LIST OF BUILDING CONSTRUCTION ELEMENTS

### U-VALUES OF BUILDING ELEMENTS

Building: Kindergarten " Colored crayons"

| Assembly No. | Building Assembly Description |
|---|---|
| 1 | Slab on grade |

Heat Transfer Resistance [m²K/W] interior $R_{si}$: 0.13 exterior $R_{se}$: 0.13

| | Area Section 1 | [W/(mK)] | Area Section 2 (optional) | [W/(mK)] | Area Section 3 (optional) | [W/(mK)] | Total Width Thickness [mm] |
|---|---|---|---|---|---|---|---|
| 1. | Concrete 2500kg/m3 | 1.700 | | | | | 300 |
| 2. | Rockwool insulation | 0.034 | | | | | 250 |
| 3. | rockwool insulation | 0.034 | | | | | 250 |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| | | | Percentage of Sec. 2 | | Percentage of Sec. 3 | | Total 80.0 cm |

U-Value: 0.066 W/(m²K)

| Assembly No. | Building Assembly Description |
|---|---|
| 2 | Wall in atrium |

Heat Transfer Resistance [m²K/W] interior $R_{si}$: 0.13 exterior $R_{se}$: 0.04

| | Area Section 1 | [W/(mK)] | Area Section 2 (optional) | [W/(mK)] | Area Section 3 (optional) | [W/(mK)] | Total Width Thickness [mm] |
|---|---|---|---|---|---|---|---|
| 1. | Concrete 2300kg/m3 | 1.700 | | | | | 350 |
| 2. | Rockwool Insulation | 0.034 | | | | | 300 |
| 3. | Concrete 2500kg/m3 | 1.700 | | | | | 350 |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| | | | Percentage of Sec. 2 | 2.0% | Percentage of Sec. 3 | 2.0% | Total 100.0 cm |

U-Value: 0.106 W/(m²K)

| Assembly No. | Building Assembly Description |
|---|---|
| 3 | Oridinary wall in cluster |

Heat Transfer Resistance [m²K/W] interior $R_{si}$: 0.10 exterior Rse: 0.04

| | Area Section 1 | [W/(mK)] | Area Section 2 (optional) | [W/(mK)] | Area Section 3 (optional) | [W/(mK)] | Total Width Thickness [mm] |
|---|---|---|---|---|---|---|---|
| 1. | Concrete | 2.440 | | | | | 200 |
| 2. | Insulation | 0.034 | | | | | 380 |
| 3. | Concrete elevation | 0.700 | | | | | 20 |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| | | | Percentage of Sec. 2 | 1.6% | Percentage of Sec. 3 | 1.0% | Total 60.0 cm |

U-Value: 0.088 W/(m²K)

# U-VALUES OF BUILDING ELEMENTS

Building: Kindergarten " Colored crayons"

| Assembly No. | Building Assembly Description |
|---|---|
| 4 | Roof over cluster |

Heat Transfer Resistance [m²K/W] interior $R_{si}$ : 0.10

exterior $R_{se}$ : 0.04

| | Area Section 1 | ⊠ [W/(mK)] | Area Section 2 (optional) | ⊠ [W/(mK)] | Area Section 3 (optional) | ⊠ [W/(mK)] | Total Width Thickness [mm] |
|---|---|---|---|---|---|---|---|
| 1. | Asphalt roofing | 0.250 | | | | | 26 |
| 2. | Vapour barrier | 0.170 | | | | | 4 |
| 3. | Insulation | 0.037 | | | | | 500 |
| 4. | Concrete | 2.440 | | | | | 200 |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| | | | Percentage of Sec. 2 | 0.0% | Percentage of Sec. 3 | 0.0% | Total 73.0 cm |

**U-Value:** 0.072 W/(m²K)

| Assembly No. | Building Assembly Description |
|---|---|
| 5 | Roof over atrium |

Heat Transfer Resistance [m²K/W] interior $R_{si}$ :

exterior $R_{se}$ :

| | Area Section 1 | ⊠ [W/(mK)] | Area Section 2 (optional) | ⊠ [W/(mK)] | Area Section 3 (optional) | ⊠ [W/(mK)] | Total Width Thickness [mm] |
|---|---|---|---|---|---|---|---|
| 1. | Asphalt roofing | 0.250 | | | | | 26 |
| 2. | Vapour barrier | 0.170 | | | | | 4 |
| 3. | Insulation | 0.037 | | | | | 500 |
| 4. | T-T concrete beams | 2.440 | | | | | 100 |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| | | | Percentage of Sec. 2 | | Percentage of Sec. 3 | | Total 63.0 cm |

**U-Value:** 0.073 W/(m²K)

# 2 - NATURAL VENTILATION RATES

## Ventilation rate

| | Group Room | |
|---|---|---|
| **Activity** | 1.4 | met |
| **People load** | 22.0 | people |
| **Area** | 50.0 | $m^2$ |
| **Volume** | 150.0 | $m^3$ |
| | 15000.0 | L |

Sensory pollution (Air change rate from person activity load)

| | | | |
|---|---|---|---|
| **Outside pollution, $c_i$** | 0.1 | dp | |
| **Satisfaction 20 %, c** | 1.4 | dp | |
| **Building pollution** | 0.1 | olf | DS/CEN/CR 1752 p. 27 |
| **Air change** | 275.4 | L/s | |
| | 0.28 | $m^3$/s | |
| | 991.4 | $m^3$/h | |
| **Air change, n** | **6.61** | **$h^{-1}$** | |

$$V_L[l/s] = 10\frac{q[olf]}{(c-c_i)[dp]}$$

Source: Slides from lecture "Bygningskonstruktioner 5" (Rasmus Lund Jensen - 5. semester)

$CO_2$ indicator (Air change rate from $CO_2$ load) DS/CEN/CR 1752 p. 29

| | | | |
|---|---|---|---|
| **Outside concentration, $c_i$** | 350 | ppm | |
| | 0.00035 | m3/m3 | |
| **Max concentration, c** | 810 | ppm | |
| | 0.00081 | m3/m3 | |
| **Person pollution pr pers** | 18 | L/h | DS/CEN/CR 1752 p. 26 |
| **$q_{CO2}$** | 554.4 | L/h | |
| | 0.5544 | $m^3$/h | |
| **Air change, n** | **8.03** | **$h^{-1}$** | |

$$c = \frac{q}{V_L} + c_i$$

Source: Slides from lecture "Bygningskonstruktioner 5" (Rasmus Lund Jensen - 5. semester)

Thermal indicator (Air change rate from temperature)

| | | | | |
|---|---|---|---|---|
| **Air change, n** | **1.8** | **$h^{-1}$** | | |
| | **270.0** | **$m^3$/h** | | |
| | | | **1$m^3$/h=** | **0.277778 L/s** |
| | **75.0** | **L/s** | | |

## Ventilation rate

### Atrium

| | | |
|---|---|---|
| **Activity** | 1.3 | met |
| **People load** | 140.0 | people |
| **Area** | 300.0 | $m^2$ |
| **Volume** | 2100.0 | $m^3$ |
| | 90000.0 | L |

Sensory pollution (Air change rate from person activity load)

| | | | |
|---|---|---|---|
| **Outside pollution, $c_i$** | 0.1 | dp | |
| **Satisfaction 20 %, c** | 1.4 | dp | |
| **Building pollution** | 0.1 | olf | DS/CEN/CR 1752 p. 27 |
| **Air change** | 1630.8 | L/s | |
| | 1.63 | $m^3/s$ | |
| | 5870.8 | $m^3/h$ | |
| **Air change, n** | **2.80** | **$h^{-1}$** | |

$$V_L[l/s]=10\frac{q[olf]}{(c-c_i)[dp]}$$

Source: Slides from lecture "Bygningskonstruktioner 5" (Rasmus Lund Jensen - 5. semester)

$C0_2$ indicator (Air change rate from $C0_2$ load) DS/CEN/CR 1752 p. 29

| | | | |
|---|---|---|---|
| **Outside concentration, $c_i$** | 350 | ppm | |
| | 0.00035 | m3/m3 | |
| **Max concentration, c** | 810 | ppm | |
| | 0.00081 | m3/m3 | |
| **Person pollution pr pers** | 18 | L/h | DS/CEN/CR 1752 p. 26 |
| **$q_{CO2}$** | 3276 | L/h | |
| | 3.276 | $m^3/h$ | |
| **Air change, n** | **3.39** | **$h^{-1}$** | |

$$c=\frac{q}{V_L}+c_i$$

Source: Slides from lecture "Bygningskonstruktioner 5" (Rasmus Lund Jensen - 5. semester)

Thermal indicator (Air change rate from temperature)

| | | | | |
|---|---|---|---|---|
| **Air change, n** | **1.8** | **$h^{-1}$** | | |
| | **3780.0** | **$m^3/h$** | | |
| | | | **$1m^3/h$=** | **0.277778 L/s** |
| | **1050.0** | **L/s** | | |

# 3 - T-T BEAM ROOF STRUCTURE

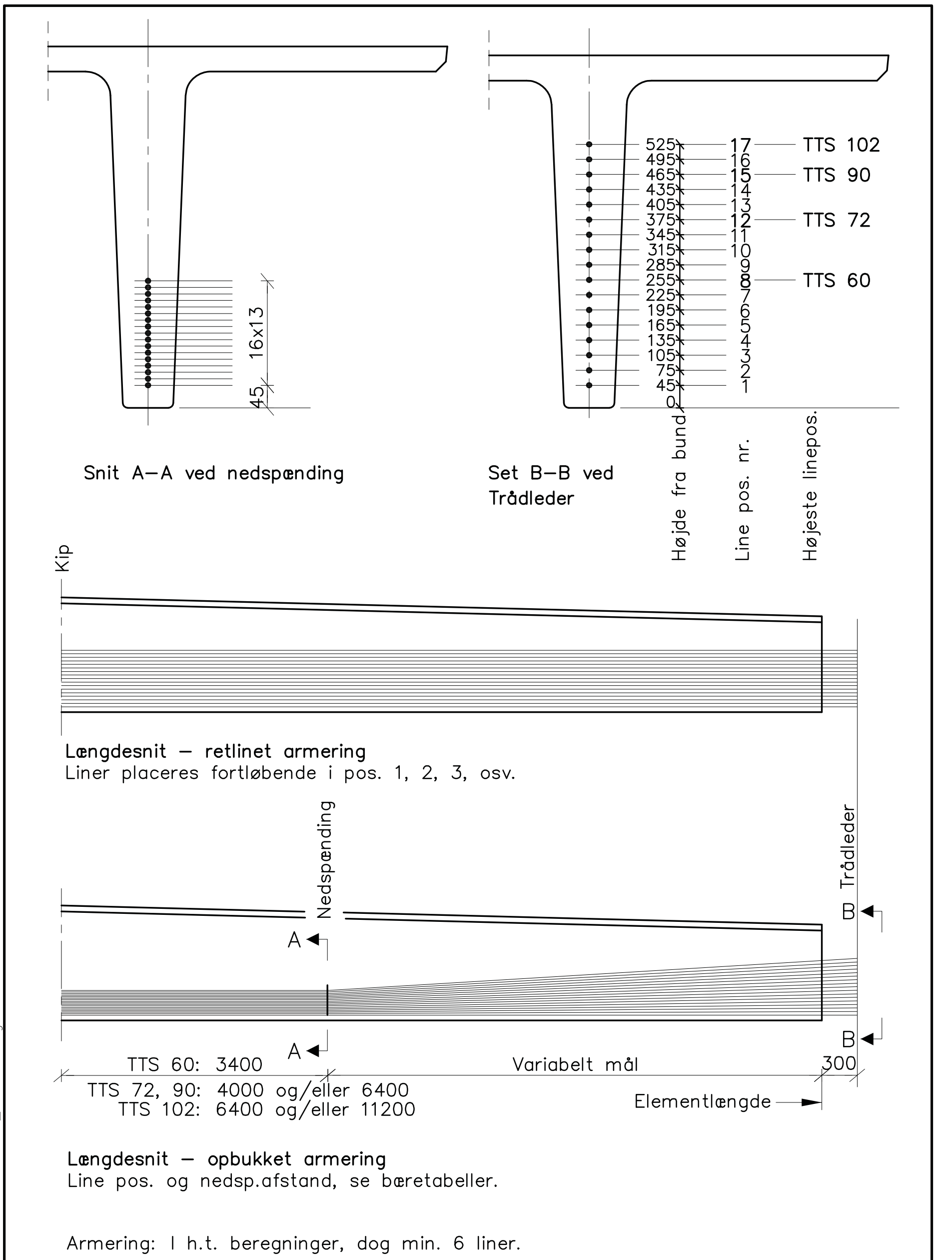
## Bæretabel TTS

Spæncom

07-08-2009

### TTS102/240 Opbøjet armering

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 L12,5 | **Lgd m** | **26,4** | **27,6** | **28,8** | **30,0** | **31,2** | | | | |
| | qRd kN//m$^2$ | 7,5 | 6,6 | 5,7 | 5,0 | 4,3 | | | | |
| | Afst kritisk snit til kip m | 2,6 | 2,8 | 2,9 | 3,0 | 3,6 | | | | |
| | qrev kN//m$^2$ | 5,4 | 4,6 | 3,9 | 3,3 | 2,8 | | | | |
| | qbal kN//m$^2$ | 2,1 | 1,6 | 1,2 | 0,8 | 0,5 | | | | |
| | flev mm | 78,8 | 73,0 | 64,2 | 51,8 | 35,5 | | | | |
| | fe1 mm | 16,3 | 19,8 | 23,9 | 28,6 | 34,0 | | | | |
| | Egenv ton | 21,2 | 22,0 | 22,8 | 23,5 | 24,3 | | | | |
| 20 L12,5 | **Lgd m** | **26,4** | **27,6** | **28,8** | **30,0** | **31,2** | **32,4** | **33,6** | | |
| | qRd kN//m$^2$ | 8,7 | 7,6 | 6,7 | 5,9 | 5,1 | 4,5 | 3,9 | | |
| | Afst kritisk snit til kip m | 2,6 | 2,8 | 2,9 | 3,0 | 3,6 | 3,8 | 3,9 | | |
| | qrev kN//m$^2$ | 6,1 | 5,2 | 4,5 | 3,9 | 3,3 | 2,8 | 2,3 | | |
| | qbal kN//m$^2$ | 2,6 | 2,1 | 1,6 | 1,2 | 0,8 | 0,5 | 0,2 | | |
| | flev mm | 96,1 | 92,0 | 85,0 | 74,7 | 60,4 | 41,8 | 18,2 | | |
| | fe1 mm | 16,1 | 19,6 | 23,6 | 28,3 | 33,7 | 39,9 | 47,0 | | |
| | Egenv ton | 21,2 | 22,0 | 22,8 | 23,5 | 24,3 | 25,1 | 25,8 | | |
| 24 L12,5 | **Lgd m** | **26,4** | **27,6** | **28,8** | **30,0** | **31,2** | **32,4** | **33,6** | **34,4** | **35,2** |
| | qRd kN//m$^2$ | 10,8 | 9,6 | 8,5 | 7,5 | 6,7 | 5,9 | 5,2 | 4,9 | 4,6 |
| | Afst kritisk snit til kip m | 2,6 | 2,8 | 2,9 | 3,0 | 3,6 | 3,8 | 3,9 | 4,0 | 4,6 |
| | qrev kN//m$^2$ | 7,4 | 6,5 | 5,6 | 4,9 | 4,2 | 3,7 | 3,1 | 2,9 | 2,7 |
| | qbal kN//m$^2$ | 3,5 | 2,9 | 2,4 | 1,9 | 1,4 | 1,1 | 0,7 | 0,6 | 0,4 |
| | flev mm | 128,1 | 128,2 | 124,7 | 118,1 | 109,4 | 95,1 | 76,1 | 67,1 | 54,4 |
| | fe1 mm | 15,9 | 19,2 | 23,2 | 27,8 | 33,1 | 39,2 | 46,2 | 49,9 | 54,0 |
| | Egenv ton | 21,2 | 22,0 | 22,7 | 23,5 | 24,3 | 25,0 | 25,8 | 26,1 | 26,5 |




bir 26.08.08 10.33 INT_1030–15.dwg

| | | |
|---|---|---|
| Spæncom Standard | TTS<br>Lineplacering | INT<br>1030 |
| | Tegn.dato: 03.11.03 · Tegn. RV / Godk. LAR · Rev. B · Dato 11.04.08 · Tegn. bir / Godk. KN | 15 |