III.1

MULTI-HOUSE PULSEN

body in space

synopsis

The aim of in this project is to create a place where the community can be gathered through different activities. The project site is located in a small village called Balling, a community where social gatherings are prioritised. Balling wants to set an example of a town that focuses on the environment by introducing a new sustainable multi-house.
Through the work with different cases and studies the result is a multi-house, where the architecture enhance movement, and gives the possibility for people to be inspired to engage in activity or just to enjoy the life surrounding them. The multi-house will focus on sustainability and energy awerness.

Title page

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preface

This project is a master thesis composed by group ma4-ark50. The subject for the master thesis is form, technique and process, where a problem has to be defined individualy. This report is based on a competition project description of a multi-house in Balling that was published in 2011. The focus is to unite the community with activity, through a building that meets the energy demands for 2020, and also incorporate the increased focus on sustainability. The relation between architecture, activity and sustainable methods will be studied and create a basis for the construction of the new multi-house in Balling.
Illustration that is not listed in the illustration list are eighter own diagrams or photos.

Summary 6
Introduction 8
Method 10
Priorities 11
Location 12
Multi-house Pulsen competition 13
Motivation 14
Vision 15

Program 16
Context Analysis 18
-Context analysis 20
Mapping - typologies 22
Mapping - functions 23
Mapping - infrastructure 24
Mapping - topography 25
Climatic preconditions 26
Mapping conclusion 27
- Serial experiences 28
Route 1 29
Route 2 30
Route 3 31
Serial experiences - conclusion 32
- Life between buildings 34
Life between buildings - on site 36
Life between buildings - conclusion 38
- Further registrations 40
- Conclusion 42
Sustainability 44
- Sustainable research 46
- definition 48

content

- sustainable design in buildings 49
- Environmental sustainability 50
- Social and economical 51
- Low wnergy building 52
- Indoor environment 53
- Demands 54
- Resources and materials 56
-Conclusion 58

Movement 60
- Architeture and movement 62
- Study of term: movement 64
- Development of physical activity 66
- Tendencies 68
- Healthy society 70
- Movement and mind 72
- Indoor environment 74
- Activitiesand spaces 76
- Space perception 80
- Conclusion 81

Concept 82
- Room programe 84
- statement of intent 86
- Design criteria 87
- Concept idea 88

Progress 90

Shaping 92
- Pulsen identity 94
- Landscaping and lines 96
- Walls 98
- Proportioning 100
- Volume creation 102

Concept 104
- concept design 106
- Outdoor atmospheres 108
- Indoor atmospheres 112
- Materials 116
-Openings 118
- Window concept 120
- Structual considderations 122
- Wind study 124
- Ventilation principles 126
- Indoor climate - cases 128
- Indoor climate - process 130
Indoor climate - results and discussion 132
- Indoor climate - during the year 134
- Energy consumption 136
- Solar panels 138
- Sunlight 140
- Acoustics 142
- Conclusion 144

Detailing 148

Detailing 150
- introduction 152
- Flow 152
-Stay 154
- Division 156
- Sustainable identity 158
- construction details 160
- material structure 162

Presentation 164
- Siteplan 166
- Plans 168
-Sections 170
- Elevations 172
- Renders 174
- Conclusion 188
- Reflection 190

References 194

Illustration list 198

Enclosures 202

Enclosures 204
- Study A: Envelope 206
- Study B: Window 208
- Study C: Light 210
- Study D: Wind 212
- Study E: Volumes 216
- Study F: Movement 218
- Study G: Material, texture and pattern 222
- Study H: Acoustics 224
- Study I: Colour 226
- Study J: Indoor climate 228

summary

Multi-huset ”Pulsen” er baseret på et konkurrenceprojekt afholdt i 2011. Som navnet siger, har projektet stor mangfoldighed, hvad hvad funktioner angår. Hovedintentionen med projektet er at skaberammer for et aktivt samlingspunkt, som har en bæredygtig profil. Projektet finder sted i en mindre by ved navn Balling, som tilhører Skive kommune. Projektet bygger primært på to essentielle parametre, som er social og miljømæssig bæredygtighed.
Der er et ønske om, at Balling som en mindre by, kan gå i front og vise sig i stand til bæredygtige tiltag. Det nye multicenter skal kunne rumme forskellige arrangementer året rundt, eftersom byen har stor interesse i at brugere involverer sig i aktiviteter og arrangementer. Projektet skal huse både store og små arrangementer og skal kunne rumme at de tilstødende byer også anvender stedet.
Projektet indeholder tre primære funktionsgrupper, som i projektet er valgt at kalde kultur, krop og sundhed. Kulturdelen skal kunne tilbyde koncerter, forestillinger udstillinger med videre, og skal samtidig have rum til intellektuel og kreativ udvikling for borgerne i form af værksteder og undervisningslokaler. Den del af multi-huset, der har med fysisk udfoldelse at gøre, er nært tilknyttet den eksisterende sportshal, men kan tilbyde helt andre stemninger og funktionstilpassede rum. Sundhedscentret skal huse læge-og tandlægekonsultationer samt skadestue apotek og andre sundhedsrelaterede funktioner.

Projektet tager udgangspunkt i en fast fysisk lokation og de kvaliteter, der er at finde i området. Her kan bl.a. nævnes de lavt beliggende familie huse, og de store åbne vider. Balling kommune har overvejelser om at investere i geotermisk energi. Dette kombineret med udnyttelsen af vind og sol er et godt fundament for ikke bare at minimere projektets energiprofil men også producere energi med minimalt forbrug at kuldioxid.
Hovedkonceptet for projektet er at aktivitet skaber rum, og rum skaber aktivitet. Der er fundet inspiration i flere forskellige projekter omhandlende, hvordan rum kan bidrage til aktivitet. Det er også intentionen at samle indbyggerne i Balling og i de omkringliggende byer gennem aktivitet, idet tesen er at aktivitet fremmer mere aktivitet.

Bygningskonceptet er inspireret af de markante træer, der skaber linjer i udkanten af og hen over projektområdet. Disse fungerer som afskærmning for vinden, som er dominerende på området. Multihuset er stammer fra disse linjer og motiver i de nære omgivelser med en vis grad abstraktion. Dette har bidraget med et simpelt system, som både har muligheden for at bringe bevægelser sammen og at række ud i konteksten. Formens brydes op gennem et flow, der dannes af brugerne til den nuværende sportshal samt en skole, der ligger ved siden af.

Bygningen består af tre volumener; et kreativt center, et aktivitetscenter og et sundhedscenter. De beslægtede funktioner er opdelt i tre grupper for at synliggøre funktionerne og skabe en klar distribution.

Bygningerne bliver sammenholdt af en central plads, der vil fungere som et distributionspunkt. Pladsen er også et sted hvor folk kan mødes, og være en del af den indirekte aktivitet. Pladsen skal kunne bruges året rundt, og er om sommeren præget af et cafemiljø, hvor den om vinteren kan fungere for eksempel som et julemarked.

Der er opnået et resultat, hvor man gennem forskellige udkig og brugen af materialer skaber en kontakt til omkringliggende aktiviteter. De lange kig ud til omgivelserne, skaber kontakt til de udendørs funktioner. Dette skal influere stemningen indendørs, så det udendørs aktivitetsniveau og stemningen kan projekteres.
Indendørs er der skabt gennemsigtighed på flere niveauer. Funktioner med afstand fra hinanden har åbnet kig mod hinanden, så folk kan inspireres og følge med. Imellem funktionerne er det valgt at arbejde med grader af translucent, således at der kan opnås en fornemmelse af stemningen og typen af aktivitet ved siden af.

Der stræbes efter at opnå energi kravene for 2020, på 25kWh/m^2 pr år, samt et indendørs klima med en minimal utilfredshed.

introduction

The town of Skive has the intention, that the multi-house should function as the joint, which connects the society in Balling so that everyone, elder as young, men and women can practise their individuality in unison so the community is strengthend.

Now a days there is an intense focus on physical activity where both young and elder start to enjoy activities. Through activities it is possible to be a individual while learning about others. By creating a multi-house it is possible to make a place, where experience is made during activities. When gathering activities in one unity it creates a possibility for people to be inspirited by others, or just be amused together. For this to happen it is important that the building itself inspire to activity by the volumes and indoor climate. To secure the environment and the social community further on, it is essential to keep a focus in the areas regarding social, environmental and economic sustainability. This will affect the multi-house due to the different activities and their demands.

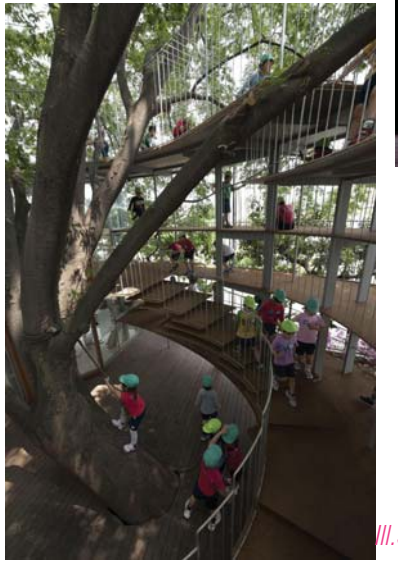
The multi-house Pulsen

- is a place where different activities are well framed
- is a place where everyone can be gathered through activities
- is a place where social connections are made
- is a place where generations meet
- is a place where the social community is a high priority

III.2

III.3

III.4



III.5

III.6

III.9

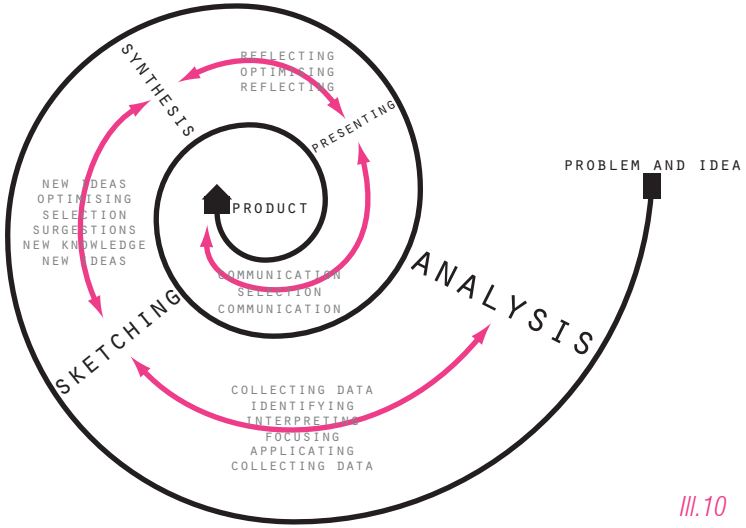
III.7

III.8

method

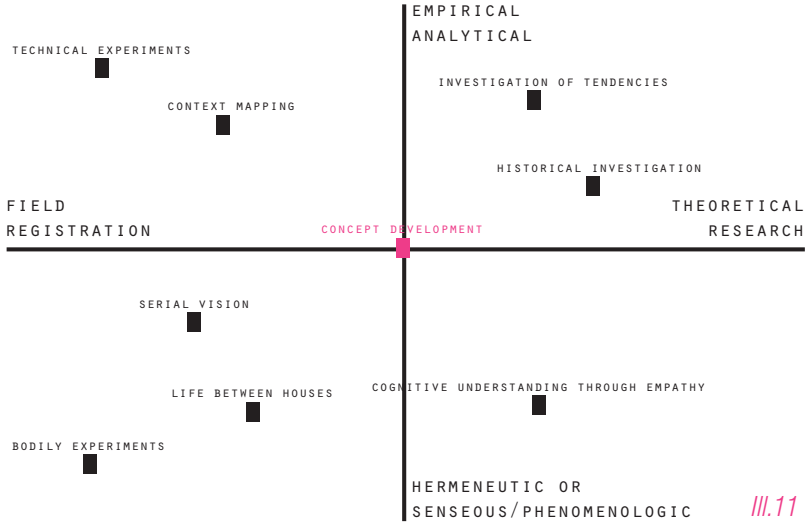
A design always starts with a problem or an idea - from there the investigation begins. The project reflects an integrated design process, where data initially is collected and analysed, which leads to a sketching phase. The sketching phase will lead to the synthesis and a presentaion of a final product. In order to create a process that results in a coherent design, different methods are applied. In this project both an empirical and a senceous approach is used to find and process information through analysis of quantitative and qualitative data.

Qualitative data is found through experiments, personal registrations, case studies and external sources. Quantitative data is found through technical experiments, external sources, project descriptions and objective registrations. It is known that in this project, all qualitative data is likely to be influenced by our subjective opinions, because the analysed data is experienced through the subject.
After data collection a hermeneutic approach is used to analyse all data for further research and development. An example is experiments, where studies of light are made in order to understand, how the light affects a room as a whole, but also to see how the experiments affect each other. [Andersen, 2009]
If you have a scale with field registration at one end and theoretical research at the other end, all methods used will be deriving from somewhere on this scale. The same counts for the scale between empirical-analytical research versus senceous experience, as can be seen in the ill.11.
Analysis methods used in the project; all contribute to the design development.



Ill.10

The integrated designproces should always involve different platforms. Every fase is in itself cyclic and interacts with other faces. [Knudstrup, 2005]



Ill.11

The horizontal axis tells whether the study is based on first hand observations or on interpretated data.
The vertical axis:
Empirical: A thesis is verifyed through objective, experience based observations. Results are independent of the subject. In its extreeme, this is the falsification of data by Karl Raimund Popper. [Jacobsen, 2010]

Hermaneutic: Knowledge through interpretation. Common for the hermeneutic and the phenomenological approach is that the knowledge is gained through the subject. Phenemenological: Gaining knowledge through the body/ the existence in the world. Non-isloated theory developed by for example Martim Heidegger. [Heidegger, 1957]

priorities

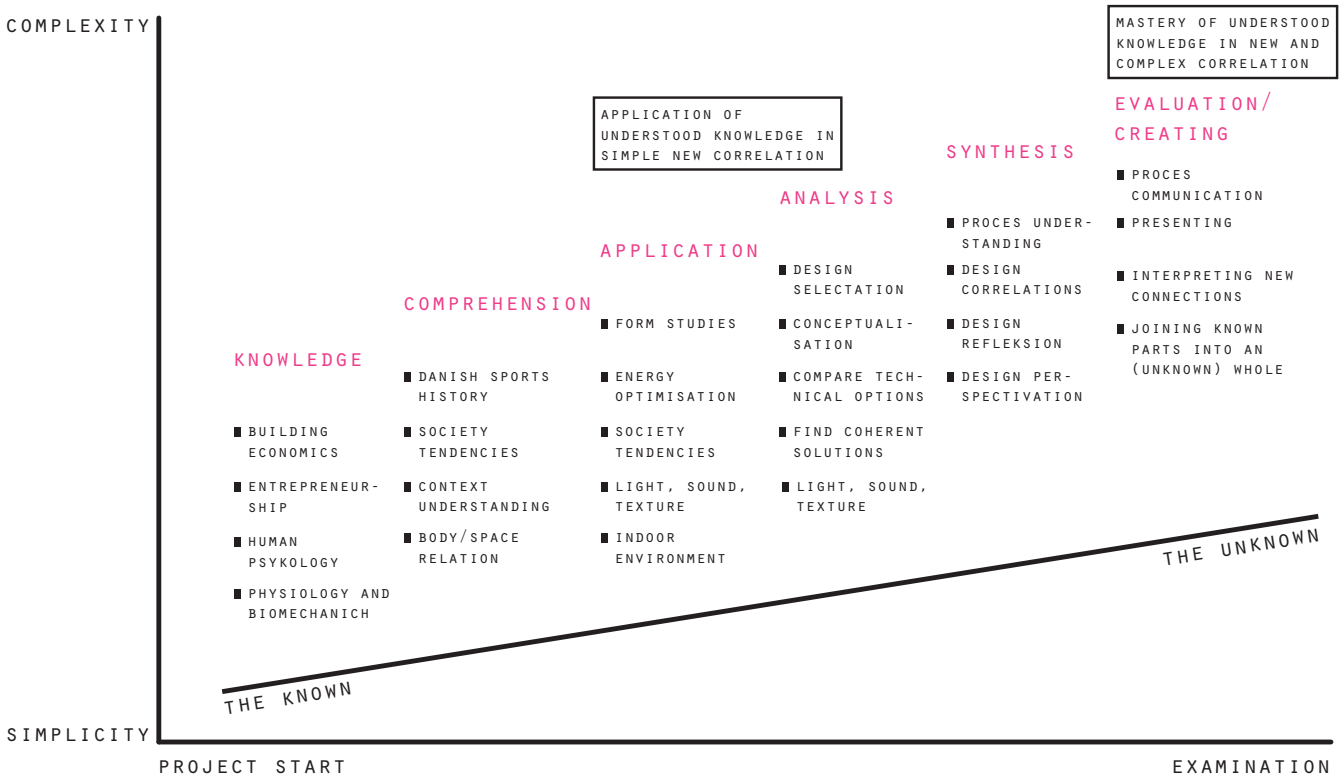


Figure based on Blooms taxonomy [Reitzels, 2012]. The figure relates the different stages of learning to themes within this project, clarifying what level of knowledge is desired for which theme.

III.13

The multi-house Pulsen is a project with many expectations from the developer regarding indoor and outdoor criterias. To specify the project, these demands are prioriticed so that overall guidelines can be defined. With basis in these guidelines a vision and later a focus can be chosen. This will lead to prioritizing the level of learning within different subjects as stated in the taxonomy above.

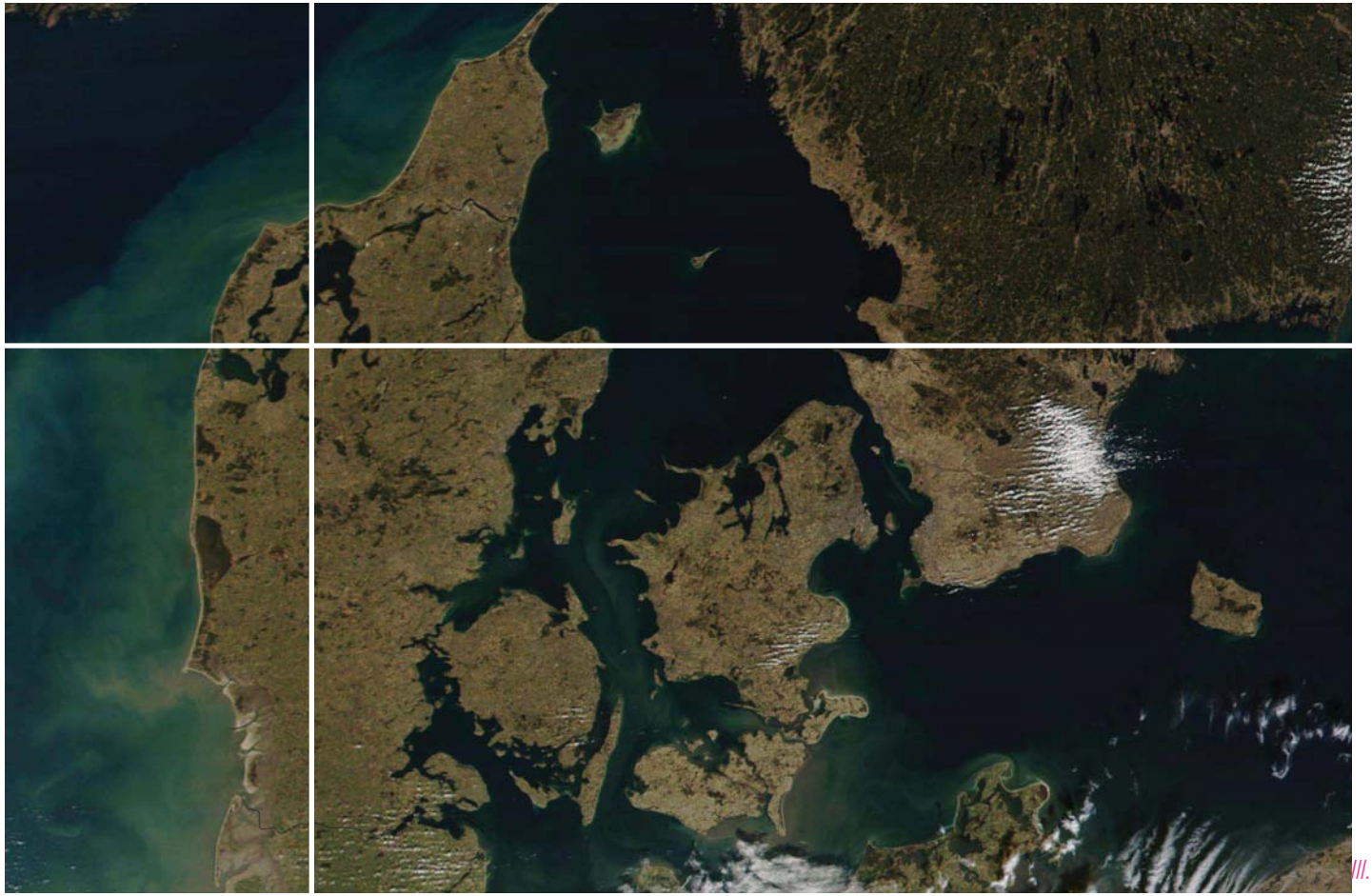
A main priority is a design which enforces social sustainability that gives the local society a place join through activities and social sports. Simultaneously it is a priority that the multi-house can set an example for environmental sustainability, where good building performance and indoor climate are the keywords, and sensible choice of energy sources and materials are used.

Creating spaces within this project is considered important, so that users can develop the way activities are performed. The overall theme is movement collaborating with architecture, and therefore also the indoor environment. It is significant to ensure that the multi-house will be used for many years from now on, by people of all ages from Balling and the local communities around.

Scope

To create a project which is based on the priorities just mentioned. The original competition program for multi-house Pulsen is related loosely to. Calculations of economy will not be executed, as well as the idea of creating a building that fulfils the cradle to cradle principles.

location



Ill.12

The site is located in Balling, a minor Danish town in the county of Skive on the peninsula of Salling. The area is rather flat and very close to the wide part of Limfjorden in the west, where the island Mors is located. Because of the open land, the climatic circumstances are similar to those at the west coast.

multi-house pulsen competition

Multi-house Pulsen is an open project competition, which extends from January until June 2011. The building site is located in the small town of Balling in the county of Skive south of Limfjorden. The ambition for the project is to give the town and the surrounding communities a local meeting point that can improve life quality for both young and old. The priorities of the competition program for the multi-house are interpreted as follows:

- Social sustainability by giving a small community the space and opportunity to meet each other through activities, and in that way finding a focus point for cohesiveness.

- A green profile that should be an innovative pioneer for sustainable solutions. Sustainability must be incorporated in economical, environmental and social aspects.

- Creating innovative spaces for activities that meet the user's individual use of spare time.

The facilities must combine the existing school, soccer fields and sports arena with the new health centre, multi-hall, training areas, fitness centre, outdoor areas and swimming facilities. The multi-house must have integrated sustainable solutions, and is to intended to be an example for other sustainable public buildings. [LoFonden, 2011]

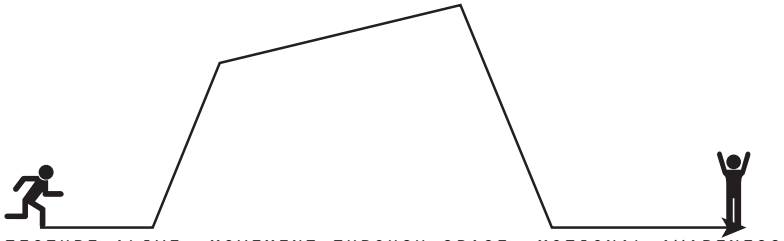
motivation

The project of multi-house Pulsen represents an interesting development in how we look at spaces for physical activity. At the same time it addresses one of the unavoidable topics of tomorrow – how do we build responsible? And even more importantly - how can sustainability be integrated in the design, so that it does not compromise the functionality and the aesthetics.

The multi-house represents a wide user group where both young and old, men and women should be able to find their place. Working with a large target group brings different aspects to a project than a narrow user group does. This is an interesting aspect in relation to planning a site that frames such diversity.

A top priority in this project is to bring both social and environmental sustainability together in the multi-house and set an example of how to join sustainability with a small town like Balling. It must inevitably start somewhere, if we are to meet the environmental goals of the future, and why not let it start in a public building where everyone can let themselves inspire into implementing such solutions themselves. Such a gathering point is of great importance to small communities like Balling town and its nearest surroundings, as they face the fact that they lose workplaces and inhabitants. [LoFonden,2011]

vision



Ill.14

Ill.15 *We are constantly surrounded by moving spaces.*

The sustainable multi-house Pulsen, will be a gathering point for Balling and other neighbouring communities.
The multi-house will in unison with the existing sports arena contribute with environmental and social sustainability to the town identity and reality. This is to be achieved by joining the inhabitants around activities essential to wellbeing in body and in mind. The different activities of the multi-house shall place people in new social constellations, so it is possible for individuals to practice their activity together.

The activities will shape the spaces and the spaces will shape the activities.

The multi-house will have spaces and climatic qualities to frame diverse activities for people. A high quality of indoor environment and atmosphere that fits to the use of the spaces, is of particular importance.

The multi-house Pulsen must furthermore make holistic attempts to be a good example of building performance through the use of renewable sources of materials along with local sources of energy.

program

Ill.16

context

- context analysis
- mapping
- climatic preconditions
- serial experiences
- life between buildings
- further registrations
- conclusion

context analysis

purpose

The site is located at the edge of the small town Balling. The final project must include and not diminish the existing sports arena and the neighbouring school in order to unite the area. It is a priority to view the surroundings both through an empirical analytical analysis and through more sensuous impressions.

There is used an objective mapping of the near context to the site, based on the mapping method of Kevin Lynch -space image of the city[Lynch,1960]. In the registration the focus point are the functions, infrastructure, typologies, typography and the climatic preconditions.

The second part of the analysis consists of serial movement through different routes at the site, documented in photos and additionally an evaluation of what kind of impression and experience the spaces leave on the subject – respectively basing the observations on the theoretics Gordon Cullen[Cullen,1971] and Jan Gehl[Gehl,2003]. All three methods of context analysis has been altered to fit the small town of Balling. The mapping has been zoomed in on a smaller context. The serial vision has been stretched out to fit more open areas with fewer visual blockades. Life between houses is adjusted to an area of less urban activity, and is focused on more specialised activity.

outcome

The desired outcome of the analysis is a wide understanding of the site and its surroundings through a wide spectre of topics. This will lead to the main focus points, as to how the multi-house is connected to the context. In the end this will play an important role, when selecting or discussing during the design process.

Ill.17

mapping - typologies

Ill.18

Mapping of typologies

The space around the project area is primarily flat terrain. A boundry from east to west divides the near context in two, one consisting of low buildings towards north, and the other larger green fields towards south. Two main roads of Balling border on the project site, creating an axis around the area. The low point block buildings in Balling are primary single family houses with gardens, which provide a strong sense of a green space.

mapping - functions

Shopping

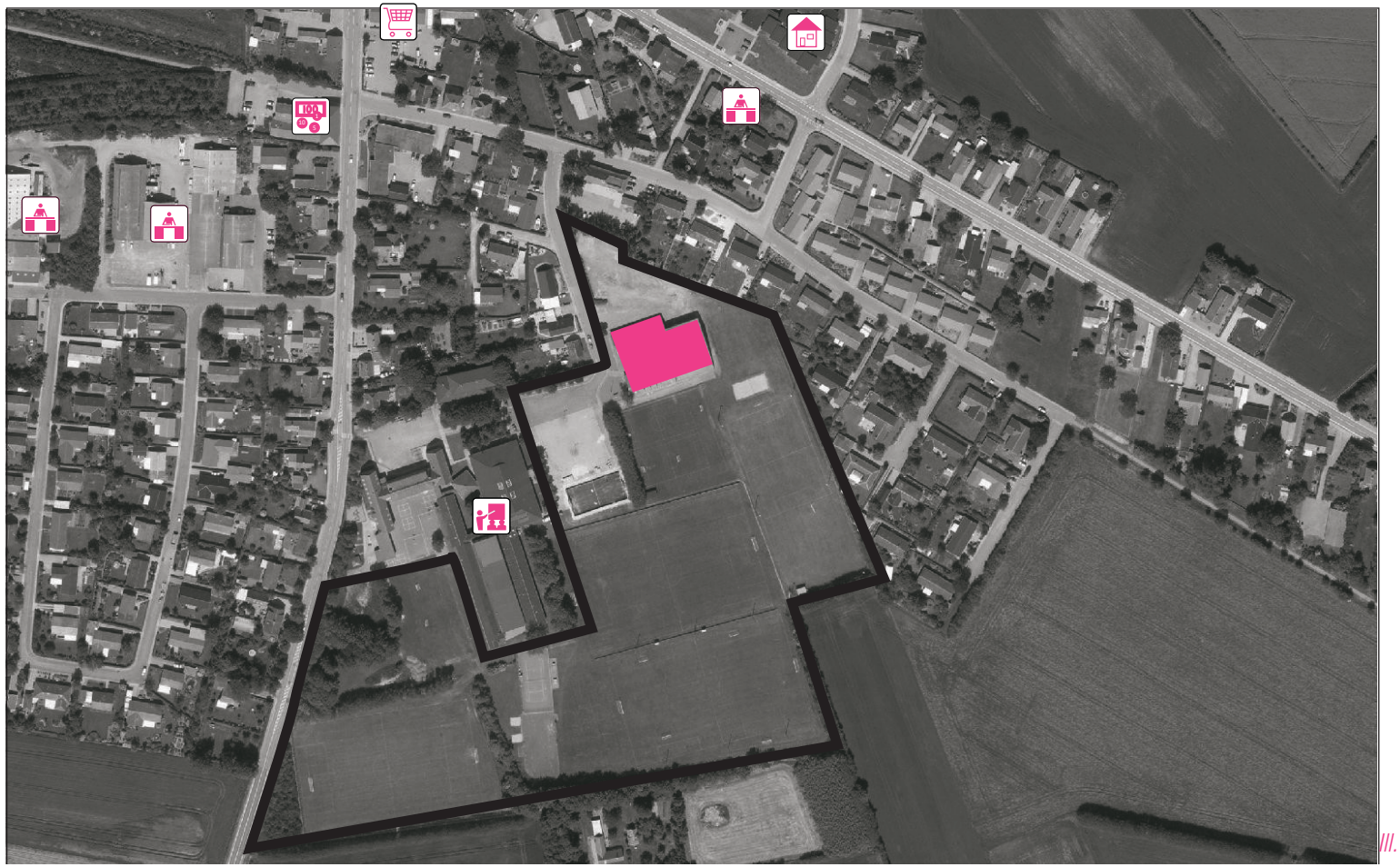
Banking

Business

Nurcing home

School

Sports hall



Mapping of near-by functions

Ill.19

Balling has 1200 inhabitants and is one of the larger towns in Skive municipality. Being surrounded by many other similar villages Balling functions as a central space where people gather around. 600 working spaces are providing the town with a kinder garden, school, nursing home, grocery shop, industrial firms and other businesses. A strong sense of solidarity exists among the community, where people enjoy many activities as well as a yearly party in their own park. They also come together to practice physical activities like biking and jogging.[LoFonden, 2011]

mapping - infrastructure

Paths

Traffic roads

Project site

Flow on site

Mapping of infrastructure

III.20

There is only one road leading towards the site stadion Allé, but by having the site placed far to the south, it is easy to find. The three larger roads (Søndergade, Posthusvej and Skivevej) placed near the site, makes it easy for nearby citizens to navigate around the area and find the site. At the site small paths exists between lines of trees. Some paths that are normally not visible becomes visible in the snow. Some of the popular routes are shown, which reveals different flows in the area. The primary paths, show a movement between the single-family houses and the school in different directions.

mapping - topography

The project area is open and nothing interrupts the view, except for a line of trees that creates a wall in the fringe of the area, and a hall for indoor sports that lies in the north corner. As seen in the section at ill.24 the project ground has no significant elevation, but it is leveled in some platforms, towards west is for example a low or platform. Some of the characteristics from the area, aside from the openness, is the way trees form small paths. Also it is surrounded by a small community consisting of a school that uses the area and single-family houses, which also seem to have good use of the soccer fields as a playground. In the horizon the glimpse of the church can be caught. The school influence the area both regarding gymnastics lessons, but also during breaks where the children use the outside facilities or the area to invent their own games.
If one look at the section and the panoramic view below, it is clear that the most dominating feature is the big white (summer green) surface. The volumes of the sports hall and school seem heavy compared to the single-family houses. The section can in its volumes be compared to sand gravel and stones organising themselves at a beach. The volumes follow no specific order or direction. In the panoramic picture the light poles serve as landmarks marking diverse points on the surface.


Ill.21


Ill.22


Ill.23


Ill.24


Ill.25

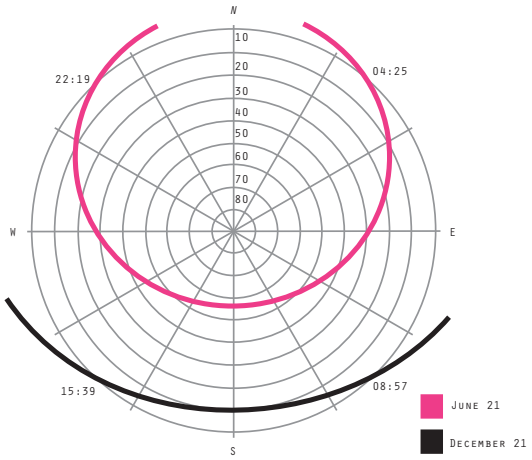
climatic preconditions

The multi house has to cope with the climatic conditions in the area. Instead of working against the climate, the building has to use it in a beneficial way, so that wind, temperatures and sun can help enforcing the project.
The average temperature in 2011 was 16.4ºC in July and -0.1ºC in February, whereas the yearly average temperature is 9ºC. In the area of Balling it rained 779 mm through the last year, and the area had 683 hours of sun. [dmi,2011]
The project site is an open field, only some low barriers divide the soccer fields. Trees in the edge of the site shield the immediate context from the wind, but are not enough to cover the site itself. exept for these trees and the sports hall to the north. The site is very exposed to the western wind and sun. Ill.26 shows that the wind primary comes from west and that high windspeeds also comes from this direction.

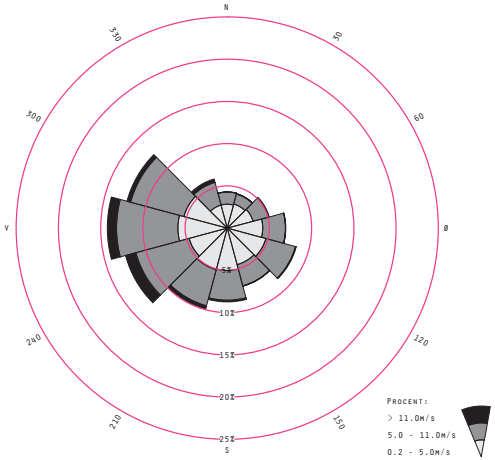
wind studies

This is an abstract from the study in the enclosures. For details see the enclosure D.

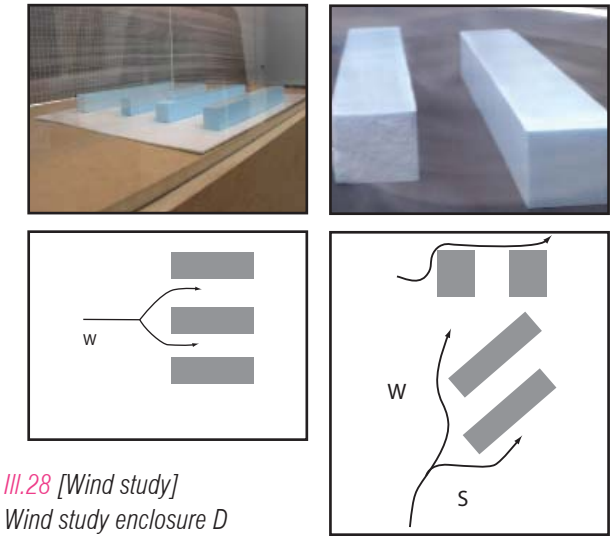
Because of the exposure to the wind, it is chosen to study the behavior of the wind around volumes. The goal is to understand, how placements of volumes can influent the direction and forces of wind, and how the wind affects outdoor areas, which is done in a wind simulator. The studies differ from reality especially due to the size of the model and wind speed, but the tendencies of how wind reacts will be similar to reality.
The studies shows that when wind meets an obstacle it is pushed around or over the obstacle. This can result in emphasizing the wind pressure, creating shelters or swirling winds and many other situations. In this case it will be obvious to use the wind for natural ventilation due to the openness of the site.
Another consideration is how to create shelters when people move across an open field, especially when opening up towards west for have the benefit of the sun.



Ill.26 [Gaisma, 2012]
Sunpath during the year, Denmark



Ill.27 [Dmi, 1999]
Wind rose, Mejrup



Ill.28 [Wind study]
Wind study enclosure D

mapping - conclusion

mapping and climatic preconditions

The functions in the area are not influencing the site very much. Primarily the life is around the school, where children are using the facilities and plays. There is only one arrival possibility to the sports hall for car traffic, whereas pedestrians have more possibilities such as unofficial paths. The most notable characteristics on site is the typology transition between the point blocks of the town towards north, and the big sports hall on the border to the soccer fields, that are only marked in the height by its tall light poles. A row of trees enclose the site, whose open plans stretches through the trees to the horizon. Due to these larger spaces with little shade and shelter, it is important to keep a focus on using the wind and sun conditions in the most efficient manner possible.

Small scale point typology *Ill.29*

Small meets large *Ill.30*

Trees border the site and filter the surroundings *Ill.31*

serial experiences

time as the fourth dimension

Gordon Cullen's serial vision is fundamentally about bringing a site to life. It is a visual method that adds time as the fourth dimension of space perception. We perceive things differently according to where our point of origin is. When moving around a corner or up a hill, the space is perceived differentially not because of what we see, but because of what we do not see. When moving on a site the spaces are either gradually or very suddenly revealed for the observer. [Cullen, 1971]

In this project the intension of using this method is to catch a dynamic movement in space through moment. Practically it has been done by walking routes on site, that we observe as the natural paths, that many other people have chosen to follow. These routes are choosen due to the natural flow in the area. On these routes we let the eye wander, photograph what the eye lingers and observe what kind of contrasts and transitions between spaces exists on site. Compared to the version of serial vision described in Cullens book, views at the site are a lot less directed and the eye is more free to wander. This has been documented through the following picture series.

route 1

approaching from the town

Awareness of multi-house Pulsen already starts by the main street (Søndergade) cross of Balling, where a city mark is placed showing the donation to the Pulsen project.A counting post is raised besides “Daglig brugsen” for collection of funds for the project (1). From there one approaches the site along the “farm-style” villas at Skivevej (2). As you turn the corner of Stadion Allé (3), the focus is on the road, directing the view to the horizon. (4) The sports hall is partly covered in trees. As you move closer, the sports hall gradually appears (5). When passing the post office on the left (6), the view of the sports hall opens up completely and creates a new focus towards the hall (7). When entering the bus turning area, a contrast is revealed between the heavy volume of the sports hall, the small parcels and the tall hardwood trees beside the parking space (8). While entering the bus turning area, you find yourself in a more enclosed space with no obvious focus on a further direction, except perhaps turning the corner of the sports hall.

Map of route 1

Ill.32

Ill.33 1

Ill.34 2

Ill.35 3

Ill.36 4

Ill.37 5

Ill.38 6

Ill.39 7

Ill.40 8

route 2

across the site from the parking space

After cornering the sports hall (1) the big soccer fields suddenly lie open in front of you. The scale of the single family houses on the left side seems small compared to the open fields (2). The masts define a path (3) leading between the fields in direction of the windbreaker, which again opens up in rising translucence as one approach it (4). The closer you get, the more you see of the open fields south of the town. As you turn right by the embankment (5) you have the whole panoramic view of the soccer fields (6). The open field ends by the basket field (7), where you get a peak through to the school yard (8).

Map of route 2

Ill.41

Ill.42 1

Ill.43 2

Ill.44 3

Ill.45 4

Ill.46 5

Ill.47 6

Ill.48 7

Ill.49 8

route 3

approaching from the school

The school is approached along the embankment, crowned by a variety of trees to the right side (1). To the other side is an open field. This contrast makes one want to walk along the embankment. When reaching the end of the embankment an uphill road appears, keeping a focus on the school while it is shown bit by bit (2,3). When standing on top of the hill a soccer field appears behind the a row of trees (4). As heading for the sports hall, the path leads you to corner the school, where you find a row of trees with space for pausing on benches during school breaks, after training or just when taking a walk (5,6). The school's main entrance (7) is passed on the left just before standing in front of Balling Hallen (8).

Map of route 3

Ill.50

Ill.51 1

Ill.52 2

Ill.53 3

Ill.54 4

Ill.55 5

Ill.56 6

Ill.57 7

Ill.58 8

The 3 routes take us in a loop from the street, past the hall, around the soccer fields, over the embankment, to the school and back to the street. *Ill.59*

serial experiences - conclusion

serial vision

The open fields easily become anonymous and lack variation so the entire area in one second is viewed. The larger fields has some atmospherical qualities when looking out on a open space. Their appearance in many ways depend on the activity of people. The embankment and the windbreaker offers that sense of playfulness and variability, which create a state where the user wants to explore and see more. This state is quite interesting in relation to the movement through the site, because we move in a different way when we move from a to b, than when we are exploring terrain and spaces.

If more volumes are added to the site, it will offer more diversity. If the volumes on site are working together in opening and closing views, so that experiences are created, more dynamicy will appear and the area becomes less static.

One of the outcomes of serial vision is, that the project site is easy to see, but that it is not registrated or experienced much because of the lack of variations and contrasts. One of the characteristics in the edge of the site is all the trees placed in a row, filtering the view and creating curiosity for moving through them. When arriving to the site it is not expected to find a sports hall but a residential neighbourhood, which promotes a curiosity for what to find next. At the current site one enters a big void after the sports hall. This can give indications, that you need to meet a contrast to this, that the multi-house can contribute with parting the site in smaller spaces that are easier to relate to.

life between buildings

introduction to life between buildings

The point of building a multi-house in Balling is to support the local community, and create a space where the community has the possibilities to meet, practise different activities and maintain or improve the social network. To create a building where this is possible, it is important to find out, what parameters that affect the users and viewers. Jan Gehl´s theory - life between buildings is studied, to understand how the environment affects the user to stay or to move. Jan Gehl focuses on the exterior environment in cities, while this project is based on a landscape in a small town. The reason why these are compared, and the hypothesis of Jan Gehl is studied, is partly because it is considered, that the same concepts that bring people together on the outside is as valid inside.

considerations on life between buildings

“People are attracted by other people” is one of Jan Gehl statements. The way this is done is either through games where children play, or in spaces where people can look at different things. Adults are focused on staying possibilities near activities, where chairs or benches are pointed towards the activity, so they can sit undisturbed and be the observers. People notice people, who are performing or engageing in diffrent types of activity.

To enhance contact between people, activities has to take place in a slow pace, so it is possible to understand what happens. Therefore it is also crucial that the distance is not too long, and there are no obstacles between those, who look for contact and activity.

Activity is positive when attracting people, because people can watch others being creative or be amused by others fun. When activities are gathered in one space, or in close relation, these can benefit from each other by attracting more and different people. When integrating different functions that applies to different users, there is a possibility to stimulate and inspire each other.

When building a place for activity it is important to relate to the outer spaces around the building. It is important that activity also thrive in the spaces around, so interior spaces that encourage for staying can view activities outside as well.

The multi-house is to be placed in a Nordic country, where it is important to relate to the climate. Especially, light and heat from the sun is appreciated to a great extent. Creating spaces where shadow and coldness are dominating will not enhance activity.

Some of the most elementary activities that are practised every day by most people are walking, standing, sitting, looking, hearing and speaking. These situations are used in many sorts of activities like sports, painting or social contact etc. It is necessary to understand what the different activities need in order to function optimally.

It is known that people often takes the shortest path from A to B and do not appreciate unnecessary obstacles due to the need of an extra effort. When walking the experience will be improved, if the padding on the path is appropriate. If people shall stand in the same position for a long period of time, it is appreciated, if there are some supporting points. A wall or an area where a person can view what happens is prefered, in order for them to be anonymous. There is also a secure feeling towards it, when the back is covered a person only have to be aware of thes front.

It is not nescessary to place benches in order to get people to sit. Everything pointing towards activity of any kind can be used like edges, stairs, boxes or footing. Different positions attract different users, often elderly people will prefer to sit on a bench due to the comfortable position, and that it is easier to get up from again. [Gehl, 2003]

Ill.60

Ill.61

Public places attract people and appeal to stay if benches and similar functions are applied.

Ill.62

Sculptures and similar elements can be used for psychical activities and as staying opportunities.

Ill.63

Ill.64

Functions that relate to people also attract people. Here is an example of a square with shops.

Ill.65

Activities preformed by people can make other people stop and look for a while, even if there are no arrangement where it is possible to lean up against or sit on.

Ill.66

Functions can be used differently. Here a staircase and curve becomes an area for sitting.

Ill.67

Ill.68 1

Ill.69 2

Ill.70 3

Ill.71 4

Ill.72 5

Ill.73 6

Ill.74 7

life between buildings on site

relation to the site

Regarding exterior activities, it is clear that it is possible to perform soccer (5), but little is done to improve staying conditions. The soccer pitches are divided by small banners (2,4), but they are not confortable to sit on or lean up against.

In the environment around the pitches, it is possible to find embankments or trees (1,3) that can simulate a wall, where it s possible to stay and observe. In general the site lacks staying opportunities. Some areas around the school has benches (6,7), so it is possible to sit and observe. A problem with these benches is that they are situated towards areas with a minimum of activity. In the project proposal there has to be incorporated more spaces for staying within zones, where activity can thrive.

On the inside there is a cafeteria between the pitches and the indoor sports hall. In order for the users to follow the activity, windows are placed towards the pitches and into the hall (1,2). Windows are installed in the ceiling (3) so that users can benefit from the sunlight. Inside the hall sitting possibilities are arranged along the track (5). It is possible to stand behind a small fence (4) when observing.

In order to enhance the activity level, it is necessary to increase the number of activities practised together. Activities could cross each other, so they can inspire each other and attract more activities. In order to attract more people places for enjoying the social atmosphere are needed.


Ill.75 1


Ill.76 2


Ill.77 3


Ill.78 4


Ill.79 5

life between buildings - conclusion

life between buildings

When looking at the area in its current state little invites people to stay, only a few places on the inside succed at this. It is known that activity attracts activity, while walls and places to sit also attract people. For people to feel secure, they need the possibility to lean their back against something, so they can oversee everything. This way one can create a focus in front, which has a lot to do with the human vision and movments that is forward oriented.

further registrations

The embankments with trees to the northwest works as a playground for children and is a natural extension of the school yard. Passing through the natural fence the large field opens up, showing its panoramic view of the three typologies:

- The big heavy sports hall
- The point blocks of the single-family houses
- The tall light poles

When approaching the hall, the primary focus is on the hall and nothing else. The consequence of this is that the wide space goes by almost unnoticed.

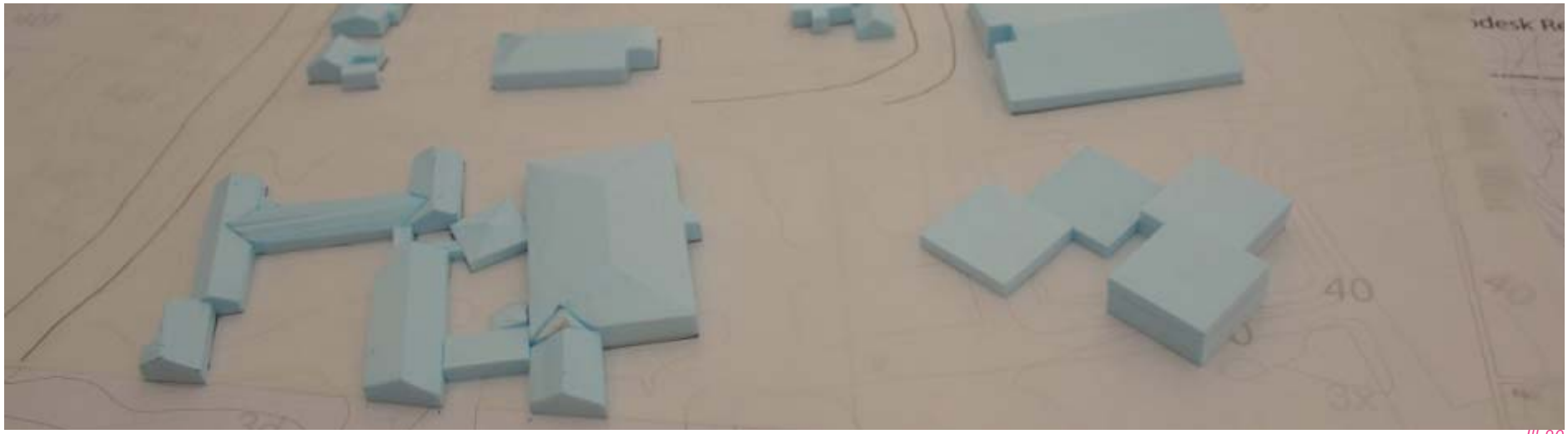
The soccer field, towards West of the trees, is on a lower platform and does not really seem like a part of the project site. Inside the windbreaker the primary experience is diversity in vegetation and in terrain. On the other side of the windbreaker the plane surface of the soccer fields is shown. When moving along the trees, they filter the external surrondings, and only small peaks appear.

At distance the windbreaker creates a solid border, but at short range it frames and emphasizes certain random views. This experience will alter with the seasons, as will the appearance of the snow-covered soccer fields. The activity on the site will also be very different during the summer.

volumetric studies

This is an abstract from the study in the enclosures. For details see enclosure E.

In order to create a project, where the concept relates to the surroundings, it is necessary to mix the different typologies or the sizes of the volumes. This improves the relation to the spaces around. It is important to create a balance between the separate buildings in order to maintain relation and clarity. The negative spaces between buildings are very important for the area as well as the experience of the spaces. Therefore the focus of this project is on the “void” - no matter if the topic is indoor or outdoor spaces.



One of the volumetric studies made in the volume study in enclosure E

Ill.80

Ill.81
Trees to clime

Photo of the project site from the air

Ill.82

Ill.83
single-family houses behind the sports hall

Ill.84

Ill.85
Open fields owards south

Ill.86
Kids playing in the trees

Ill.87
Football field closed and placed far away from everything.

Busses park in a unused and undefined space
Ill.188

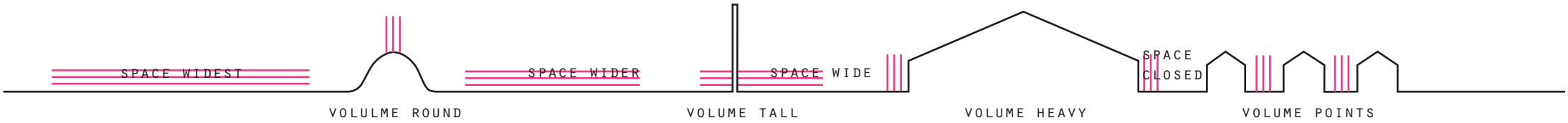
Football field creates large open spaces.
Ill.89

conclusion

There are many characteristics within the area, some of them are:

- High vs. low tpologies
- Undefined flow on site
- Expectation vs. Surprise
- Open fields
- Filtration
- No clear possibilities for stay
- Undefined spaces

Together these highlights improvement, possibilities and parameters that shall be carried on.
To attract more people and activity to the site more elements, which appeal to stay or invite to activity are needed. The area needs to be more defined, but also divided into smaller pieces. This prevents that the entire area can be viewed from one point, so an element of surprise can be maintained.



YOU HASTE THROUGH

YOU DWELL

III.90 *The diagram adds up the types of spaces found on the site of multi-house Pulsen in Balling.*

Ill.91

sustainability

- sustainability research
- definition
- sustainable design in buildings
- environmental, social and economical sustainability
- low energy building
- indoor environment
- demands
- resources and materials
- conclusion

sustainability research

Ill.92

Ill.93

The blue lagoon in Iceland is an example of energy released from the nature, that would be present in any case, is taken into use for the benefit of leisure and tourism.

purpose

The goal for the project is to incorporate sustainable solutions in both environmental and social aspects, while achieving a comfortable indoor environment. The project aims for meeting the energy demands for 2020, as these will be the demands a near future building has to be measured against. The angle is to implement sustainable design solutions from the beginning of the process, this makes the solution an integrated part of the process.

The process is to compare simple technical investigations with experimental studies. One example is by looking at the energy use for a space held up against an atmospherically study of light in the same space.
Later in the process calculations and simulations gradually approximate a more realistic picture of the concept. Rooms and spaces will be chosen for calculations that are either representative for the multi-house or particularly critical in relation to energy use or indoor climate.

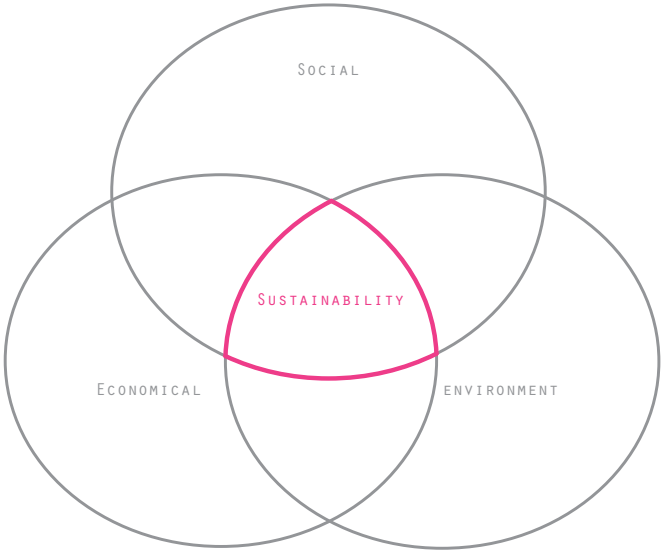
Regarding the environmental solutions an interest is taken in local resources, particularly energy from the sun, geothermic energy and methods to implement wind as an energy source. A serious effort will be done in optimising the project by the use of renewable or recyclable materials and creating spaces that will give the multi-house social relevance many years forward. This is way to ensure sustainability in a greater perspective.

outcome

These studies will contribute with some of the significant design criterias, and will shape the project on an equal footing with aesthetical evaluations. Furthermore the calculations will be a key in understanding how a person will feel in a certain room and to draw a more realistic picture of the buildings performance.

definition

Ill.94 *Sustainability is the balance between needs and future.*



Ill.95 *Sustainability consists of environmental, social and economical aspects.*

The word sustainable has different meanings when referring to diffrent matters. One matter is sustainable architecture which covers a larger field, but the overall sense can be described by a definition from the Brundtland report from 1987.
"The sustainable evolution is an evolution that meets the existing needs, without jeopardising future generation's opportunities to meet their needs.
The awareness of the evolution and environment started an interest for how future resources should be handled, from there a commission was established in order to secure the evolution and environment." quote [Bu, 2012]

The sustainable evolution is divided in three subjects, which the Danish government in a publication has defined as: Environmental sustainability, economic and social.
Environmental is dependent of the natural resources, where it is essential to protect and use the nature in a sustainable manner without polluting the environment.
Economic sustainable is the economic resources like development and growth.
Social sustainable is the social resources as solidarity and preventing poverty. [Mst, 2002]

sustainable design in buildings

Ill.96 *Ill.97* *Ill.98* *Ill.99*

Diagram for the different ways sustainable design can show itself in buildings. It depends of the general intention with the building and the general standpoint on environmental sustainability.

own definition

When speaking of sustainable design, there are many styles of design that call themselves sustainable, though looking very different. Firstly there is the very low-tech approach, that depends on passive means and quality materials. These buildings usually work with compactness and have a rather low complexity. In the opposite direction we find the high-tech sustainable buildings, where the visual language is affected by the “newest” science. An example is by using intelligent systems for regulating the climate of the facade in relation to the sun. Secondly both the high-tech and the low-tech approach can be more or less exposed. Here the question is whether or not to show the standpoint of green architecture or science. The examples shown above only serve as examples of a visual approach on sustainable design. Whether or not their environmental design works from a technical point of view, is not the question here.

When striving for a sustainable approach to a design, it is important to take a standpoint, as to how the design should express itself through the sustainability theme. This makes it possible to incorporate sustainable solutions from the beginning of the proces.

The multi-house in Balling will primarily use passive means, while having focus on the use of new combinations of materials and planning of functions from a sustainable perspective. To this active means will be added. It is important that the project, being a identifying place for the local inhabitants, have some exposition of sustainable solutions.

environmental sustainability

Regarding environmental sustainability the Danish society has developed own visions and goals for the future. [Bu, 2012b] This is specified further in the publication - Denmark national strategy of sustainable development. [Mst, 2002]

Today methods exist for using alternative energy like the sun. The government wants to create a focus on other initiatives like the use of materials. The purpose is to develop the way we use, reuse and produce different kinds of materials to minimise waste and be more efficient. [Mst, 2002]
In 2002 an evaluation was made on how the Danish society handled the agreements of the international sustainable evolution. One of the points was the global sustainable production and consumption pattern, where Denmark only scored 5 out of 10. [Bu, 2012c], [Bu2012d] This emphasizes an urgent need to evolve the way we use and produce.

When constructing buildings it is important to consider the environmental sustainability, because many aspects when constructing a building are affected. Construction and daily use is both considered a part of the total energy use in Denmark and most other countries. Initiatives are taken because the human race has become more conscious about their effect on the planet. There is a reason to believe, that the strain that humans cause is more the planet can carry in the long run. This is in itself a long discussion, that will not be explored in further details here.[Fenger,2010]

In this project we take the environmental sustainability into account. Especially consumation reduction and the matter of which products and materials to use and how we secure the use of materials regarding reuse.

EXAMPLES OF ENVIRONMENTAL STRESSES

- MATERIALS - RARE MATERIALS, ILLEGAL LOGGING
- PRODUCTION - ENERGY AND WATER CONSUMPTION, POLLUTION
- TRANSPORT - TRANSPORTATION OF PRODUCTS AND MATERIALS POLLUTE
- THE PRODUCT - THE USE OF THE PRODUCT EX. CAR, THE DISPOSAL OF PRODUCTS

social and economical sustainability

Social

The Danish society strives to create a society that is social harmonious, where the individual has freedom in action, and where the health is not influenced in a negative way. It is the belief that everyone must support the community if they have the possibility, while those who are unable to contribute will be supported by the community. [Mst, 2002]

Social sustainability is all about creating a society that is efficient, solid and democratic, so that further generations can benefit from it. It is necessary to feel secure and have a cultural identity in the surroundings. [Damvad, 2010]

If a building is socially sustainable it will be usable for many years, which in itself is a plus for the environmental sustainability. The first three environmental stresses, mentioned in the diagram on the previous page, that has to do with the production, are reduced in the total stress calculation. As a result running and maintenance stand as primary stresses, until the building becomes outdated and replaced. This is the reason why social sustainability is beneficial for both users and environment.

Ill.110

Economical

Denmark as a society is focused on generating economical progress. There is an enhanced focus of the individual opportunity for expression and of one's own free will to make an effort, so it is possible to secure an economical basis by increasing the will to make an effort. It must be worthwhile working for those who are able, so it is possible to maintain and improve the standards of living. [Mst, 2002] Economical sustainability is to pass on the economics for the next generation. It is preferred to achieve a positive development of the society in order to improve the economic wealth. [Damvad, 2010] In this case of constructing in a small town with limited resources the project has to stand alone so that the primary expense is the process of building, not maintaining or providing unnecessary services.

low energy building

envelope studies

This is an abstract from the study in the enclosures. For details see enclosure A.

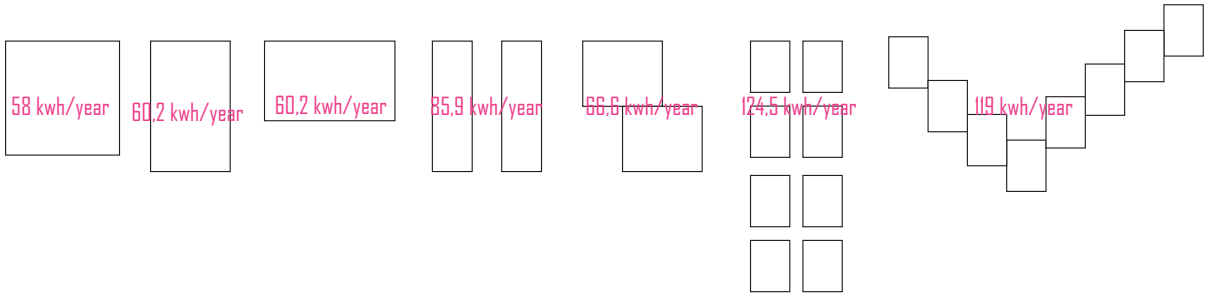
The results show that when a building is compact, the volume uses less energy than a volume with a bigger surface. The orientation has little effect on the volume itself though this becomes evident when looking at the window areas in the following study.

In relation to the multi-house it is important to create the best possible basis for a sustainable design. The building design must help to decrease the energy consumption and not leave it all up to the applied systems, that also use energy.

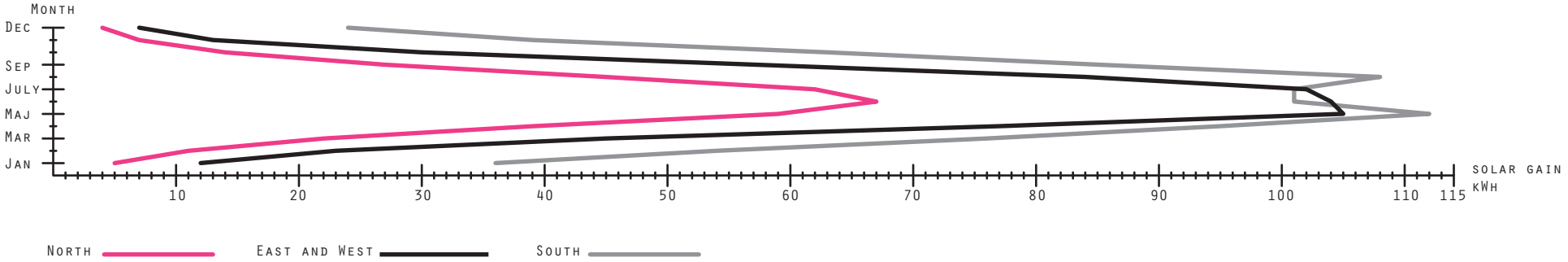
window and shading studies

This is an abstract from the study in the enclosures. For details see enclosure B.

A close connection exists between the solar gains and the window area of a building. This does not only depend on the window size itself, but also the orientation of the windows has influence. The placement of windows to the east/west shows a steeper relation during the year than the north/south direction. The solar gain towards south is greater during the winter period, while it isn't necessary to use larger windows during the summer in order to prevent overheating. In a temporate climate like Denmark, windows to the south can be an important source for solar gains. during the winter.



III.111 *A connection is seen between density and energy consumption which will affect the way of designing in this project.*



III.112 *Solar gains over the year. The window is 36m2. The space is 10x20x7m. See the other results in enclosure B.*

indoor environment

These studies schall give the needed information about how material, colour and light affects the atmosphere in a room.

light study

This is an abstract from the study in the enclosures. For details see enclosure C and I.

A focus is taken on the placement of windows in high or low space. This is relevant in relation to the use of a space for activities, where one needs a stable illumination without having too much direct light. A high placed window sends light far into the room, and speads it out so that the space seems brighter. A low placed window puts a focus on a certain surface and reflects light from there. If high and low placed windows are combined, like in ill.113, it creates a space where the middle of the room (in eyeheight) becomes a soft space, but simultaneously a well lit space. This effect is also suitable for the multi-house.

study of texture and materials

This is an abstract from the study in the enclosures. For details see enclosure G.

Materials with a ruffled texture are emphasized in light, and increases the curiosity for the sense of touch. The materials also absorb more light than smooth surfaces due to the reflection as shown in ill.116.

An important observation is that textures and materials can be used as a tool to interact with the building, by viewing and touching.

colour study

Colour has impact on the whole appearance and the atmosphere of a room. This can be used in relation to the multi-house, so that specific atmospheres can be created to focus on the space as in ill.114 and 115.

acoustics

This is an abstract from the study in the enclosures. For details see enclosure H.

The scheme below shows the calculation of reverberation times for diffrent materials.

When a material has a higher absorption coefficient, it absorbs the sound more, though this does not necessarity mean that one material absorbs the different HZ levels linearly. To create the best possible acoustic indoor environment every single case has to be studied separately to be able to reserve the different HZ levels. This study is a technical follow up on the study of materials, texture and patterns in enclosure G. Here the atmospherical impressions of different materials and their behavior in direct and diffuse light are studied.

ill.113

Siobhan Davies dance studio in London uses the light entering from the height through vertical slits in the roof structure..

ill.114

High and low window placement and coloured surface.

ill.115

ill.116

Net texture in direct and diffuse light

Reverberation time in seconds

	125HZ	250HZ	500HZ	1000HZ	2000HZ	4000HZ
Concrete - coarse	8,89	7,27	10,32	11,03	8,21	12,8
Wood - plywood panel	11,43	14,55	11,85	35,56	16	29,09
Foam - SDG 3"	13,33	5,52	4,78	3,52	3,33	3,23
Brick unglazed	106,67	106,67	106,67	80	64	45,71

Results of the acoustic studies

demands

energy consumption

The demands for the multi-house is a total supply of energy for heating, venting, cooling, hot water and lighting that must not exceed 25 kWh/m^2 per year. Additinally the indoor temperature must not exceed 26 degrees for a longer period of time. These are the requirements a building is to meet from year 2020. [Ebst, 2011] This goal is chosen to aim at a realistic energy sufficiant building, which fulfills given requirement, which will soon enough be the present.

indoor climate

To create a building, where it is possible to practise different activities, it is important to secure a good indoor environment so people want to use it. Therefore the project will strive to achieve category A, when it comes to perceived air quality. This requires a maximum of 15% dissatisfied persons, and a ventilation rate of 10 l/s pr. pers. [CR 1752]

The temperatures will vary through the different activities. When having a high activity level the temperature has to be lower and vice versa. In thermal comfort it is the wish to have a maximum of 15% dissatisfied persons, which means that the predicted mean kvote lies between -0,5 to 0,5 meaning that few think, it is either a little too cold or a little too hot. [DS 474] The aim is to measure the indoor climate against the building requirements for housing, as there are no predecided requirements for a function like the multi-house.

resources and materials

As the awareness increases the focus on the use of resources also increases. Often the use of resources combined with the environmental situation is a topic in the media and in general consciousness. In year 2000 a report on lifestyles was executed. It was noticed that water, heat and the supply of electric power are some of the main environmental problems. In Denmark one third comes from households. [Ole, 2002] The ecologic footprints are used to define the area size that is needed to establish any type of resource consumption. The ecologic footprint is calculated in global hectare per person in order to compare with other countries. In 1961 there was a use of 5.3 global hectares in the Danish society, this increased to 8.0 in 2005, which places Denmark in a fourth position over the countries in the world, which has the highest use of global hectares per person. The reason is our use of fossil fuels, which is not an infinite resource. [Dkmj, 2011]. A selection of resources are displayed in the scheme on the next page.

///.117

Non-renewable resources

	supply horizon years
Oil	43
Hard coal	170
Brown coal	390
Natural gas	60
Iron	120
Aluminium	200
Zink	20
Copper	36
Nickel	50
Manganese	86
Lead	20
Tin	27

Renewable resources

Wood
Straw
Bushes
Crop
Alga
Methane from duping grounds

The rule of renewable resources:
A certain material cannot be used faster than the time it takes to regenerate it.

Renewable energy resources

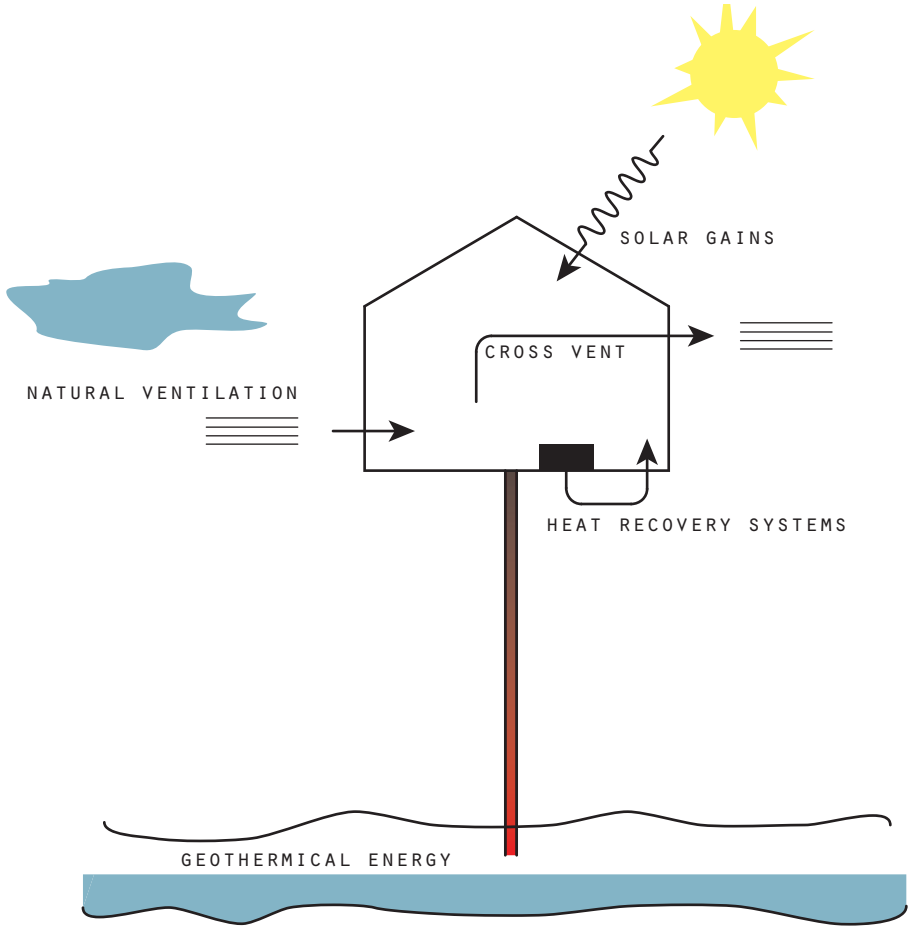
Wind
Solar energy
Geothermical energy

To optimise the project by environmental sustainability it is natural to look at what the area can provide. This concerns minimising the overall energy usage but also regarding more eco-friendly resources of energy for the operation of a building. The reason for using local resources is to benefit from what already exist in the area or close by. This can also minimise costs and prevent pollution by transporting materials.

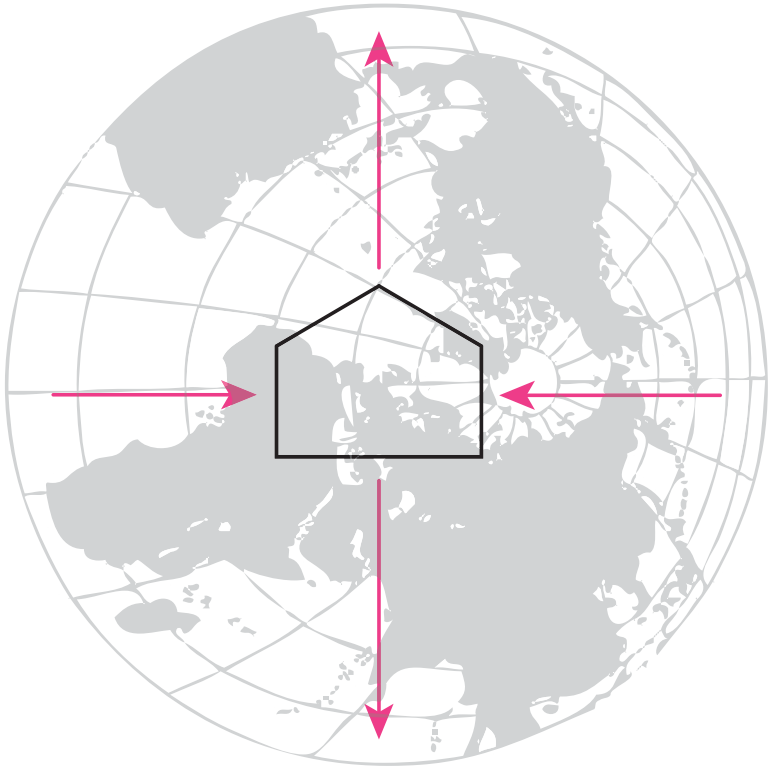
In Balling some of the resources that are interesting, is the sun for energy, but also the wind can be used for venting due to the open spaces. In addition to this Skive municipality has an occurance of geothermical energy and plans of investing in the technic and equipment to utilise it.

What is geothermic energy?
When the warm water deep inside the earth is pumped up and used for energy, it is defined as geothermic energy. This type of energy can be used for several things like heating, which is the primary use in Denmark. [Geotermisk, 2012]

In Denmark there is a potential to use geothermic energy, due to the quantity in Gassum reservoir. There are many kind of sands, but only the Gassum reservoir has the right thickness. In order to use the geothermic energy for heating buildings, it is necessary to establish a geothermic plant, which is mostly done in larger cities due to the expenses. These plants pumps water from the underground and use the energy to heat houses. When the water from the underground is cooled down, it is pumped down in the underground again. [Sørensen, 2005]



Natural sources of energy does not cost as much for the environment as the sources derived from fossil fuels. *Ill.118*



Constructions and constructing has many effects on the environment, but the environment will still contribute in its own sence in running the building. It is our job to open the possibilities for this. *Ill.119*

conclusion

Sustainability is a way to benefit the public and the planet, as the consequences will affect the next generations. In this case environmental and social sustainability is in focus, while economical sustainability will be ignored. Environmental studies will be used as a tool to reach a design, where environmental and social sustainability is met at a certain level.

Within the technical aspects wind can be used for venting principles, while sun and geothermic resources can be used in heating principles. Materials provide insulation and create a suitable indoor climate, that resists the external impacts from the climate. It is also considering whether the materials are renewable.

Ill.120

movement

- architecture and movement
- study of term: movement
- development of physical activity
- tendencies
- healthy society
- movement and mind
- indoor environment
- activities and space
- space perception
- conclusion

architecture and movement

Ill.121

purpose

The multi-house is a place for many different activities, such as physical and creative activities and additionally health related functions. In this project a particular interest is taking in spaces, which encourage physical movement. This is the background for this investigation. This is done by finding out, how the physical activities has developed in the past years, and looking into what kind of activities have increasing popularity today and maybe tomorrow.

To dig into these topics, data from empirical studies are found and reflected upon. Some of the information are collected through case studies and experiments. The case studies and experiments has the intention of contributing to an understanding of space, materials, light and volumes. Typically the case studies and experiments are qualitative, as they build upon our own subjective interpretations and priorities.

It is essential for the project to have an understanding for these tendencies. It will also be reflected upon how health, mind and activities are connected and in which way they depend on each other. This is necessary to perceive how spaces can shape activities and vice versa. Additionally an interest is taken in how movement and architecture affect each other with the intention to create spaces that can encourage activity.

outcome

This study is defined as a theoretical study of the relations between movement and architecture. The intent with these studies is to reach an understanding and a standpoint on the relation between people and spaces for movement. This will be essential when evaluating different design suggestions.

study of term: movement

Ill.122

Interpretated movement:
Some shapes seem in movement though being static. Here Skuespilhuset, Copenhagen.

Ill.123

Foral street bridge at the ballet school of London.

Ill.124

Applied movement:
Other shapes are clearly inviting for movement, like the Maritime Youth House by BIG.

Ill.125

Human biomechanics are normally very fixed in certain movements, but can have many possibilities if challenged.

Ill.126

Litteral movement:
Some shapes are literally in movement by mechanics, here in a kinetic sculpture by Theo Jansen

Ill.127

Duchamps "Nude decending a staircase". A two dimensional picture expressing a movement

what is movement? - a study of abstraction

This is an abstract from the study in the enclosures. For details see enclosure F.
This study origin in the thought of what movement is in relation to shape, and is based on analysis of models and how these can illustrate movements.

In all cases it is discovered that expressed movement divides the models into two groups:

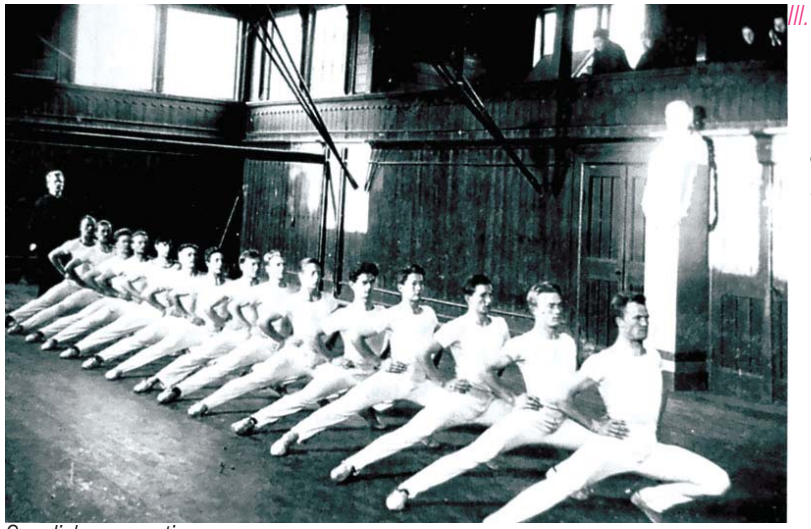
- Association to a movement
- Generating movement

Group one involves the cases, that shows a direction of movement or simply gives associations to a moving object or space. These make a distance to the observer, that has to study the model as a whole.
Group two are the cases, that are relating to their content. These are typically rather static and balanced to look at as a shape. They work in 3 dimensions, and depend on you to imagine someone moving through, under or over the spaces to get movement. These make the observer more of a participant, while group one makes the observer more of an actual observer.

Both groups often use cuts, displacements or an additive approach to create movement, but this can also be related to the foam material that acts in a specific way. Nevertheless the tendensies show, that the models expressing the most movement, invites the eye to extent the shape and/or invites the body or imagination to explore the shape. A general term to describe this may be progress.

In the multi-house Pulsen, it is essencial that the spaces can create possibilities for involvement in the architecture. A tool for this is to work with process in the sence, that one space can progress to the next one in numorous ways; abrubt, soft, in steps etc. It is these transitions that create a characteristic movement through a site, building or model.

Ill.128



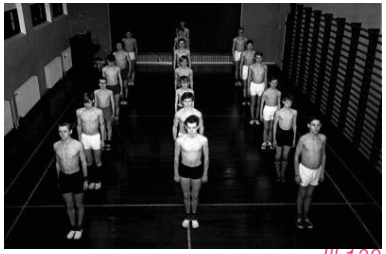
Ill.129

Swedish gymnastics around 1900.

Jane Fonda in the 80's founding what would become aerobics.

Ill.130

Boys gymnastics in the 60's. Here you still see the origin in the militaristic exersises.



Ill.132

Ill.131

Today many artists, performers and sportsmen take their physical activity to the space of the city. Maybe because the urban space can offer them what they need, in contrast to the traditional gymnastics hall. Here the yoga/art centre Y8 in Hamburg.

Ill.134

A performance of women gymnastics in the local house in 1957.

Ill.133

Swimming has been a popular activity for both men and women since the 60's.

development of physical activity

Today the Danish society is relatively active, around 2/3 of the population is frequently active. [Ellehammer, 2010] Through the last 45 years this number has increased nearly 4 times for the adults, where nearly all children practise some sort of exercise regularly. [Pilgaard, 2009]
This is due to increased awareness of health, and the need for fun or spending time with friends. [Ellehammer, 2010] It has not always been like this, in the start of the 18 century gymnastics was introduced to the country. The gymnastics upbringing was characterised by strong military and nationalistic pressure, and was made mandatory for boys in the schools by 1814. In 1858 there was an attempt to abolish gymnastics in schools which failed, instead shooting unions appeared. This introduced gymnastics on another level, that appealed to the rural public causing a rift between the two methods. By introducing these shooting unions and by preserving the military form of gymnastics, different gymnastic cultures were developed. Later on people were inspired to use the whole body in gymnastics, to straighten out the body.

Along with the gymnastics, sports became a new way of exercising. Sports appealed to the citizens and competitions started to occur. Firstly sports was only for nobles, but later spread to regular citizens and then industrial workers. Some of the values within the world of sports were fastness, momentum and strength. [MiCu, 2009]

Through the years the way activity is practiced has changed and during the last 50 years the variety of activities has changed. In the 60's, small communities offered a low variety of activities as ballgames like handball, football, badminton or gymnastics and swimming. It became a place, where people gathered to play sport in teams or one man sports with focus on results and competition. This form of activity decreased and developed into forms of unorganised and self organised activities in the 80's, where activities was enjoyed in the public alone or with friends. In the 90's everyday things like hiking, fishing, biking and physical work like gardening had focus and was characterised as activities. This also resulted in diminishing boundaries for the definition of what exercise is. [Fedders, 2011], [Pilgaard, 2008]

Together with the variety of activities, an increased focus is establishing on exercise, health, wellness and individuality. Meanwhile the market also becomes more dominated by women. The companies and communities, who offer these activities, are also realising an increased need of varied activities, which they comply in order to satisfy the customers. [Ellehammer, 2010], [Pilgaard, 2008], [Pilgaard, 2009]

Earlier on physical activity was a rather social activity in an association. Nowadays it is more flexible and individual activity sometimes (and sometimes not) takes place in the company of many individuals, but not necessarily someone that you have to relate to or communicate with. [Pilgaard, 2008]

Over the years there has been a change in the popular activities, but also a changing variety, going from few and social sports towards more offers being more individual. In order to create a place, where it is possible to unite people of different ages and sexes, and also comply with nowadays trends within activities, it is essential to follow these tendencies. Not only to affect a wide range of the public, but simultaneously to have a social intent with the multi-house.

tendencies

Running or jogging has been a very popular exercise the last years, and especially running as a social activity, which can be seen in the cityscape and landscape.

Ill.135

Ill.140

There are a lot of prejudices, when it comes to who likes what in sports. Here a variety of sports with different ages attending.

Ill.141

Ill.136

Boys like soccer

Ill.138

Girls like dancing

Ill.142

Exercise is becoming part of a walk down the streets. Here the collaboration project between BIG and Trygfonden to raise awareness of exercise in the daily life.

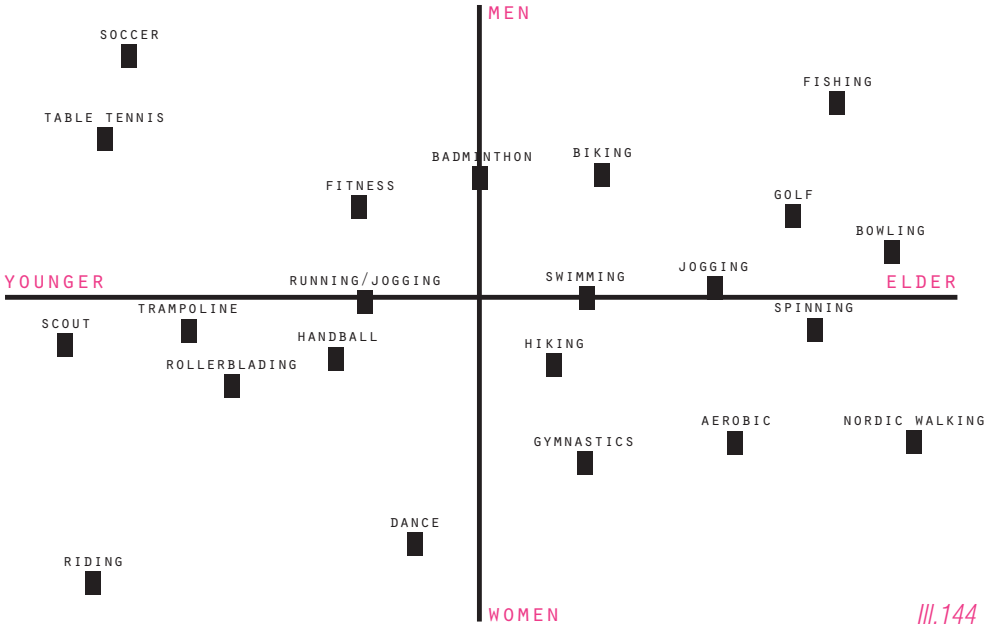
Ill.137

Ill.139

Young like skating...

and elder like nordic walking

Ill.143



Diagraam showing an approximate popularity distribution of individuals in various sports based on [Pilgaard, 2008]

Ill.144

Some of the more traditional activities for children are sports like football, gymnastics and swimming, that are practised in sports clubs. Popular activities in none organised clubs are primary jogging, hiking and trampoline. Regarding adults the popular activities are very individual, due to the flexibility of the activities; some of them are jogging, hiking, strength training, aerobics, swimming, biking and gymnastics.

The elderly prioritize the nature, and use it for activities; some of the most popular activities for this segment are hiking and Nordic walking.

Most children that practise regular exercise are approximate 7 to 12 years. When they are around 13 to 15 years the number decreases. The number of children doing regular exercise decreases from 87% when the children are 7 - 9 years to 78% when they are 13 - 15 years. When the children are around 13 years, it is often boys, who are more active than girls. This tendency continue until they are approximate 30 years old. The most popular activities for children are generally the same for both girls and boys with a few exeptions, but the distribution of girls and boys varies within the specific activities.

The number of active adults decreases from 63% at 16 years of age to 47% at 39 years. From the age around 40 to 69 there is an increase of the percentages of active adults to 68%. When reaching the age of 70 or more, the active part is stagnant around 59%. When the adults reach the age of 30 to 70 years, it is primary the women, who are more active than the men, but after the age of 70 is it equal.

The most popular activities for adults are generally the same for both men and women.

There is a mixed opinion, nearly half/half, as to whether adults and children will use other facilities or activities if they are nearby. This indicates that when having a large variety of activities, it is possible to gather more people. [Pilgaard, 2008]

healthy society

Ill.146

Ill.145

In the latter years fitness centers have become increasingly popular, as they offer the flexibility and variance in courses and schedules that modern people seek. The traditional training Monday, Thursday and match in the weekend does not meet the un-rhythmic life of many people.

Ill.149

Ill.150

Ill.147

In today's society there is focus on keeping your body and mind young for as long as possible. This has both good and bad effects one of the good is, that many chose to do exercise even when it is not as easy as it once were. This is an objective in the multi-house, as physical activity is not only for sportsmen and competitors, but just part of a healthy lifestyle.

Ill.148

Ill.151

Much physical activity is taken into the urban spaces.

PROGRAM

Around year 1900 the need of human phychical activity decreased in work situations. It was a due to development of mechanical replacements and technology, but at the same time discussions of health and physical activity appeared. When the first epidemiological studies in USA showed a connection between premature mortality and inactive individuals, it had a minimal affect on the Danish society. Years later, when the focus on the topic had evolved and connected it with illnesses, the Danish society has been more influenced, and are now focusing on a healthier lifestyle. [Klarlund, 2011], [DNBH, 2012]
Phychical activity is when mussels promote the combustion of energy. To gain from an activity it is not necessary, that the activity is exhausting, both the body and mental state gain in strength. Everyone can benefit from exercise; young, adult and elderly. [Kjøller, 2007]
Today there is a broad consensus that activity equals health and prevent illness. In the Danish society psychical activity is used for treating some illnesses. The positive effects that are gained from the phychical activity will diminish in a matter of short time, if the level of activity is not maintained. To maintain or increase a healthy lifestyle, it is in general necessary to work out. 2 times a week of 20 minutes for adults and elderly, and 3 times a week of 30 minutes for children, and the level of activity have to be medium or high. It is not only phychical and mental states that gain from psychical activities; also social psychological benefits like happiness, social well being, and confidence when goals are achieved. [Klarlund, 2011], [Kjøller, 2007]

The Danish society has implemented different adjustments to enhance a healthier population, and promote the importance of exercise. The landscape is a part of these adjustments; green spaces, playgrounds and an active biking policy is some of the efforts. Other actions are daycares where they learn about exercise, medical training with a physiotherapist or training instructors and also national campaigns. [Kjøller, 2007]
This philosophy will be implemented in the project by focusing on movement and exercise for everyone.

movement and mind

Ill.152

Y8

Ill.153

Ill.157

The experimental combined yoga and art centre, Y8, in Hamburg uses the same space for exercises, performances and art exhibitions - often at the same time. The architecture itself is not the interesting aspect, but the use of the space is. Performances, movement, architecture and art seems to meet in this space and compliement eacg other.

Ill.158

Ill.154

Helsingør psykiatric hospital by BIG. This building is working with psykological welbeing in its views, colours etc. As seen in this picture, exercise is a part of it.

Ill.156

An illustration of a roman gym with baths.

Ill.159

Y8, Hamburg

Ill.160

sport versus art

The fact that smaller multi-houses begin to appear in many Danish towns and suburbs is a rather remarkable revival, seen from a historical perspective. In modern times the tendencies has been to seperate the location of physical activities and artistic development. It has become the norm, that culture and sports are repelling magnets that hardly have anything to offer each other. This is a rather new development, that is limited to the last couple of centuries. For example the greek gymnasion was a facility, where training and competition in antique sports existed along with cultural tuition. It was believed that no “mindbuilding” took place without “bodybuilding” and vice versa. At the same time the gymnasion was a gathering point for many social arrangements. Later on the romans added a variety of baths to the facilities. Also the European academies in the renaissance were built on the same thought. Here fencing, dance and riding coexisted with poetry, theatre, philosophy and music. [Bøcken, 2010]

Nowadays in the western world most things are seen as either belonging to the rational world or to the emotional world. Sports and arts have, slightly unjust, suffered the same division. Sports have through militaristic training and later of competition become the rational participant that can be measured and weighed, and arts have become the emotional one. This is a pretty rough division, as most art needs some craftsmanship to become art and most sports need an intelligent use of emotions to be successful. And somehow this latest interest in the multi-house is trying to bring together, what has been parted for many years – exploring the mind and exploring the body. This is practically shown in the way we chose to occupy our spare time. A much wider spectrum of activities are seen than earlier, and we use our activities to define who we are with the philosophy taht wht you do defines who you are. Therefore it is also in much higher extent common to mix different activities to make them individual. [Bøcken, 2010]

Following paragraph is a subjective reflection.

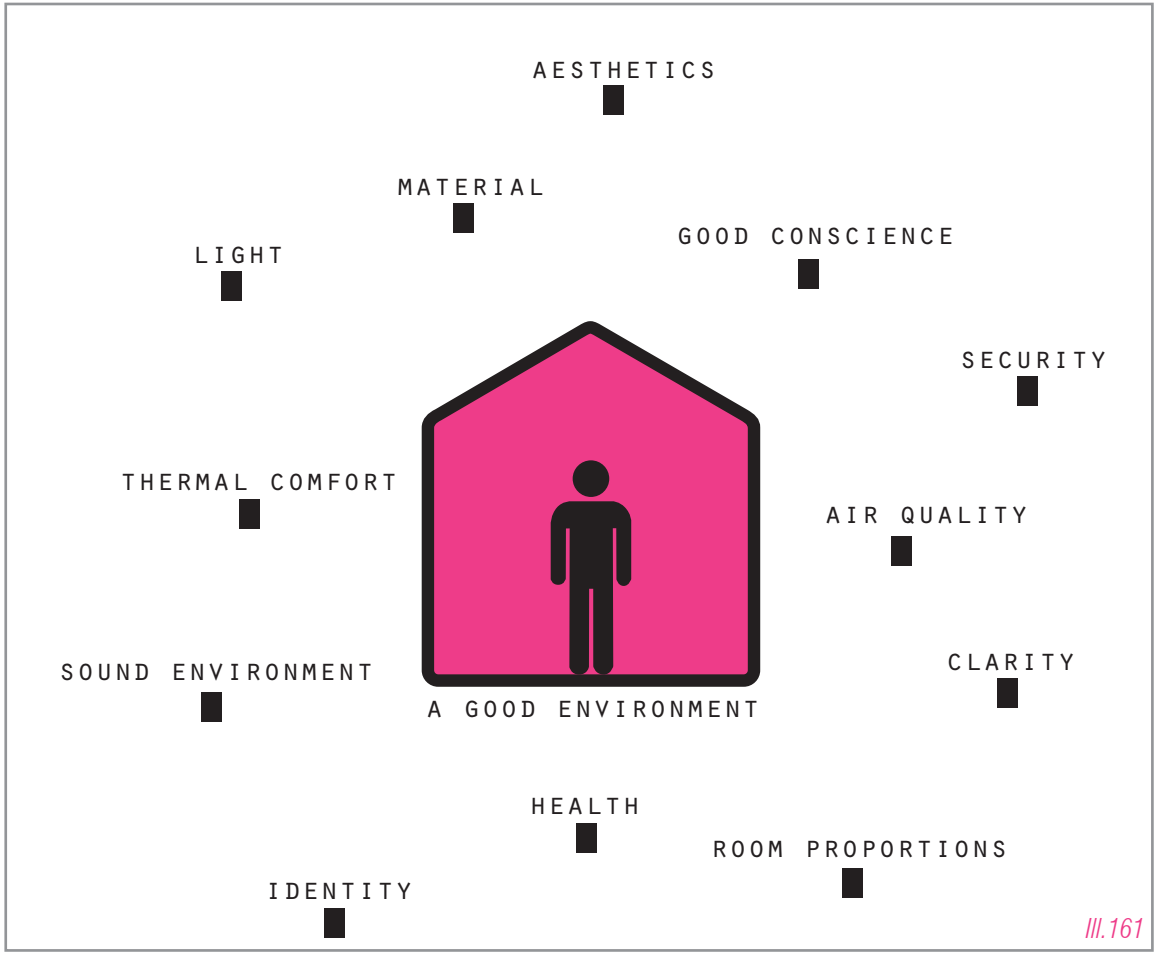
As described in the previous study of tendensies, very individual activities have lately become more and more popular. Concurrently with this the activity life of the small towns have emerged to a more asocial activity life from the perspective of the users, so that only the dwelling and the sleeping takes place in a small town like Balling. You work in the city. You shop in the city, and sometimes you eat in the city. Often you drop by the fitness centre in the city on your way from work to get your healthy dose of exersise. Could the interest in multi-houses be seen as an opposing realation on this development? After all the social purpose of the multi-houses is actually rather similar to the social purpose of the local house (Danish: forsamlingshus). The multi-house just has the primary focus on the activities, but should still be able to house cultural and social arrangements. Most importantly the multi-house must be able to join a community and give inhabitants a sence of identification with their local surroundings and fellow inhabitants. A new multi-house must be able to offer facilities that meet the changing needs, but still not forget to make room for the social possibilities such a house can offer. In the western world we have a general priority of the rational world compared to the emotional world, but to combine them could benefit both parties.

psychological wellbeing

We identify ourselves very much with what we do, inside and outside of work. Identity and feeling comfortable inside ones own skin is therefore very important when speaking of activity, movement and sports. Even with the focus on health in the society the ever-present stress-culture is hanging as a heavy lid. We are always somewhere else, at work, at home, in the past, in the future. Most people wish to use their spare time escaping the working stress. The activities that they do helps them to achieve that. I a way we use movement to draw us into present time and space. [Bøcken, 2010]

Movement is even used in medicating depressions, stress and different lifestyle deceases. Studies have shown that even relatively low doses of physical activity has a relation with the occurrence of depressions [Teychenne, 2008, p 409]

indoor environment



What is a good environment? Illustration sources: [Gyproc, 2012], [Lading, 2008], [Abts, 2012]

Ill.162

A user defines his or her space more when moving, and is at the same time more aware of the space around. When moving the requirements for a space gets more specific and measures itself against the biomechanics of a human being.

Architecture is a complex character – complex in the sense that no topic can be isolated for a longer period of time during the design process. This also count the comfort of the user. If the user does not consider just one of the issues shown in ill.161 as uncomfortable, the whole room will without doubt be uncomfortable. Therefore it is very essential to make the qualities of a space rise as parallel as possible – not to let one topic stay behind. In spaces for movement these comfort issues becomes even more urgent for two reasons:

- The use:
The use of the space is more extreme. More air pollution, certain lighting, specific dimensions, durability and equipment demands etc.

- The user:
The user has a hightened awareness of the body. This is due to, that physical and artistic activity brings a person more into time and space than normally, and therefore being more aware of the immediate surroundings.

What makes a space comfortable to be in? Roughly this can be divided in what mostly affects the physical comfort such as thermal comfort or air quality, and what mostly affects the psychological comfort such as a sense of security or feeling at home (identity). When a matter affects both the physical and the mental wellbeing (for example light), it is significant to keep both aspects in mind when designing. The diagrame on the opposite page also counts for an outdoor environment, though some aspects are more difficult or even impossible to control outside; such as air quality or sound environment.

Ill.163

Though the new construction of the thermal bath in Aibling might not be so well relating to the existing, it works its theme in a senceous way. The spa-feeling is communicated very clearly here.

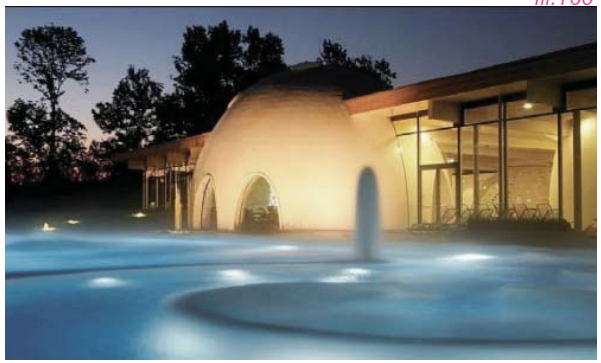
The final wooden house in Kumamoto, Japan, by Sou Fujimoto Architects is in its materials relating very directly to the human body, which recalls childhood in a dynamic but suddle way. Wall, floor, ceiling, chair, bed and table blurs together in the lunber structure.

Ill.166

Gymnase Maurice, Berlemont has been adopted by the young of the city as an active whereabout. [Bøcken, 2010]

The inside/outside dynamics of Skuespilhuset, Copenhagen

Ill.165



Ill.164

Birkerød sportsarena by Schmidt Hammer Lassen

Ill.167

Laban Dance studio in London is the biggest building designed for the "softer" forms of movement. Colours succesfully decide the orientation in- and outside the building. [Bøcker, 2010]

Ill.168

Ill.169

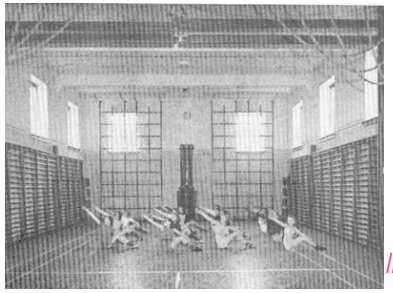
Kastrup Sea Bath by White Architects has a very atmospherical use of lighting

Ill.170

Ill.171

A fun and safe pedestrian crossing from the "Gør motion til en leg" campaign by Tryghedsfonden and BIG.

Dance space in Edinburgh by Malcolm Fraser Architects.



Traditional gymnastics hall at Græsted School.

Ill.172

activities and space

movement generating spaces

If a space shall be movement generating nothing can be isolated. One need to look at the technical, the physical and the mental parameters of the interplay between body and space. The wellbeing of people must be measured against the use of space. Even though it is clear that there are many positive effects on human psychology, by having plenty of natural light in a room, it might not be pleasant to play badminton with the sun in the eyes. Maybe a higher temperature and sound absorption might be good for yoga, but it does not necessarily give a good space for zumba. Each space must be looked at individually. A space for any kind of activity as sports, art classes, exhibitions etc., must stimulate the body or artistic input and output. Many prefer that their spare time activities and the environment offer some sort of contrast to what they experience in their working lives.

Additionally to the function of one particular space for an activity comes the ritual progress of engaging in a sport. Here the changing room becomes a very important buffer zone. When engaging in an activity, the ritual of moving through spaces is very distinguished. First one goes through a fase of preparation, which is also the time when one is drawn into the world of the activity. After follows immersion into warmup, training andstretching (for most sports). The buffer zone of the change room is entered again in the end of the session, but now the role has changed from a place to clear the mind to a more social atmosphere.

There are different ways of thinking of movement in relation to spaces. A space or a shape might seem to be in movement even though it is stationary (hence the study of term: movement i the appendix). One can also speak of spaces that encourage movement in the subject, which is something else. Even relativly static spaces through appearance can enforce the human interest and curiosity in exploring. Such a room generate movement through the behaviour of the subject and not from associations.

It is important to acknowledge that aesthetics are in no way limited to visual impressions. A space is experienced with all our senses in correlation. The senses even have an interaction between each other, which is why we can speak about the taste of something we only have smelled or feel something that seems green. As facilities for movement are spaces that are experienced through our bodies it becomes evident to speak to the senses in the work with the space. Light, acoustics, texture and colour link to the movement on more different platforms, than what you create through your own body, when moving through a space. [Bøcker, 2010] For elaboration see studies of this in enclosures.

One could ask whether or not the space is really there? Or does it occur when someone moves through it? Questions like these have throughout history been part of the philosophical and scientific discussions concerning the relation between body and space. [Bøcker, 2010]

In architecture psychology, which concerns the relation between the “build” world and the human, you speak about three different relations between human and space:

- The architecture affects the action. The human adapts. The architecture as a initiative/the architecture as controlling.
- Human needs adjust the architecture. Actions shape the architecture. This is the modernistic approach, such as le Corbusier’s “living machine”.
- The human and its surroundings are in dialog with each other. A space is only really there when inhabited and a personality is formed by its surroundings.

The third approach is rather interesting when speaking about spaces for movement. It adds the aspect of real-time to the architecture, which is often the dimension people seek through their hobbies. The building moves with the inhabitants, so to speak. The appearance and the perspectives changes when moving through a building, which gives a certain kind of individual dynamics to an experience. [Kaya, 2003]

Ill.173

A stair case can have numerous functions, maybe a step-class can also be held here.

Thermal Bath in Vals, Switzerland by Peter Zumthor. The view becomes interactive through movement, and the views are created not from what you see, but from what you do not see.

Ill.174

Gaps of "unspend" time, such as waiting for a bus, can and will be spend actively, if someone has the imagination to open for the possibility. Here simple swings in a busstop from the tryg / BIG collaboration campaign: Gør motion til en leg. A real experiment of this, by Bruno Taylor, can be seen at: http://lifewithoutbuildings.net/2008/08/bus-stops-as-urban-playground.html

Ill.175

Ill.176

Taking the cityscape in use. Why do people use the spaces, squares, streets and platforms of the city for doing exercise, rather than the traditional sports hall? Is it just the see and be seen factor that is important, or is it because the city can offer an artistic freedom that the sportahall cannot?

Ill.177

Ill.178

Spaces for a specific purpose can and will often be used for another - especially if it offers better conditions than those spaces actually made for the purpose.

Spaces for activity is here subdivided into those of higher, spordical and lower level of activity. Clearly the intention is not to make a perfect space for each activity rather to make a few room, which can house more than one group of activities.

higher activity

Pulse-up
General examples: Running, swimming, most condition training and some team sports

Tracked
Examples: Swimming and athletics
Physical characteristics: Short linear tracks. Frames for focus and few disturbances

Linear
Examples: Running, rollerblading and biking
Physical characteristics: Variety in a forward oriented environment

Bordered
Examples: Beach volley, soccer and badminton
Physical characteristics: The rules are drawn on the floor, fixed geometries

sporadical activity

Pulse-up/pulse-down
General examples: Skating, dancing, surfing, fitness and some team sports

Stationary
Examples: fitness and bodybuilding
Physical characteristics: Equipment, layout after muscle groups

Contact (physical or social)
Examples: Dance, team-sports in general, martial arts and gymnastics
Physical characteristics: Orientation and relations, space for "eye-contact" but also withdrawal

Urban
Examples: Parcour and skating
Physical characteristics: The city as a playground

Playful
Examples: Playgrounds, to some degree dancing, fitness and some team-sports
Physical characteristics: Focus is not on the game's consequences for the body, but on the game itself [KBH,2009]

A to B activities
Examples: Transport to work/school and stairs instead of elevator
Physical characteristics: Exchange indolence with multitasking in an "I would be here anyway" environment.

lower activity

Pulse-down
General examples: Wellness, meditation, yoga and walks in nature

Recreational
Examples: Hot tub and massage
Physical characteristics: Calm environment without "sudden movements"

Health related
Examples: physical therapy, doctor and acupuncture
Physical characteristics: Space for treatments and consultance

Meditative
Examples: Yoga, meditation and tai-chi
Physical characteristics: Mind in body, body in space, Zen and simplicity

Presenting
Examples: Exhibition and show
Physical characteristics: Space for exhibitioners, audience and "backstage" handlers

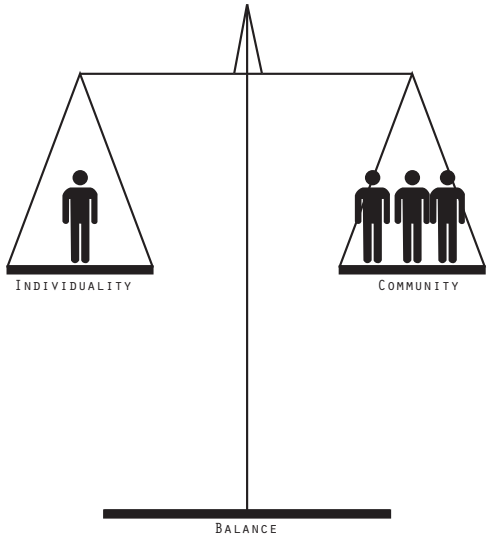
Creativity
Examples: Painting, sewing and sculpturing
Physical characteristics: Spaces for expression

space perception

Ill.179

fill the void

"As human beings we stand on a horizontal surface with angles to the world, captured by the gravity. Our eyes are forward directed and within a small margin - 1,5 m's above the ground. We bend easily in one direction, but not in the other. With our two-of-each set of - eyes, arms, legs etc. - we are symmetrical around a central axis. This colours our inevitable limitations as a natural thing, and the body's inherent ability to registrate space, time and phenomenons is too easily taken for granted and is not utilised to its full potential." Sarah Wigglesworth, translated from Danish [Bøcker, 2010]

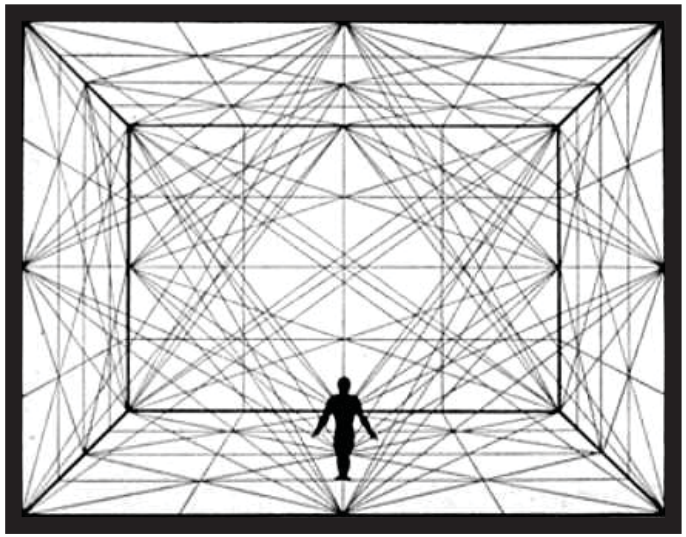


Ill.180

conclusion

Over the years physical activity has become more individual and practised in communities. Relating to others was easy when all practised the same and believed the same, today it is harder to relate due to the individuality. Everything starts to get mixed, and more girls start to join. The societys focus on activating people by enhancing urban spaces, brings the topic in the news which generate opinions about being active.

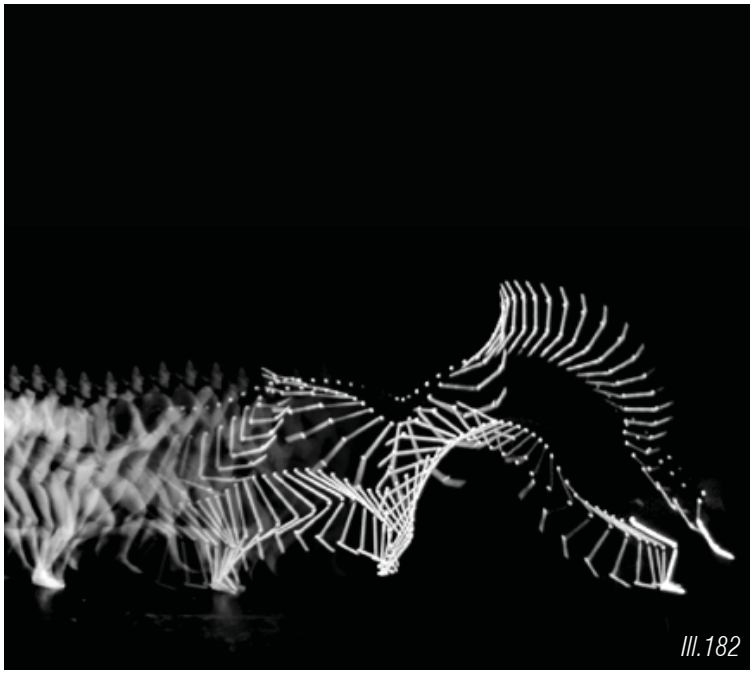
In order to inspire, spaces must challenge the body and mind, and find a balance. This places a focus on spaces that invite to activity, staying and are appealing to the mood. It is important not to define every movement to keep the inspiration.



Ill. 181

A person is in a flowing dialog with the surroundings and is constantly downloading and uploading information to and from the surrounding space. The perseption of a space is changing when moving through it - even a cubic room, althrough the higher the complexity, the higher the demands for perception. It is essential both to have have spaces, that challenge the curiosity for exploring and spaces for resetting and clearing the mind for concentration.

If a person is to identify themselves with a room for sports of any kind, the room must simultaneously relate to the body and mind. The functionality of the space must be fit for that specific purpose. A space which is not relating to the inhabitants in its proportions easily gets confusing and uninteresting.



Ill.182

concept

- room program
- statement of intent
- design criteria
- concept idea

room program

	M²	Temperature +/-1^{0}C	Air quality % dissatisfied	Light: Direct, indirect, artificial	Room height: Low, medium, high
Shared facilities					
Foyer	100	22	15	Direct, indirect	High
Cafeteria	200	22	15	Direct, indirect	Medium
Kitchen	40	15	15	Indirect, artificial	Medium
Administration	20	22	15	Direct, indirect	Medium
Total	360				
Activities and community centre					
Multi spaces	300	15	15	Indirect, artificial	High
Music room	30	20	15	Indirect, artificial	Medium
IT / AV editing room	30	20	15	Indirect, artificial	Medium
Creative spaces	60	20	15	Indirect, artificial	Medium
Workshop	30	15	15	Indirect, artificial	Medium
Total	450				
Sports facilities					
Changing room for judges and players	150	20	15	Direct, indirect, artificial	Medium
Office for clubs and sports clubs	80	20	15	Indirect, artificial	Medium
Laundry and drying room	15	15	15	Artificial	Medium
Room for materials	20	15	15	Artificial	Low
Accessory store	10	15	15	Artificial	Low
Total	275				
Fitness and wellness centre					
Changing room for men and women	120	20	15	Direct, indirect, artificial	Medium
Pool area	250	20	15	Direct, indirect	Medium
Fitness	110	15	15	Indirect, artificial	High
Total	480				

	M²	Temperature +/-1^{0}C	Air quality% dissatisfied	Light: Direct, indirect, artificial	Room height: low, medium, high
Health centre					
A. Shared facilities					
- Staff kitchen and lunch room	20	22	15	Direct, indirect	Medium
- Changing room	20	20	15	Indirect, artificial	Medium
- Cleaning and sluice room	10	15	15	Artificial	Low
B. Group medical practice					
- Reception	20	22	15	Direct, indirect	Medium
- Waiting room	30	20	15	Direct, indirect	Medium
- Toilets	20	18	15	Indirect, artificial	Low
- Work space for secretary, nurse and laboratory	25	20	15	Indirect, artificial	Medium
- Consultation room	120	21	15	Indirect, artificial	Medium
- Emergency room	20	20	15	Artificial	Medium
- Laboratory	10	20	15	Artificial	Medium
- Store	15	15	15	Artificial	Low
C. Other trade groups					
- Shared facilities	40	20	15	Direct, indirect	Medium
- Dental clinic	60	20	15	Indirect, artificial	Medium
- Secretary office	15	20	15	Direct, indirect	Medium
- Physiotherapy	40	20	15	Indirect, artificial	Medium
- Chiropractor	20	20	15	Indirect, artificial	Medium
Total	485				
Tecnic					
Technic for wellness	300	15	15	Artificial	Low
Technic swimmingpool	50	15	15	Artificial	Low
Storage room multi-hall	80	15	15	Artificial	Low
Changing room kitchen staff	20	15	15	Artificial	Low
Total	450				
Net area	2500				
Gross area	3500				

statement of intent

The multi-house is a centre for social, physical and artistic activity, where individuals cross between spaces and inspire each other. The spaces shall enhance the desire for activity and movement while encouraging a sensuous interaction with the surroundings. It is an objective to make the users aware of the sustainability, and set a good example with regards to energy efficency and an indoor climate that suits the different activities, even if different activities need to share spaces, so that the multi-house can function now and for many years to come.

design criteria

Further progress parameters for the design are formulated into the three subjects; aesthetic, functional and technical.

Aesthetic:

-The multi-house is a place, where exercise, inspiration and wellbeing is prioritised, being a result of a volume generating movement through spaces.

-The exterior use of daylight shall be arranged so that it contributes to the movement instead of blocking it.

-The centre must in a human scale relate directly to the bodies that fill the spaces.

-The design shall reflect the current issues of sustainability, so that the user becomes aware of the relation between needs and future.

- The outer facilities must reflect an environment and make use of atmospheres, where the user is taking part in the surroundings.

Functional:

- The activities will shape the spaces and the spaces will shape the activities.

- The architecture shall improve the community but allow individual activities.

- Flexibility is prioritised, so that it is possible to create new forms of activities and still keep the ones practised now.

- The volume shall enhance the social connections through different activities. It must make generations and genders meet.

- The exterior spaces must invite for interaction and dwelling in its organisation for regular users as well as people passing by. The activities is to float out into the public space.

- The room sizes will take their point of origin in the competition project Pulsen and from there be evaluated and altered.

Technical:

- The concept must be sustainable in aspects like material, energy vise and durability. The sustainability shall not be subtractable.

- The energy consumption may not exceed the demands for 2020.

- The climate shall be integrated in the systems, so sunlight benefits heating, though not overheating the building.

- Installations for renewable energy and the use of materials shall be incorporated, so that sustainability is improved and seen in a bigger perspective.

- It is strived for a acceptable indoor environment

The project is generally based on the program for the multi-house “Pulsen”, but can be reconsidered on the way due to issues of interests and visions for the project.

concept idea

Gather

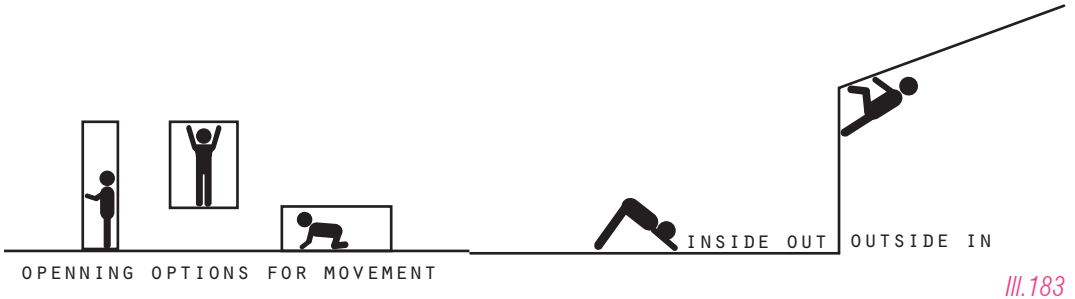
Multi-house Pulsen is a gathering point of interests, but also of generations and genders, which is seen in the architecture's way of inviting visitors to the centre. Multi-house Pulsen is a social place with room for individuality. At the same time it is not a neutral building; it is a house that wishes to speak a statement not about an architectural icon, but about sustainability in an environmental, a social, a physical and a cultural understanding. The focus is to give Balling a multi-house that can show the way towards a healthier lifestyle.

Dissolve

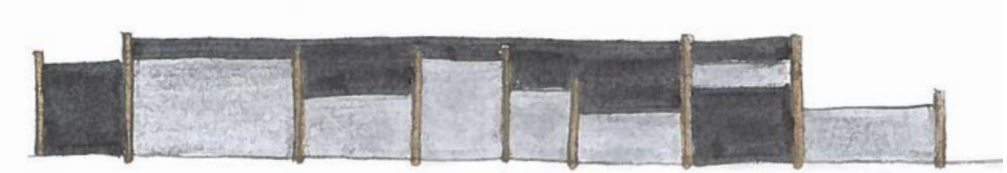
The architecture of Pulsen is working with dissolving spaces into each other, where one ends, another one begins. The transitions between spaces become ever the more evident, when the spaces are meant to be moved in and not only to dwell in. The architecture opens for the possibility of using the outside as well as the inside for various activities, that might not be expected to meet respectively in the public space or indoor.

Generate

In order to contribute to a healthier lifestyle, multi-house Pulsen will generate movement by opening up for various options for exercising. This means that it will relate very closely to the body in its dimensions, lighting and material, but at the same time challenge the perception. The point is that movement is actually fun, it is just a way of exploring the world. In fact the concept is to take the focus away from the exercise itself, so that the individual starts interacting with the surroundings while being active. Meanwhile planned activities will have a central role in inspiring each other.



Ill.183



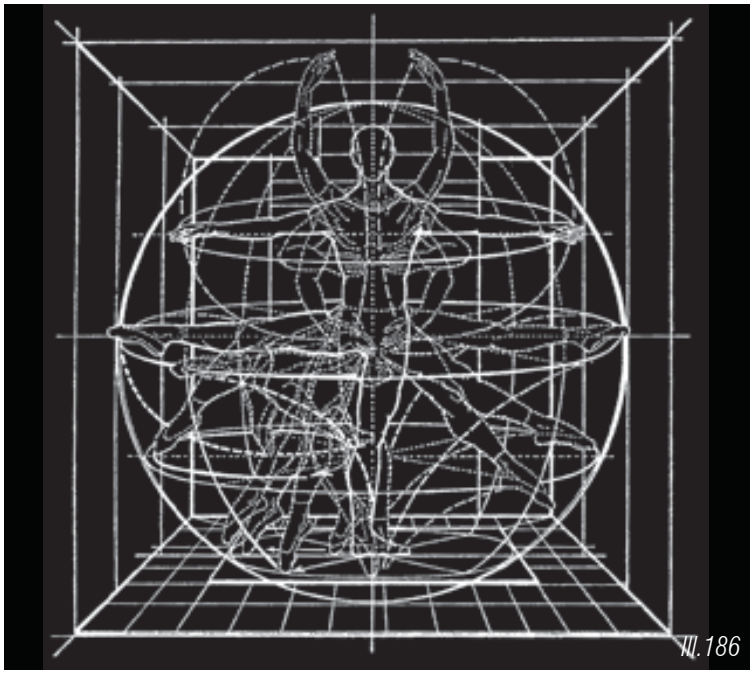
Ill.184 *Lines of trees*

Buildings rising from the ground

In the design an interest is taken in the motif of trees enclosing the site. An abstraction of how light and views can be filtrated through branches form the foundation for how the conceptual idea is comming to life through the parameters mentioned on the previos page: Gather, dissolve and generate.

Ill.185

process



Ill.186

shaping

- Pulsen identity
- landscaping and lines
- walls
- proportioning
- volume creation

pulsen identity

The multi-house Pulsen has to be an architectural stamp for the region, which includes social values, sustainability and physical movement. In the process of designing such a centre, a starting point is taken in motifs discovered in the area and investigations of how these can generate flows in and around the sports hall.

Often it is seen that the social activity level rises when moving closer to the city center. The soccer fields sort out the activity creating an opposite effect on the construction sire. With this in mind the desire is to relate the multi-house both to the town and to the open fields in its materials, direction and organization.

Pulsen's sustainable stamp shall be a passive and active approach to the 2020 demands, which is soon what is strived for in new buildings. To that comes a comfortable indoor climate fitting the purpose of the rooms regarding temperatures, acoustic comfort, CO^2 levels, odder and daylight. The sustainable identity is closely linked to how the building performs and thereby being an example of sustainable design. Another approach is the sustainable awareness for visitors a building that shows it is environmental sustainable to the public and users. It is nearly impossible to sum up a buildings total strain on the environment. Therefore solutions which are known to be problematic are deselected, and other solutions are discussed regarding:

Materials: Source, recycling, transportation, disposal, energy saving abilities etc.

Energy source: Local or depended on power plants, production systems, run-effort etc.

Additional design solutions that can be added to sustainable qualities. This may be water collection, improving factors on the indoor climate, use of alternative energy sources etc.

The environmental sustainable awareness has to be visible, but not sentimental. It is wished that the solutions are not of pure technical appearance and neither pure ecological appearance. It has to be balanced in between so the social awareness is centered.

Ill.186

Air photo of the northern Balling city, where the school and sports hall is situated up front.

landscaping and lines

The surroundings at the project site have many previosly mentioned characteristics that define the area, one of the more dominating is the guidelines created by trees. These guidelines distinguish the area from the rest of the town. The structure becomes the definition of the site and therefore a guideline for the project.

Inspired by the guidelines from trees, a grid is created by using some of the important characteristics in the area being the trees, school, sports hall and flows. The trees primarily form a direction between the town towards north and the open fields towards south. The flows in the area form another direction between the school and the single family houses, while the buildings, the school and the sports hall creates directions.

In total these directions form a grid that is used to form a volume, squares, and passages. The intention is to make a building that is an extension of the existing trees and sports hall. Views and passages are created or blocked by using directions from the flows.

When arriving to the area from north a volume is placed to create attention towards the multi-house. The sports hall is continued with a volume block. The flow from the school penetrates the volume, in order to lead guests coming from this direction into the area. The volume in the middle is modelled after the directions from the hall. Forming a link between sports hall, multi-house and soccer feilds. The third volume stretches arround the hall being exposed in minor degree to the north.

Ill.187

Walls inspired by mountains

Ill.188

Building inspired by the contoures and grass fields

Ill.189

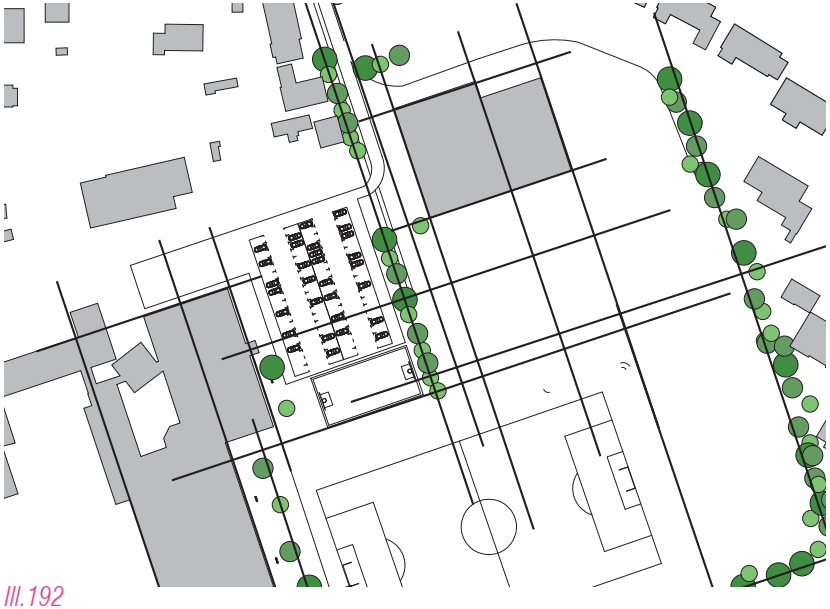
Tre rows of trees form directions primary in an NNW and SSE direction.

Ill.190

Flows on site form directions primary towards ENE and WSW.

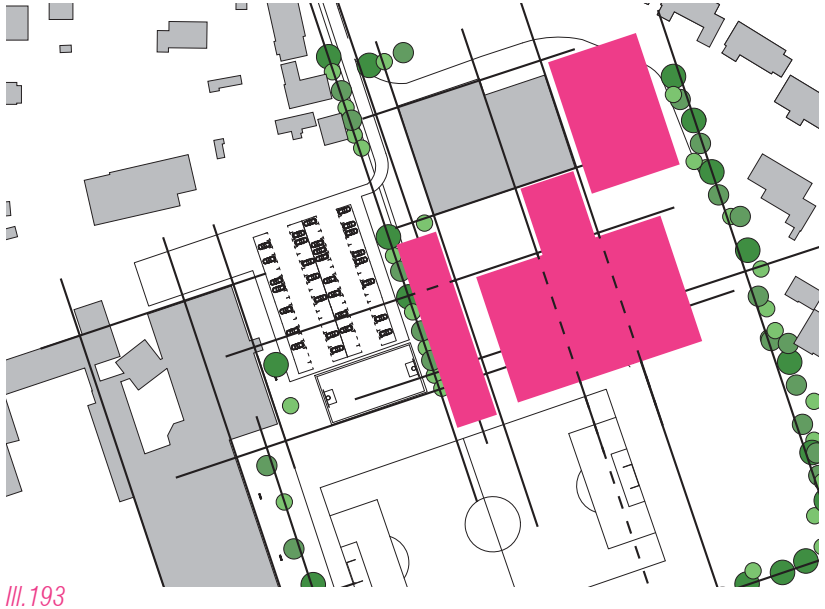
Ill.191

The school and exsisting sports hall creates directions towards: NNW, SSE, ENE and WSW.



Ill.192

The three typpes of parameters above form a grid structure.



Ill.193

The grid structure is used as an base for creating the building.

walls

Some of the lines created from the directions of trees, form walls that define the volumes of the multi-house. An interest is taken in the wall, both as a constructive element and for its symbolic and psychological value. A wall is an architectural component, a line which decides what is inside and outside literally and metaphorically. The wall is what marks the envelope and has both practical and symbolic value of something protective. It is also an important part of the construction, which protects users from the environment.

The theme of movement makes a wall interesting. There are two sides and always one that cannot be viewed by a person. A wall can be used for multiple purposes such as creating specific views, staying possibilities, one can move through the wall, over it or along it. The position of the wall also matters in relation to the wind as shown at ill.27, wind study. How the wall is penetrated and how tall or long it is affects how the wind interacts with it. This is also seen very clearly in the wind studies. Regarding people the same parameters affect whether they want to go over, through, around the wall or simply turn back.

A wall can be an indication of change, either change of direction or change of scenery. A transition happens when passing through a wall, and this transition can be made into a game, generating movement. When you know a border the curiosity steps in making it very attractive to know what is on the other side. At the same time a wall can be used for providing a sense of being secure and a resting area where one can overview the area.

From an architectural point of view, a wall can contribute to some interesting aspects: How the spaces differs one the two sides of the wall (creating anticipation for the next transition) and how the wall is broken down. Leaving possibilities to pass through openings in the wall or climb over will generate curiosity. The experience is different whether the wall is closed (with a door) or if it offers peaks of what is on the other side. Gaps in the wall material can create more or less visual contact with the opposite side with more or less physical possibility to follow that vision, all depending on how the wall is dissolved. It can also create a filtration of the distant vision like the trees in the windbreaker does, or maybe create a mirror by reflection, making anticipation even higher than with just a closed off un-transparent wall. Another important deformation of a wall is transparency or translucency in linking one side to the other, which can draw visual and even behavioral links between the two sides.

With a simple example in Hadrian's wall, located close to the border between Great Britain and Scotland, different interactions with a wall is examplified. Here moving along the wall.

Ill.194

Approaching the wall

Ill.195

Ill.196

Protected by the wall when moving

Ill.197

Sheltered by a wall while dwelling

Ill.199

Over the wall

Concouring the wall in height

Ill.198

proportioning

Early in the design process it is decided to work with separated volumes. This results in an outdoor square which functions as a meeting point and a connection between the sports hall, the multi-house and the soccer fields. The outdoor areas become an important part of creating spaces for activities.
From the grid explained in the paragraph on “landscaping and lines”, building placements and volumes start to form. The functions are divided into culture, sports and health related facilities and besides those common facilities.

- The sports hall will be kept to the same location, but will be thoroughly renovated.
- The culture centre will include a multi-hall, along with various creative spaces.
- The activity centre will include a fitness centre, wellness centre, dance studio and changing rooms.
- The health centre will include consultations, pharmacy, emergency room etc.
- The common facilities are cafeteria, foyer, reception, technical rooms etc.

Layout of functions

The culture centre will be a first presentation of the centre with its foyer pulled out in front of the street of arrival. It is the first section entered, with a presentation of the entire project in the foyer and a reception and ticket office available. The creative activities are a good representative for the whole centre and can function as a parallel to the school, which can benefit from giving creative lectures in the multi-house. The main reason for the placement of the culture centre is access and clear distribution. As a social gathering point the existing cafeteria has been expanded into a more open café-like atmosphere and opened up to the main square.

The activity centre is placed so it elongates the existing sports facilities, and can be entered from the main square. A focus is kept on the rituals and logistics of a building accommodating different types of physical activity. The wish is that the exsisting changing rooms at the sports hall can provide service to the existing sport facilities as to the

Building felts derived from lines in the area.

III.200

4 theme buildings.

III.201

Estimated areas of the new constructions.

III.202

new facilities.
The ritual one goes through when practicing some kind of activity is important for the layout of functions. When attending a class or going to the fitness centre a person goes through a preparation, execution and a closing process of the activity. The changing room works as the preparation zone. The placement of the activity centre is dependent on having an outdoor swimming pool for the wellness centre with the needed privacy.

The health center shall be able to be used separately of the other activities. This is a function with a higher need for privacy than the other functions; aside from that it is also a workplace with directives that follows. Therefore the placement between the sports hall and the single family houses is found ideal for the health centre. Also the health centre can have its own entrance and parking spaces, which alternatively can be occupied during concerts or theaters in the evening. A separate entrance gives patients increased privacy and a space for arrival with the ambulance. To make a nice view, without compromising the privacy and daylight, it is chosen to attach a garden space to this building. This makes a calmer atmosphere, compared to the main square.

The third dimension

Through the function planning a distribution of rooms is slowly forming and thereby creating volumes. This gives information about where on the site spaces need extra height, also taking in consideration their proportions regarding openness. These spaces are seen as the higher spaces:

- The foyer
- The multi-hall
- The fitness centre
- The reception of the health centre
- The sports hall

In most cases these are also the most extrovert spaces, sending a message to the surroundings. These are outward oriented spaces with a focus on social wellbeing.

The more introvert spaces are considered to be:

- The changing rooms
- The wellness centre
- The consultations

These are inwards oriented spaces with focus on wellbeing in terms of treatments, preparation, concentration and recreation.
The foyer, multi-hall, fitness room, sports hall and wellness facilities are considered some of the most influential and characteristic spaces. These are stretching up and towards the periphery of the site; an exception is the café, which is not considered a tall space. This is a social space and outwards orientedin its function, which is done to give the café a homely atmosphere that is not too grand.

Outdoor spaces

Ill.203

Function layout

Ill.204

Room heights

Ill.205

volume creation

After arranging the functions in correlation to identity and surroundings, the height of the buildings are looked into. The necessary height is primarily a result of the functions. Opportunities in the surrounding context, which can contribute to the site, are also included in the considerations.

Today the context around the site is rather contrasted. When moving in the area towards north of the site, the view is constantly varied by the different houses, gardens, roads etc. This emphasizes the local atmosphere and gives a sense of calmness. Within the site towards south everything seems to be at a distance, which creates long views with no focus other than the horizon. This functions well, when the aim is to overview the site, or just to enjoy the open fields. Balling is also a town with minimal height differences; therefore it is possible to get a complete view of the town when standing at a high point. This could be of importance when creating a place for movement, community sense and activities. Adding a vertical movement to the site, in form of a building that can be walked upon, would also add an unseen perspective to the experience.

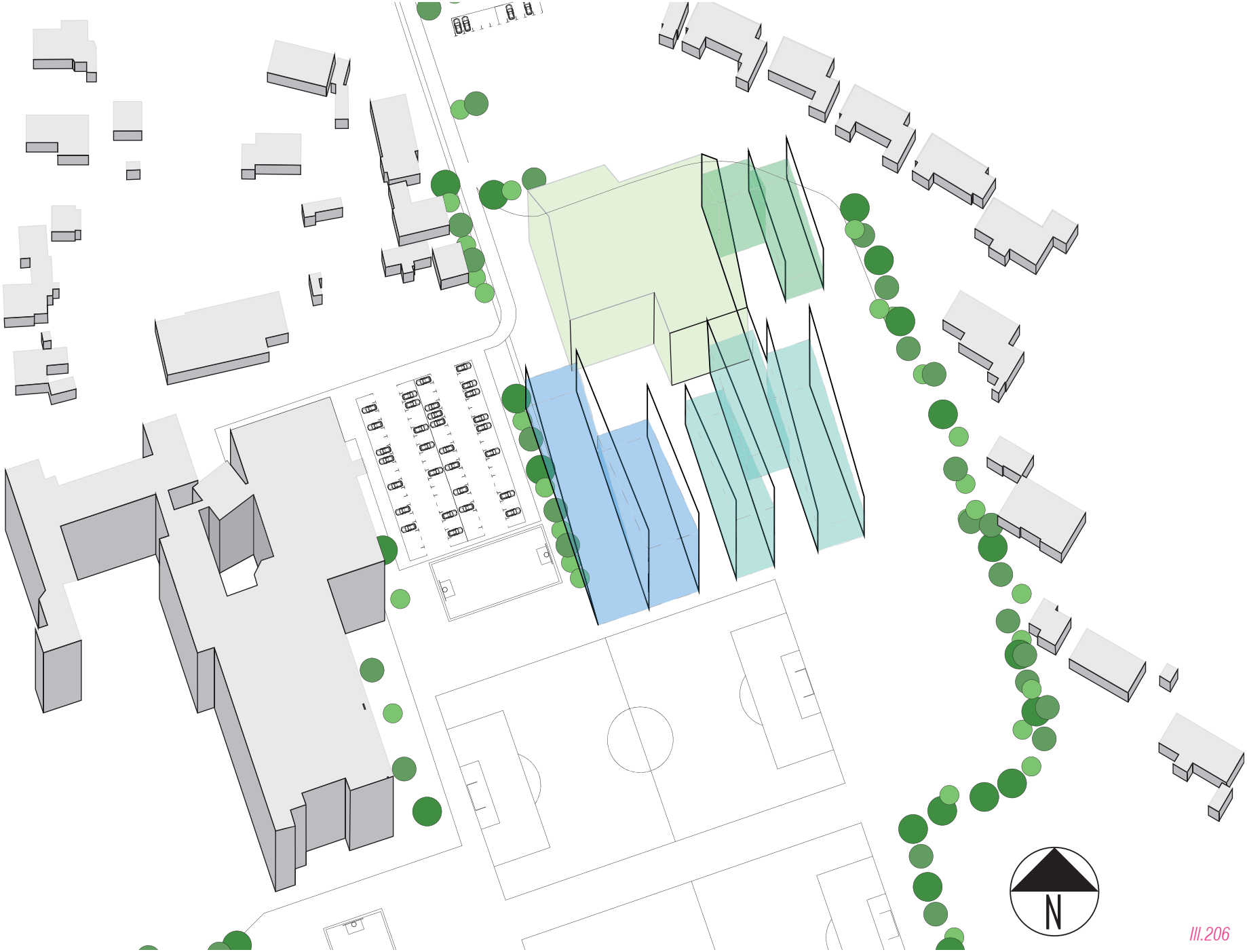
The qualities in Balling are the local atmosphere where all the buildings appear from the ground, but also the open fields in the area. To incorporate both within the site, the multi-house is to be inspired by the existing buildings to create a sense of volumes growing from the ground. When standing at the football fields, towards south, the multi-house seems to fade into the surroundings.

The dynamics also show through the culture house that has a roof levelling with the ground. This makes it possible for visitors to go up on the building and get an overview over the two main contrasts, the city and open fields. some roofs of the multi-house are sloped to introduce a more varied landscape to the site, while creating a connection to the single-family houses in the area.

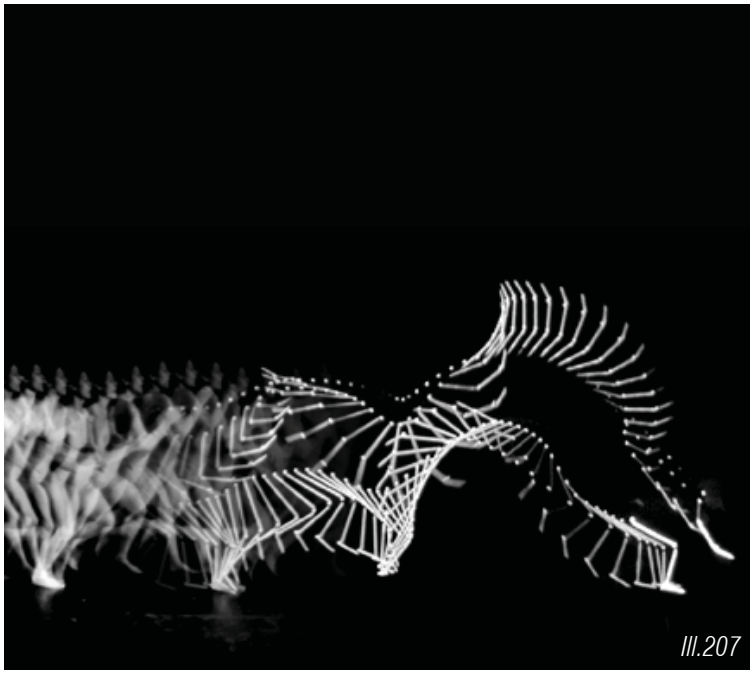
When looking at the multi-house functions, some of these imply a special need for room height as mentioned earlier.

This is solved through a slope on the roofs, which also introduce a varied landscape and connect to the single-family houses.

The volumes have different appearance from east and west relative to north and south. Towards east and west the volumes are angled, which defines the functions inside. The volumes in northern and southern direction have varied height, creating an illusion of a cityscape.



Ill.206

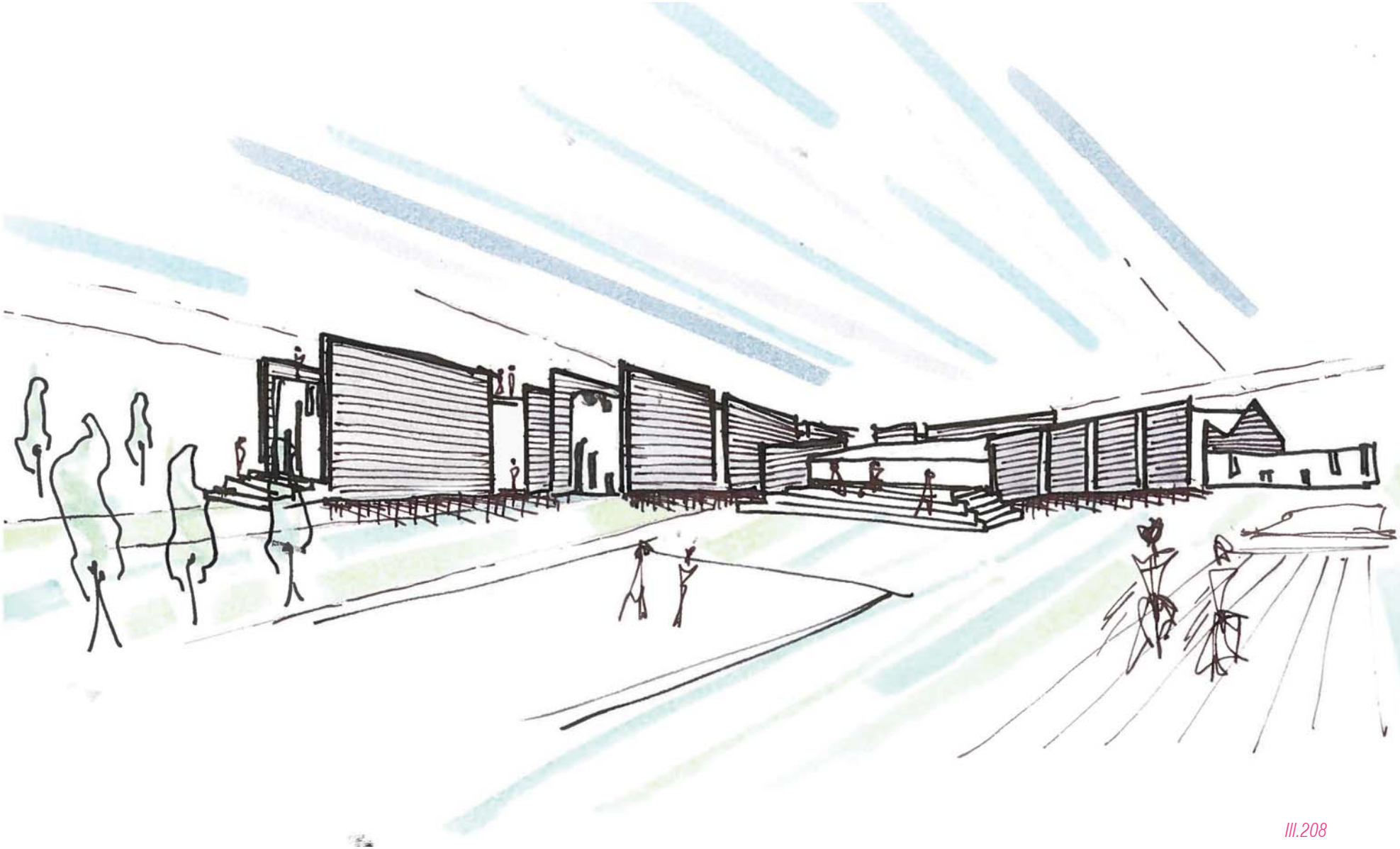


Ill.207

concept

Concept design

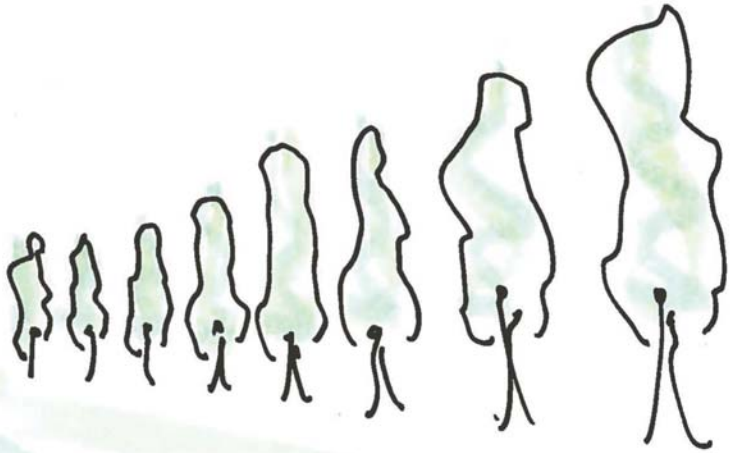
- outdoor atmospheres
- indoor atmospheres
- materials
- opening
- window concept
- structual considerations
- wind study
- ventilation principle
- indoor climate
- indoor climate during a year
- energy consumption
- solar panals
- funligt
- acoustics
- conclusion

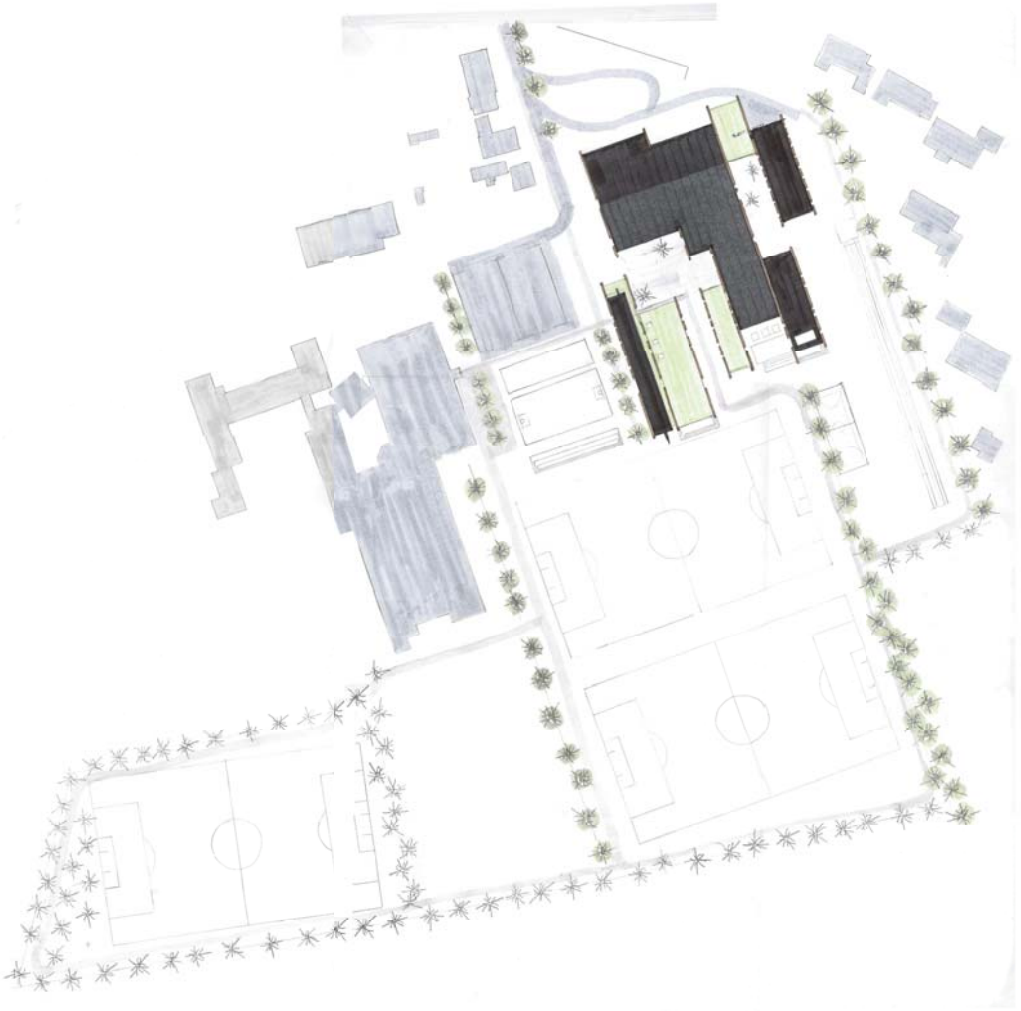


Ill.208

concept design

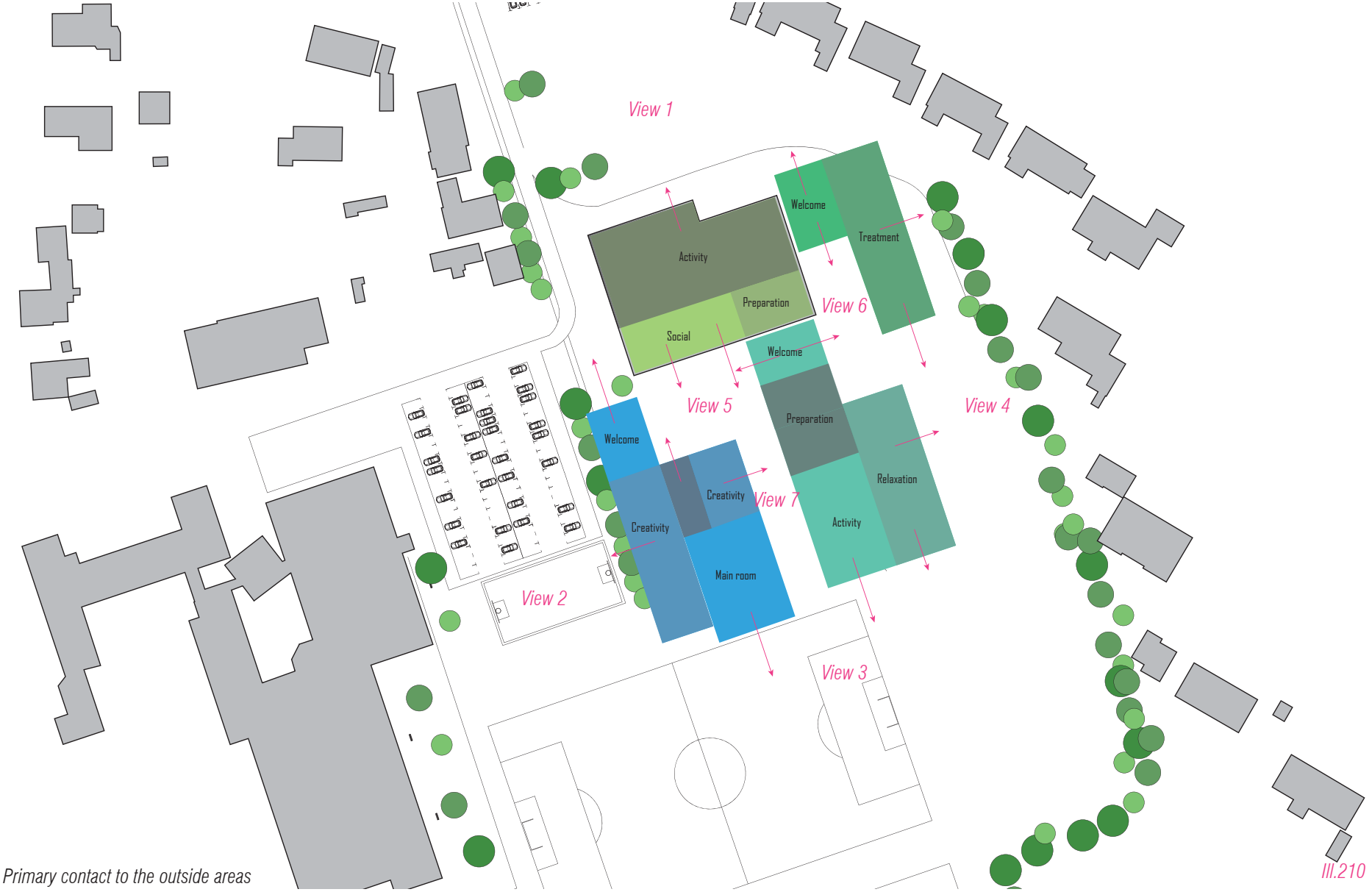
The concept is turning lines inspired in the surrounding buildings and vegetation into an extention of the sports hall. The new center will reach out to the soccer areas towards the south. The indoor and outdoor spaces are derived from gaps between lines and are distributed around a main square, being the gathering point of guests. The motif of the roof lines is an indicator of movement towards the highest space both inside and outside. Long walls are interupted by openings, creating an arcade-like atmosphere inside spaces, where rays of light dissolve the walls into fragments.





Ill.209

outdoor atmospheres



Primary contact to the outside areas

Ill.210

Ill.211 view 4

Ill.212 view 1 and 4

Ill.215 view 5

Ill.218 view 1

Ill.219 view 3

Ill.220 view 7

Ill.214 view 6

Ill.213 view 2

Ill.216 view 3

Ill.217 view 3

Ill.221 view 4

outdoor atmospheres

The central aspect of this project is to gather people on the inside and outside.

Some of the outdoor activities are playing grounds, where it is possible for children to play. These function as an extension of the school, but also of the atmosphere between the single-family houses.

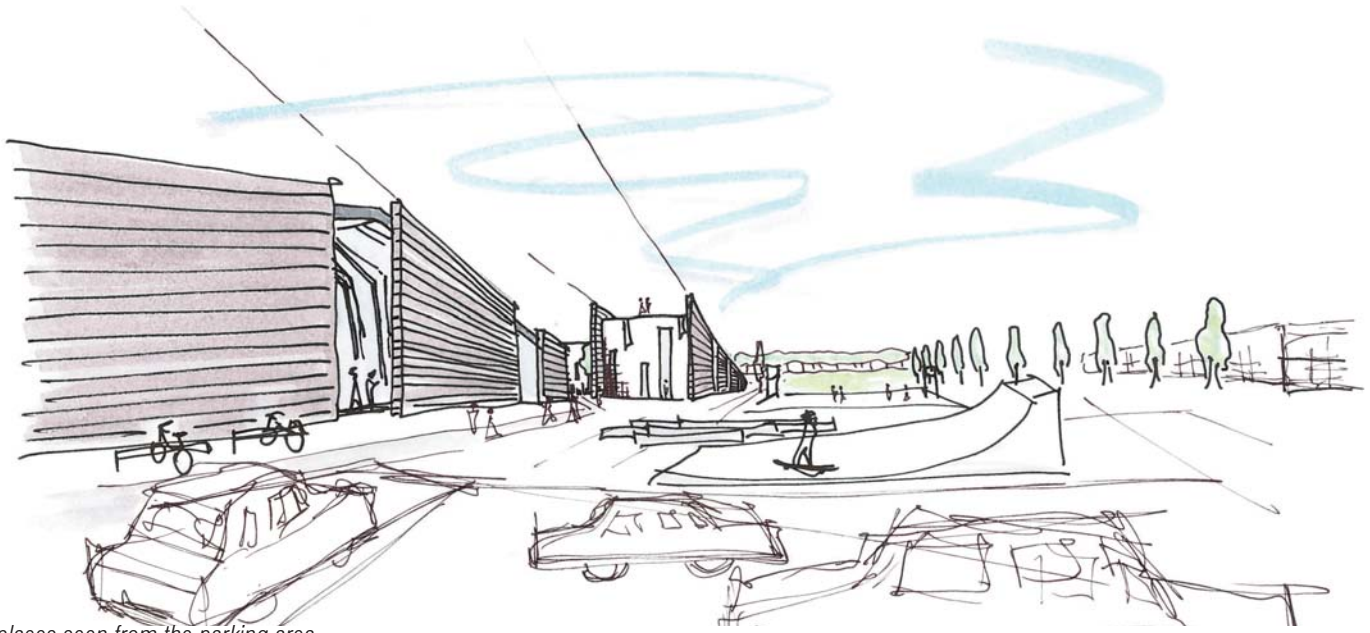
Other functions like football, basket, skating, hockey, ice skating and athletics apply to a wide range of ages and personalities, that can supplement each other when preforming the different activities. Therefore these activities are arranged in the middle of the site.

Running and walking is also possible along the entire site. This is often a more individual sport where one concentrates on one self or wants to look at something inspiring. If the activity is practised by several individuals together these are often focused on each other. This activity is placed in the outer edge, where it is possible to have long views or small views through the trees. Another reason for the placement of the function is that it is a sport where people move in a certain direction and don't stay in one area for a long period. So people will not benefit from a locked placement for a long period as for instance basket.

The last type of activities is people who stay in the area to view the different activities. For this central platforms are made to view all the activity on site.

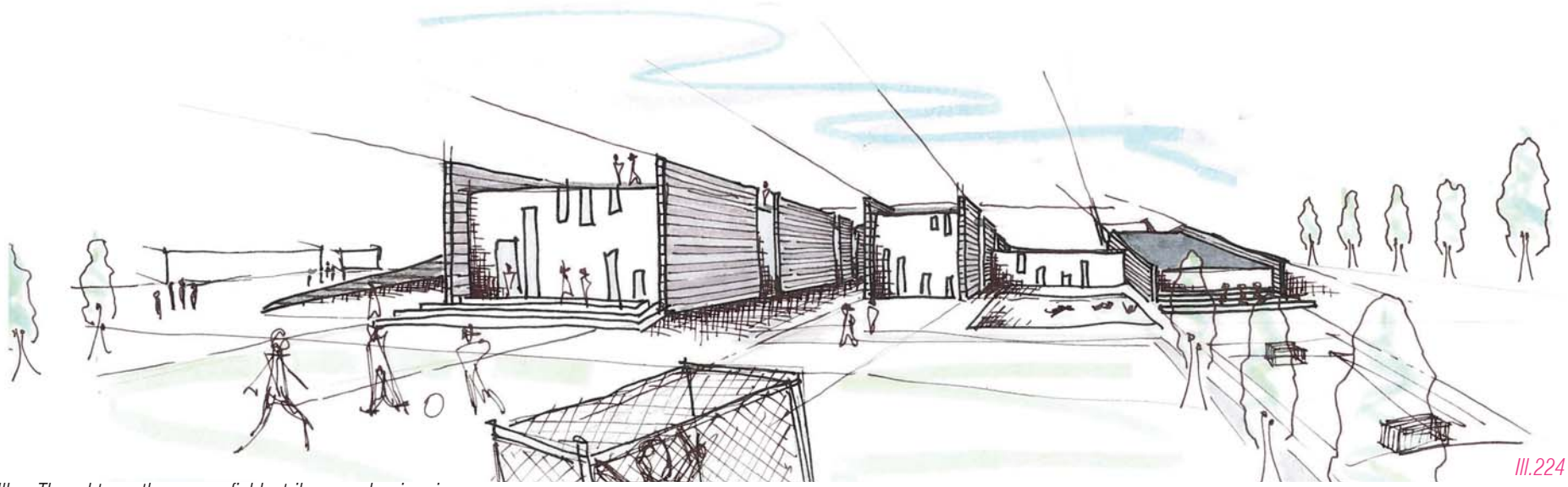
III.XX Thoughts on the café area

III.222



Ill.223

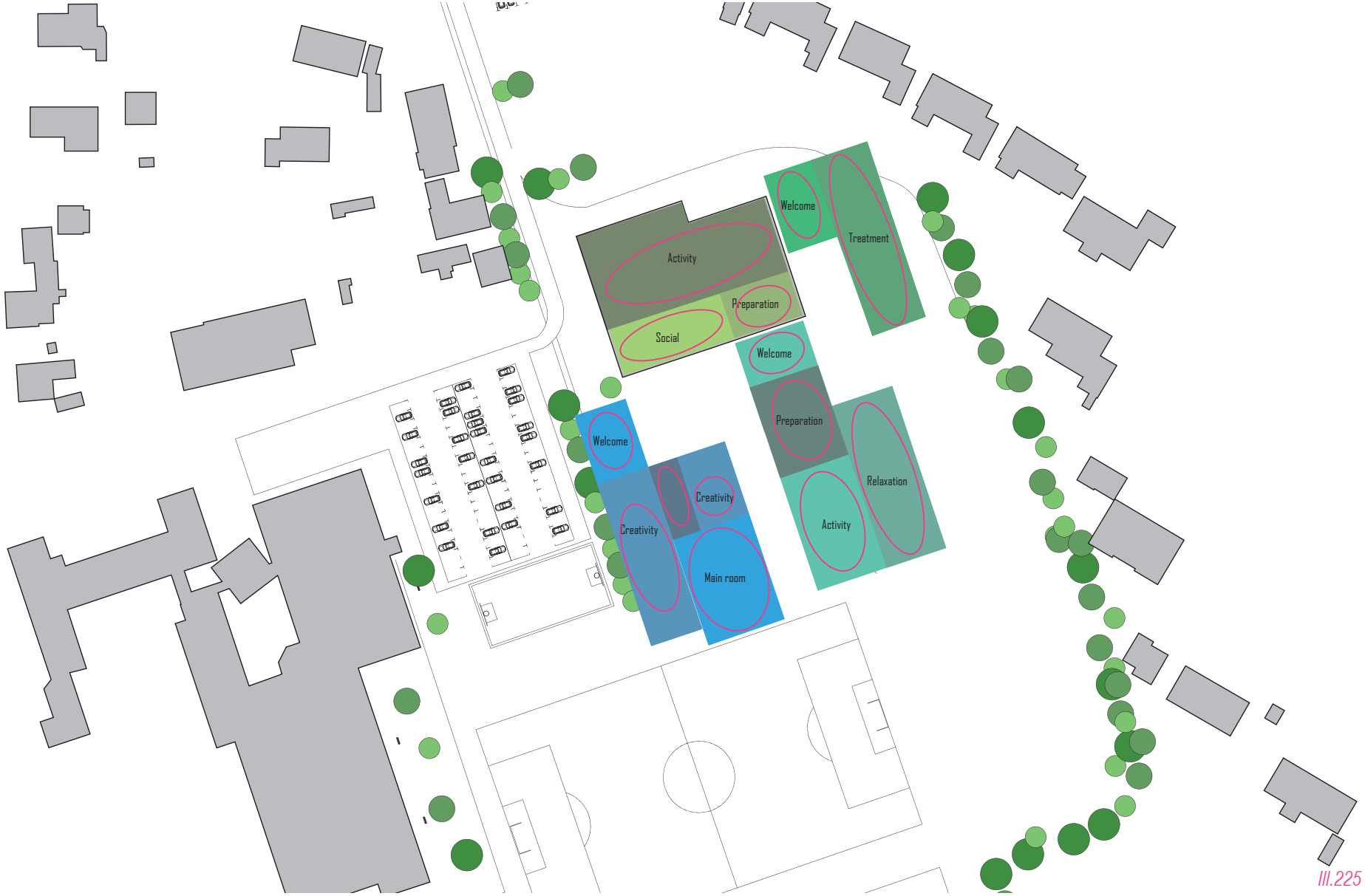
Ill.xx Thoughts on the arrival places seen from the parking area



Ill.224

Ill.xx Thoughts on the soccer fields, tribune and swimming area

indoor atmospheres



Ill.225

Ill.226

Ill.227

Ill.228

Ill.229

Ill.230

Ill.231

Ill.232
Project: Arcade Dutch Institute of Architecture

Ill.233

Ill.235

Ill.236
Project Seebad Kaltern

Ill.237
Project: Thermal Baths

Ill.234
Project: Casa G

Ill.238

Ill.239

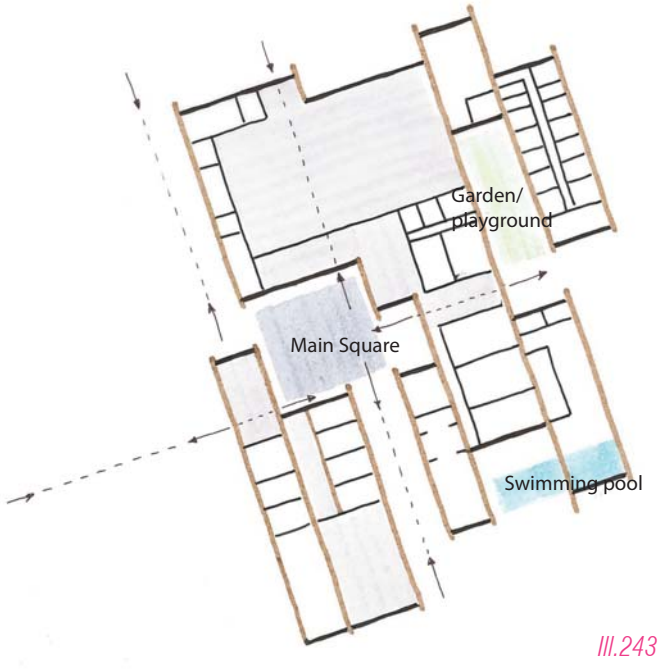
Ill.240

Ill.241
Project: Versailles Pavilion

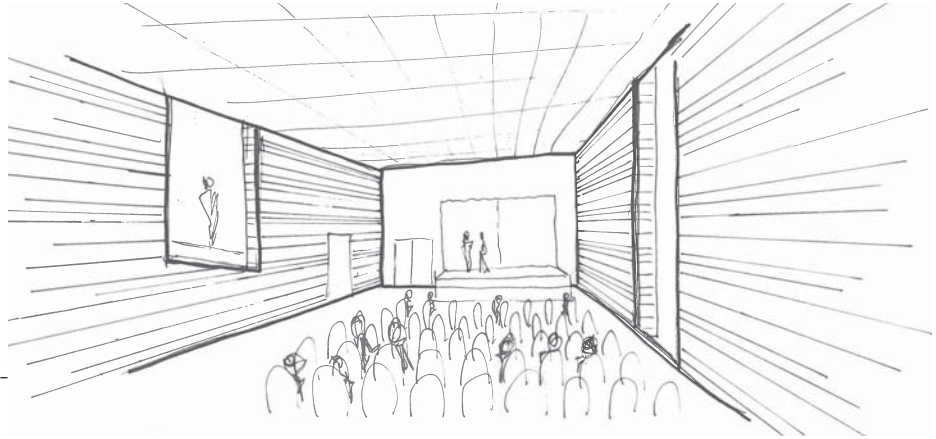
Ill.242
Project by DOS architects

indoor atmospheres

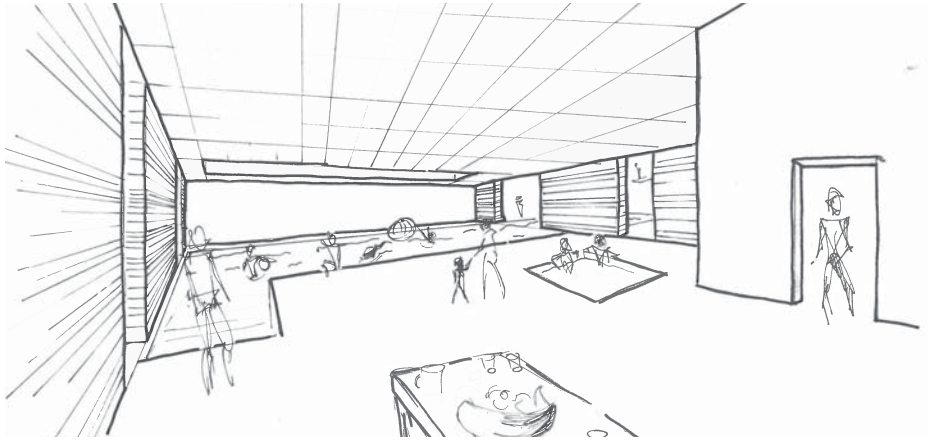
As with the outdoor spaces the purpose inside is to gather people through activity.
In the outdoor spaces gathering people is primary through a specific activity that is influenced by people's individual personality. Inside different activities are combined, so people with different hobbies and personalities can influence each other by their creativity.
This is done through the design and choice of materials. The design is made so every function opens to another through views. The creative centre is formed so all functions opens to a hall where all functions are directed towards each other. The same principle applies for the activity centre and health centre.
Another initiative used for gathering people is to, make them curious and aware of the activity around them through materials. The insidewall material is translucent concrete that show silhouettes of people and materials on the other side. This contributes to open spaces where different types of activities are displayed in rooms. It helps to encourage contact between people through the specific activity but also across activities.



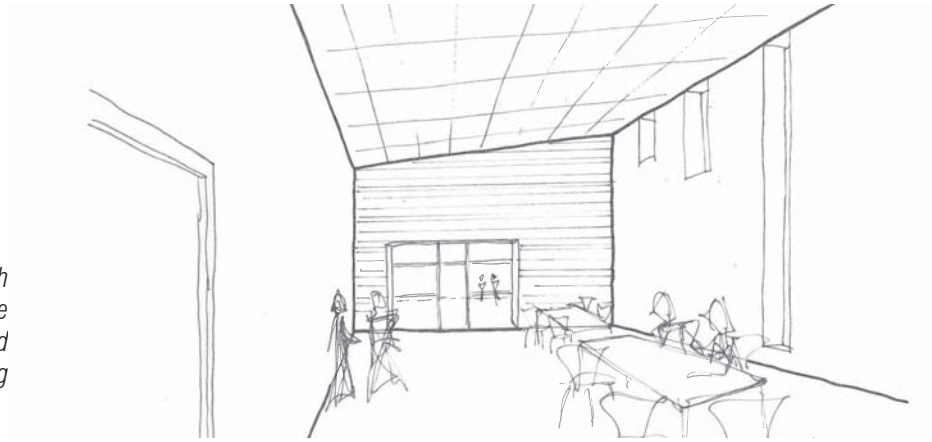
Ill.243



Ill.244
Sketch of the multi-hall



Ill.245
Sketch of the wellness area



Ill.246
Sketch of the lunch area for staff. The interior is extended outside with seeting posibilities

materials

When deciding materials for the construction, two aspects are considered as the primary criterias. One being the aesthetics and second whether the materials are sustainable. The materials has to blend with the context, material type and colour.

Aesthetics

The materials suitable for the construction are chosen through a colour comparison study, ill.247 shows three different attempts to combine colours. When the area is open, the sky is has the primary focus. If this is combined with the middle attempt, only using light colours, the volumes starts to disappear. Looking at the lower combination of colours, the illusion of a building rising from the ground starts to emerge, but the roofs begin to disappear due to the light colour meeting the sky.

The first combination where the roofs have a dark colour helps framing the volumes, which emphasize the illusion of a building rising from the ground. The light material on the facades support this illusion and differs from the context, thereby keeping a focus towards it. In order to perceive that more than one volume is present, the disks are made in other colours. The disks are applied with wooden materials to show the connection with the trees, while the colour relate to both the facades and roofs.

It is considdered to have grass on the roof to create a link to the fieldds when arriving.

The facades towards the town and football fields uses zinc to create a slightly reflection in the material. This extends the fields into the volumes, while achieving a light expression. The roofs are covered by solar panels and roofing felt, to benefit from the sun, but also to create the frame around the volumes.

Technical

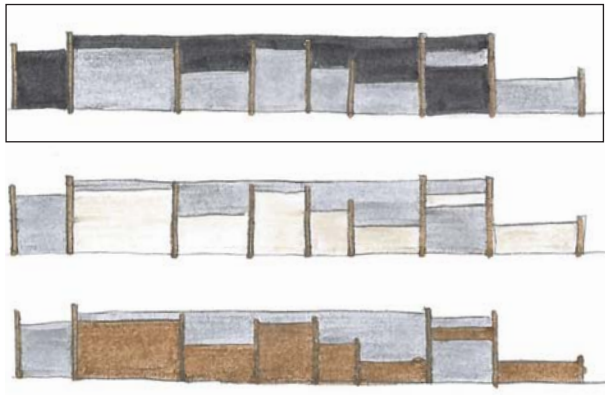
To optimize the buildings the materials are carefully chosen with considerations regarding energy, acoustics and sustainability. Sustainability regards the materials life cycle through manufacturing, service life, reuse and disposal.

Paper is used for insulation, primarily because of the sustainable manufacturing process and good insulation characteristics. When producing the material it utilizes recycled papers, paper from surplus and others alike. One of the negative things during the process is the chemicals needed in order to make it fire and fungus retardant. [Jan, 1999]

Wood is used due to its qualities being a long lasting and flexible building material that has the ability to store CO_2. Tree also has the opportunity to be reproduced. [Bretner, 2012]

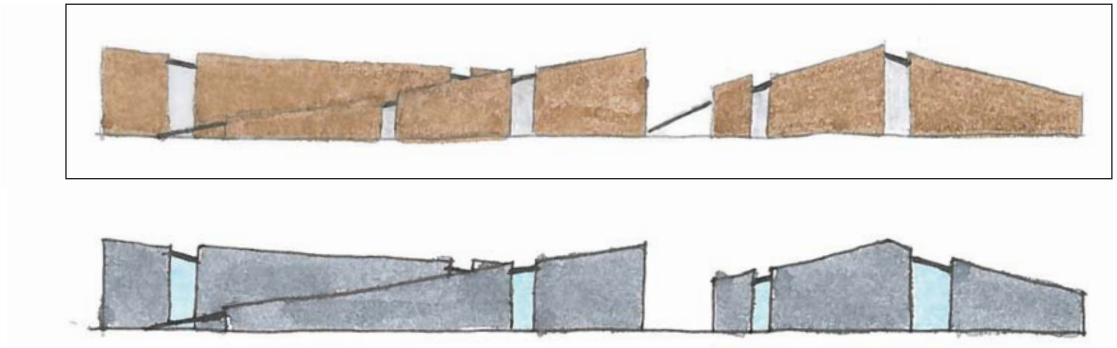
Solar panels are applied to utilize energy from the sun. This helps minimizing the need of energy from power plants that uses fossil fuels or similar resources that influence the envirnment negatively. [Godske, 2012]

The reason for using zinc is the sustainable characteristics such as being long lasting, easy to reuse, abrasion-resistant and maintenance-free. Zinc is especially sustainable because of the low energy usage for producing, processing and recovering. Many new products can have op to 40 % of reused zinc. [Peitersen, 2012]



Ill.247

The process of chosing materials starts with a study of colour applied to the building concept.



Ill.248

Ill.248

Grass on the roof, creates a sense of wanting to walk on it

Ill.249

Solar panels for producing energy

Ill.250

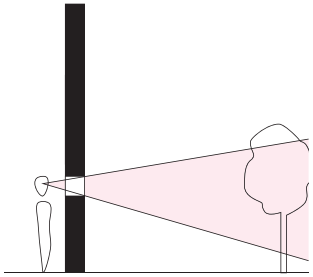
Wooden wall as an extension of the trees

Ill.251

Zinc on the facades facing the fooiball fields and the town,
to make a light expression

openings

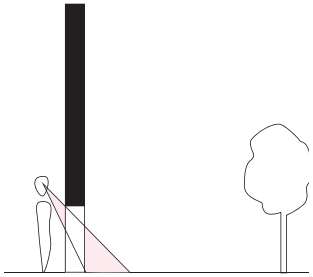
The height and placement of a window has a large impact on how the atmosphere is experienced within a room. But a window is not just a tool to control the indoor light conditions; it is also a possibility to create views. The placement of windows is based on a small study of how windows can be used to affect views. The intention is to create a connection between views and areas.



Ill.252

Ill.253

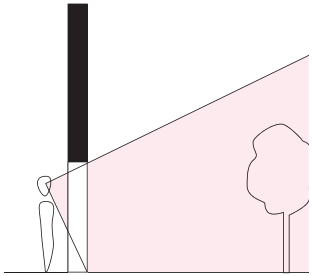
A narrow window with a size of a human head creates specific views, only focusing on a part of a whole. This can be used when emphasing a certain element on the outside, but also in creating specific atmospheres.



Ill.254

Ill.255

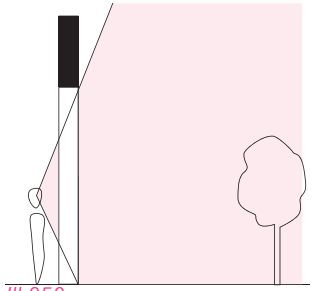
The second window is larger and placed by the floor - the focus is oriented towards the ground. It can be used when standing from a longer distance, so more of the view outside is shown, or for lighting purposes.



Ill.256

Ill.257

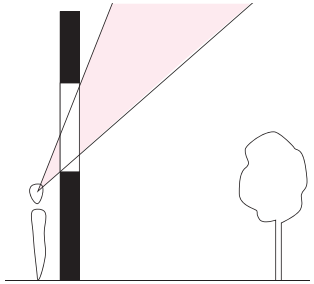
When having a window at the size of a person that starts from the ground, the view opens up and it is possible to see the earth, horizon and some part of the sky. If a unity in the context is to be shown, this is a possible solution.



Ill.258

Ill.259

When having a larger window, the same results are achieved as with the previous type of window. The only difference being that more of the sky is shown.



Ill.260

Ill.261

The last type of window is placed higher than a person, thus creating at view towards the sky. This type of view is normally very static and calming, due to the minimum of changes in the sky. In some circumstances it can also be very dramatic by the change of weather, signalled through the light and colours from such an opening. This type of window is very usable when more light is needed, because of the high placement, which sends light further into the room.

Conclusion

The context surrounding the multi-house has little variety. Therefore larger windows are primary used so the users have views they can relate to and place in the context.
The walls towards east and west are dissolved by larger windows. Their function is to connect the inside and outside, so that people on the outside can see what happens inside the building and likewise in the other direction. The aim is to make a parallel experience between the inside and outside spaes so that the arcade-like dilution of the walls becomes the primary visual and social interaction between users. By making larger windows the functions can be viewed in a unity, no matter if it is from the inside or outside.

Ill.262

window concept

The concept of the window placement is to pair two different ways of observing with two different types of views.

When one is observing a close context through a window it is neccesary to get a bit of a wider perspective to get a picture of what is happening outside.

When one is observing a big panoranic view through a window it is possible to imagine a total picture from small views, like bricks of a puzzle.

The multi-house has the longest view to the south (soccer fields) and to the north (main square and arrival road), so here it is chosen to use the views mensioned in the previous section (low, medium and high views) in creating fragments of the total panoramic picture. The verticallity of the window enable us to show bits of the sky, the horizon or the ground.

The views to the east west are typically somewhat shorter and more focused on showing people, buildings and life between those. The short views are a little wider and very tall to give the possibility to observe the outdoor fascilities in a bigger connection. It would be very hard to get a feeling of the living atmosphere (inside or outside), if one only has a small outlook and is not very close to the window.

Ill.263

Conceptual diagram of window layout

Ill.264

East facade: long disks split by windows

Discussed options of the south facade

Different windows designs. The top one is chosen to work with.

Ill.265

The process of selecting the window concept is intermingled aesthetical and technical considerations regarding window ares, orientation, shading and height. All parameters affect the energy consumption, the temperatures and the daylight factor in the space.

Of the options shown on the right the evaluation is, that the top and the bottom version makes the best fit for the architectural intentions. At the same time they are very flexible for opening the part of the facade, which makes sense for the indoor space and lighting conditions. The top version is chosen because of its similarity and coherency with the way the wooden disks are split up at the longsides of the building.

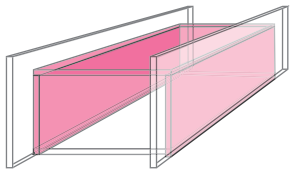
structural considerations

The conceptual design is based on frames and slaps, so it is evident to consider using this as a structural system. The challenges are a big span of the multi-hall at around 13m x 24m and the structure of the sports hall, where the existing construction is preserved. The sports hall, which has a span of 22m, is constructed by steel frames carrying a light roof. Due to the functions the construction will follows the same structure as the frames in the sports hall in the multi-hall.
The discussed options for structural systems are:

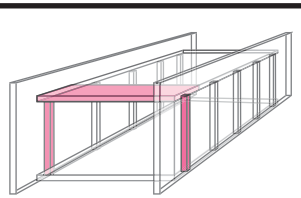
The structural considerations are:

- Disk-slap construction
- Inside frame construction
- Columns with slaps
- Disk - beam construction
- Column - beam construction

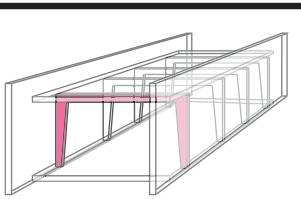
The structural principles are evaluated by, if they are realistic and if they are correspondent with the architectural intentions. A combination of two principles is chosen, one being a frame construction and another slaps combined with beams as is seen at ill.266. The multi-hall uses a steel frame structure as in the sports hall, due to the amount of weight this part shall carry. The rest of the multi-house uses wood columns with concrete slaps also illustrated in ill.266.



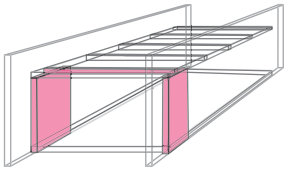
Disk - slap construction



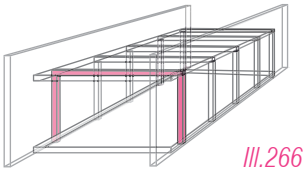
Column - slap construction



Frame construction

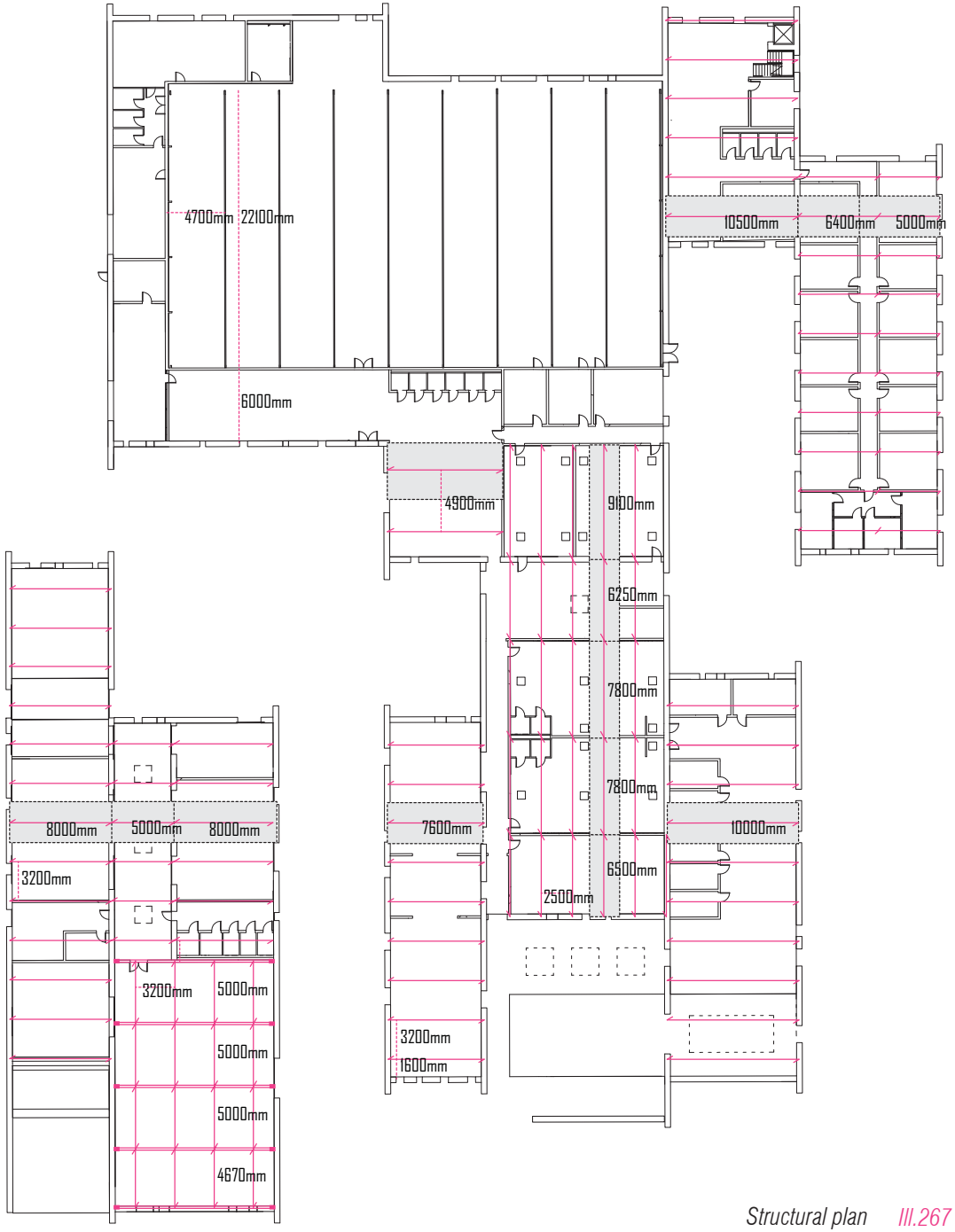


Disk - beam construction



Column - beam construction

III.266



Structural plan *III.267*

wind study

Aim

The wind is a relevant topic because the project site is relatively open and close to Limfjorden. Earlier analysis has shown that the wind primarily comes from the west, where the landscape has a minimum of barriers. The wind can easily gain high speeds, so it is important that the design prevents uncomfortable spaces. The purpose of the study is to collect information and inspiration for processing the site, volumes, outdoor spaces and ventilation.

Preconditions

In this case it is not possible to simulate the correct wind speed compared to a full size building. It is estimated that results are acceptable due to the correct shapes and context, which gives a relevant overview for the situation around and between the buildings.

Method

The wind flow is studied by blowing sand over the site, to see where shelters occur. Pictures are taken in equal intervals to document the results. The sand lays where shelters exist, or where the wind pressure changes direction. The directions of the wind depend of the building shapes. The aim is to indicate shelters and ventilation possibilities while planning the multi-house. Therefore two kind of studies are made one being the site without volumes to see how the wind effect the area, and one with the wind affects the new site planning to see how the new building volumes.

The site

The first study concerns the behavior of the wind in the close context. The sand is distributed evenly over the project site south of the sports hall. The topography has little influence on where the sand is situated, due to the smaller slope. Most of the sand lies at the western side of the sports hall, pushed up against it, which reveals that the sports hall functions as a barrier. On the eastern side a smaller amount of sand lies, which shows that the area is sheltered from the wind.

Volumes

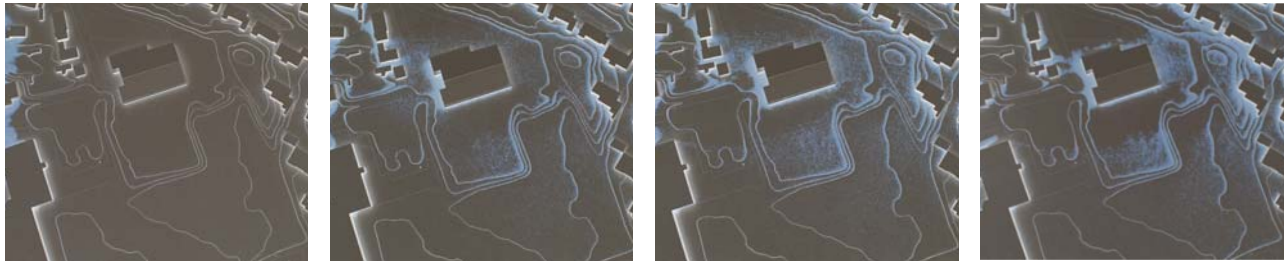
The second study concerns the behavior of the wind, when adding more volumes to the site. Volumes placed towards west functions as a windbreaker where the sand pushes up against it, leaving the areas behind it sheltered. After a while the sand has penetrated the small opening between the sports hall and the western volume leaving a pile of sand in the staying zones. This shows that the spaces around the volumes are sheltered in some degree. Further on, when the sand starts to disappear, it is possible to see the details of the wind around the corners. These places show that the wind is gathering in strength, forcing the wind around the corners. Especially the opening between the sports hall and the western building shows that the wind is maximized due to two wind directions that are combined.

Outdoor spaces

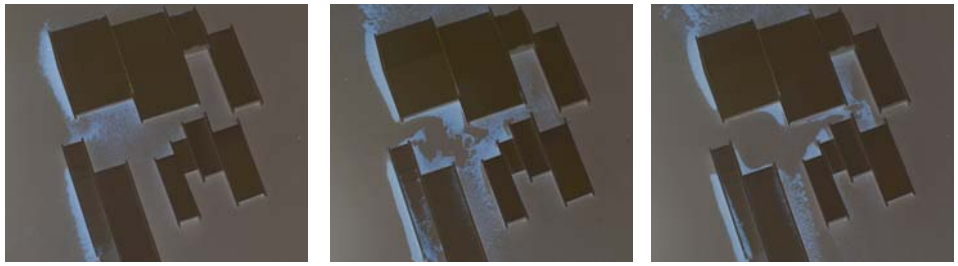
Spaces for staying or movement, has to be sheltered areas for people to enjoy the surroundings. In this case it is observed that the spaces within the garden and pool area are influenced a bit. The main staying zone is influenced by a constant moderate wind. The passage on the roof is influenced by the wind at a high degree, which can be used to emphasize the characteristics of the area.

Ventilation

The wind studies affect how the ventilation is formed within the building. The long facades towards the wind direction can be used for letting wind in, whereas the gable can let the wind out.



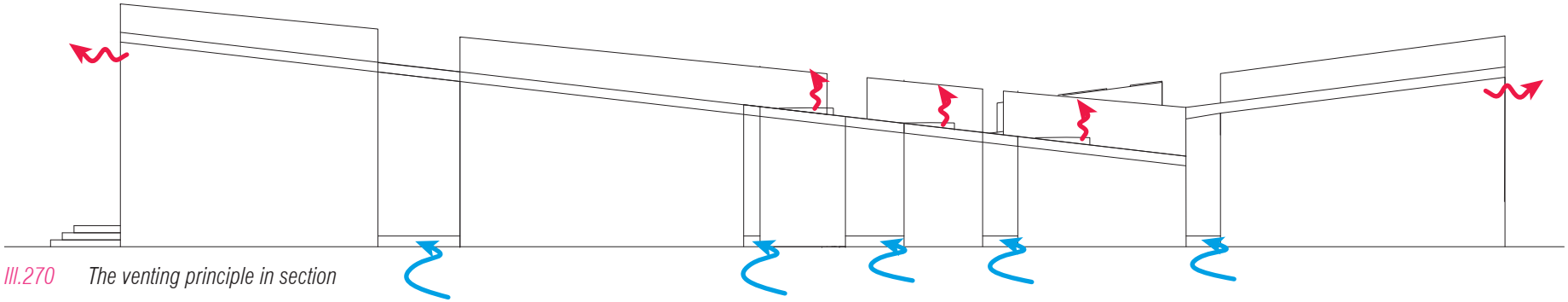
Ill.268 *Experiments of sand blown over the site*



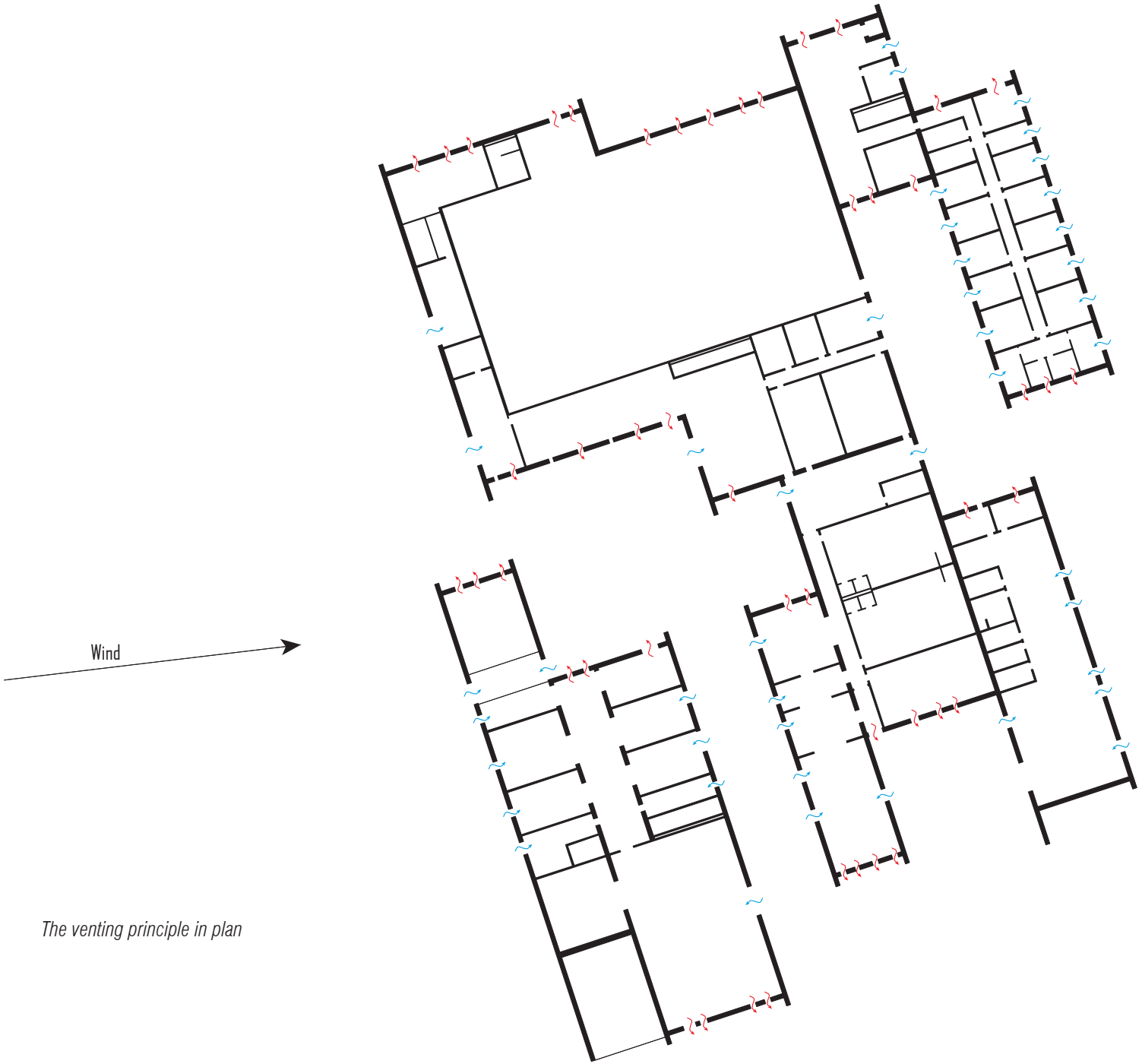
Ill.269 *Study of wind between, over and around building volumes*

ventilation principles

During the summer natural ventilation is used to regulate the inside temperature and create a fresh air supply. To implement this, the study of how the wind moves on the site is taken into consideration. Most of the buildings are two sided, and therefore fresh air is drawn in through low openings from the sides (east and vest, as the wind mostly comes from the west). The polluted air is removed through the tallest spaces of each building. The roof of all the buildings are angled in some degree and air is primarily removed from the space with the highest room height. In ill.270 and 271 it is possible to see how the ventilation functions in plan and in section. In some cases mechanical ventilation is used during the summer, but mechanical ventilation is often used in the winter period. This is elaborated in the text about indoor climate.



Ill.270 *The venting principle in section*



Ill.271 *The venting principle in plan*

indoor climate - cases

In the following three paragraphs the indoor climate investigated thriugh simulation in Bsim with a particular focus on overtemperature and CO_2 levels.
It is chosen to study five cases that are either expected to be critical or representative for many rooms in the multi-house.

The multi-hall

The multi-hall is chosen as it is a big room with multiple uses, but also a complex room regarding the indoor climate. It is of great importance that the room functions under different circumstances. A choice is made to look at two scenarios – one with minimum load and one with maximum load. Both scenarios complies a realistic use of the space.

- Scenario 1: moderate use during the whole opening time.
- Scenario 2: moderate use during the day, two hours of preparation in the evening followed by three hours of concert.

The fitnes centre

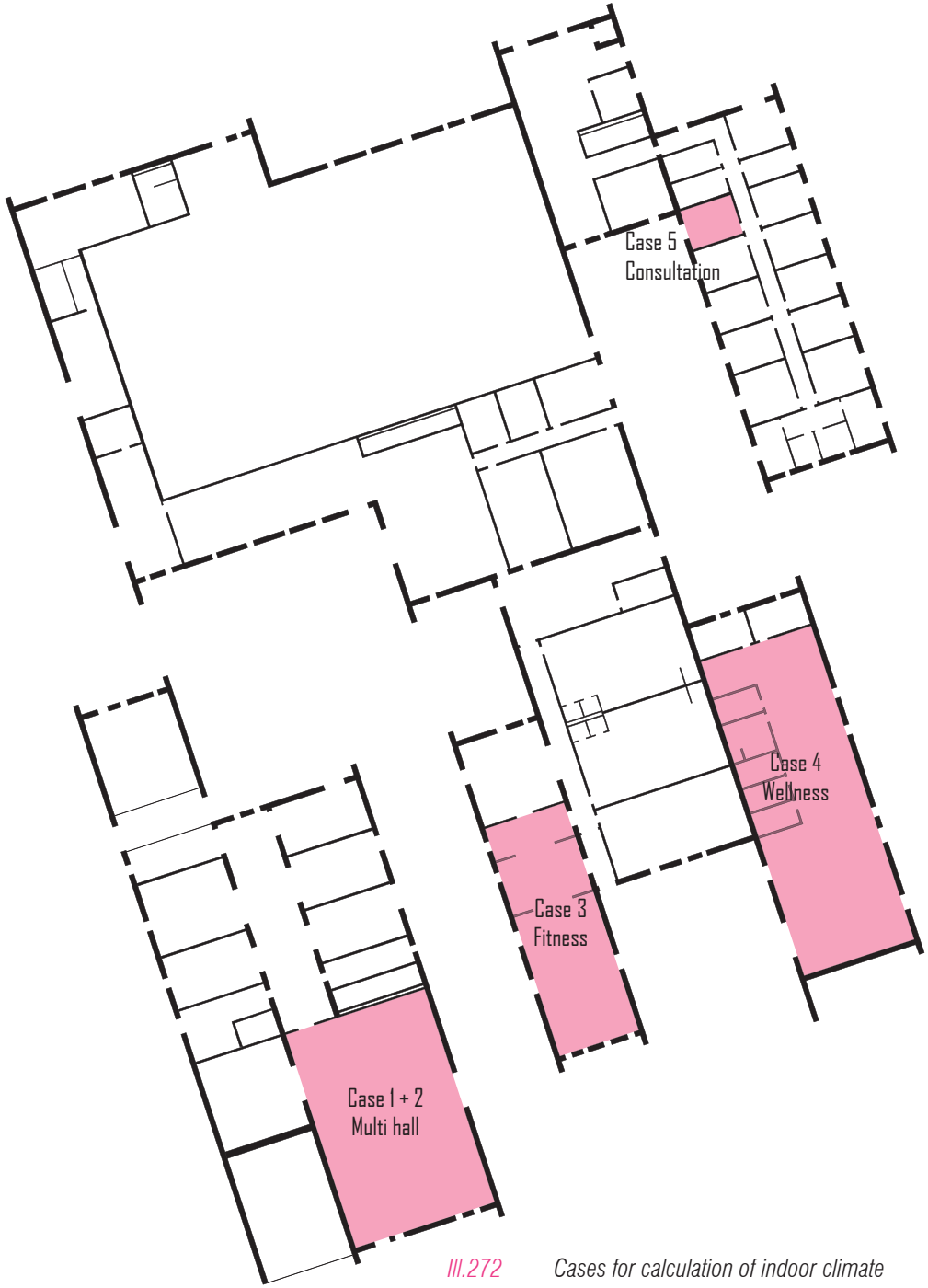
The second study deals with the fitness centre. It is expected that this room will pose a challenge for keeping down the temperature, so that this fits the comfort for performing on a higher activity level. The room is calculated with a maximum load, being half people load during the common working hours and full load during the afternoon and evening. This is believed to be a realistic maximum load scenario.

The wellness area

The third room of particular interest is the big room in the wellness centre. The many external factors that play a role in this room may give some insight to discuss. The room has a pool of a constant temperature that will affect the results. Furthermore an opening exists to the outdoor pool; this will contribute to the natural ventilation, but will also result in heat loss during spring and autumn.

The consultation

The fourth room is a doctor's consultation, which is a room with proportions of common occurrence in the multi-house. Due to this it is seen as a representative for many rooms. The health centre is considered to be closed in the weekend, so indoor climate is only important during weekdays. The calculated room is just 20 m2 and has a window to the west, which may give problems in relation to overheating. In the specific case though, the window is shaded by a building to the west, so the problem is considered to be controlable.



III.272 *Cases for calculation of indoor climate*

indoor climate - process

The process of optimising the indoor climate is reflected in the result scheme, and the detailed process is described in enclosure J. The aim of the initiating process is to investigate five cases to find out which spaces are critical and in which way. It is discovered that the spaces have different problematics: The multi-hall gets too cold, the fitness and wellness centre gets too warm and the consultation has problems with overheating and CO_2 levels.

As mentioned before, there are many things influencing whether a building is comfortable. Here the focused is on temperatures and CO_2 levels, due to the chosen demands that can be held against the results. The aim is to make the multi-house comply with the BR2011 (7.2.1 stk 13) demands for building class 2020. This implies that the building may not exceed more than 100 hours above 26^{o}C a year and no more than 25 hours above 27^{o}C a year. The CO_2 level must stay below 900ppm.

In all spaces the temperature have been difficult to reduce, so there are no more than 25 hours above 27^{o}C a year. The solution found is to have less window areas, tests show that this does not combine with the architectural ambitions and wished daylight level. The permitted maximum of 100 hours above 26^{o}C has been easier to meet. It is chosen to minimize the hours above 27^{o}C as much as possible with ventilation, and then optimize by adjusting window areas within an acceptable range.

During the process all cases are optimised through several variable systems. Each system is based on a worst case schedule so it is verified that the building can withstand maximum strain on the indoor climate and still be a good space. The following variables have been used to regulate the indoor climate:

Heating: Mainly held up against the energy consumption.

Ventilation: Is measured against energy usage, quality of comfort and in minor degree architectural considerations.

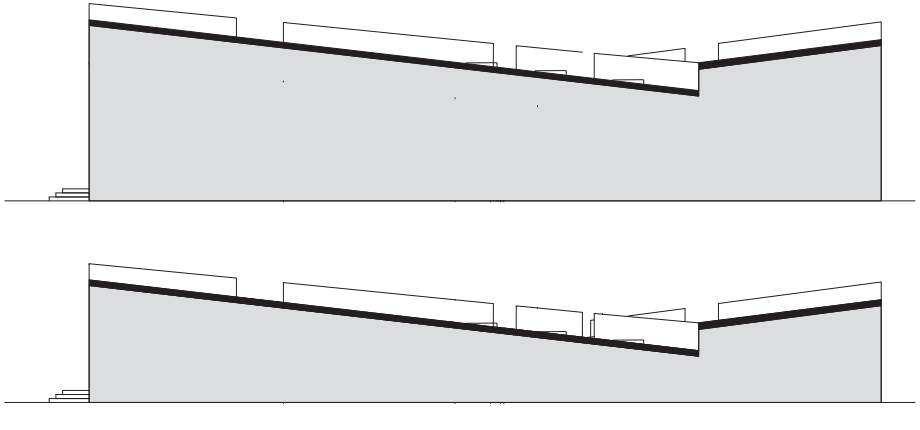
Shading: Mainly held up against the architectural wishes for the facade and the efficiency of shading in different directions.
Window areas: Efficient when regulating room temperatures. In general larger windows towards south results in easily accessible heating during winter but difficulties when cooling in the summer, though it is controllable by shading. Windows to east and west are more problematic to shade because of low solar altitude. The window areas and their orientation are mainly measured against the inlet of light, the atmosphere inside a room, the facade expression, the temperatures and energy consumption.

Venting: Efficient to level the temperature. The venting principle is derived from the building shape and considerations of how the warm air is transported out of the building, and how cool fresh air is drawn inside. That being said the natural ventilation in “Bsim” is mostly weighted against an estimate of a possible achieved air change and comfort genes, which includes draft from open windows.

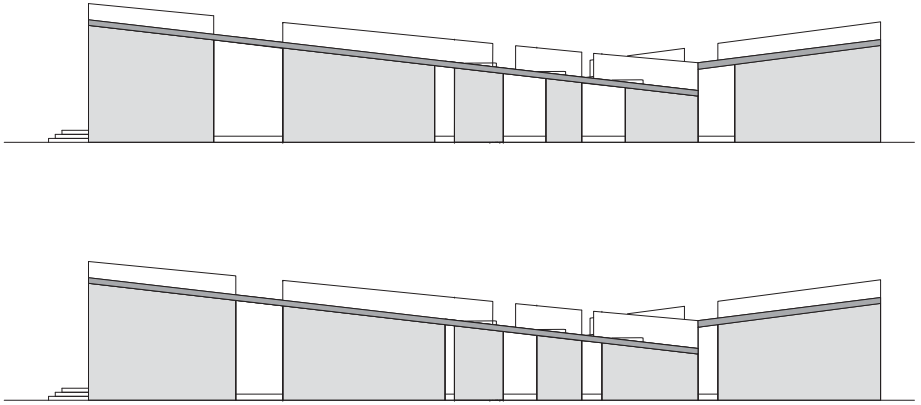
Window openings: The placement and size of window openings are mainly seen in relation to the amount of possible air inlet. Also architectural considerations are made to find out how the divisions can be.

The more fixed systems are:

- Lighting: The amount is decided by the wish for average daylight conditions in each room. Light is turned on when optimal conditions are not fulfilled with natural light.
- Infiltration: This is the unintended air change happening through the construction, which can only be controlled through the density and leakage points of the building envelope. New buildings are considered to be very tight, and the air change through leakage must not exceed 0,5 l/s pr. m² at 50Pa
- Construction: The construction, or actually the insulation thickness, has impact on especially the energy consumption but also room temperatures. This however is already from the beginning of the calculations adjusted, so that the building has a relative thick layer of efficient insulation material, therefore this is not adjusted later on.



Building changed in height to decrease the need for heating



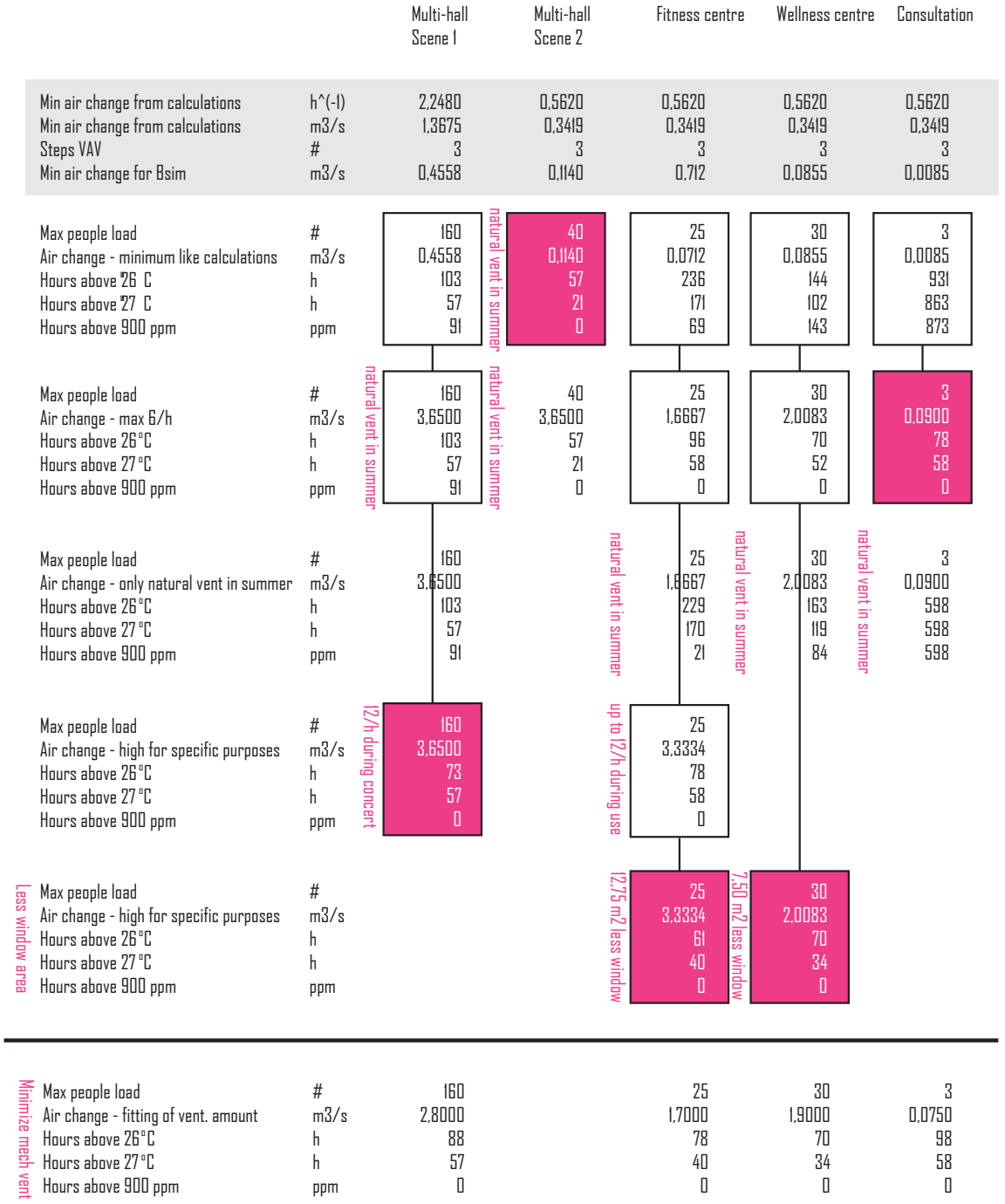
The windows is minimized to reduce the heat gain. *Ill.273*

indoor climate - results and discussion

It is found unrealistic to reach below 25 hours of 27^{O}C a year for the chosen cases, because the choice is made to not decrease the window areas more than already done during the process. In the worst case the amount of hours above 27^{O}C is at 58 hours. All spaces are far below the other two demands of not exceeding 100 hours of 26^{O}C a year and max 900ppm in CO_2 level. It is further chosen to decrease the mechanical ventilation as much as possible, while staying well within the demand of 100 hours below 26^{O}C. This decreases the energy consumed on mechanically extracting hot air from the three spaces, which uses that.
The most efficient parameters regarding overheating, in relation to energy consumption, is ventilation and solar gain. This affects the architecture and therefore a cycle of redesigning the openings and volume has been made.

1. Estimations is made through calculations
2. Daylight conditions is evaluated in “Ecotect”
3. Architectural qualities and intentions are re-evaluated and window areas are adjusted
4. New estimations are made in “Bsim”

The simplified version, of what this process has done to the architecture, is that some window openings to the east and west have become narrower. This confirms the atmosphere through the use of light and simultaneously decreases overheating. The windows to the north and south have changed appearance several times during this process and are therefore difficult to compare. Overall they have become slightly bigger, without changing the inside temperature radically. The main criteria’s has been the specific views from inside the building.



IThis and similat diagrames in the report show a technical process. The pink boxes show the final results, while the white boxes show steps on the path of getting there. Thouse without a box is a failed attempt in the progress.

III.274

indoor climate during the year

To study the indoor climate in greater detail, it is chosen to take a look at the multi-hall, scenary 1, concerning the temperatures, the CO2-level, the need for mechanical ventilation and the natural ventilation possible to get in through the window openings. In the graphs show these over the year, and for chosen weeks in the four seasons, to gain information on how it feels to be in the building.

Temperature [^{o}C]

Looking at the graph the temperature inside the multi-hall varies from about 20,9^{o}C during winter to 22,3^{o}C during summer. These are average values, so it is much more interesting to look at the temperatures at a weekly basis. The temperature is generally stabile at the weeks were the heating system and the mechanical ventilation is regulating the temperature at 21^{o}C. That the temperature is slightly lower in the afternoon and evening, probably because the mechanical ventilation is only running in the time of use. The temperature rises in the late evening because of excessive use during a concert. In the summer, when only natural ventilation and no heating is regulating the temperature, there is a much bigger deviantion in temperature. The temperatures seem to be a little lower during and after the weekend, when the room is not in use.

CO_2 level [ppm]

The carbondioxide level in the multi-hall is relatively constant during the year varying from 440ppm to 550ppm. The highest level is in the summer months June, July and August. On a daily basis the CO_2 level rises dramatically during the concert at 9pm and takes until the next morning to fall into the level of normal moderate use. The CO_2 level is not a big problem, as the room is rather big and tall and because the use during the working hours is moderate. After the most strained time in the evening the building has a long night to reach the nornal level of CO_2 concentration again.

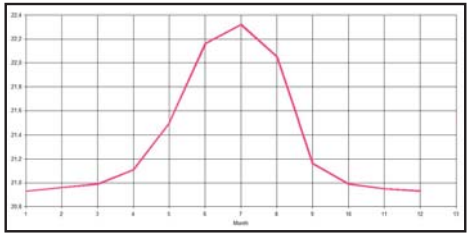
Total air change [h^{-1}]

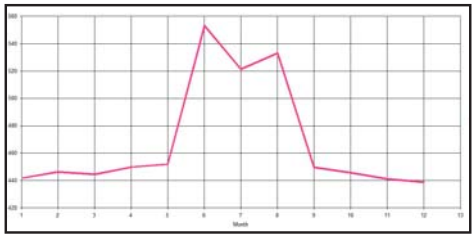
The need for ventilation is regulated by mechanical ventilation in the winter, spring and autumn. The total airchange is less than half in the winter compared to the summer. In the summer the air quality is regulated by natural ventilation only, except for the three hours of concert from 9pm til midnight. Here the need for ventilation is suddenly much higher (12/h), because of overtemperatures compared to the same three hours of concert in the winter, spring and autumn. The rest of the airchange, seen in the graph for week 28, is the airhchange from natural ventilation. This is equivilent with the graphs below, which show how much air can come in through the window openings. In the rest of the year the mechanical ventilation turns on before midday and is in use the rest of the time. The ventilation looks to have only one step (off or on) and a satisfying explaination is not found for this, as the mechanical venlilation is set to have 3 steps in Bsim.

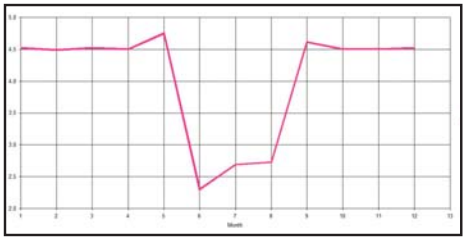
Natural ventilation [m^3/s]

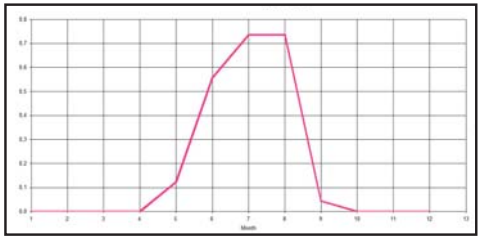
These graphs are conserning how much air can get through the window openings. This natural venting exceeds the three summer months as it is also used to regulate the temperature on warm spring and autumn days. If one looks at the 28th week in July, it is clear that this approximately follows the need for neccesary airchange from the graph above. Together with the graph for temperatures this is a good sign that the window has big enough openings for letting in the needed air.

Over the year 2012







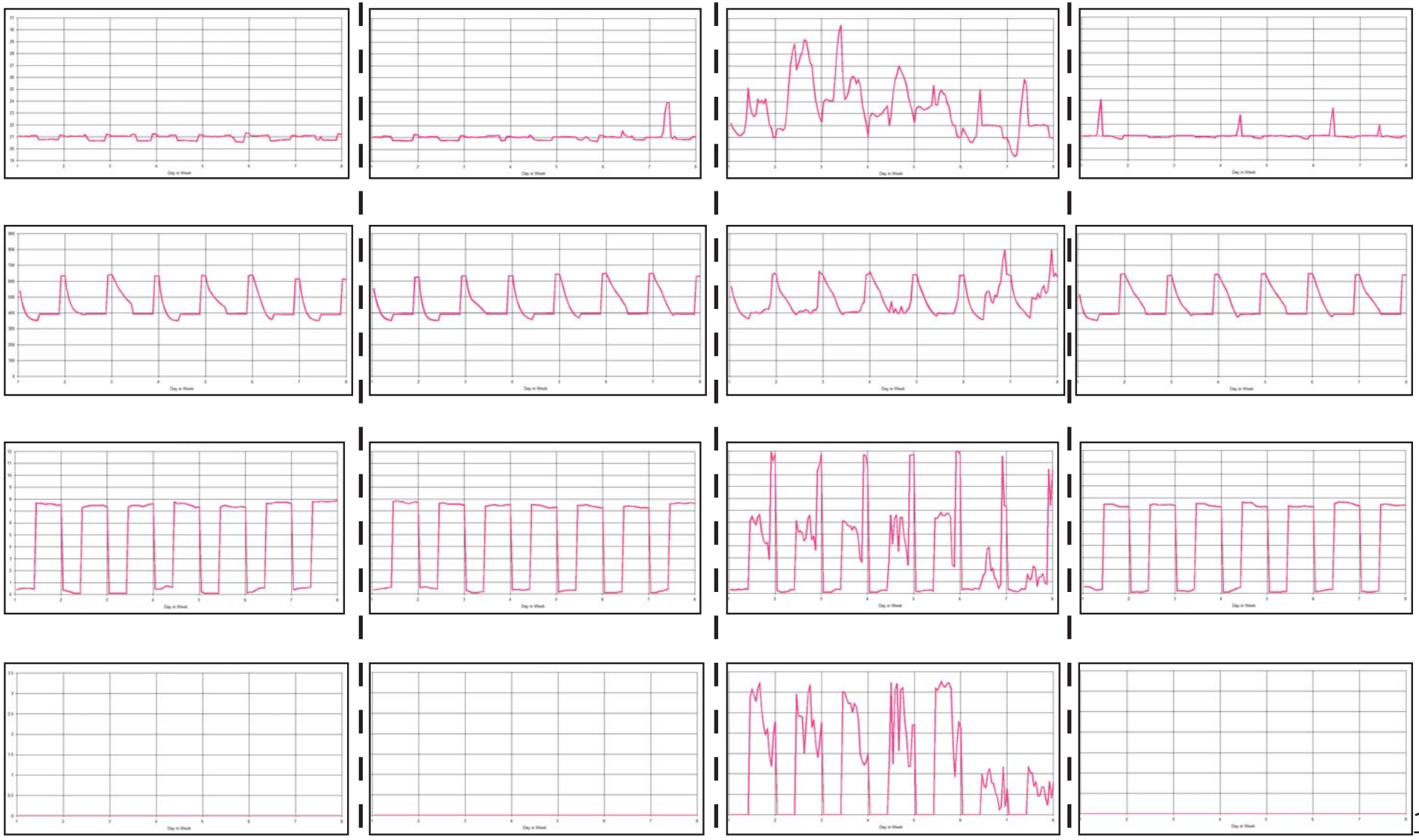


Week 2, winter 2012

Week 15, spring 2012

Week 28, summer 2012

Week 41, autumn 2012



Ill.275

energy consumption

To adjust the energy consumption of the multi-house, calculations are performed on three different buildings; the health centre, the activity centre and third being the multi-centre. Calculations are not performed on the existing hall, because it is not a priority in this project. The concept is along the way based on studies regarding:

- How to place the volumes to benefit from the wind for ventilation
- Volume making regarding aesthetics but also to optimise the indoor climate
- Types of: Insulation, wall thickness, materials, windows to minimise heat loss.

Every individual case is based on the same gross and roof area. The values for linear thermal transmittance, lighting, people load, hot water and ventilation are also the same for each case. The ventilation differs in some cases, when the room height differs. The variables when calculating energy consumption are the surface of the walls, window areas and shading. The goal is to ensure the multi-house complies with the demands for 2020, where energy consumption must be less than 25.0 kWh/m^2 year.
The variables used to influent the energy consumption is the building volume that can be increased or decreased for instants to affect the temperature. The direction and size of windows are also used to control how much light and heat gain the building. Another factor to control the supply of light and heat is by adding more or less shadows in this case by trees. The process has been iterative so decisions made earlier have to be adjusted to meet the demands for 2020.
As seen in ill.137 there is made a stepwise process, so the progress for each case can be followed.

Multi-hall

The case starts with a design with a large room height and much surface for windows. No shading exists in form of trees, only the existing buildings. These parameters result in overheating during the summer but increase the need of heating during the winter period.
Next the room height is decreased, so less volume is needed to be heated and cooled. Also trees are added for shading purposes during the summer. This decreases the use of heating and cooling so the energy consumption is lowered.
The last action is minimising and orientating the window areas so heat loss and gain are adapted to summer and winter time. This results in less heating and cooling demands while achieving an energy consumption of only 25 kWh/m^2 year.

Fitness and Wellness centre

From step two to three more room height has been added due to aesthetics, while the window area is minimised. When having more volume relative to window area the building does not get overheated as easily. The situation does not affect the need for heating during the winter period. Much of the building area is for active purposes, which produce a lot of heat and therefore don't need as high a temperature as some of the other functions.
The primary changes in this case is minimising and orienting the window areas and adjusting the building height. The end result shown in the scheme is 24.5 kWh/m^2 year.

Health centre

The building height is the same through the entire case, due to that the building is based on a minimum height. The changes lie within the window sizes and shading. In step two more window area is added, while adding shading in form of trees to prevent overheating. This has been done to reduce the need for room heating and cooling, which helps lowering the total energy consumption. To minimise the consumption further in the last step, the window areas has been reduced slightly again, so heating is lowered. With adjustments a total energy consumption of 24.1 kWh/m^2 year is reached.

	Multi-hall	Fitness and Wellness centre	Health centre
Hot water	5.3	15.8	5.3
Electricity for building operations	11.4	8.3	9.4
Area:			
Floor (m^2)	1044	1658.57	823.14
Roof (m^2)	959.26	1458.57	627.62
Area:			
Exterior walls (m^2)	1339.84	969.9	640.54
Window (m^2)	253,88	191.9	121.04
Adding shading in form of trees	No	No	No
Results:			
Energy needs (kWh/m^2 year)	46.6	29.6	36.5
Heating	15.4	24.6	14.7
Room heating	10.1	8.8	9.5
exceeding temperature	17.6	1.1	10.7
Area:			
Exterior walls (m^2)	772.1	839.66	640.54
Windows (m^2)	253.88	196.7	165.08
Adding shading in form of trees	Yes	No	Yes
Results:			
Energy needs (kWh/m^2 year)	26.3	28.9	25.3
Heating	9.6	17.9	14
Room heating	4.4	2.2	8.8
exceeding temperature	0	5.1	0
Area:			
Exterior walls (m^2)	772.1	935.08	640.54
Windows (m^2)	141.44	130.42	123.92
Adding shading in form of trees	Yes	No	Yes
Results:			
Energy needs (kWh/m^2 year)	25	24.5	24.1
Heating	7.5	15.9	12.1
Room heating	2.2	0.1	6.9
exceeding temperature	0	0	0

III.276

solar panels

Solar cells

To minimize the use of energy produced from power plants the use of solar cells are investigated as an alternative and sustainable energy source.

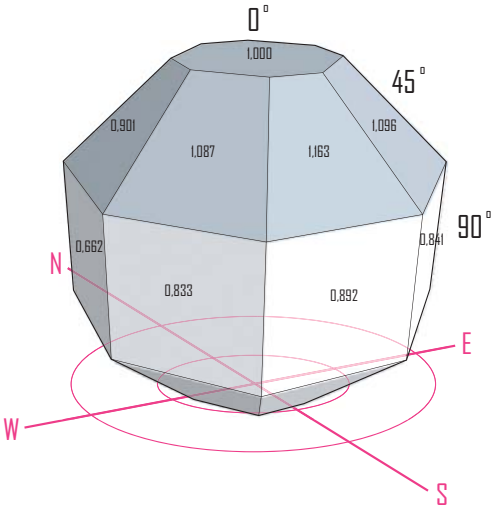
Selected areas

The multi-house is designed so that most roof areas evident for using solar cells. The optimal placement of solar cells is roofs, which are angled towards the south. All roofs have the direction SSE or NNW, so roofs of the first case would give the solar cells an acceptable efficiency. This involves half the roof of the sports hall, of the creative spaces, of the wellness centre and of the staff areas on the first floor. In addition to that the flat roofs of the changing rooms and consultations can also be used for solar cells. The angle of all roofs, except for the sports hall, are small enough for calculating the performance of the cells as a flat roof (all $7{,}47^0$ or below). This gives an acceptable efficiency of the solar cells, without compromising the expression of the multi-house through the use of angled solar cells.

The choice lies between monocrystalline cells, polycrystalline cells and amorphous cells. Crystalline cells are the most efficient under optimal circumstances, meaning in no shade and a fairly clear sky. These are also less space consuming than the amorphous cells. A problem with these cells though is in a broad perspective, that the demands exceed the possibility of producing the pure crystalline silicon of which they are made. This may result in more stresses on the environment. Amorphous solar cells does not depend on silicon, but currently they have a somewhat lower efficiency. The development is fast though, as they are considerably cheaper and easier to apply and to maintain. Amorphous cells produce better in diffuse light, which makes the production start at sunrise and end at sunset. This is furthermore an advantage in a country such as Denmark where the sunlight often is diffuse because of clouds. [katic, 2000] The manufacturer, Nanosolar, has successfully experimented with ink made of Copper, Indium, Gallium and Selenium in not fabricating solar films, but printing them directly on a surface. This gives a low cost and impressively high efficiency. (kilde) These solar films has been in the market since 2010 and might become the future of cost-low high performance panels, when developed even further. [nanosolar, 2012] Mainly because of the cost and maintenance advantages the amorphous solar cells are chosen for the multi-house.

Results

The project has a large surface area where it is possible to apply solar cells which gives a good yearly performance. The results show, that the large roofs of the sports hall and the activity centre, produces very well. The culture centre does not produce as much because of moderate shade during the morning hours.



The efficiency of the solar cells are dependent of the angle of deviation from south and of the angle of deviation from 45 degrees of declination of the roof.

III.277

		Sports-hall	Culture centre	Activity centre	Health centre	Total performance
Roof area	m2	1704	959	1459	638	6218
A: Area of solar cells	m2	836	485	1120	420	2862
Part for solar cells	%	49,1	50,6	76,8	65,9	46,0
Roof angle	degrees	17,14	7,47	(close to 0)	0	(various)
Monocrystaline solar cells						
B: Modulefficiency degree	%	15	15	15	15	
- High efficiency crystaline cell						
C: Installed effect	kW peak	63,00	72,80	167,97	63,00	
D: Evaluation of system factor		0,75	0,55	0,7	0,75	
E: Solar radiation	kWh/m2	999	999	999	999	
Yearly performance	kWh/year	47203	40001	117461	47203	304196
Yearly performance per m2	kWh/m2 pr year	112,4	82,4	104,9	112,4	526,5
Amorphous solar cells						
B]: Modulefficiency degree	%	9	9	9	9	
- High efficiency amorphous cell						
C: Installed effect	kW peak	75,28	43,68	100,78	37,80	
D: Evaluation of system factor		0,75	0,55	0,7	0,75	
E: Solar radiation	kWh/m2	1084	999	999	999	
Yearly performance	kWh/year	61202	24001	70477	28322	182518
Yearly performance per m2	kWh/m2 pr year	73,2	49,5	62,9	67,4	315,9

Comparison to the energy use						
Total energy use for respective building	kWh/year	-	26100,0	40645,5	19834.3	86579,8
Yearly performance mono cells	kWh/year	47203	40001	117461	47203	304196
Yearly performance amorphous cells	kWh/year	61202	24001	70477	28322	182518
Percentage covered by mono cells	%	-	153	289	238	*227
Percentage covered by amorpheous cells	%	-	92	173	143	*136

III.278

* The energy use of the sports-hall is not included in this persentage, which is an average value for the energy covered by solar cells for the culture, the activity and health centre. The sports hall is considered to be even more productive with its big south directed roof.

sunlight

If a room is used for a specific purpose, then the amount of daylight is an important parameter for the indoor climate. The necessary amount of light, lux, varies in correlation with functions, so working with a high level of detailing often needs more light. A correct amount of light ensures that people easily are able to see what appends in a room.
As starting point it is estimated that every function needs at least 200 lux to function. This is equivalent to a working space in a school or consultation room. (DSA,2005) It is a goal to reach a minimum of 200 lux in every room by using natural lighting, this way the need for electric lighting is minimised during the day.

Cases:

Three cases are evaluated for the use of daylight; the culture centre, the fitness room and a consultation room. The results are based on a cloudy day, so a day in the summer with no clouds will benefit the result, whereas a day during winter without clouds can have adversely affects.

The culture centre

The building is used during day and evening. The multi-hall has to be suitable for different arrangements and the creative spaces need good lighting for painting, sculpturing etc. The daylight has to be flexible in the multi-hall to meet the needs of the functions, so when having concerts or exhibitions the light can be lowered or increased. The variety within the function areas, and the specific need of daylight, is the reason for illustrating the entire building.
In general the entire building meets the demands of a daylight factor of 200 lux. The only place where this is not achieved is the toilets; here artificial lighting will be needed.

The foyer has a lux level at 750 due to the openness in both ends. This makes it suitable for both presenting detailed work and for being a reception.
The creative spaces are well lit with an average lux level above 200. The lux level varies from 200lux to 1000lux making the rooms suitable both for detailing and more traditional work.
The multi-hall has an even distributed light at approximate 300lux, which makes it suitable for different arrangements such as exhibitions, concerts or presentations.

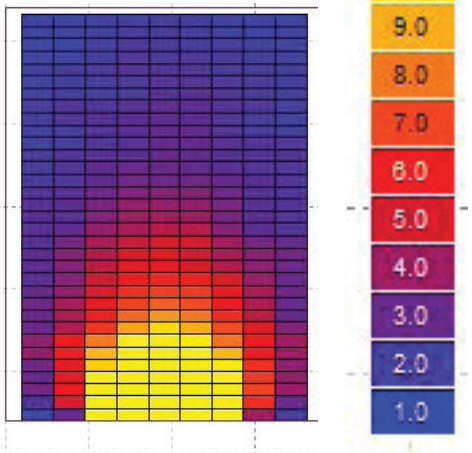
The fitness room

In the fitness room it is preferred to have diffused lighting that is even distributed. It is chosen to calculate on the fitness room due to the high activity level and the possibilities for overheating, which has influenced the size of the windows.
The lux level in the fitness centre is more varied than in the multi-hall. In general there is an average of 300lux, but close to the windows around 700lux, which is unnecessary for performing exercises. Therefore it is possible to reduce the amount of sunlight by using shading, which brings down the temperature and decrease the possibility of overheating. Also it helps avoiding direct sun in the room.

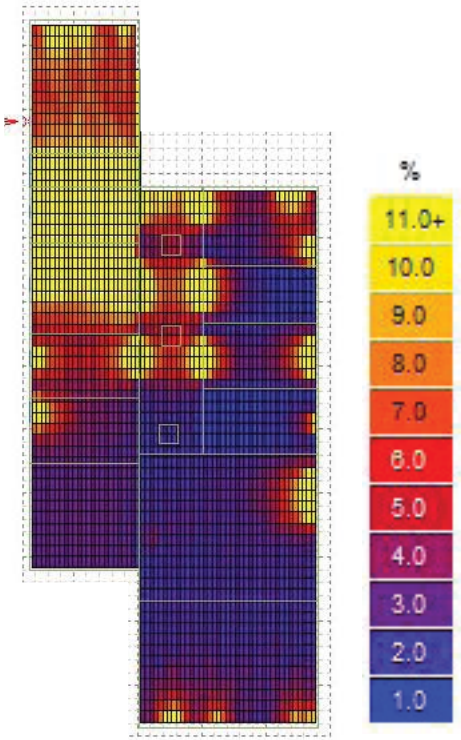
The consultation room

In the consultation room an even light distribution is preferred. The case is based on a consultation room with a low amount of sunlight.
The consultation meets the demands of 200lux as the lowest level, and manages a lux level of 700 in the working zone.

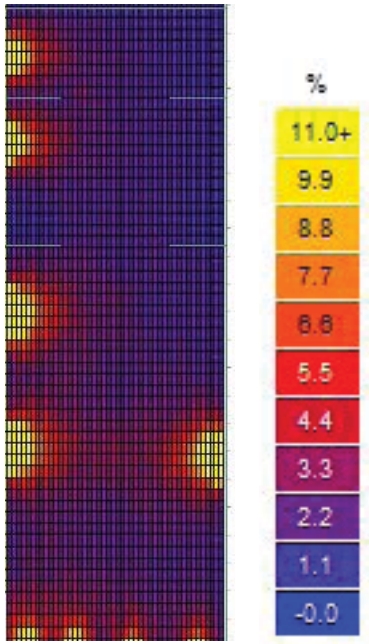
Ill.279



Daylight factor for a consultation room, indicated in percentage. 1% equals 100 lux.



Daylight factor for the culture centre, indicated in percentage.



Daylight factor for the fitness room, indicated in percentage.

acoustics

Many things influence ones opinion regarding how comfortable a particular room is, some of these parameters are the room temperature, acoustics, light and CO_2 level. The experience of optimal acoustics depends on the usage of a room. It is easier to make a room with comfortable acoustics when the room is only used for one purpose. When having a space like the multi-hall, that has to be used for several things like concerts, exhibitions, lectures or gymnastics it gets difficult due to the necessary flexibility. Within acoustics several things influence whether the conditions is considered to be acceptable. Some of those are the echo, background noise, volume, sound distribution and reverberation time. Especially the reverberation time are close combined with the consideration of good acoustics. Reverberation time is primarily affected by the materials and surfaces in a room. (Troldtect, 2012)

To ensure a good acoustics environment calculations are made on three different cases. First case being the multi-hall due to the flexibility, second the fitness centre due to the noise from people, machines and music and third the dance studio due to the constant music and speech. All cases are calculated with a minimum amount of people being zero, and a maximum amount of people.

Ill. 280 show a selection of absorption coefficients regarding different types of functions. Ill. 282 is a sheme of the results of the different cases are shown.

Case 1: Multi-hall

The reverberation time varies from 1.04 to 1.95 seconds without people, and from 0.86 to 1.72 seconds in worst case with 160 people. When no people are in the room the sound don't decay as fast compared to the full room. In general the room is too sound absorbent considering the room has to be used for other activities than concerts like lectures. Though when having a room with the size of the multi-hall, with seats for 160 people, it is expected for a lecturer to use a microphone, which improves the sound in the back. The room is also suitable for exhibitions where people can talk without influencing others. Generally the reverberation time are considered to be reasonable for the activities in the multi-hall when the span covers both talking and music.

Case 2: Fitness centre

When no people are in the room, the reverberation time varies from 0.49 to 0.97 seconds. With 25 people it varies from 0.47 to 0.95 seconds. The results show a rapidly decay in sound absorption which fits the function, being a place where many machines, people and music creates a lot of noise.

Case 3: Dance studio

In this case the reverberation time varies from 0.28 to 0.78seconds with no people and 0.25 to 0.71seconds with 30 people. The optimal atmosphere is a quiet calm place where it is possible to focus on steps and movement to music, which consist with the results. Music played in this room is often from a CD, where the music already has been exposed to environments and therefore is not as affected by this room.

Absorption coefficient	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Polished concrete	0.01	0.01	0.02	0.02	0.02	0.05
Wood panels	0.30	0.25	0.20	0.17	0.15	0.10
Rubber floring on concrete	0.09	0.08	0.21	0.26	0.27	0.37
Plasterboard	0.30	0.12	0.08	0.06	0.06	0.05
Glass	0.10	0.07	0.05	0.03	0.02	0.02
Persons	0.16	0.24	0.48	0.52	0.55	0.45

Ill.280

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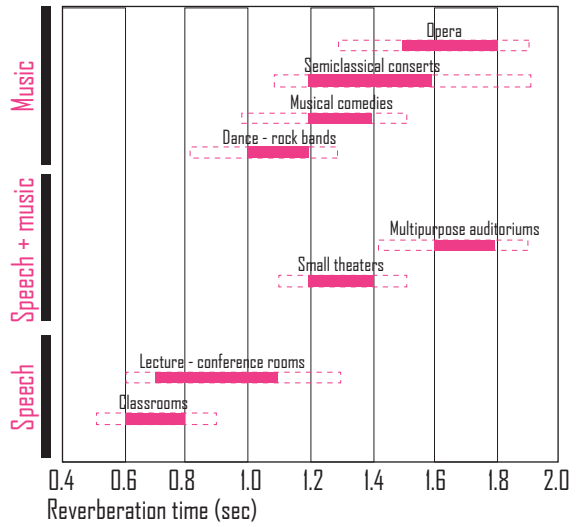


III.281

Multi-hall

Length (m)	Height (m)	Width(m)	Roof (m²)	Floor (m²)	Volume (m³)
21.6	8	14	302.4	302.4	2419.2

Reverberation time

	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Rubber floring on concrete	27.22	24.19	63.50	78.62	81.65	111.89
Wood panels	103.68	86.40	69.12	58.75	51.84	34.56
Plasterboard wall	67.2	156.80	224.00	201.60	212.80	224.00
Plasterboard celing	90.72	211.68	302.40	272.16	287.28	302.40
Total effective area:	198.10	267.39	356.62	338.98	346.29	370.45
Reverberation time:	1.95	1.45	1.09	1.14	1.12	1.04
Max 160 Persons	27.20	40.00	80.00	88.00	96.00	80.00
Total effective area with pers.	225.30	307.39	436.62	426.98	442.29	450.45
Reverberation time:	1.72	1.26	0.89	0.91	0.88	0.86

III.282

Dance studio

Length (m)	Height (m)	Width(m)	Roof (m²)	Floor (m²)	Volume (m³)
13.5	2.5	6.9	93.15	93.15	232.88

Reverberation time

	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Polished concrete	0.93	0.93	1.86	1.86	1.86	4.66
Wood panels	5.18	4.31	3.45	2.93	2.59	1.73
Glass	3.38	2.36	1.69	1.01	0.68	0.68
Plasterboard wall	10.13	23.63	33.75	30.38	32.06	33.75
Plasterboard celing	27.95	65.21	93.15	83.84	88.49	93.15
Concrete	0.17	0,39	0,278	0,31	0,30	0,28
Total effective area:	47,73	96.61	134.25	120.36	126.03	134.82
Reverberation time:	0.78	0.39	0.28	0.31	0.30	0.28
Max 30 Persons	4.80	7.20	14.40	15.60	16.50	13.50
Total effective area with pers.	52.53	103.81	148.65	135.96	142.53	148.32
Reverberation time:	0.71	0.36	0.25	0.27	0.26	0.25

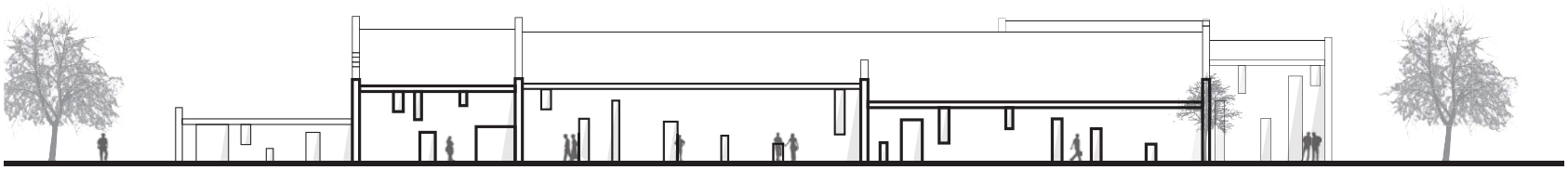
Fitness centre

Length (m)	Height (m)	Width(m)	Roof (m²)	Floor (m²)	Volume (m³)
22.9	5	8	183.2	183.2	916

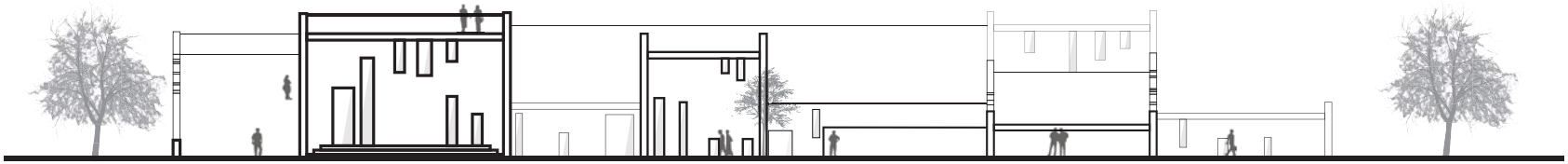
Reverberation time

	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Rubber floring on concrete	7.33	7.33	9.16	9.16	5.50	3.66
Wood panels	68.70	57.25	45.80	38.93	34.35	22.90
Plasterboard wall	18.60	43.40	62.00	55.80	58.90	62.00
Plasterboard celing	54.96	128.24	183.20	164.88	174.04	183.20
Concrete	0.40	0.40	0.80	0.80	0.80	2.00
Total effective area:	149.99	36.62	300.96	269.57	273.59	273.76
Reverberation time:	0.97	0.62	0.49	0.54	0.54	0.54
Max 25 Persons	4.00	6.00	12.00	13.00	13.75	11.25
Total effective area with pers.	153,99	236.62	300.96	269.57	273,59	285.01
Reverberation time:	0.95	0.60	0.47	0.52	0.51	0.51

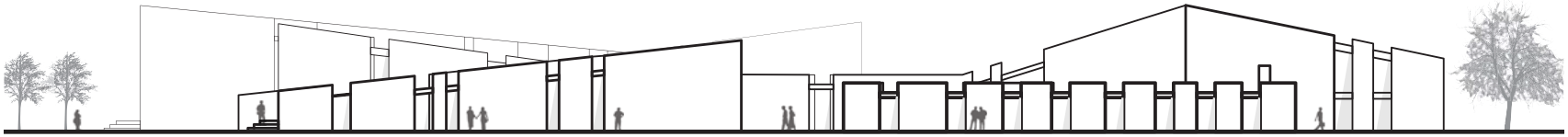
conclusion



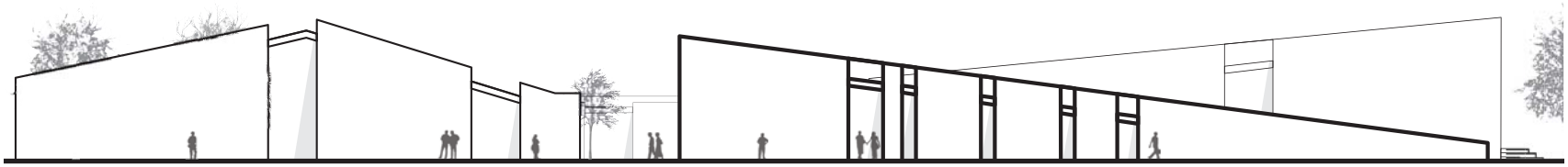
Ill.283 North facade 1:500



Ill.284 South facade 1:500



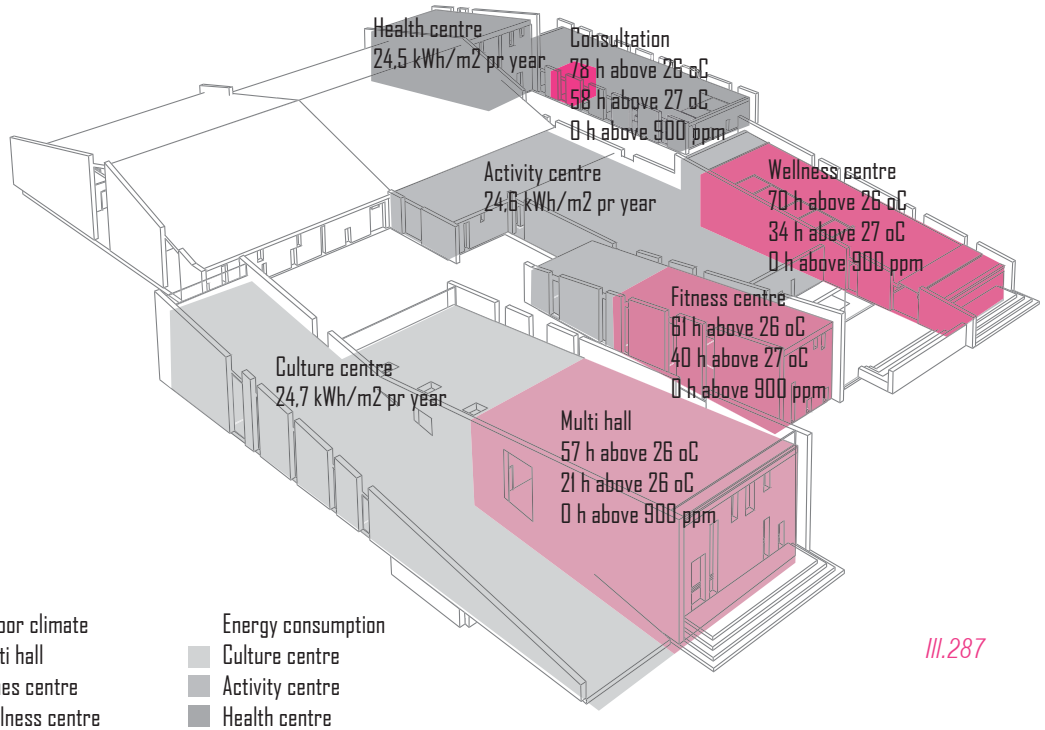
Ill.285 East facade 1:500



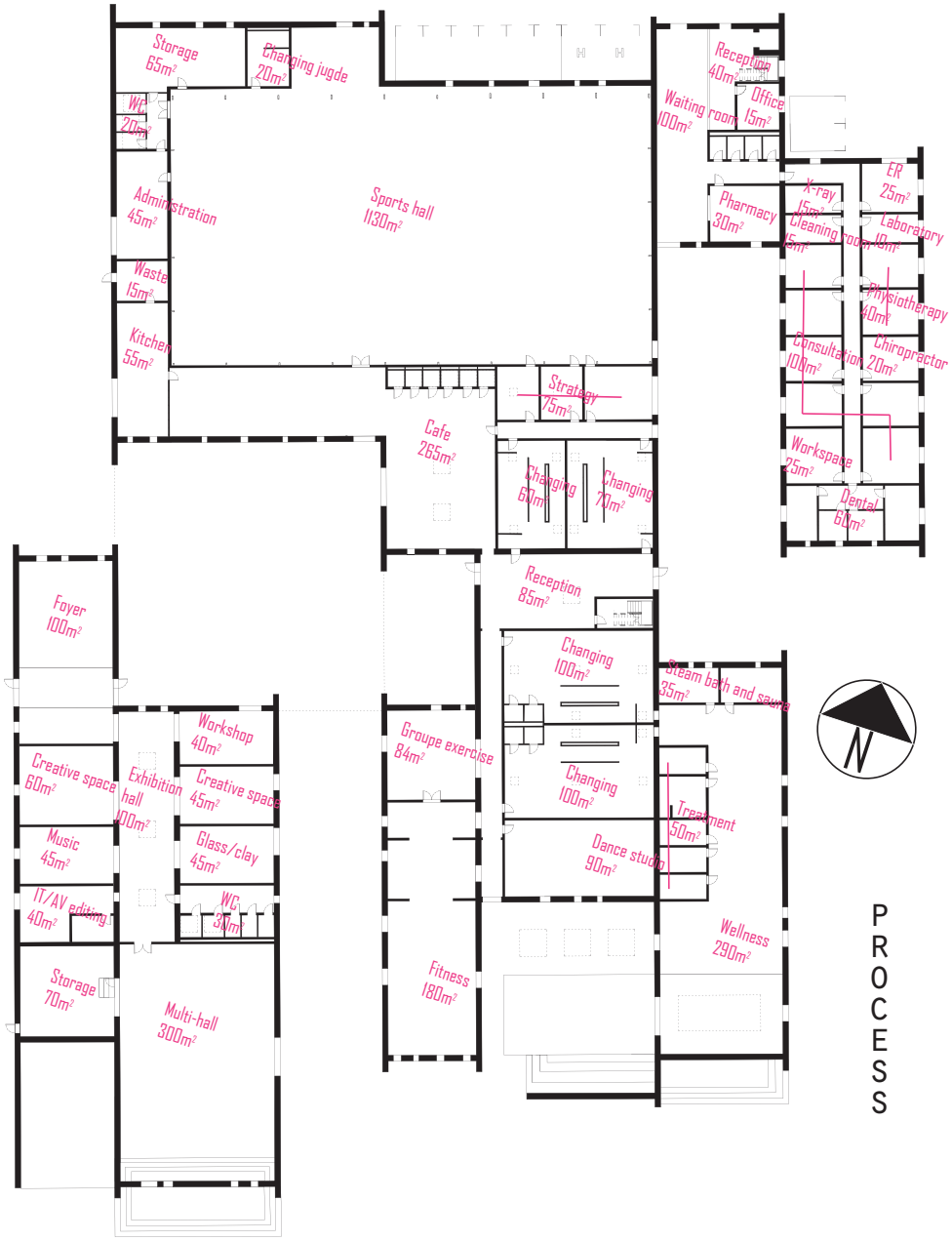
Ill.286 West facade 1:500

The buildings created are places where people can meet through different indoor and outdoor activities. The functions are divided in three main parts being the culture centre, the activity centre and the health centre. This is to define the associated functions and make the users aware of what the different buildings stands for. To combine them there are created a central square, from where people are distributed to each function both outside and inside. This central point is placed outside so it is easy for those outside to hear and see the activity in this spot. The main square is placed centrally so those inside also can see the activity.

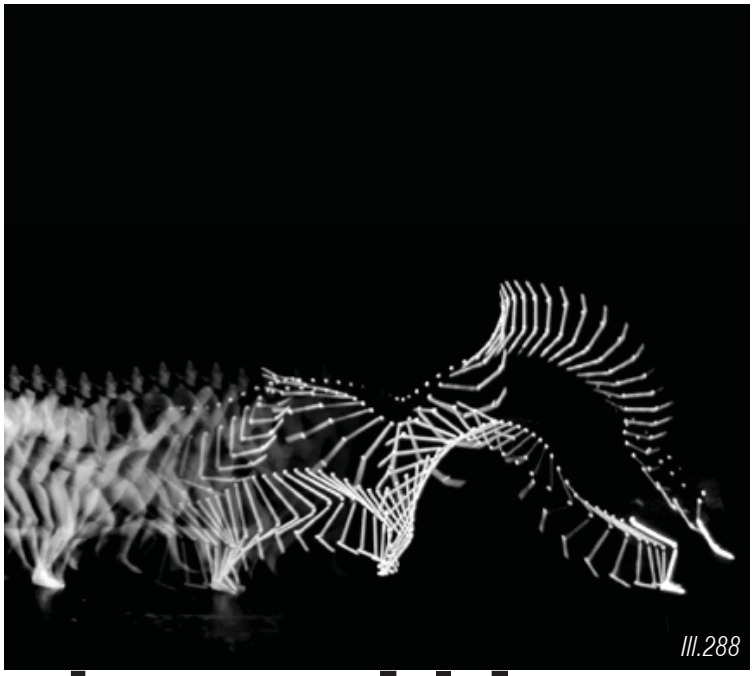
By creating several volumes it is achived to make a building that seems like it rises from the ground. The illusion of creating a small scaled city scape appears. Inside the attention is to focus on the activities and emphasise each function by the usage of little effects. The the sustainable requirements aimed for are met, and the building is within 2020 demands. Additionally solar panels produce enough energy to cover the centers own use and more.



III.287



detailing



Ill.288

detailing

- Introduction
- flow
- stay
- division
- sustainable identity
- construciton details
- material structure

introduction

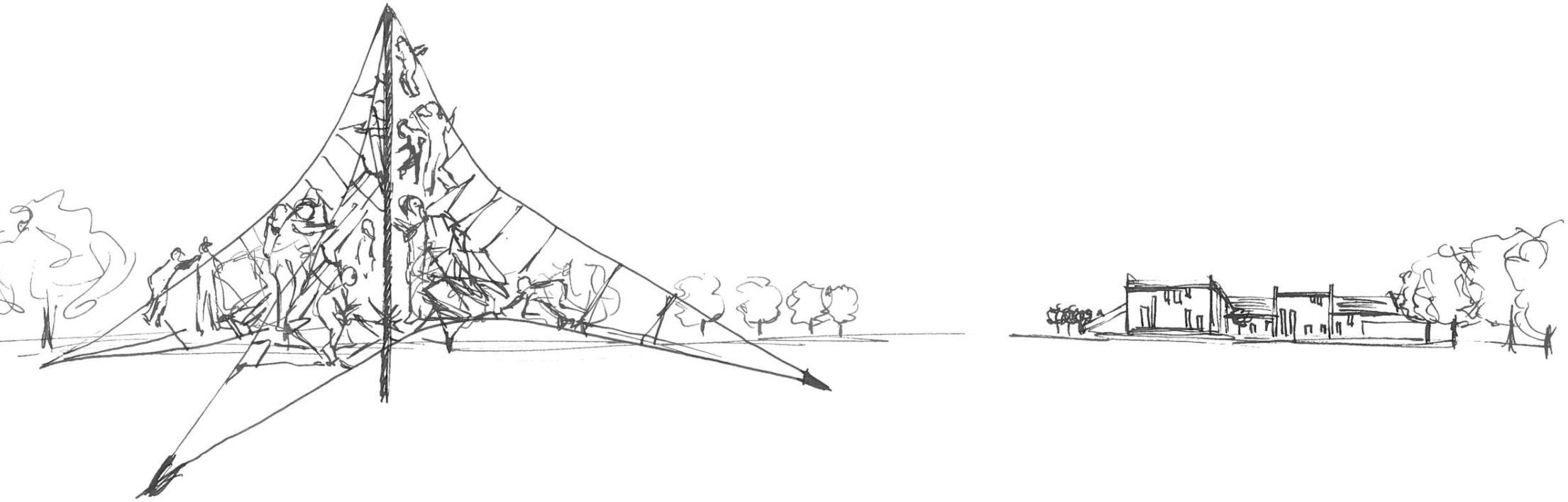
This section includes aspects of the project that needs further detailing in order to get a general impression of the design. First some of the basic outdoor functions are elaborated; these include flows, staying zones and area divisions. Sustainable solutions are also introduced, but primarily those who are not included in calculations etc. The last part of the detailing is a section with construction details, where joints between different elements and materials are shown.

In the area, belonging to the multi-house, particularly one problem is seen; it is very open which creates a lack of whereabouts. This is influencing on the flows and the dwelling on the site in the attempt to make comfortable places for people to move and to stay. It is wished to treat this openness with care and keep long views to the south, but simultaneously divide spaces with softness. The idea is to use a concept equivalent to the borders of trees to create a filtration of views so that spaces dissolve into each other. The overall concept is to unwrap the soccer fields and surroundings bit by bit, instead of seeing everything at once in one homogeneous panoramic view. The detailing of the site is based on three criteria's:

Flow: The development of the area through specific passages where the atmosphere and characteristics of the routes are shown.

Stay: Time is passing, space is stabile. Different places need spaces where activities and creativity can be processed and ideal spaces for interaction and socialization.

Division: Transition from one space to the next.



Ill.289

flow

There are four main flows, one being from the arrival to the foyer, ill.290. The second flow is from the school to the main square through the foyer, ill.291, the secound to the foyer. and the last flow is between the football fields and the main square, ill.292 and ill.293.

Route 1

The first and second flows are both situations regarding the arrival to the site. What differs them is how one arrives, and primarily how formally the arrival is. As shown in ill.290 the first thing a person sees is the building masses, with the foyer directing people towards it. From this point it is the intention to link the multi-house with activity from the school and the existing sport hall through the basket court, the skate area and the football fields in the background. From this view it is also possible to see the continuation within the building and the nature with the long views and trees lined up in a row.

When walking closer towards the foyer the details on the building increases as the material starts to get more clear and defined. The activity level also gets more defined when getting closer. When standing in front of the foyer, it is possible to sense what happens inside, which appeals to the curiosity and draws one inside. The relation between the disks becomes clear from this point, functioning as a wall with penetrating views.

Route 2

This view focuses at the passage through the culture centre, making it possible to sense something happening behind the volume. It is also possible to see a bit of the main square and skate area, though it has less focus than the passage.

When moving closer, the passage between the foyer and the rest of the creative centre is kept in focus. The materials start to be more specifics and the texture becomes more visible. When standing close to the passage, it is possible to see what happens on the other side of the building, leading a person into the passage to the foyer.

Route 3

The third view stats at the main square and is focused towards the football fields. Much detailing is organized around the starting point, which can lead the attention to the square, buzzing with activity.

When moving through the passage the focus intensifies towards the windbreakers and the open fields. The passage itself offers a more intensified atmosphere, where activities from inside the buildings shine out through the wooden walls and opens into a larger space. Details start to vanish and simple lines from the landscape take over. After passing through the passage no detailing exists, only the open view remains. Here the wind breakers and football fields provide a calm and idyllic view.

Route 4

from the football fields the individual is directed to a passage created by the two volumes. At this state one gets a feeling of what is happening at the end of the passage. When moving through the passage, the perspective is dissolving towards the end where it is replaced by a shared space for activities and social engagement. During the course the detail and activity level increases. The path itself creates a focus on the experience of the light and the change of perspective as one follows along. At both sides larger windows are placed, which shows the atmospheres and types of activity inside the buildings. When approaching the end of the path, the view opens up to the main square, that functions as a gathering point and a distribution delta.

Route 1 view a

Route 1 view b

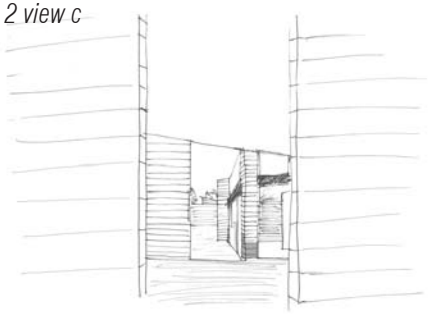
Route 1 view c

Ill.290

Route 2 view a

Route 2 view b

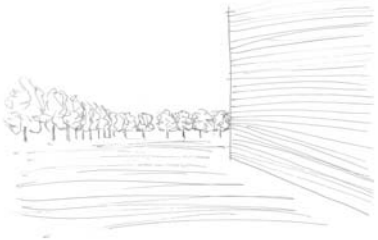
Route 2 view c



Ill.291

Route 3 view a

Route 3 view b



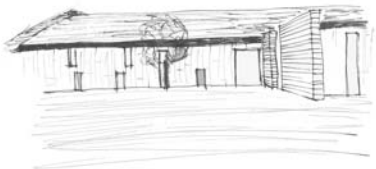
Route 3 view c

Ill.292

Route 4 view a

Route 4 view b

Route 4 view c



Ill.293

As potential gathering points the outdoor spaces for social interactions does not have to be many, but spaces of this character need to be comfortable and secure by not being too exposed to climate and public. In this project the public spaces for staying are either a space for activity or dwelling.

Spaces for activity

-The soccer fields at the existing locations, where team spirit can be enjoyed.

-The swimming pool, which makes a clam atmosphere.

-The outdoor fitness area creates intensity in the passage between the main square and the soccer fields.

-The skate and basket area is placed in close connection with the school and offers creativity and fun.

-The area with ice skating during winter and hockey in summer draws activity between the soccer fields and the multi-house by being a more compact and comfortable place to stay.

-The playground south of the school works with height by its trampolines and climbing arrangement.

-The athletics area aligned with the running path as a border to the east.

Spaces for dwelling

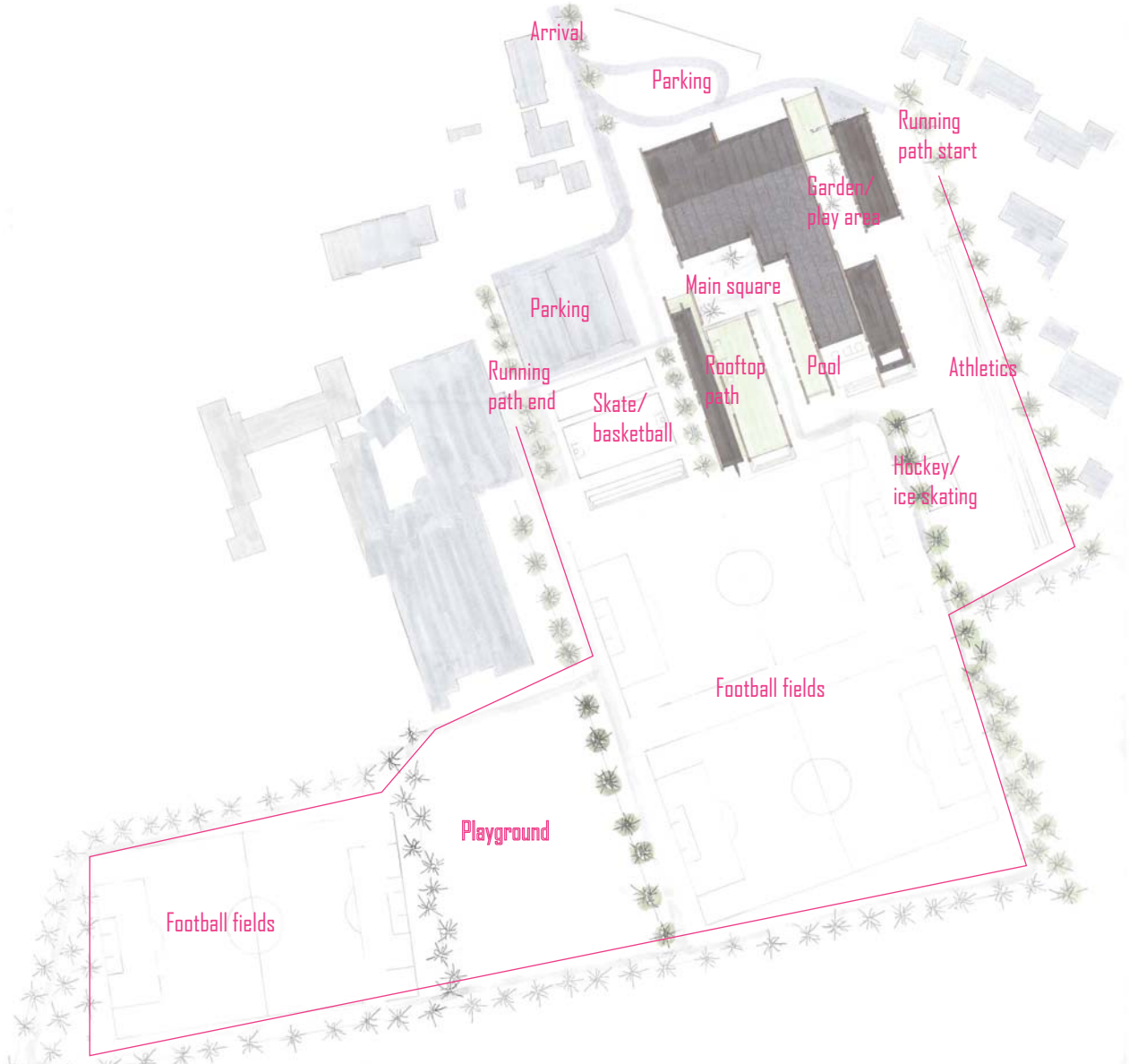
-The café space as the main social location, derived from the indoor café.

-The tribunes where spectators follow the activities.

-The Garden yard, which is a space for recreation merging with a playground for small children in the area.

-The avenue at the school, as a place for observing and conversation.

The first category is generally considered to need a less protective environment, as it is valued, that the activities will take the focus. The attention is on the balance between views, connections and the engagement in and concentration on an activity. The spaces for dwelling are more immobile and the comfort is greatly dependent on environmental factors such as shelter, shade and sunlight, but also on overview and safety comfort, which is why they often are placed in immediate connection with a bordering element. These spaces are placed so they have a view to at least one activity, so that the life on the site is transmitted from one space to the next.



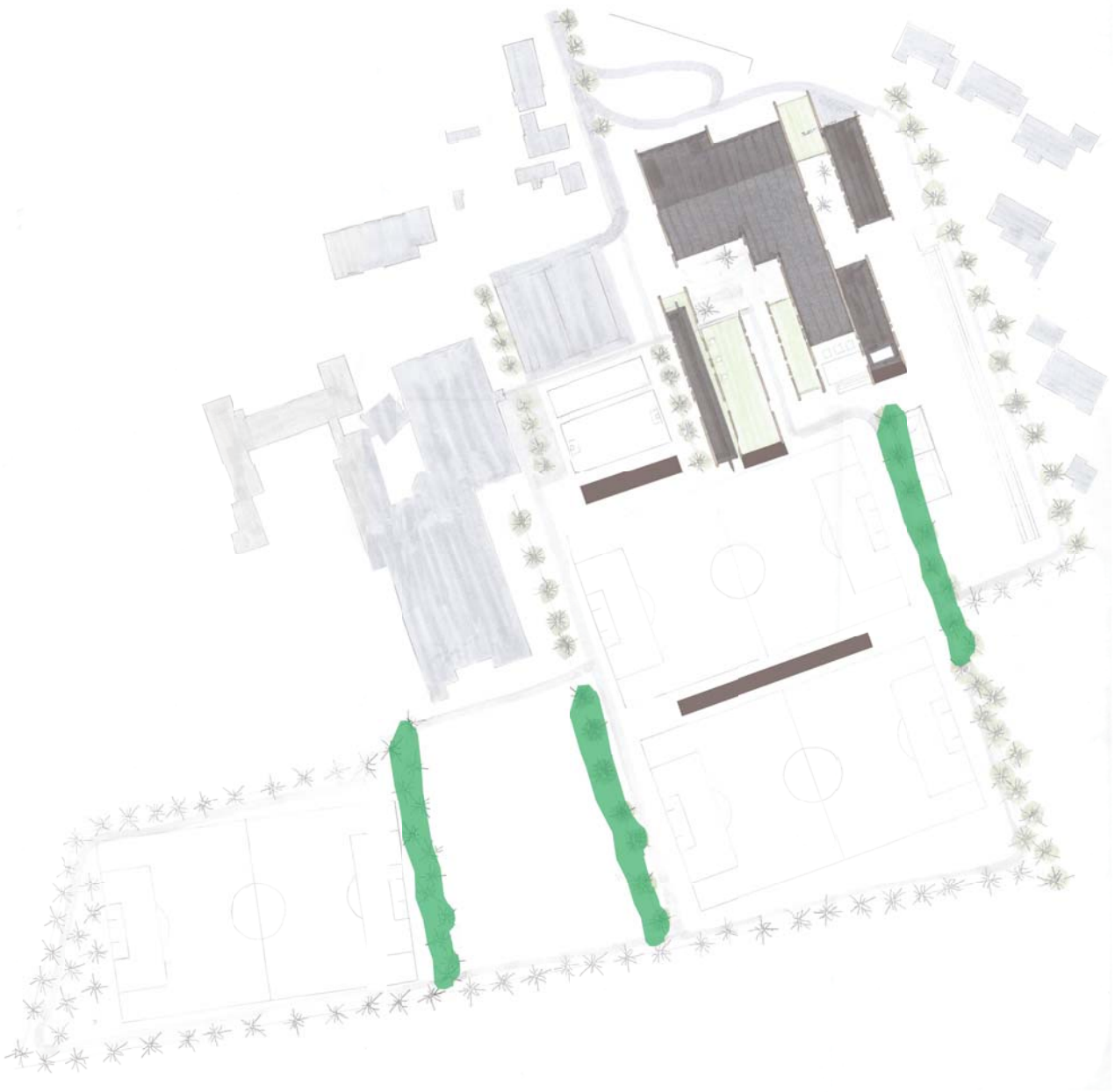
Ill.294

The site is surrounded by a track with stations of different activities spread out over the site. All activities function as links between the multi-house and something else. This includes a connection to the school, to the soccer fields, to the agricultural fields, to the single-family houses, to the town and of cause to the sports hall.

division

One characteristic that defines the area is the open fields and long views, which makes everything is easy to overlook. To make people more attentive to what actually happens in the area, extensions of the trees are used to divide the area into smaller views.

It is the intension to keep some of the long views, so what defines the area is still recognisable. The area is divided into functions to emphasize each different atmosphere. The football fields are open, because they are spaces where players and spectators shall overview actions. The playground in front of the school is more closed, so the focus is turned towards own actions instead of the whole situation. The athletics area has a long narrow view to strengthen the focus on destination. The destination is a target in the end of a track where speed is in focus. Spectator platforms are used in several places to part areas in a subtle way, without blocking the views completely.



Ill.295
North south divisions by trees, east west division by tribunes or walls

sustainable identity

Additionally to the optimization of the buildings in relation to performance an attempt is made to include other sustainable strategies.

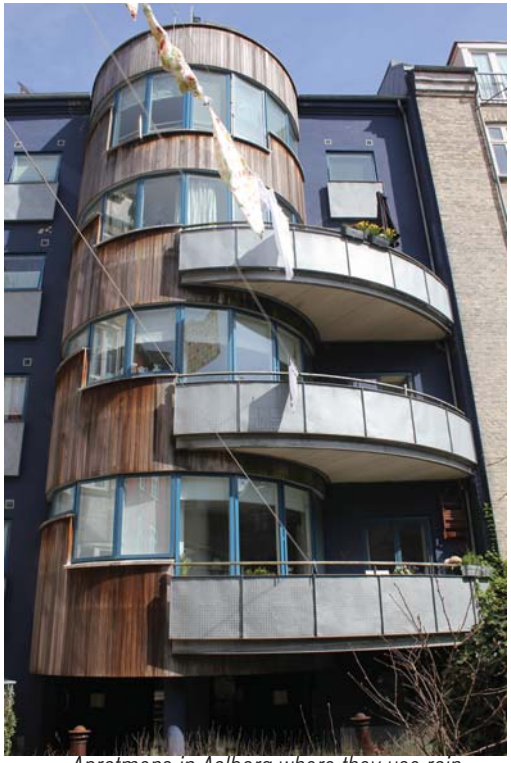
Potentially energy-saving solutions, such as collecting water from the sloping roofs, can be used for toilets and watering the fields in dry periods. For this a need exists to include a tank for storage of water, which will be located in the basement.

Another strategy is green roofs on the north-sloping roofs, which can have advantages in cooling the building in warm summer days, while protecting roof material from getting worn down. The green roof on the culture centre is also meant as a space for staying, social cohesion and viewing the community. This stresses the construction due to the weight of both grass and people walking on it, hence the structural considerations has to include this.

It is the intention to use geothermic energy for warming up the swimming pool. This requires that the municipality makes it possible.

Solutions like these make contributions to the sustainable profile of Pulsen. They are all part of creating a sustainable awareness for users and visitors. Raising this awareness requires that some solutions are visible, and that a holistic approach is taken on sustainability. The whole picture matters more for the public than a simulation result and is therefore more inspiring.

Ill.296



Apratmens in Aalborg where they use rain whater for whasing clothes. Here the front of the building.

The back of the building. Here it is possible to se the method used to collect rain whater.

Ill.297

Ill.298

Solar panels that is easy to install.

Hospice in Bispebjerg. Here seen pools heated through eothermic energy.

Ill.299

construction details

Ill.300

Window placement

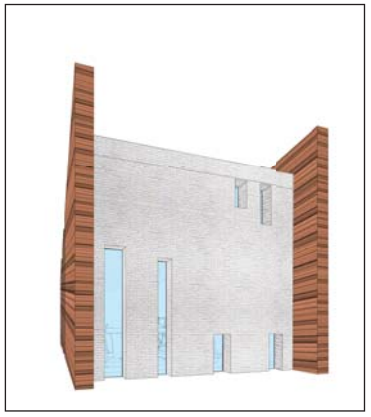
Regarding window placement the prefered expression is that the depth of the material is shown as clearly as possible from the outside so that the glass lie quite deep in the disks. This gives the impression of the openings being carved out of the wooden walls rather than ordinary windows. From the inside the inlet of light takes care of showing the depth in material.

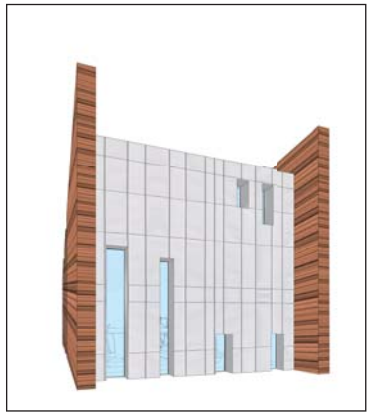
Ill.301

Concrete slap meets wooden wall

The prefered sliced expression of the disks is best repressented with something similar to the middle solution. This has the line of the roof lieing behind the wooden wall, making the structural hierachy clear of the disks and the slap. Here it is important to make sure that a version of this expression can be made without the slap providing a cold bridge in the construction demining the performance of the building. See details on the next page.

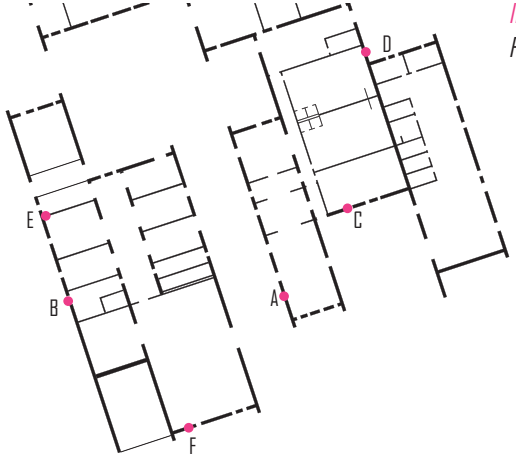
Ill.302





End wall in zink meets roof

The marked line, showing the angled roofs behind the disks, will be shown at the end walls in zink as well by letting the roof level with the front facade. The roof will need an insulated front and the slaps will rest at the wooden disks. In the process the discussion fell on whether the end walls should be a heavy material taken from the context (like the brick) or a material of light appearance. The outcome is a light material that has the ability to enforce the way the openings divide the facade, and that show the structural hierachy clearly.



Ill.303
Plan of constructing detailing

Details 1:50

A. Disk: 400mm insulation, wooden constructions, wood sheathing
Roof: 500mm insulation, concrete slap, asphalt roofing, solar cells

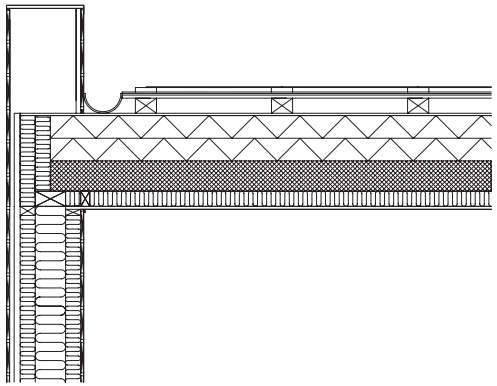
B. Disk: 400mm insulation, wooden constructions, wood sheathing
Window: 3 layered energy glass
Roof: 500mm insulation, concrete slap, asphalt roofing, solar cells

C. Floor: concrete slap, polished concrete flooring
Basement wall: insulated blocks and lower 100mm outside insulations
Disk: 400mm insulation, wooden constructions, wood sheathing
Window: 3 layered energy glass

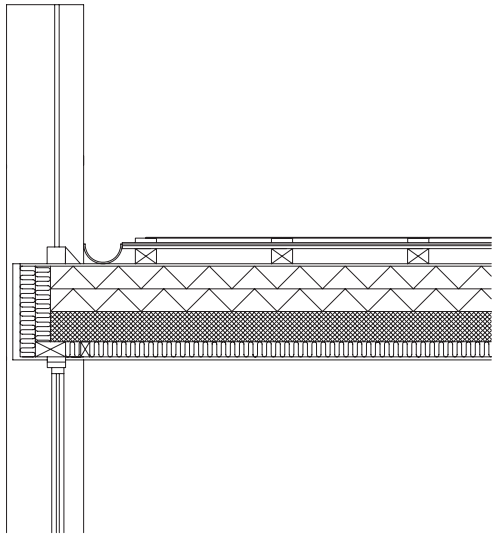
D. see detail C

E. Disk: 400mm insulation, wooden constructions, wood sheathing
Inside wall: 150mm translucent concrete

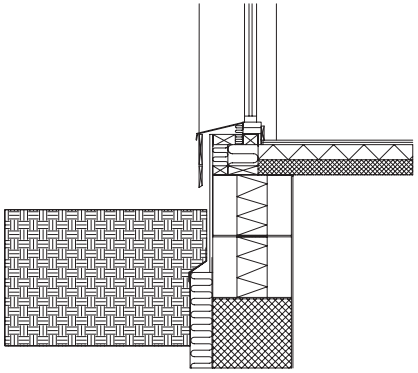
F. End wall: 400mm insulatioon, wooden construction, zink sheathing
Window: 3 layered energy glass



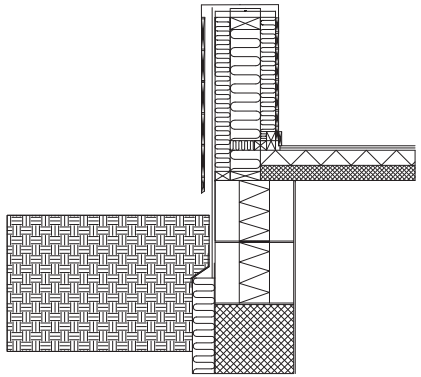
Ill.304 Detail A



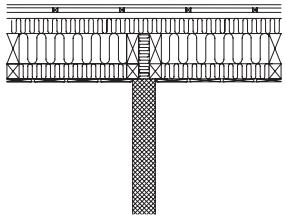
Ill.305 Detail B



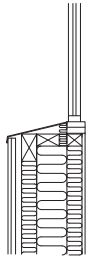
Ill.306 Detail C



Ill.307 Detail D



Ill.308 Detail E

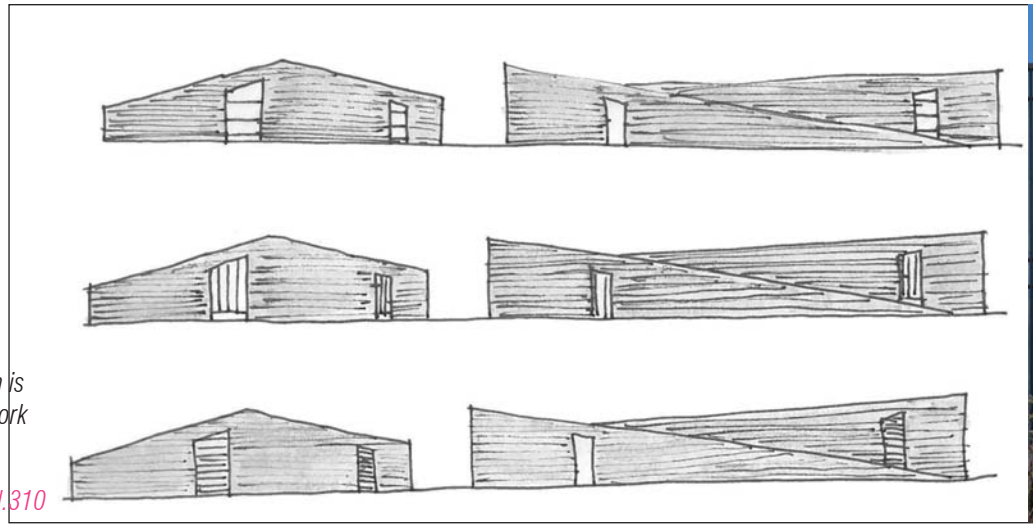


Ill.309 Detail F

material structure

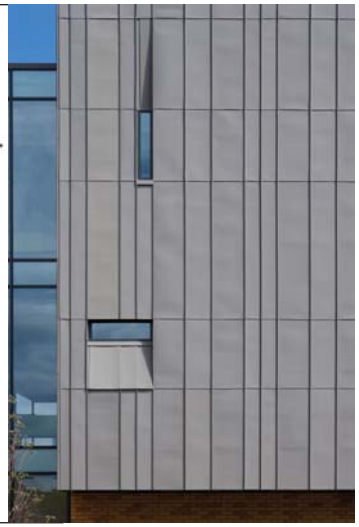
Wood covering is used on the disks and are chosen to be horizontal panels, creating lines which highlights the horizontal directions. This is yet another way to mark the position of the multi-house in the context, being located at the borderline between the small town and the open landscape. To create a livelier expression the height of the panels varies vertically.
The facades towards north and south are covered with zinc, as mentioned earlier. This material is displayed by vertical lines that also vary in size. It follows a structure so the expression shows continuity, where the zinc plates are intact, and breaks where the zinc plates ends and windows are placed.

A small study has been made to optimally divide the windows, three options are considered. The first is a vertical division, the second being horizontal division in larger parts, and the last a horizontal division in parts, which matches the wood covering. The study is based on the need of natural ventilation, where the best solution is to have windows that can be opened in the bottom.
When making vertical windows there will be two necessary directions for windows, one upwards but also one horizontal due to the need for natural ventilation. This creates inconsistent detailing in the windows. The entire facade becomes overly detailed and it is hard to notice the overall idea.
When dividing the window horizontally a simple system is followed, making the whole section simple. Combined with the wooden structure the overall idea with the larger windows are kept. It preserves a hierarchy between the wooden walls and the windows by making two different systems.
The last case is to divide the windows horizontally by using the same structure as the wooden covering. This makes the windows disappear in the wooden structure. The motif of walls cut by high windows disappears, both when looking from the inside and outside. On the other hand this division may have advantages at places where external shading is to be incorporated.
It is chosen to divide the windows in a horizontal direction and with most possible distance to keep the impression of larger holes cut out of the wooden wall.



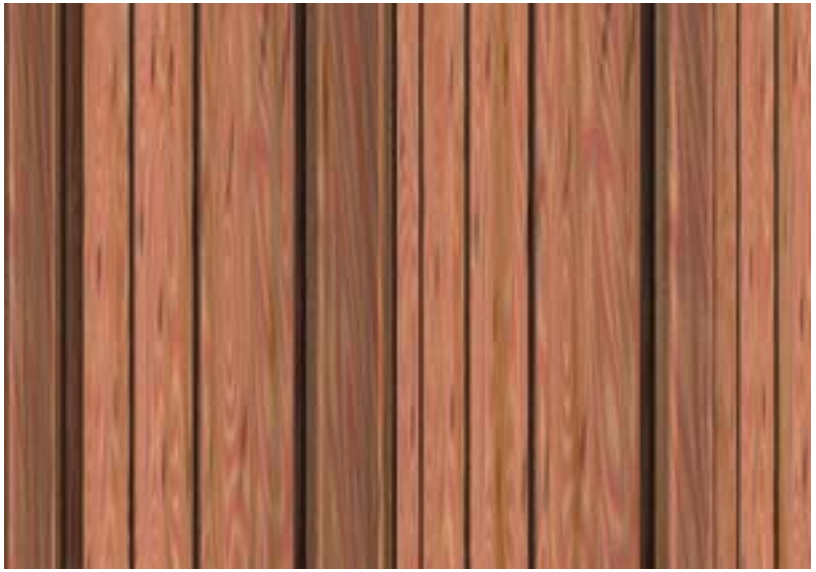
Division in windows the hies solution is chosen to work further with.

Ill.310



Ill.311

Zinc covering used on the facade



Ill.312

Wood covering on the disks.

Ill.313

presentation

siteplan

Ill.314
Siteplan 1:1000

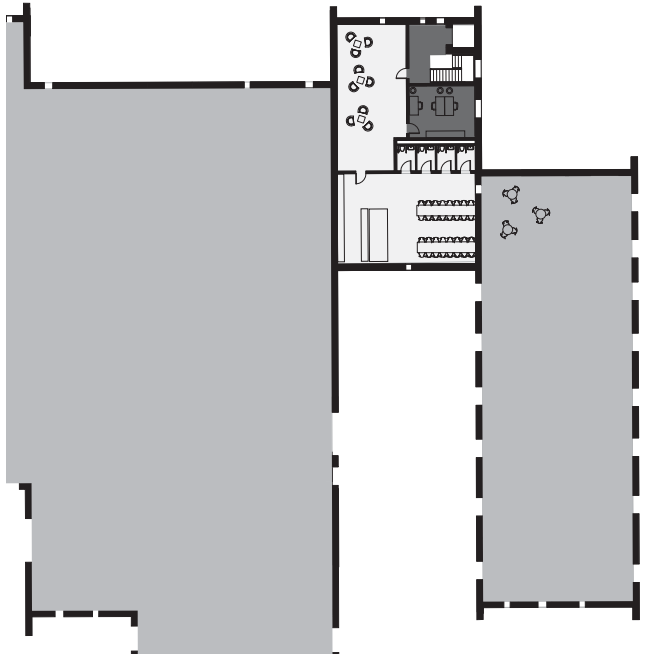
Ill.315

Rendering of the multi-house placed in the context. The lines from the threes can be seen continued trough the building. The long shapes apply to the school, whereas the sloping roofs apply to the single-family houses. The buildings are primary facing the direction towards the area to increase the connection through the site.

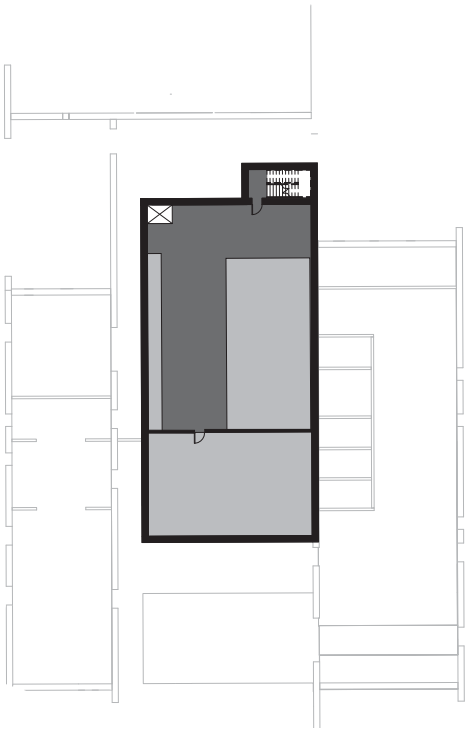
plans

Ill.316 *Ground floor*

The plans are divided in public, semi public, private and functional spaces.
The light colour symbolises the public spaces, whereas the colure that is slightly darker shows the functions that primary is directed to users of these functions.
The darkest colour is areas only addressed for staff, where the slightly lighter colour is for a specific user group like the changing room and strategy room.

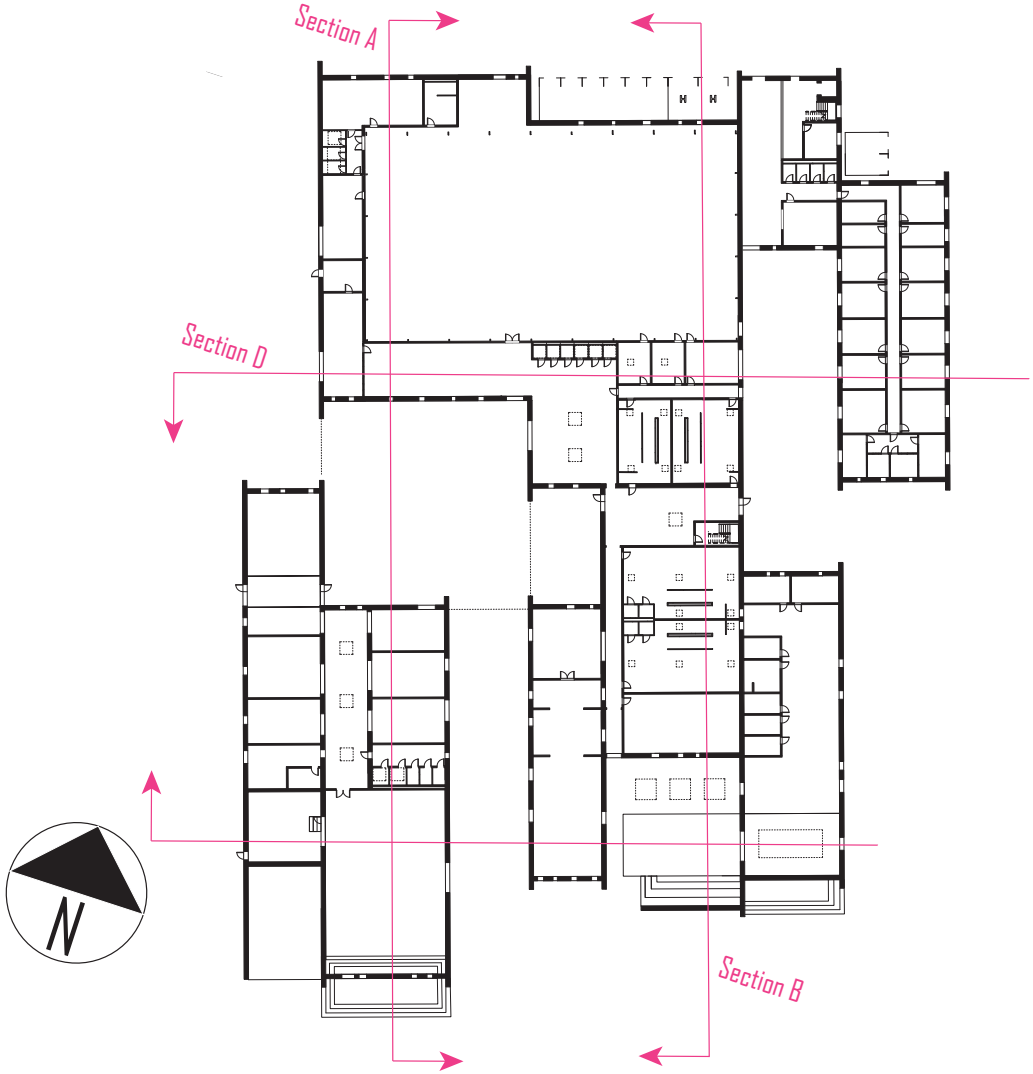


Ill.317
1st. floor

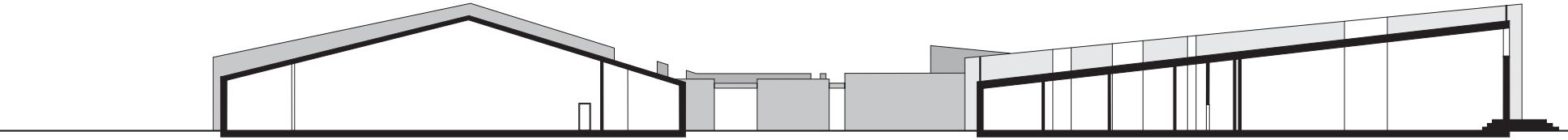


Ill.318
Basement

sections

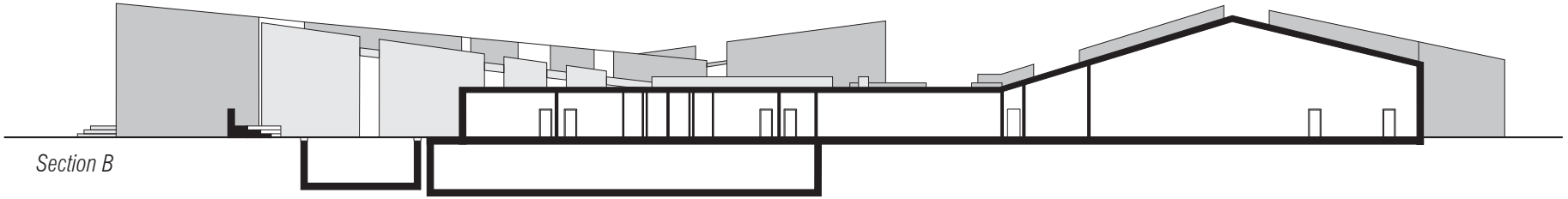


Ill.319 Overview of sections



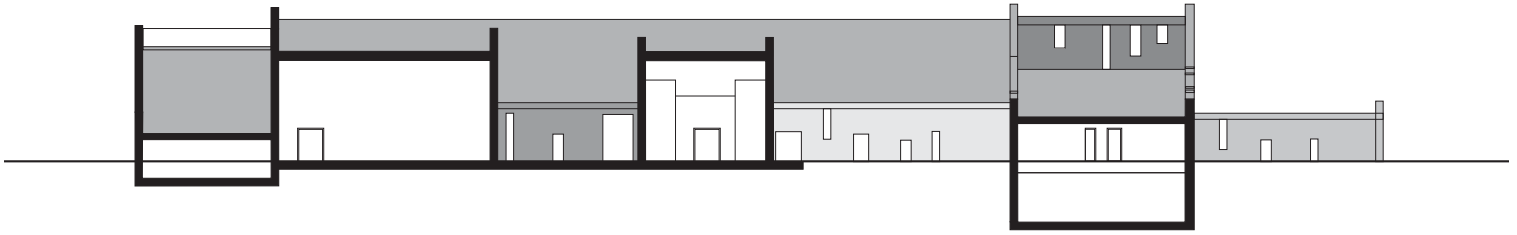
Section A

Ill.316

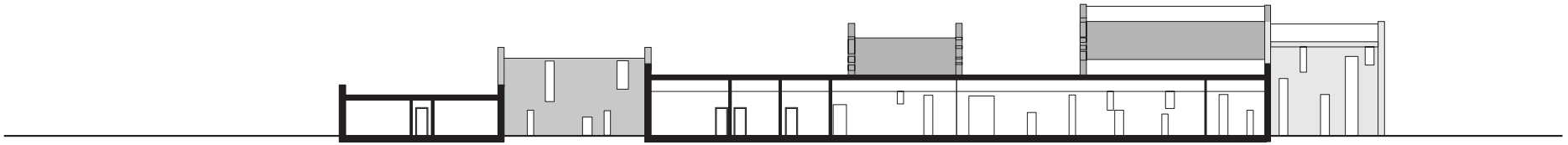


Section B

Ill.320

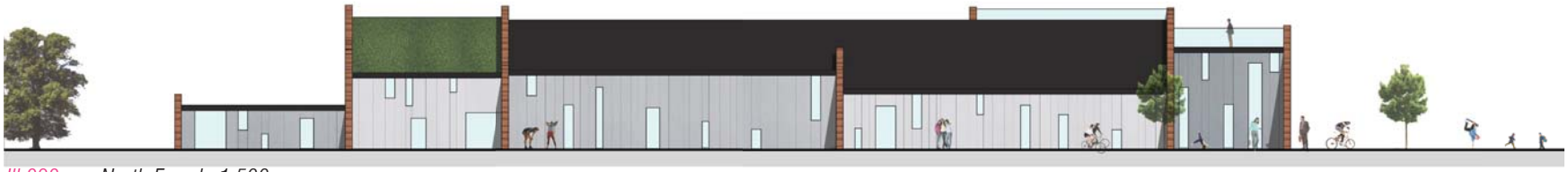


Ill.321 Section C



Ill.322 Section D

elevations



Ill.323 North Facade 1:500

Ill.324 South Facade 1:500

Ill.325 *East Facade 1:500*

Ill.326 *West Facade 1:500*

Ill.327

Rendering of the foyer

The foyer functions as a starting point for exhibitions or concerts. It is also a place that functions as the primary link that connects the site to Balling. This is done through views but also through models and history, that inform the user about the project and Ballings intentions. The foyer reveals how the building functions by having a transparent wall at the end, which shows how activity can be seen. A display is also available to inform the users of how much energy the different buildings consume and produce.

Ill.328

Rendering of the exhibition

The exhibition functions as a gathering point that combines the functions on each side. It is a place where users have the possibility of displaying art or general work, so others can be inspired. The place is very open so it is possible to see the different functions on each side in action. At the end of the hall a view to the cafe extends the lively atmosphere.

Ill.329

Rendering of the multi-hall

The multi-hall has several purposes. It is a space of great importance to the community both regarding cultural and physical arrangements. The space is designed so it functions as a frame, framing the function so this is kept in focus. The room has an open space with no columns in order to be flexible and have the most possible usage of the room. Multiple windows connects the room to the outdoor facilities.

Ill.330

Rendering of the fitness room

The fitness room is an open space to ensure a calm atmosphere, which is supported by arranging windows around the room, so users have the possibility to view the site. On the inside transparent walls are used to emphasise movement and gather people through activities, despite the individuality of the activity practised.

Ill.331

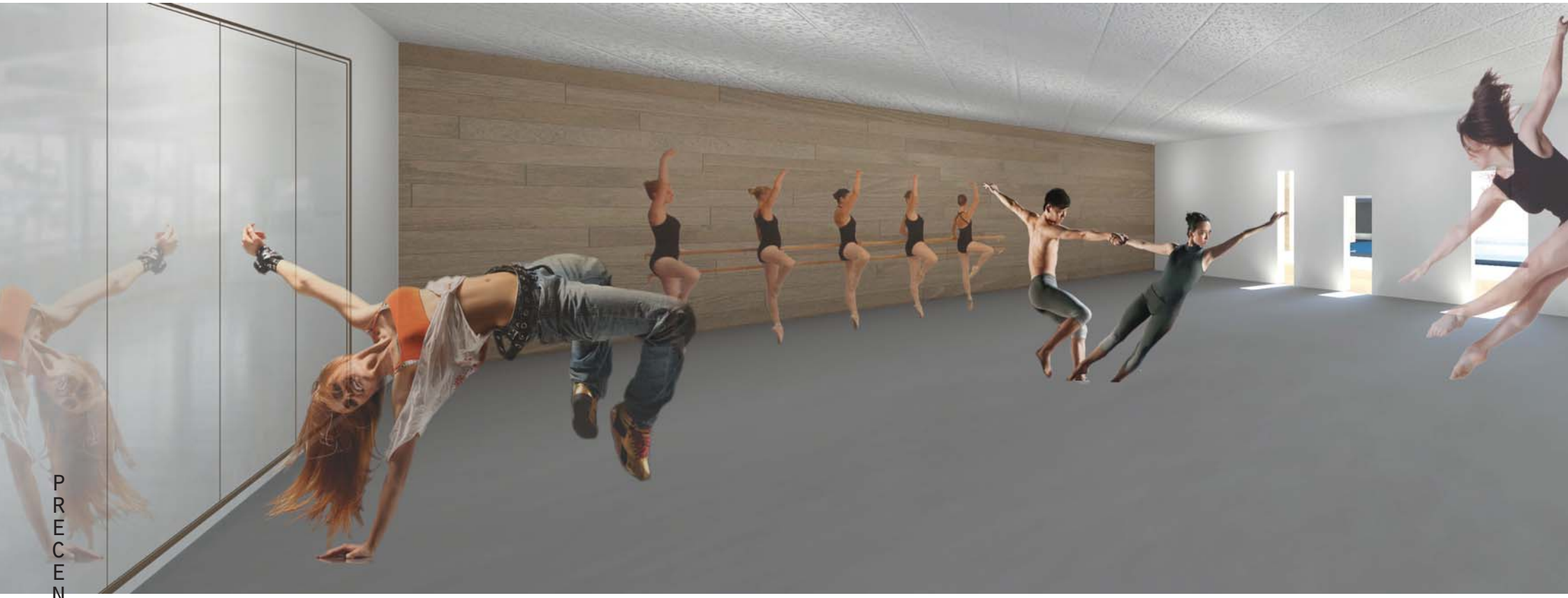
Rendering of the wellness area

The wellness area is a place where people can come to relax and enjoy themselves and each other. The atmosphere is kept simple to maintain a calm atmosphere. The functions such as massage room, steam bath and saunas are transparent so users can see whether they are in use. This makes it possible to overview the entire situation and it affects the atmosphere by introducing calm movements. At the end of the wellness a central pool is placed, this starts on the inside and continues outside to extend the wellness area. The wellness area is both an open and closed space that physically narrows down, but opens up through views. The openings at the pool direct one towards the exterior, where users gets new possibilities of relaxing functions such as different spas.

Ill.332

Rendering of a changing room

The changing room is kept simple to strengthen the atmosphere for those who are passing through to the wellness area. The wall that service the water supply to the showers are transparent, again to emphasise the movement from people.



Ill.333

Rendering of the dance studio

The dance studio is focused on funtionality. The room has one wall with mirrors showing the dancers moves. At the opposite wall windows are placed so the dancers can see the exterior and calm atmospheres from the wellness area. The entrance wall is translucent so users outside can see what happens inside and the other way arround.

Ill.344

Rendering from the waiting room in the health centre

The waiting room in the health centre is a quiet space where the soothing atmosphere is enhanced by the linear perspective into the yard across the room. It is discrete and is prohibiting too much insight, while still ensuring a light and welcoming space.

Ill.335

Rendering from the arrival

When arriving from the road one is met by the massive sports hall with the foyer pulled out in front of the road. This welcoming takes the guest either in a curve into the main square or straight through the tall entrance of the foyer. It is the primary arrival place, which flows into a delta of different directions when passing around the foyer. The foyer is the welcoming from the ground, but it is also a viewpoint, which can be used to look over Balling city.

Ill.336

Rendering from the school

This is a secondary path between the school entrance and the foyer of the culture centre. The movement cuts through the foyer, bringing additional life into the space, while offering an easy access to the main square. This makes the foyer frame a cross of paths, which can lead to unexpected meetings.

Ill.337

Rendering from the football fields

When seen from the south the building is characterised by its black solar roofs and the ends of the wooden disks, which adds a rhythm in which the functions are placed. Observing the centre from the wide planes, emphasise the perspective leading through the passage into the main square. The preparation for this movement is a narrowing of the space into a gap, where activities can be observed to both sides.

Ill.338

Rendering from the main square

The main square is a meeting point. This must be understood in the sense, that the space is not only used as a landmark for planning meetings, it is also here you are confronted with fellow guests. This is where the guests using the facilities actively and the observers of activity come together. An obstacle path leads from the passage between the fitness centre and the multi-hall, offering a fun and informal way of moving. Additionally the square can be used for various exhibitions, markets and performances.

Ill.339

Rendering from the garden space

The garden space between the sports hall and the health centre is seen as a visually appealing garden with small bushes, that does not shade too much, and a few trees. Here parents can come with their children to play at the playground in a safe environment away from the roads. The activity is concurrent with the consultation function alongside the yard, which thrives best in discretion.

Ill.340

Rendering of the café

The café is floating to the outside during the summer and withdrawing again for the winter. This is the main social gathering place at the site and therefore a place that is open for all users. The café is supplied by a kitchen, where simple dishes can be bought. The façade of the café faces towards south and the space in front will be a sunny space for interaction and for developing new relations.

conclusion

Design

The design of the multi-house has been created, which finds its main worth in being a place where citizens can gather around spare time activities while nurturing their body and mind. Pulsen is a place for evolving and for relaxation - preferably at the same time. This is what the activities can do for the users, and the multi-house can provide good circumstances for this engaging in physical and creative activities. The multi-house approaches this by having a userfriendly distribution for planned activities along with multiple spaces in and around the centre for spontane or open arrangements. Here citizens can meet with people they would not normally make plans with, with the effect of raised regional solidarity and perhaps new friendships. Along with this follows a healthier individual and a healthier community.

why

Pulsen and the context

The multi-house is derived from lines and motiefs in the nearby surroundings with a certain degree of abstraction. This has contributed with a simple system that has qualities of:

- bringing flows together in the crossfield of the main square, which is the meeting point of the centre
- reaching out into the context

In this manner the context contributes to Pulsen. In return the centre contributes to the context with spaces fit for both planned and spontane activities and interaction. From inside the spaces reach out and bring certain views into the room like fragments of a whole. Simultaneously movement brought by the planned outdoor activities bring the views to life and make them threedimensional. At the site of Pulsen it is possible to engage in various activities during all seasons of the year, making it natural that some users are just passing through, while others are there to stay for a longer time, contributing to the area in their diverse ways.

where

Pulsen and the purpose

The multi-house Pulsen is meant as a design raising awareness on wellbeing and spare time activities, but it is not a convensional building, as it is also a building of low energy comsumption following the 2020 demands. Inevitably many new constructions will soon follow similar standards, but in the present moment it is still neccesary to show that this can be done without compromising the architectural intentions - or rather letting the sustainability be part of the architectural intention. The centre consists of three buildings exclusive the sports hall, which is only renovated. Each house has its own stamp of atmosphere forthcoming the useage of the spaces. The culture centre is for example progressive, building up towards the multi-hall. The activity centre has its more dramatic use of light and the health centre is progressing from the big room to the small units.

what

Pulsen and the sustainability

Aside from following the 2020 demands for new buildings, the multi-house Pulsen has additional attempts of bringing a building that does as little damage to the surroundings as possible, while meeting the current needs of visitors and staff. The additional solutions are: mostly using renewable materials (exept the zinc facades and the constructional steel frame), using mainly recyclable and recycled materials, working with rainwater collection, producing solar energy for the multi-house own use plus providing for the grid with the excessive energy. These initiatives add to the identity of the multi-house as an example of a sustainable construction in coherency with current and future needs.

now

reflection

Here certain topics of the project are reflected upon. The chosen topics are very directly linked to specific choices in the design, which either have not been detailed as much as wished, or that is not the obvious option, but based on multible parametres. Each of these solutions are briefly discussed.

The reception

The reception by the changing rooms are responsible for the distribution of all users of the fitness centre, wellness centre, sports hall and soccer fields. All these users come together in one cross field, which makes the logistics of the reception and the change rooms ever the more important.

Issues:

The topic here is mainly how to make the distribution space and the change rooms work without interubting the ritual of preparation for the individual.

Reason for chosen solution:

The solution chosen is to have a reception ares, which can be staffed, but does not have to be. If one can buy a card for the needed facility in the foyer, it is possible to have a simple system of barriers to part one function from the other.

Alternative considerations:

It is considered how the changing rooms can be used in case of a bigger arrangement like a soccer tournament. Here the fitness change rooms can be shared by the users given that the system of using the fitness and wellness centre is digitalised, so that one can buy access to what ever facilities you need at the centre.

The main square and the garden space

Several of the outdoor spaces need more detailing. It is chosen to show the general idea of the functions of areas, but each space needs further detailing in atmosphere. Here the small yard at the health centre and the main square is particularly important.

Issues:

Firstly a big square space often seems empty with interior and people only at the border. Secondly the garden space must not become a backyard with activities not fitting with the health centre.

Reason for chosen solution:

The thought on the main square is that the space must function as a outdoor café area in the summer, but it can also house for example a christmas market in the winter. Through the space activities are drawn in through an obstacle course involving trees and light of the square in an unformal game, which can encourage and challenge for spontane movement of all ages. The garden space is thought as a safe, homely space where small play areas for young children is divided by blooming bushes and small trees.

Further considerations:

It is the wish that these active possibilities will add life to the square and hopefully multiply as movement in seen to breed movement. The obstackle course is drawn to the square from the south in the passage between the culture and fitness building, which already have a perspective bringing attention to the movement towards the main square.

Surface materials

The intention is to spend much more energy in investigating the properties and capacities of different materials, which had to be down prioriticed because of time limitations. However this is still a very interesting matter that can contribute massively to the expression of the project.

Issues:

If the of each material had been investigated further, this might have contributed in a positive way to the spaces and to the facades.

Reason for chosen solution:

The chosen solutions are using materials in a very traditional manner. Wood is wood and looks like wood in its structure and division. Equally counts for the zink, the glass and the light inner walls.

Alternative considerations:

The wooden disks have been chosen because of their appearance and belonging in the area. If the material division and structure had been challenged in direction of fibers etc. the connection may be even more clear and so will the depth in the material.

Overtemperatures

It is seen that the goal, that was not possible to meet or at least down prioriticed in the process, was the maximum of 25 hours above 27ºC a year. It must be mentioned that this demand is applicable for housing, but is adopted for the multi-house to have something to measure our results against.

Issues:

The issue of having a room that is too hot is crusial for spaces for physical activity. Simultaneously it is also of high priority that the spaces have sufficient daylight.

Reason for chosen solution:

The solution chosen is not ideal, but it does offer spaces that are comfortable to be in by far the majority of the time. The solution is chosen by measuring results for temperatures, daylight factors and architectural expressions against each other.

Alternative considerations:

Other options can be to allow higher ventilation with the risk of draft genes, or to reduce the window areas to the east/west and maybe slightly increase the window area to the south to keep the solar contribution in winter.

Four buildings in stead of one

Pulsen is one center in four buildings including the sports hall. This is in reflection done to create a clear grouping of functions.

Issues:

A problem with having four buildings uniting in one center is to keep a clear distribution and a natural social space that gather visitors and regular users.

Reason for chosen solution:

In relation to the above it is prioritised to make the main social space an outdoor space, and supplement this with more compact indoor spaces for social interaction. It was known from the beginning that the kind of centre, we wanted to make, is one that combines indoor activities with outdoor movements as one is a natural extension of each other. Both are part of gaining presence in the moment, in the environment and in one self.

Alternative considerations:

As this is a choice taken early in the process, alternative choices are discussed not in detail. The general idea is that it offers something special to the centre and that users are confronted with the outdoor climate even in the winter, or in a rainy autumn day. The alternative to this is to have a central social space of the purpose that the main square has now. This might be slightly more formal than the outdoor space, just for the fact that one has to enter the building.

reflection

Passage in the foyer and reception

While the passage through the waiting room of the health centre is more visual than an actual movement, one can ask how the physical passage will actually work throughout the foyer and the reception.

Issues:

In the case of the foyer the movement is enforced through the passage but slowed down through the foyer. In the case of the reception, the physical and visual movement through the passage is present but not very accentuated

Reason for chosen solution:

The reason for keeping the passage through the foyer is its connection to the schools entrance pavillion. If it is possible to drag people in through this entrance, it will also show when entering the foyer through the main entrance, resulting in showing the direction to the exhibition area and the multi-hall.

Alternative considerations:

Alternatively these connections can be shown only visually like in the health center, making the outside areas more parted. This was though considered demotivating for the users natural flow in between, along and through the buildings.

Three seperate entrances

It is chosen that each building has its seperate entrance oriented towards the arrival.

Issues:

The problematic here is that it may be difficult as a first-time user to go straight to the space you need. This problem is met by drawing out the foyer, which is the most likely place first-time users will need to go. This is the space/ entrance that faces you when arriving from the road.

Reason for chosen solution:

It is considered valuable for the project that the health centre can have its own entrence offering more privacy Also the seperate reception for the fitness and wellness function (paired with the entrance to the sports-hall changing rooms) is seen as an advantage argumented in their specific needs in atmosphere and creating frames where it is possible to fall into ones own ritual in preparation for physical activity.

Alternative considerations:

In relation to the four-buildings-discussion it is an option to join entrances to a united (covered) welcoming area. For the same reasons as uniting the buildings, this is not chosen.

The height of the wellness centre

The roof of the wellness centre is declining towards the swimming pool to enforce the diving movement, but in the other end the sauna and steam bath has no use of the hight.

Issues:

The tall room is may be a way waste of space, but at the same time the wished declination towards the pool is an important part of the intensifying atmosphere in the wellness centre.

Reason for chosen solution:

The chosen solution has the advantage of working well with the spacial intention, while being more doubtable over the small spaces of the sauna and steam bath. The declination is chosen based on multiplying the contrast between the indoor and the outdoor part of the swimming pool.

Alternative considerations:

Alternatively the roof can be flat as the small declination does not make much of a difference to energy production with solar cells. This however makes the space around the indoor part of the pool somewhat different and the contrast to the outside somewhat smaller.

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Ill.248 stonehenge visitors' centre, uk, title: unbuilt masterworks of the 21st century , author: Will Jones isbn: 978-0-500-34254-1
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enclosures

Ill.341

enclosures

study A: envelope

study B: window

study C: light

study D: wind

study E: volumes

study F: movement

study G: material, texture and pattern

study H: acoustics

study I: colour

study J: indoor climate

study A: envelope

aim

The purpose of this study is to investigate the relation between the building shape and the use of energy. We are especially looking at the factors compactness and density, as we expect to se a close connection between the surface/ volume ratio and the energy consumption.

preconditions

When preforming this experiment it is taking into consideration, that only one parameter that is changed. In this case there are not taking into account other variables that can effect the outcome as windows, people or others. The only thing changed is the dimensions of a box.

method

A monthly average spreadsheet is used to document the results. The case is based on a box with a specific volume in total, 1400m2. The height of the volume is not changed but the density and the orientation is changed to show wether the statement is correct.

background

The envelope is what separates the indoor from the outdoor climate. The building envelope must provide an efficient protection from all seasonal weather conditions to be able to call itself energy efficient. The demands for the envelope have high dependency of location. In Denmark the biggest concern is heat loss, but in another climate it might be humidity or the need for cooling. In optimizing the envelope there are different techniques doing so.

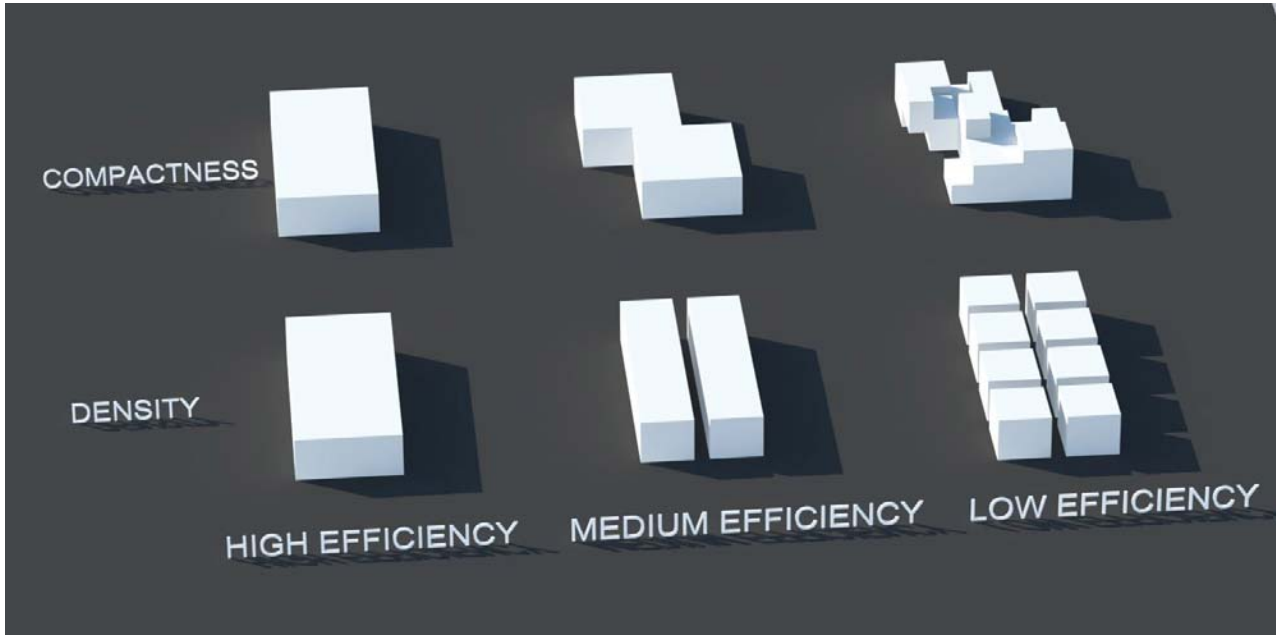
One approach is to optimize the surface to volume relationship and the density of the built volume. The fact is that - like in biology - the bigger the surface compared to the volume the bigger the heat emission. Therefore optimizing of the building shape has to do with the compactness and the density. A building with compact, dense shape will have a heavy, monolith appearance where it can be difficult to drag in the daylight, so these are some of the challenges in working with the surface to volume ratio. (Rockwool 2011)

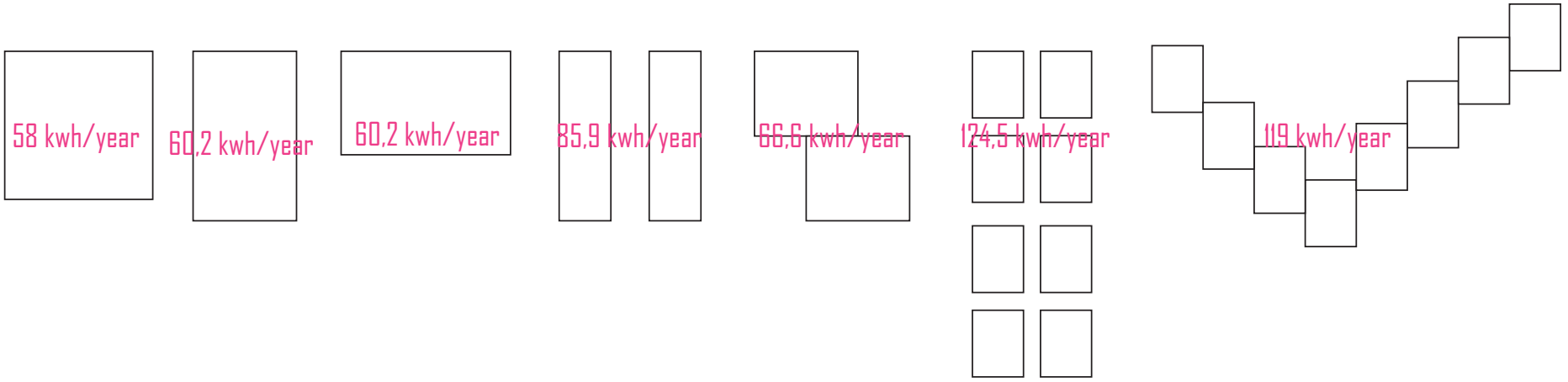
The insulation is essential for building energy efficiency. The u-value is an important factor. This result in deep openings and thick walls. Furthermore it is important that the building is airtight and so cold bridges should be minimised. (Rockwool 2011, b)

conclusion

The results (summed up in the diagrams to the right) show, that when the building is more compact, the volume uses less energy than a volume with a bigger surface. The orientation has little effect on the volume itself, though this becomes evident when looking at the window areas in the following study B.

It is seen that the compactness and the density of volumes have an impact on the energy consumption. The density apparently has the biggest effect, because of the bigger exposition of surface. In relation to the multi-house this is important to create the best possible basis for a sustainable design. The building design must help to decrease the energy consumption and not leave it all up to the applied systems that also use energy to run.


COMPACTNESS
DENSITY
HIGH EFFICIENCY
MEDIUM EFFICIENCY
LOW EFFICIENCY


58 kwh/year
60,2 kwh/year
60,2 kwh/year
85,9 kwh/year
66,6 kwh/year
124,5 kwh/year
119 kwh/year

ENCLOSURE

study B: window

aim

In this study the relation between window area, shading and solar gain is investigated. The aim is to prove the expected dependency of the three factors. It is expected that solar gains will increase as a function of the window area. Additionally the aim is to investigate the relation between the solar gains and the seasons.

method and preconditions

The site area is primary flat which gives access for the sun. As mentioned earlier the sun is a great factor regarding the sustainable environment, because it is a source that is renewable. To find out how the sun can be used most efficiently through the building itself, two experiments are created. One regarding window size and orientation, the other about a specific window size with different shading. In both cases the box has the same values through the different experiments. The starting point is a box with the dimension: 20m x 10m x7m, which is approximately equal to a small gymnastic hall. In the box there is one window. To find out how much efficiency the window has, the individual load, ventilation or other parameters that can affect the outcome are not taken into account.
The data only serves for comparison to each other, and the numbers are not meant to show anything in isolation about the total performance of the room.

results

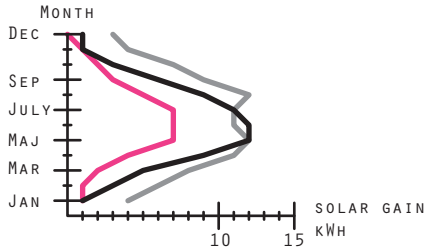
As seen in the first graphs less kWh is gained toward north opposed to the directions of south, east and west. The value of the eastern, western and southern direction is close to each other in the summer period, whereas the Northern, Western and Eastern value is closer in the winter period. This is seen at all three window sizes.
Windows towards south provides most heat during the entire year, most during the winter where it is necessary. The southern windows provide only a bit more heat during the summer than the east and west oriented windows which result in limited cooling.

Also it is noteworthy that the increase in solar gain is approximating linear, when the window is increased in size. This connection applies both to the southern, northern and the east/west direction. During the winter period there is not a dramatically change in the starting value compared with the window size, it is primary the Southern direction that have greater variability in this stage.

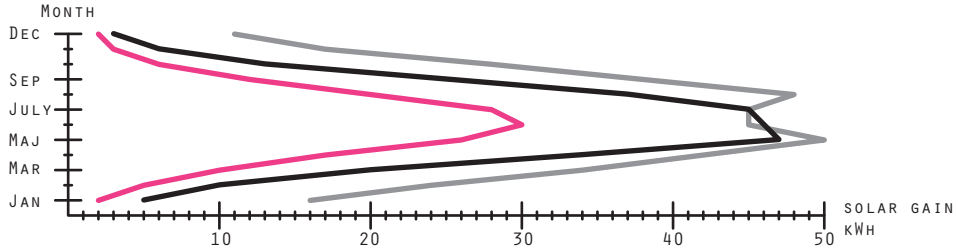
The shading investigations show, that when covering the window more and more there will be less energy (kWh) penetrating the building. The decrease of energy when using shading also seems to be linear. The results have been ambiguous, but tendencies are seen, that shading towards the south has the biggest impact on the decrease in solar gains.

conclusion

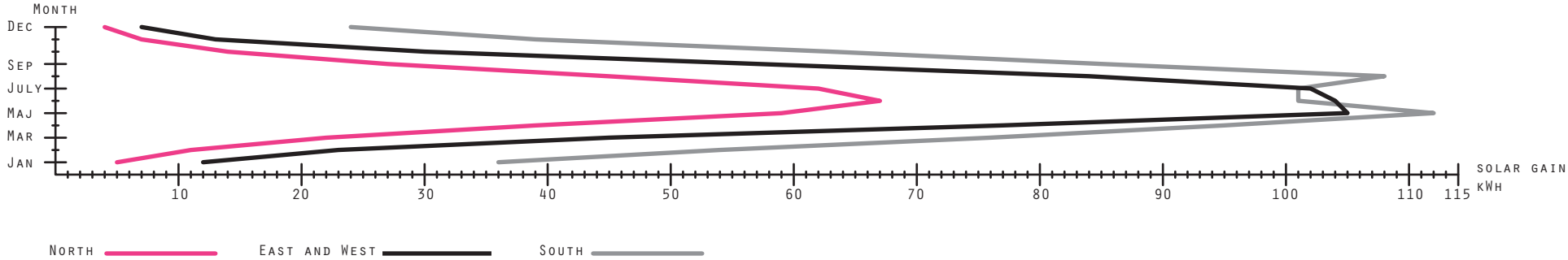
The results show a close connection between the solar gains and the window area of the building room. This not only depends on the window size itself, but also on the orientation of the windows. The placement of windows to the east/west shows a steeper relation during the year than the north/south direction. Practically this means that an east/west window will only be slightly better in gaining heat from the sun than a north window during winter time. In a cold climate like Denmark, windows to the south will during winter time be an important source for solar gains. At the same time windows towards south only requires a little more cooling than west/east during summer.



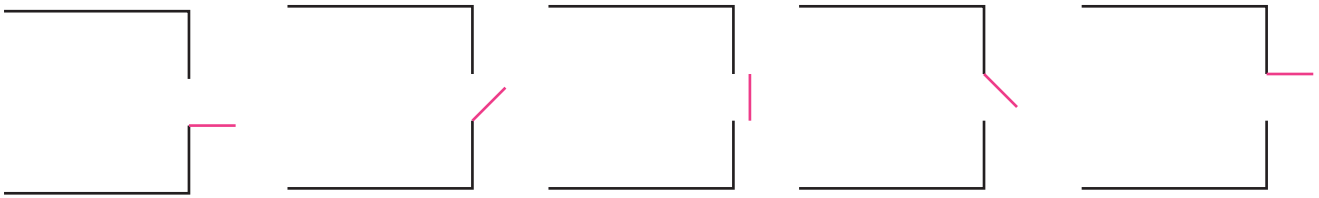
Solar gains during the year. The window is 4m²



Solar gains during the year. The window is 16m²



Solar gains during the year. The window is 36m²



Different types of shadings are applied to the 4m2 window to see what effect this has on the solar gains. The results have not been unequivocal, but tendensies are seen, that shading towards the south has the biggest impact on the decrease in solar gains.

study C: light

aim

The aim of the light study is to learn about how light acts, what effects there is in different placements when basing the study on a room usable for activity.

method and preconditions

The size of the room is a 1:50 model of a normal proportioned gymnastic hall, which we belive is a relavant size for the study.

When creating these experiments there has to be locked parameters in order to compare the different results. In this case the distance and position of the box is locked, so it is ensured the same direction of light and the quantity of it. The study is based on a situation during mid day towards south. One side of the box is considered being the variable where different arrangements are made, documented and compared.

results

Horizontal vs vertical

The height of a window placement is deciding for light distribution in a room. A window placed high (1) spreads light far into the room. A low placed window (2) creates a focus, but only at floor level. Horizontal windows (7) generally enlighten the perspectives of space, where vertical windows (6) enhance the width of a space.

Pixels

A grid structure of windows (8) filter the light from outside in a pixelated way, but also makes the room a bit flat, depending on the placement of the light source.

results

These studies are based on two different conditions. One for ill.xx to ill.xx, where the sun is constant and the shading an viable. Second from ill.xx to ill.xx where the sun i variable and the material constant. This is to understand how shading can influent the amount of light based in extreme situations. The last studies ill.xx to ill.xx is to see how a material can be used for shading purposes while the atmosphere in the room changes.

Transparency

Grid structure (5-6): This type of grid-structure gives dynamics to the room for two reasons. It shows very readable shadows that follows the sunlight, and the amount of light perceived is directly dependent on ones position in the room.

Translucency (7-8): Translucent surfaces, creates a soft atmosphere in the room. No matter which direction the sun is the light is always translucent.

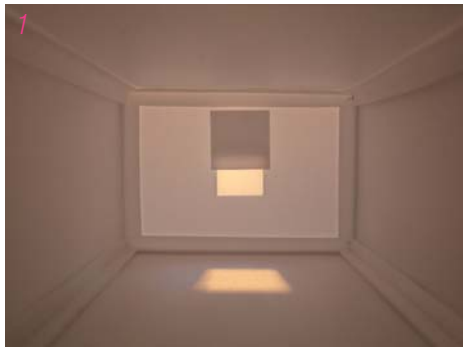
Shading

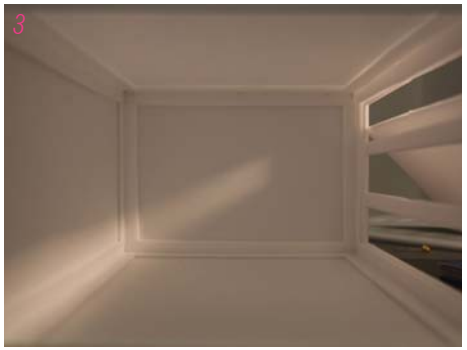
Horizontal shading (2): The type of shading affects how much light there is entered the room. During periods where the sun is high on the sky it has a big impact, where those periods the sun is low it is not efficient. The efficiency of the shading device depends on how high it is placed. The shading also reflects the sun in the room, and the amount of reflected sun depends on how low the shading is placed and also the material type. This is studied further in study G.

Vertical shading (1): The effectiveness of the vertical shading mainly depends on the position of the shading, how close it is to the window and how much of the window is covered. Additionally it blocks the in- and outlook very much, even when experimenting with angles opening or closing for the sun.

conclusion

Conclusively a focus is taken on the placement of windows high or low in the space, as this is relevant in relation to the use of a space for activities. Here one needs a hich illumination without having too much direct light. A window placed high sends light far into the room and speads it out in a way so that the space seems light and open. A window placed low puts a focus on a certain surface and reflects light from there. If these two are combined like in picture 4, it creates a space where the middle of the room (in eyeheight) becomes a soft space, but simultaneously a well lit space.





study D: wind

aim

Wind diagrams from the Danish meteorological institute shows that the wind often is from a western direction. *[Dmi, 1999]* To see how it effects the area, a wind study is performed, Volume studies are aldo made to understand how the wind affects different volumes on site and off site.

preconditions

The object of investigation is a 1:500 model of the imidiate context. Beavare that the wind may behave diffrently in a model with a different scale.
In this case it is impossible to make the wind tunnel completely realistic in relation to how the real wind streams would behave on the site. The aim is to be inspired regarding climatic conditions and wind streams that are created.

method

The experiment is practiced by using a wind tunnel, where smoke illustrating wind is blown in from one side and sucked out in the other. It is important that the box is closed so nothing besides the climate affects the outcome.

---

results

The first situation the wind is blown over the context around the site see ill. XX(den første). The outcome is the wind being stopped by the walls of the school and houses towards west of the project site. The wind is pushed up over the houses and around them where the wind goes from being streamlined to being vortexes. When the wind hits the school, an area behind the school is created, where a shelter from the wind appears.

When three blocks are added to the model, with the longitudinal side is facing against the wind, the vortexes from the school continues over the blocks. This also affects the space between the three blocks where no wind is passing see ill. xx and xx(2 og 3). When rotating the blocks 90 degrees, the sheltered area disappears and the vortexes are stretched over a longer distance ill.xx(4).

When creating corners of 90 degrees the wind get cut in the volume and creates an even larger vortex in order for the wind to pass over the volume as seen in ill. xx(5).

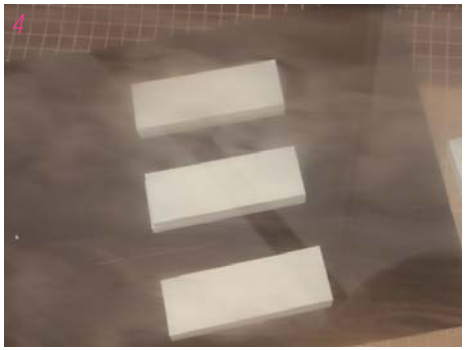
When applying more but smaller volumes in the area more shelters appear due to the increased amount of volumes. The wind pushed around the volumes is gathered creating stronger winds streams. When the volumes are placed closed to each other the wind is pushed even closer creating stronger and more voluminous winds ill.xx(6).

When having less wind through the area better shelters are created behind the buildings, which can be seen behind the school. In front of the volumes it seems that there are no wind. This is caused by the volume, so when the wind hits the volume it is pushed back a little and mixed by the wind behind so it creates a vortex in front of the volume as seen in ill.xx and xx(7og8).


1


2


3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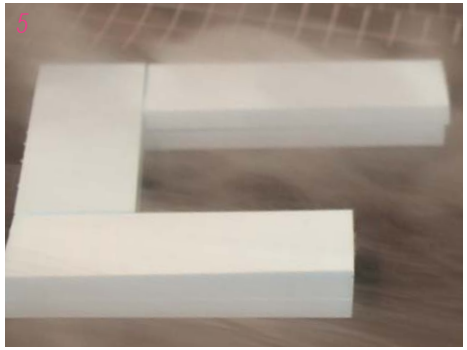
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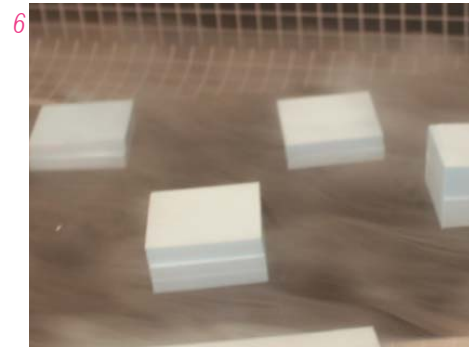
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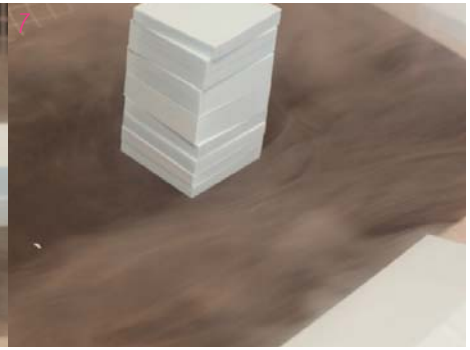
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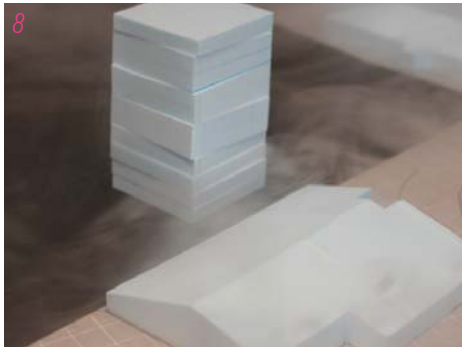
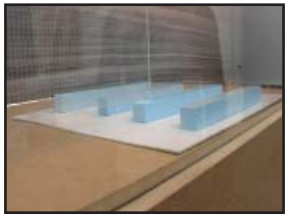

8

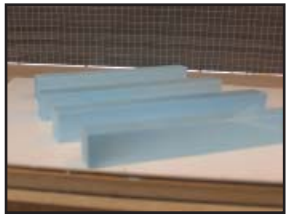
study D: wind

relink til rettelsesmappen under desingprocess

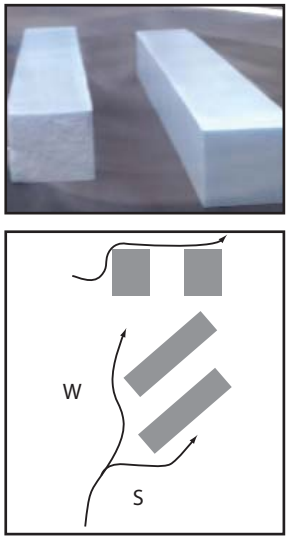
results of simple wind studies



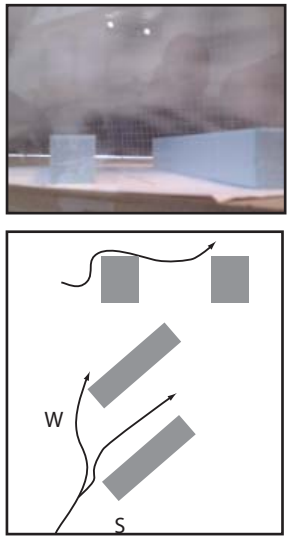
When having the openings direct towards the wind, the wind goes directly through without creating any disturbens.



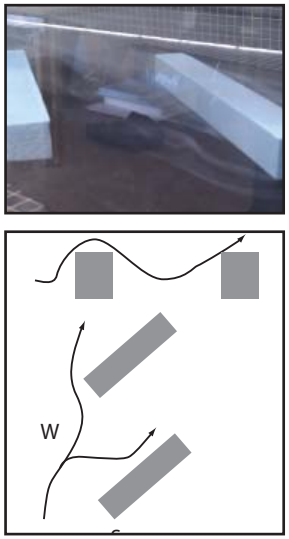
When the elements is angled so there still is a little opening towards the wind direction, the wind is directed between the elements.



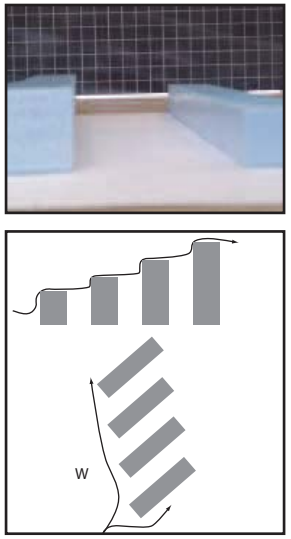
The wind blows over the rest of the elements, so there is a calm area between the elements. The wind is not directed between the elements creating a calm area.



The wind is drawn a little down between the elements when the distance is larger. The wind is drawn in between the elements creating a calm area in the back of the elements in the right side



Here the wind is drawn down to the bottom of the elements. The wind is drawn more in between the elements creating 2 calm zones.

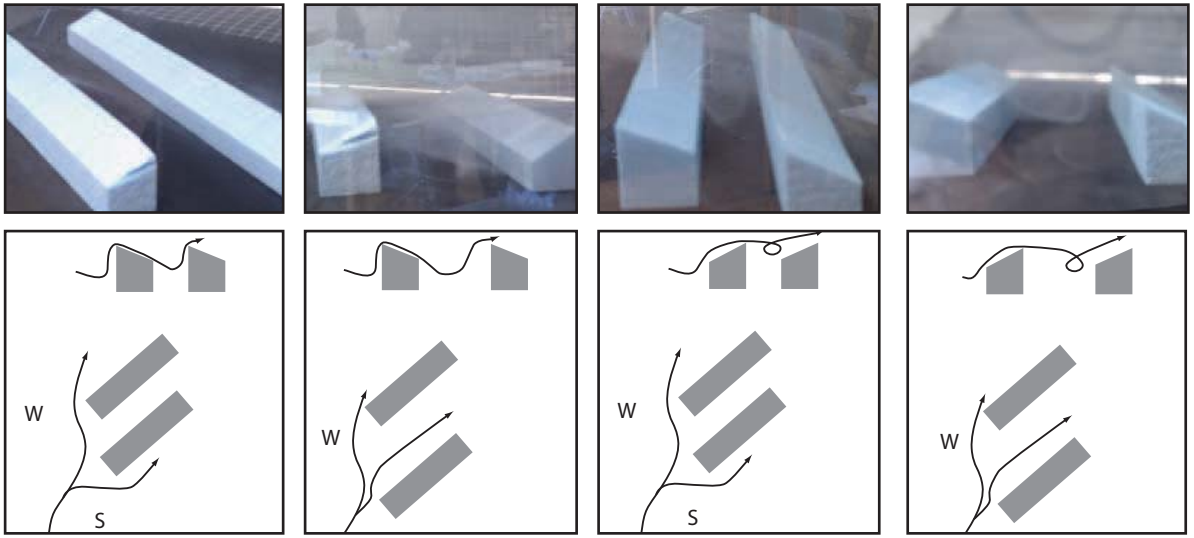


When the elements gets larger from right to left the wind easier hit the front of the elements.

conclusion

The simple wind studies show that the wind does not only work in direct pressure but are also filling the negative spaces by sucktion. The wind is splitting and collecting in very dynamic ways and is relatively unpredictable, which also is the interesting part when observing and registrating the movements of the wind, from a designers point of view. A comparison could be taken to the way in which people move over an open space, such as the site in Balling, creating a dynamic network of flows over the area. In most cases it could be an advantage to open public spaces towards east or south, because of the combination of sun and wind conditions in Denmark.

From a technical point of view the behavior of the smoke particles, reacting on surfaces and corners are interesting for useing the existing forces in natural ventilation for creating the best possible indoor climate of the building.

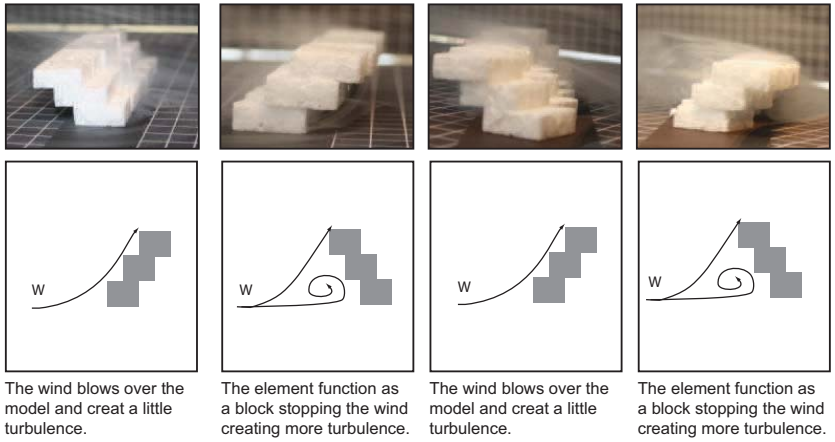


Making the sloape with the high end towards the wind it pushes the wind down between the which means that it needs a shorter distance between the elements. The wind is pulled into the buliding directing the wind in a nother direction.

When makeing the distance larger, the turbulens is bigger and it affects all the area between the elements. The wind is pulled into the buliding directing the wind in a nother direction.

When making a slope on the roof with the low end towards the wind, the wind gets pushed down creating turbulens. The wind is not directed between the elements creating a calm area.

When makeing the distance larger, the turbulens is bigger and it affects all the area between the elements. The wind is drawn in between the elements creating a calm area in the back of the element in the right side



The wind blows over the model and creat a little turbulence.

The element function as a block stopping the wind creating more turbulence.

The wind blows over the model and creat a little turbulence.

The element function as a block stopping the wind creating more turbulence.

study E: volumes

aim

In this study the volumes on the existing site are investigated in relation to different options of organising other volumes on the site. The aim is to understand what systems will be more or less optimal for the relation between the existing school, sports hall, villas and infrastructure.

preconditions

The study is an overall investigation of typologies in the scale 1:500.
The near context consists of many point blocks from single-family houses and some larger point blocks and row building from the school and existing hall.

method

To understand what kind of volumes the site can harmonise with, an exercise where volumes are placed in the project site are made to compare how they relate to the area.
The exercise is based on a model of the context where different volumes are placed. the focus is small versus big, many versus few and rectangular versus square. The choise of volumes and methods are due to the volumes already in the context.

---

results

Case 1-3
First attempt is to arrange a square volume in the context, this does not relate with the area, due to the openness around it and the volume itself is not in direct relation to any other volumes in the area. Next attempt is to arrange a rectangular volume to the site, which starts to relate to some of the volumes in the area as the school, existing hall and some of the houses. Still it is misplaced because of the openness around it. When rotating it, it relates more to the space around it, because it creates spaces with help from the existing volumes.

Case 4
When adding more volumes of same kind to the area, it is possible to start creating different types of spaces between. When doing this the volumes also start to relate more to the existing volumes in the area, due to the intensity of them. When changing the heights of the rectangular shapes it also relates to the different typologies in the area.

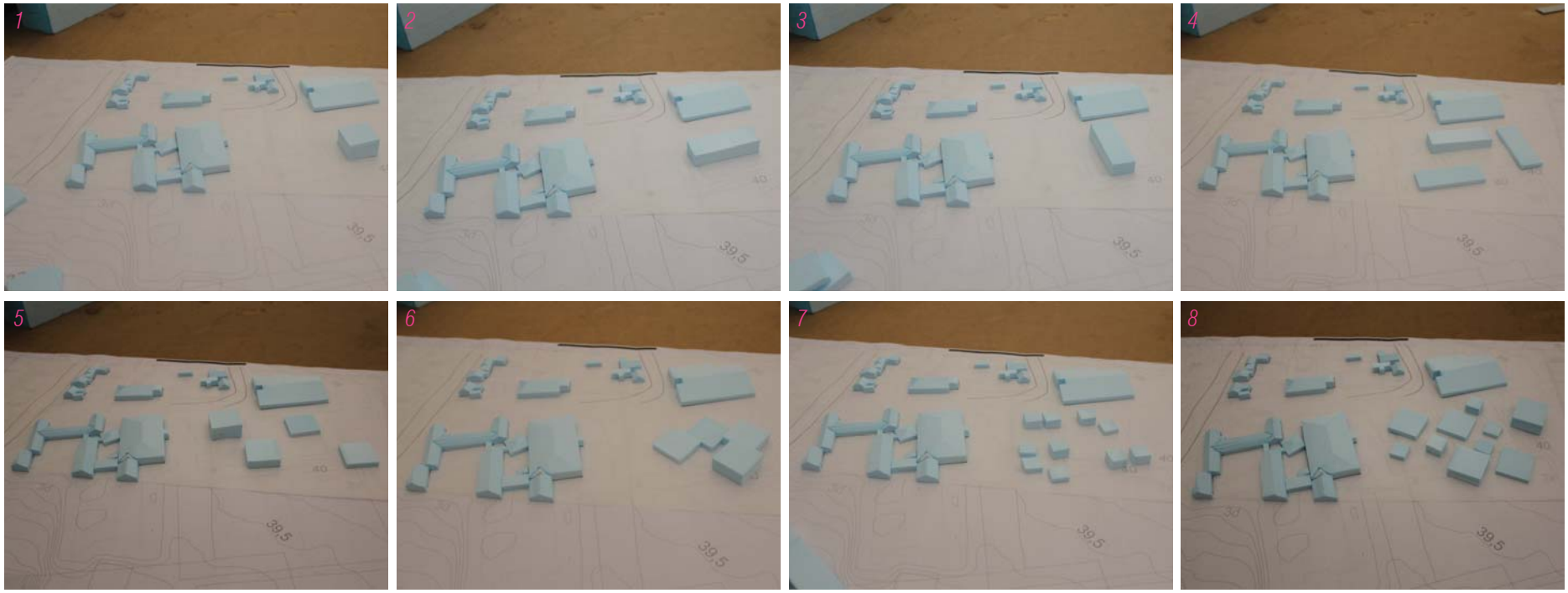
Case 5-6
The space between the volumes and the relation toward the existing volumes is changing, when arranging them spread out or close to each other. The case with the spread out square volumes relate to the existing volumes through the open spaces between them. It is possible to create different spaces by arranging them differently and still maintain the spread volumes. When the volumes are gathered it starts to create its own “society” and distinguish itself. In this case there is created a small space in the middle of the volumes which is the primary focus, where as the spaces around become secondary.

Case 7
When arranging many small volumes it relates to the point block buildings, creating relation across the typologies. It is also easy to create many different exterior spaces between the squares.

Case 8
When combining both small and larger volumes it starts to relate to many of the volumes in the area, while it is possible to create many different spaces between. It is also necessary to look at the intensity of the volumes. In this case it starts to be too dense when comparing it to the area, so they start to differ from the context.

conclusion

In order to create a multi-house where the concept relates to the surroundings, it is necessary to mix the different typologies or the size of the volumes, which can improve the relation to the spaces around. A balance between the separate buildings are required to maintain relation and clarity. The negative spaces inbetween buildings are very important for the area, as well as for the experience of the spaces. Therefore it is chosen to focus on the “void” - no matter if the topic is indoor or outdoor spaces.



study F: movement

aim

Here movement in volumes are studied to understand through own interpretations what movement actually is in reation to space. So it is possible to answer why one shape seem to have movement, while another doesn't.

preconditions

The material used for this study gives some preconditions as to how the 3-dimensional shapes can be made, as the foam is cut most easily with a string.
The studies are influenced by our interpretation of what movement looks like.

method

To reach an understanding of what movement is, this study is performed, so that different volumes and spaces can be observed and analysed. Simple models are carved in foam, as many as the imagination allows until they start looking similar. This works as a 3-dimensional brainstorm over the theme "movement". All models are analysed as separate cases, so it is possible to investigate them thoroughly. We will isolate and evaluate on the following questions:

Do movement occur in the model? (direction, balance etc.)

What kind of movement?
(velocity, accelaration, jumps, 1, 2, 3-dimensional ect.)

How is the movement created? Which manouvers are made?
(rotation, cuts, scewing, mirroring, hierachy ect.)

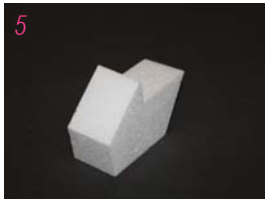
Results on the opposite page

Low movement
Organic line associates movement
Simple structure
2 dimensional
Concave - convex
No direction

2 dimensional
It wants to be extended
Direction
Simplicity
Dynamic

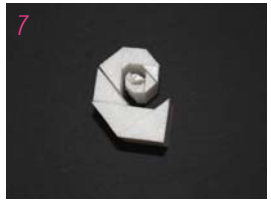
Chaotic
2 dimensional
Vertical direction
Movement in the space
No direction in model

Development
Simplicity vs. complexity
Individual volume creates direction
3 dimensional
Contrast between space
Sizes
Crystalline

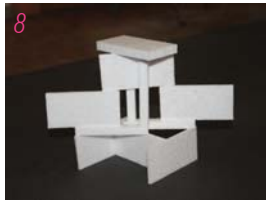


2 dimensional
Simplicity
The top creates direction
Small and large spaces
Rotation

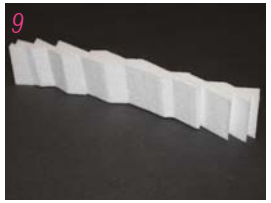
Chaotic due to no progress
Dynamic in the slanting sides
Starts and ends with horizontal planes
The middle is slanting
Graduation of open/closed



2 dimensional
Rotational movement
Addition
The centre is in focus
More speed in the start than in the end
Movement in the space
Progress/acceleration



Diagonal direction creates movement
Horizontal/vertical lines creates a coordinate system
Focus in divided spaces
Simplicity axis, form complex



Direction
Lines
Static
Calm
Simplicity
Movement in details
Asymmetry in details

Movement in two directions
Focus in the square angle
Heavy backside
Hierarchical front
Simplicity
Static centre

Surreal/unrealistic
Playfull
Chaotic
2 dimensional
Simplicity
The movement lies in the gravity
We expect it to fall!

Movement in domino
Simplicity
Stability/forces
Movement stopped in the end, but still affecting
Focus on process
Pleasant/unpleasant rooms

Displacement
Linier
Encourage movement
Static centre
Dissolve in ends
Dynamic in ends
Room vs. function
Different dimensions

Dynamic between axes
Stronger than movement
Movement through balance
Penetrating
One eats the other
Creates spaces through direction

Simplicity
Chaotic due to dynamic between volumes
Slices
Interaction between 3 edges form one angle
Other angle confusing due to direction of volumes

3 dimensional stability
Static, no movement in volume
The space around invites movement
Disc and slab structure
Interaction between high and low spaces

Two movemen cross in oppsing direction
Each element has no movement
Addition and displacement creates movement
We extend the volume our selves

The eye follows a spiraling direction
Process
Our mind extends the volume
Define spaces
Obstacle course
No fixed orentation

Crystalline shape
Displacement in one direction for each element
Focus on spaces
Movement in space and in volume
Main movement space
Backside vs. front

Complexity
Focus in spaces
Hierarchy in spaces
Manipulates gravity
No movement
Defined
Formation of cells

Simplicity
Displacement
Exponential openings
Static
Ambiguous volumes and direction
Closed volume to open
Associates to waterfall

conclusion

In all cases that express movement the models can be devided into two groups:

1. The ones that associate to a movement
2. The ones that generate movement

Group one is typically the cases that show a direction of movement or simply give associations to a moving object or space. These make a distance to the observer, that has to study the model as a whole. Group two is typically the cases relating to their content. These are typically rather static and balanced to look at as a shape. They are always working in 3 dimensions, and depend on ones imagining someone moving through, under or over the spaces to get movement. These make the observer more of a participant, while group one make the observer more of an actual observer.

Both groups uses cuts, displacements or an additive approach to create movement. This can also be related to the foam material that acts in a specific way. Nevertheless the tendensies show that the models expressing the most movement invites the eye to extent the shape and/or inviting the body/imagination to explore the shape. A general term to describe this may be the word “progress”.

In the multi-house, it will be essencial that the spaces create posibilities for involvement in the architecture. A tool for this is to work with process in the sence, that one space could progress to the next one in numorous ways (abrubt, soft, in steps etc.). It is these transitions that create a characteristic movement through a site, building or model.

study G: material, texture and pattern

aim

The purpose of this study is to observe the effect of different materials in a room, and investigate how light is reflected as an effect of matrial, texture and pattern.

preconditions

The size of the room is a 1:50 model of a normal proportioned gymnastic hall, which we believe is a relevant size for the study. The light will behave diffrently in a room with other proportions.

A source of error may occur in relation to the camera that recieves the light in slightly different ways even with fixed settings.

There is tried to decrrease the errors by using our own eyes, if the camara seemed to represent a realistic display of the light.

method

This experiment is based on a specific box, where one window is carved out in the top of one corner pointing out to a light source in a locked position. The window is arranged so the light hits the material direct, in order to see the change in material when illuminated in direct and in diffuse light. The box itself is also locked in one position, so that the distance and angle between the light and box is the same through the different experiments. The only variable is the wall material.

results

Reflection:

A reflective surface manipulates the experienced depth of the room because of mirroring. Even though there is quite a lot of light reflecting in the room, the overall precipitance of the room is gray (1). A shiny silver surface also reflect and manipulate, but in a more suddle way (2-3).

Patterns:

In structured but smooth surfaces such as wood or the rusty metal, the patterns take focus and smoothen out light spots (5,7). At the same time the structure adds movement and scale to the room especially the wood (4,6).

Noise:

A moderate “noisy” surface is confirmed in direct light, whereas smooth patterned surfaces steal focus from the light (8-9). With a noisy surface, the effect of the direct light becomes less evident compared to the diffuse light (10-12).

Structure:

A grid-structure only adds movement to the room when light is send through it, but here you see the play of light more than the actual texture (13-14).

Vertical waves are confirmed more in this light setting than horizontal ones (15-16).

conclusion

It is clear that a material with noise in the surface is confirmed in direct light. This may be a good tool to attract the hands or just the attention to the material in question. As oppose to the ruffled surface, the surface with a pattern steals a lot of the light

study H: acoustics

aim

The purpose of this study is to observe the relation between material and reverberation time in a room. This is primary done to get an understanding of the material and texture in study G in relation to its effect on sound.

preconditions

The size of the room is a 1:50 model of a normal proportioned gymnastic hall, which we belive is a relevant size for the study. The acoutiscs would behave diffrently in a room with different proportions.

method

Different materials are investigated in conection with their reverbration time. The reverbration time is calculated at 5 frequensies between 125Hz and 4000Hz which is the spectrum of sound in human speach.[Troldtekt,2012]

The studies are done with basis in the same room as the previous study of material and light studies. Though only a few materials are chosen for calculation, they are mixed to give information on materials that behave very differently.

Theory

When designing spaces for people it is important to include acoustics to secure a functional indoor environment. When designing spaces for different activities, where the number of persons varies, is it important that a comfortable environment can be established when there are many or few users. One of the stresses affecting the acoustic negatively, if not controlled, is the reverberation. To understand how the reverberation acts, a case is made based on specific room dimensions where one wall is changed with different materials. It is based on different hertz levels to show how the different materials cope with the stresses.

The formula used is Sabine´s which goes T=0,16xV/(A)
Where T is the reverberation time in sec, V is the volume of the room and A is the absorption of the room.

conclusion

The scheme shows that a material with a higher absorption coefficient, absorbs the sound better. It does not necessary mean that one material absorb the different Hz levels linear. To create the best acoustic indoor environment every single case has to be looked at separately. A specific Hz level cannot be defined as good sound in general. Good acoustics is defined by the rooms funktion, wether it is a room for music or speach and what quind of speach and music.

Reverberation time in seconds

	125HZ	250HZ	500HZ	1000HZ	2000HZ	4000HZ
Concrete - coarse	8,89	7,27	10,32	11,03	8,21	12,8
Wood - plywood panel	11,43	14,55	11,85	35,56	16	29,09
Foam - SDG 3"	13,33	5,52	4,78	3,52	3,33	3,23
Brick unglazed	106,67	106,67	106,67	80	64	45,71

study I: colour

aim

The purpose of this study is to observe what effect different colours have on a room, and how light is reflected as an effect of colour and brightness of the room.

preconditions

The size of the room is a 1:50 model of a normal proportioned gymnastic hall, which we belive is a relavant size for the study. The light will behave diffrently in a room with different proportions.

Error may occur in relation to the camera that recieves light in slightly different ways even with fixed settings.

The errors are decreased by useing our eyes, if the camara seemed to represent a realistic display of the light.

method

This experiment is based on a specific box, where one window is carved out in top of one corner pointing out to a light source in locked position. The window is arranged so the light lits the wall direct, in order to see the change in the surface when illuminated in direct and in diffuse light. The box itself is also locked in one position, so that the distance and angle between the light and box is the same through the different experiments. The only variable is the material in one of the walls.

theory

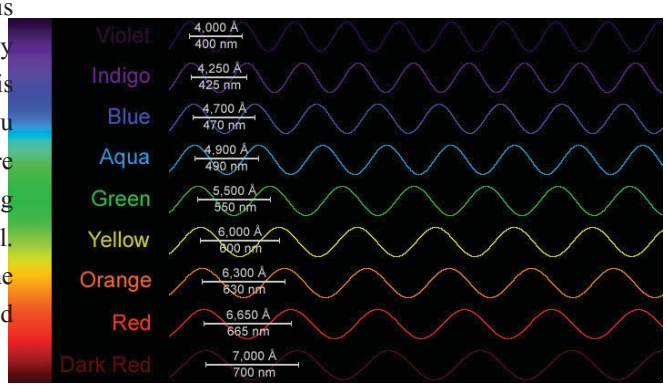
When light meets an object it is either absorbed, transmitted or reflected.

By absorpsion - the light is changed to thermal energy.

By transmission - the light goes either unchanged or in broken lines through the material, like light through a window.

By reflection - the light is thrown back in the same, an angled or spread out direction. This can for example be seen in a mirror.

Many times all three things will happen in the same material, when lit up directly. The colour of a material is dependent of what part of the colour spectre is absorbed by the material and thereby also which part is reflected. This is again dependent on the wavelenght of the colour. You speak of addition, when looking at which wavelenghts are reflected on a material and about subtraction when speaking of what wavelenghts are transmitted through a material. The additive priciple becomes very important, regarding the colour of the diffuse light in a room reflected by a coloured wall, like in the study. [Nelleman]



results

From light to dark:

An all-white room appears grey because of the lack of contrast. In a way the room seems very anonymous and dim. Surfaces blend together and lose characteristics (1).

The grey wall puts a lot of focus on the income of light. Also the room proportions become more clear, because the back surface is “highlighted” and because the back wall gives the room a direction and thereby a depth (2).

Black absorbs the direct light very much, but the room in total (the other surfaces) seem much brighter because of the extreme contrast (3). This effect appears to be so both in the camera as well as with the bare eye.

Change of wavelength

The lighter the colour the darker the room. And furthermore the clearer and brighter the colour, the more effect in the room. The red, purple and blue colours dominates the room the most, where as the green and yellow colours seem softer. Simultaneously the colour is diffused out into the room from reflection. In all the cases the room light change by this reflection.

conclusion

The colour obviously has a big impact on the whole appearance and the atmosphere of the room. This can be used in relation to the multi-house, so that specific atmospheres can be created and thereby make spaces more clear and put focus on the use of a space.

Study J: indoor climate

Cases:

It is chosen to study four rooms that are either expected to be critical or representative for many other rooms in the multi-house.

The multi-hall is chosen as it is a big room with multiple uses, but also a complex room regarding the indoor climate. It is of great importance that the room functions under different circumstances. A choice is made to look at two scenarios – one with minimum load and one with maximum load. Both scenarios complies a realistic use of the space.

- Scenario 1: moderate use during the whole opening time.
- Scenario 2: moderate use during the day, two hours of preparation in the evening followed by three hours of concert.

The second study deals with the fitness centre. It is expected that this room will pose a challenge for keeping down the temperature, so that this fits the comfort for performing on a higher activity level. The room is calculated with a maximum load, being half people load during the common working hours and full load during the afternoon and evening. This is believed to be a realistic maximum load scenario.

The third room of particular interest is the big room in the wellness centre. The many external factors that play a role in this room may give some insight to discuss. The room has a pool of a constant temperature that will affect the results. Furthermore an opening exists to the outdoor pool; this will contribute to the natural ventilation, but will also result in heat loss during spring and autumn.

The fourth room is a doctor's consultation, which is a room with proportions of common occurrence in the multi-house. Due to this, it is seen as a representative for many rooms. The health centre is considered to be closed in the weekend, so indoor climate is only important during weekdays. The calculated room is just 20 m2 and has a window to the west, which may give problems in relation to overheating and CO2 level. In the specific case though, the window is shaded by a building to the west, so the problems are considered to be controllable.

Initiating process:

As a start the spaces in question are modelled and shading is applied for the windows. Systems for internal loads such as heating, infiltration, mechanical and natural ventilation are defined, based on user hours, schedules and various control-systems. After the first calculations it is clear that especially two rooms are difficult regarding the indoor climate, the fitness centre and the doctor's consultation.
First of all the fitness centre is easily overheated due to the high people load and the high activity level. Furthermore it is even more important that the temperature stays within defined limits, because of the comfort of the users, who are engaged in physical activity. The best solution for a room, with this high strain on the indoor climate, will probably be to run the mechanical ventilation all year round, instead of using natural ventilation in the summer, as we had hoped to do. This is made as an attempt and it improves the results significantly, but there are still too many hours above 27 oC a year. The following attempt is to decrease the window areas to the west, by leaving only the most necessary part transparent. This is weighed against the architectural qualities and the wished daylight factor.

The doctor's consultation initially has a worse indoor climate than expected, both regarding overheating and CO2 level. First the two strategies mentioned above are applied with some gains, but the results are still not good as required. This gives two options; either we have misjudged how difficult a room like this actually is, regarding the indoor climate, or a mistake has been made. The first job is to exclude the option of an error influencing the results in a negative direction. After investigations an error is found regarding the adjustment steps of the ventilation system. This changes the results to the better.

In all the chosen spaces we have had difficulties bringing down the temperature so that there are no more than 25 hours above 27oC a year. After many attempts, the only possible way to meet this demand is to have less window areas. Tests show that this does not combine with the architectural ambitions and the wished daylight factors. The permitted maximum of 100 hours above 26oC a year has been easier to meet. It is chosen to minimize the hours above 27oC as much as possible with ventilation, and then optimize by adjusting window areas within an acceptable range. The last aim is to not have any CO2 levels above 900 ppm.

Further process:

Multi-hall – scene 1

The main point of the further process is to avoid overheating with ventilation, before cutting down the window areas. First the calculated minimal necessary air change is tried, and then the room is simulated with the highest realistic air change. The air change is set to 6/h for both natural and mechanical ventilation. When comparing these two results, no difference exists in overheating and CO2 level. This only has an effect when bringing the temperatures further down. The next attempt is to use mechanical ventilation for specific requirements – such as an evening concert. In this situation it is obviously not overheating from solar radiance, which is the cause of bad indoor climate, but the high people load. During summer only the natural ventilation works rather well for the multi-hall. At concerts and probably also other performances with maximum people load, the indoor climate will benefit of exhausting hot air from the space, by use of the ventilation system. It will be difficult to keep temperatures and CO2 on a comfortable level without a ventilation system. This improves the results somewhat, and it is seen, that it matters if the air change is permitted higher than the calculated value.

Multi-hall – scene 2

In this case it is easy to have no more than 100 hours over 26oC, as it has smaller loads than the previous case. On the other hand it is necessary to use more energy for heating. Under normal circumstances natural ventilation is sufficient for the multi-hall during the summer months. The air change will probably not need to be higher than the minimal calculated air change for keeping the CO2 level below 900 ppm, hence the results.

Fitness centre

The fitness centre starts with having too high temperatures and CO2 levels, because of high people and equipment loads. The process starts with generating a higher air change - a maximum of 6/h is set. This changes the results significantly, but levels are still high. The experiment only uses natural ventilation in the summer, even though it is not expected to be sufficient. This assumption turns out to be correct, as levels raises more than ventilation and window area can affect. Before altering the window areas the mechanical ventilation is defined for 12/h as a maximum. This has brought the number of hours above 26oC down, but not the hours above 27oC. The window area is decreased with 12,75 m2, while taken in consideration the architectural qualities and the needed day light amount. Even though the results are improved significantly, there is no success in bringing the number of hours above 27oC below 25 a year.

Wellness centre

The process of optimising indoor climate in the wellness centre is similar to the fitness centre. One exception is that the air change is kept at 6/h. Also the change in window area has a positive effect.

Consultation

Initially the consultation has bad CO2 levels with the calculated air change. It helps tremendously when the air change is set to 6/h. Neither the wellness centre or the consultation is able to do with only natural ventilation during the summer. Even though temperatures are not at the desired level, it is decided not to minimise the window areas more than they already are. Additionally it is decided to work with a type of shading that can be integrated in the facade.

Adjustments for minimising energy consumption for mechanical ventilation

The last part of the process is to minimise the use of mechanical ventilation for all spaces that use such. This excludes the second scenery for the multi-hall, which does not use mechanical ventilation. The criteria for this optimisation are to not get more hours above 27oC. This is the comfort demand, which cannot be met without compromising the architectural intentions in relation to the window area.